6:4 Risk Assessment

All Components of this Risk Assessment were developed using the best available data in the Purchase Region. GIS resources and public input were used to identify which hazards, of those listed below, affect the Purchase Region. The Purchase Area Development District (PADD) staff compiled this information to identify hazards and the Jackson Purchase Hazard Mitigation Council (JPHMC) reviewed the definitions and discussed their occurrence in and impact on the region. This review identified all hazards to the region and consequently all hazards that affect Graves County.

For this revision, the Graves County Mitigation Planning Team (MPT) reviewed and revised the prioritization of hazards from their 2018 Plan using updated climatic/event data, 2016 revised flood zones, local events occurring since the previous plan, 2020 Census data and 2020 American Community Survey. These provided a higher resolution for the resulting Hazard re-prioritization and revised risk assessments. The resulting prioritization and risk assessments are contained in this chapter.

6:4.1 Identifying Hazards

FEMA recognizes many forms of natural hazards. Major natural hazards that may occur include:

- Geologic hazards
  - Tsunami
  - Volcano
  - Earthquake
  - Land Subsidence/Karst Topography
  - Landslide
- Weather generated hazards.
  - Avalanche
  - Hurricane
  - Severe Thunderstorm
  - Hailstorm
  - Windstorm/Microburst
  - Severe Winter storm
  - Tornado
- Wildfire
- Flooding
  - Flashfloods
  - General Flooding
  - Coastal
  - Riverine
- Urban
- Climatological
  - Drought
  - Extreme Heat
- Failure of Man-made structures from the impact of natural forces
  - Dam Failure
  - Levee/flood Wall Failure

Natural Hazards Addressed by the Regional Plan

The regional planning process identified hazards that significantly impact the entire region and eliminated from consideration those natural hazards that do not. Natural hazards where a historical record of damage to people and property exists, or the potential for such damage to occur, are addressed in the plan. This determination does not preclude the plan from including more hazards in future updates. The Graves County MPT agreed that the identification process was sufficiently

thorough to serve all the signatory counties of the plan and will not be repeated for the Graves County 2023 Update. Table 6.1 summarizes why hazards were identified.

Table 6.1 Hazards Identified and Reasons for Identification

Hazard	How Identified	Why Identified
Tornado	* Review of past disaster damage * Review of FEMA hazard maps * Public Input	* Several past occurrences * Hazard maps show all jurisdictions affected
Flood **Flash Flood River Erosion**	* Review of past disaster damage (FEMA & National Climatic Data Center) * Local Emergency Management * Public Input * Review of FIRM maps	* Affects the region frequently. * Maps show many floods prone areas. * Public identified several regions not mapped affected by flooding * Repetitive flooding has led to the deposit of enormous amounts of silt in Kentucky's Mississippi River ports
Thunderstorm Wind Hail	* Review of past disaster damage * Public Input * Review of past occurrences from National Climatic Data Center	* Many events in the past * Widespread: affects all jurisdictions * High wind zone
Earthquake	* Review of Ground Motion Maps * Review of the New Madrid and Wabash Seismic Zone Maps * Public Input	* Proximity to New Madrid/Wabash Seismic Zones * Historic accounts of 1812 disaster. * Potential for destructive impact in some jurisdictions
Winter Storm / Ice Storm	* Review of past disaster damage * Review of past occurrences from National Climatic Data Center * Public Input * Local DES/KYTC	* Several past occurrences * Variety of events including snow/ ice * Can affect all jurisdictions
Excessive Heat / Drought	* Review of past disaster damage * Public Input * Review of Palmer Drought Severity Index	* Losses have occurred in the past. * Large impact of agriculture on the region
Dam Failure	* Review of High-Risk Dams in the region * Corps of Engineers Input	*Potential for flooding *Number of High-Risk dams in region
Wildfire	* Review of State Mitigation Plan * Public Input	*Potential for loss at Wildland/urban interface, * Increased fuel supply due to ice storm damage

6:4.2 Hazard Profiles

The Graves County MPT reviewed the previously profiled hazards based on; historical evidence gathered from the National Centers for Environmental Information (NCEI), Kentucky State Climatology Center, FEMA's Hazard Mapping website, the Kentucky State Hazard Mitigation Plan and the Kentucky Geological Survey. PADD staff gathered GIS information and historical data to provide to the MPT. There are some limitations to the best available GIS and historical data pertaining to hazards. The Graves County MPT identified hazards affecting the county based on past experiences. Information collected throughout the planning process by means of public input was a pertinent resource to the plan. Because the purpose of this plan is to identify hazards that present a threat to the safety of life and property, only moderate and high-risk hazards will be fully addressed in this plan.

Summary of Hazard Profiles

Several overall conclusions can be drawn from the information gathered in the hazard profiles. Based on historical frequency and past disaster damages, several hazards identified in the regional plan stand out as more significant threats to Graves County, while several others appear to be less significant.

According to frequency and damage figures, Tornado, Thunderstorm Wind, Flash Flood / Flood, and Winter Storm / Ice Storm Events stand out as the most significant threats to Graves County. Earthquake is a hazard rated by committee members as one of the biggest potential threats. There is no historical data on actual earthquake damage in Graves County to analyze the threat, and considerable debate as to the severity of the resultant damage even for the "worst case scenario".

Table 6.2 is a summary of past Declared Disasters as provided by FEMA for Graves County. This table is limited to providing information only related to declared disasters on the county level and does not list each jurisdiction.

Table 6.2 Presidential Disaster Declarations that Affected PADD Counties

DR#	Declaration Date	Disaster Type	Total Declared Counties	Declared Counties	Counties Declared for Public Assistance and Individual Assistance	Counties Declared for Public Assistance Only	County	DH Approved Funding	IFG Approved
381	5/11/1973	Severe Storms, Flooding	5	Ballard, Carlisle, Fulton, Hickman, McCracken	Ballard, Carlisle, Fulton, Hickman, McCracken	0			
461	3/29/1975	Severe Storms, Flooding	17	Ballard, Calloway, Fulton, Graves, Hickman, Marshall, McCracken	Ballard, Calloway, Fulton, Graves, Hickman, Marshall, McCracken	0			
821	2/24/1989	Severe Storms, Flooding	67	Ballard, Carlisle, Graves, Hickman, Marshall, McCracken	Ballard, Carlisle, Graves, Hickman, Marshall, McCracken	0			
1089	1/13/1996	Blizzard	120	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken			
1163	3/4/1997	Flooding	101	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	Ballard, Carlisle, Fulton, Hickman, Marshall, McCracken	Calloway	McCracken	$137,084.85	$78,709.00
1802	10/9/2008	Severe Windstorm	36	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken			

3302	1/28/2009	Severe Windstorm	114	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken,			
1818	2/5/2009	Severe Winter Storm, Flooding	117	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	0	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken,			
1976	5/4/2011	Severe Storms, Tornadoes, Flooding	22	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken		Calloway			
4057	3/6/2012	Severe Storms, Tornadoes, Straight-line Winds, Flooding	1	Ballard		Ballard			
4216	4/30/2015	Severe Winter Storms, Snowstorms, Flooding, Landslides, Mudslides	3	Ballard, Marshall, McCracken		Ballard, Marshall, McCracken			

4218	5/12/2015	Severe Winter Storms, Snowstorms, Flooding, Landslides, Mudslides	3	Calloway, Fulton, Marshall		Calloway, Fulton, Marshall			
4278	8/26/2016	Severe Storms, Tornadoes, Flooding, Landslides, Mudslides	2	Calloway, Marshall		Calloway, Marshall			
4358	4/12/2018	Severe Storms, Flooding, Landslides, and Mudslides	22	None		None			
4361	4/26/2018	Severe Storms, Tornadoes, Flooding, Landslides and Mudslides	35	Carlisle, Graves, Hickman, Fulton, McCracken		Carlisle, Graves, Hickman, Fulton, McCracken			
4428	4/17/2019	Severe Storms, Straight-line Winds, Flooding, Landslides, and Mudslides	60	Ballard, Carlisle, Fulton, Hickman, Marshall, McCracken		Ballard, Carlisle, Fulton, Hickman, Marshall, McCracken			
3469	3/13/2020	Covid-19	120	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken		Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken			

4497	3/28/2020	Covid-19 Pandemic	120	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken	Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Marshall, McCracken				
4540	4/24/2020	Severe Storms, Flooding, Landslides, and Mudslides	27	Hickman, McCracken		Hickman, McCracken			
4592	3/31/2021	Severe Winter Storms, Landslides, and Mudslides	45	None		None			
4595	4/23/2021	Severe Storms, Flooding, Landslides, and Mudslides	44	Ballard, Graves, Calloway		Ballard, Graves, Calloway			
3575	12/11/2021	Severe Storms, Straight-line Winds, Flooding and Tornadoes	16	Fulton, Graves, Hickman, Marshall					
4630	12/12/2021	Severe Storms, Straight-line Winds, Flooding and Tornadoes	23	Fulton, Graves, Hickman, Marshall	Fulton, Graves, Hickman, Marshall				

4643	2/27/2022	Severe Storms, Straight-line Winds, Tornadoes, Flooding, Landslides	13	None		None			

Source:https://www.fema.gov/disasters?field_state_tid_selective=49&field_disaster_type_term_tid=All&field_disaster_declaration_type_value=All&items_per_page=20&=GO

According to State Department of Emergency Management records Graves County was eligible for Public Assistance as a result of the above declarations.

For this revision, the MPT for Graves County reviewed the previous prioritization of Hazards from the perspective of how they impacted their jurisdictions. All the following discussions of risk and risk assessment are in the order of these revised priorities.

Table 6.3 Graves County Hazard Summary Table

PLAN VERSION	2022	2017
HIGH RISK HAZARDS	TORNADO THUNDERSTORM WIND FLASH FLOOD / FLOOD WINTER STORM / ICE STORM EARTHQUAKE	TORNADO THUNDERSTORM WIND FLASH FLOOD / FLOOD WINTER STORM / ICE STORM EARTHQUAKE
MODERATE RISK HAZARDS	EXCESSIVE HEAT/DROUGHT HAIL	EXCESSIVE HEAT/DROUGHT HAIL
LOW RISK HAZARDS	WILDFIRE DAM FAILURE	WILDFIRE DAM FAILURE

SOURCE: Graves County MPT 2022

The storm events database for the NCEI, formerly the National Climatic Data Center, will be the source utilized for the best available data for the Purchase Region. Please see the NCEI contact page if you have questions. **https://www.ncdc.noaa.gov/customer-support**

Table 6.4 represents a summary of the hazard events identified by the MPT that are recorded in the NCEI Storm Events Database for Graves County for the period 01/01/1950 through 03/31/2022. Data is available as early as 1950, but depending on reporting for events, the first event on record may come at a much later time. The detailed, disaggregated listing of these events is included in Appendix 1.

Table 6.4 Summary of Hazard Previous Occurrences and Impacts for Graves County January 1, 1950 – March 31, 2022

Event	Events	Death	Injury	Property Damage ($)	Crop Damage ($)
Tornado	35	24	222	7.029M	5.00K
Thunderstorm Wind	177	1	3	2.264M	0.05K
Winter Storm	21	0	0	58.00K	0.00K
Ice Storm	4	0	0	22.200M	0.00K
Flood	27	0	0	4.305M	0.00K
Flash Flood	38	0	0	757.00K	0.00K
Hail	87	0	0	25.00K	0.00K
Excessive Heat	10	1	0	0.00K	0.00K
Drought	32	0	0	0.00K	9.200M
Wildfire	1	0	0	0.00K	0.00K
Dam Failure	No History				
1 class A structure = no loss of life anticipated, only damage to dam owner's property					
2 class B structures = loss of life not probable, some economic loss & environmental damage					

Source : https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=21%2CKENTUCKY
*** NOAA storm database currently does not have the correct property damage values for the December 10, 2021, tornado and therefore the total property damage values are inaccurate.*

For the purpose of the update to the 2023 Jackson Purchase Hazard Mitigation (JPHM) Plan, the events from April 1, 2017, through March 31, 2022 (4/1/2017 – 3/31/2022) will be reviewed. This provides 5 years of recent data covering the current period for this cycle of the JPHM Plan update. For a complete listing of all events, please refer to Appendix 1.

Tornado

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. It is most often generated by a thunderstorm when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly and upper-level winds, especially the jet stream runs at an angle relative to the prevailing surface winds. These conditions occur with regularity over the Purchase Region in the spring, but as evidenced recently, can occur at any time of the year. Tornadoes are often accompanied by large hail and damage is most often the result of the high wind velocity and wind-blown debris. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction. They have the power to uproot trees, structures, and turn harmless objects into deadly flying debris.

Most tornadoes aren't very wide and touch down only briefly. However, a highly destructive tornado may carve a path over a mile wide and several miles long. Tornadoes typically cause the most damage to lightly or poorly built structures, such as residential homes. An average of 800-1000 tornadoes are reported nationwide and they are more likely to occur during the spring and early summer months. Tornadoes can occur at any time of the day but are more likely to form in the late afternoon or early evening.

In 2007 the Enhanced Fujita (EF) Scale was introduced to better reflect wind speed and the amount of damage produced by tornadoes. It replaced the Fujita-Pearson Scale that defined every tornado on record in the United States since 1950. EF rankings are assigned after a tornado event has occurred and the National Weather Service has inspected the damage.

Table 6.5 The Enhanced Fujita Tornado Measurement Scale

Scale	Estimated Wind Speed	Typical Damage
EF0	65-85 mph	Light Damage - Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; signboards damaged.
EF1	86 – 110 mph	Moderate Damage - Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
EF2	111 – 135 mph	Considerable Damage - Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light object missiles generated; cars lifted off ground and thrown.
EF3	136 – 165 mph	Severe Damage - Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
EF4	166 – 200 mph	Devastating Damage - Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown, and large missiles generated.
EF5	>200 mph	Incredible Damage - Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Table 6.6 represents the tornadic events that occurred in Graves County during the update period.

Table 6.6 Tornado Events and Impacts in Graves County April 1, 2017 – March 31, 2022

Location	Date	Time	Time Zone	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
BALTIMORE	04/26/2017	18:20	CST-6	EF0	0	0	75.00K	0.00K
BELL CITY	02/24/2018	19:37	CST-6	EF1	0	0	100.00K	0.00K
VULTONCREEK	2/24/2018	19:42	CST-6	EF1	0	0	50.00K	0.00K
PRYORSBURG	4/03/2018	18:36	CST-6	EF1	0	0	20.00K	0.00K
VIOLA	3/14/2019	10:27	CST-6	EF0	0	0	2.00K	5.00K
STUBBLEFIELD	01/11/2020	05:17	CST-6	EF1	0	0	2.000M	0.00K
LOWES	10/23/2020	14:18	CST-6	EFU	0	0	0.00K	0.00K
CUBA	05/04/2021	02:55	CST-6	EF1	0	0	165.00K	0.00K
MAYFIELD GRAVES ARPT	05/04/2021	02:59	CST-6	EF1	0	0	15.00K	0.00K
WINGO	12/06/2021	03:23	CST-6	EF0	0	0	25.00K	0.00K
TRI CITY	12/06/2021	03:34	CST-6	EF0	0	0	4.00K	0.00K
BALTIMORE	12/10/2021	21:16	CST-6	EF4	24	210	0.00K	0.00K
				TOTALS:	**24**	**210**	**2.456 M**	**0.00K**

Source: National Oceanic and Atmospheric Administration, National Centers for Environmental Information, Storm Events Database: https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=21%2CKENTUCKY

**** The Tri City tornado on 12/10/2021 does not have accurate property damage values and those values may not be determined before the plan is updated**

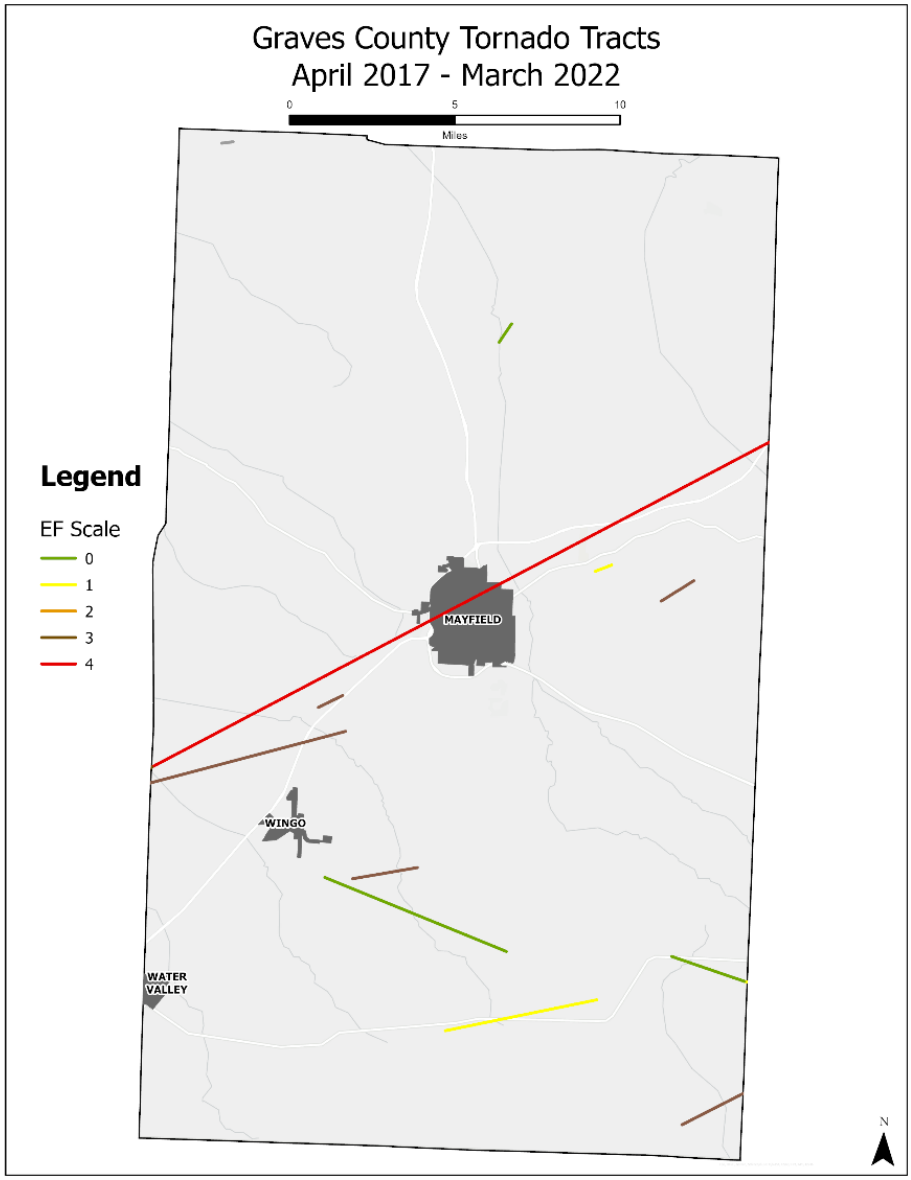
Below is information on the historic December 10, 2021, tornado that impacted Fulton County, Hickman County, Graves County and Marshall County:

On December 10, 2021, four of the Purchase Region counties were impacted by the Quad State Tornado three of those counties were impacted by an EF 4 tornado causing substantial damage that is not currently available on NECI Strom Event website. This historic EF-4 tornado was part of the continuous tornadoes that occurred from this supercell. This tornado started in northwest Tennessee, northwest of Union City. This tornado crossed from Hickman County into Graves County about one-half mile north of us Highway 58 crosses the county line, close to the tiny community of Baltimore. The tornado was 1.3 miles wide when it entered Graves County and varied in size as it moved across the county. The primary impact to Graves County was on the city of Mayfield, where the tornado achieved a rating of EF-4. The city of Mayfield suffered a devasting impact, in terms of both loss of life and property destruction. There were 23 fatalities county wide and many more injuries. On the southwest edge of Mayfield as the tornado entered Mayfield, a candle factory was demolished, and at least nine workers at that factory were killed. The tornado continued northeast through the heart of Mayfield at 9:28 PM CST, at one mile width downtown Mayfield was directly impacted, crippling the police and fire department headquarters and communications. Residential neighborhoods both southwest and northwest of downtown and numerous businesses in the downtown district were destroyed. Several damage sites in the City of Mayfield received a wind speed estimated 188 mph, the highest in the county. At least 1,500

structures were damaged or destroyed including businesses, and 730 dwellings were determined uninhabitable by the Red Cross. Many vehicles and farm equipment within rural areas were destroyed. Nearly total tree destruction occurred. The EF-4 damage in the county began near the candle factor and the last point of damage was on the northeast side of Mayfield including a nursing home. Once in Graves County the tornado intersected I-69 four miles southwest of the Mayfield city limit, and the tornado then closely followed I-69 into Marshall County. From Highway 131 to Highway 301 northeast of Mayfield, the tornado followed the exact same path as the May 10, 2016, EF-3 tornado, some of the same structures were damaged in that tornado and were destroyed by this tornado.

Figure 6.1 illustrates the tornado tracks for the 12 events recorded during the update period.

Figure 6.1 Vulnerability to Tornados through Identification of Tornado Tracks April 1, 2017 – March 31, 2022



SUMMARY AND CONCLUSIONS OF TORNADO PROFILE

During the period covered by the update (04/01/2017 – 03/31/2022) there have been twelve occurrences of tornadoes in Graves County recorded by the NCEI. There were 24 casualties and 210 injuries and $2.456 million in personal property damage reported as of a result of these events.

Information from Table 6.6 and Figure 6.1 related to Tornadoes can be used to define the frequency of tornado events and the impact of these events. Data on tornado event magnitude is provided in the form of the Enhanced Fujita Scale as shown on the map.

Graves County experienced twelve reported events over a 5-year period, which divides out to 2.4 Reported Tornado Events per year, or a 100% probability that such an event will occur in any given year. Based on recorded events and reported damages, the cost of a Tornado Event could be calculated as:

- $2,456,000 divided by 12 events = $204,666.67 per event.
- $204,666.67 times 2.4 events/year = $491,200.01 per year.

Any area in the county is as vulnerable as another and the events are completely random and unpredictable. Of critical concern to the Graves County MPT, and the main contributing factor in their consideration of risks and vulnerability, is the potential human cost of Tornado Events. The recent December 2021 tornado that impacted Graves County results in 24 fatalities and 210 injuries. It caused destruction/ damaged to 1,889 single family residences, 183 Commercial Properties and 103 other structures. The historically damaging EF4 tornado on December 10, 2021, that travelled through Graves County emphasizes the potential vulnerability to tornadoes that Grave Count suffers. Graves County has suffered frequent tornado events over the 5-year period and will continue as time goes on.

Thunderstorm Wind

A thunderstorm is formed from a combination of moisture, rapidly rising, warm air, or a force capable of lifting air, such as the meeting of a warm and cold front, a sea breeze, or a mountain. Thunderstorms can produce tornadoes, large hail and heavy rain which can cause flash flooding. The National Weather Service considers a thunderstorm as severe if it develops ¾ inch hail or 58 mph winds. Straight line winds during thunderstorms can exceed 100 miles per hour and are responsible for wind damage associated with thunderstorms. One type of straight-line wind, the downburst, can cause damage equivalent to a strong tornado and can be extremely dangerous to aviation.

Thunderstorms affect relatively small areas when compared with winter storms, as the average storm is 15 miles in diameter and lasts an average of 30 minutes. All thunderstorms are dangerous and capable of threatening life and property in localized areas. Every thunderstorm produces lightning, which results from the buildup and discharge of electrical energy between positively and negatively charged areas.

Thunderstorms are quite frequent in Graves County. They can produce damage, injuries, or fatalities. Numerous recorded severe thunderstorms have produced high winds, lightning, and hail, in the county. Many of these thunderstorms have caused property or crop damage. These storms, although relatively short in duration when compared to other weather events, are often long lived enough to track across the entire county before dissipating their energy or exiting the region.

Table 6.7 Thunderstorm Wind Events and Impacts in Graves County April 1, 2017 – March 31, 2022

Location	Date	Time	Time Zone	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
MAYFIELD	4/26/2017	18:37	CST-6	56 kts. EG	0	0	0.00K	0.00K
DOGWOOD	4/26/2017	18:40	CST-6	61 kts. EG	0	0	5.00K	0.00K
LYNNVILLE	5/27/2017	17:55	CST-6	56 kts. EG	0	0	0.00K	0.00K
SEDALIA	6/26/2018	19:37	CST-6	56 kts. EG	0	0	6.00K	0.00K
WINGO	6/28/2018	10:00	CST-6	52 kts. EG	0	0	3.00K	0.00K
KANSAS	6/28/2018	19:25	CST-6	52 kts. EG	0	0	40.00K	0.00K
WINGO	6/28/2018	19:45	CST-6	52 kts. EG	0	0	5.00K	0.00K
CUBA	7/15/2018	11:40	CST-6	52 kts. EG	0	0	2.00K	0.00K
MAYFIELD	7/15/2018	11:42	CST-6	56 kts. EG	0	0	5.00K	0.00K
BOAZ	12/31/2018	11:52	CST-6	65 kts. EG	0	0	10.00K	0.00K
SEDALIA	6/19/2019	15:10	CST-6	52 kts. EG	0	0	3.00K	0.00K
PRYORSBURG	6/21/2019	16:39	CST-6	65 kts. EG	0	0	25.00K	0.00K
FANCY FARM	6/23/2019	15:37	CST-6	70 kts. EG	0	0	8.00K	0.00K
HICKORY	6/23/2019	15:45	CST-6	78 kts. EG	0	0	50.00K	0.00K

Location	Date	Time	Time Zone	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
SYMSONIA	6/23/2019	15:53	CST-6	61 kts. EG	0	0	5.00K	0.00K
MAYFIELD	6/26/2019	18:25	CST-6	61 kts. EG	0	0	20.00K	0.00K
BOAZ	7/17/2019	19:28	CST-6	52 kts. EG	0	0	2.00K	0.00K
WINGO	05/03/2020	13:45	CST-6	56 kts. MG	0	0	40.00K	0.00K
DUKEDOM	05/03/2020	13:51	CST-6	61 kts. EG	0	0	50.00K	0.00K
FANCY FARM	08/27/2020	18:55	CST-6	56 kts. EG	0	0	10.00K	0.00K
LOWES	10/23/2020	14:22	CST-6	52 kts. EG	0	0	1.00K	0.00K
LYNNVILLE	11/15/2020	03:09	CST-6	52 kts. EG	0	0	0.00K	0.00K
TRI CITY	05/04/2021	03:01	CST-6	65 kts. EG	0	0	50.00K	0.00K
SYMSONIA	03/18/2022	16:33	CST-6	52 kts. EG	0	0	0.00K	0.00K
WINGO	05/03/2020	13:45	CST-6	56 kts. MG	0	0	40.00K	0.00K
DUKEDOM	05/03/2020	13:51	CST-6	61 kts. EG	0	0	50.00K	0.00K
FANCY FARM	08/27/2020	18:55	CST-6	56 kts. EG	0	0	10.00K	0.00K
LOWES	10/23/2020	14:22	CST-6	52 kts. EG	0	0	1.00K	0.00K
LYNNVILLE	11/15/2020	03:09	CST-6	52 kts. EG	0	0	0.00K	0.00K
TRI CITY	05/04/2021	03:01	CST-6	65 kts. EG	0	0	50.00K	0.00K
SYMSONIA	03/18/2022	16:33	CST-6	52 kts. EG	0	0	0.00K	0.00K
TOTALS					**0**	**0**	**340.00K**	**0.00K**

Wind Magnitude Definitions: Measured Gust:'MG', Estimated Gust:'EG', Measured Sustained:'MS', Estimated Sustained:'ES' *Source: Source: National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI), Storm Events Database*
https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=21%2CKENTUCKY

The following descriptions are typical of Thunderstorm Wind events in Graves County:

- In the Event from June 23, 2019, a cluster of thunderstorms formed over western Kentucky early in the afternoon. Several of these storms produced large hail or damaging wind. Several Ef-1 tornadoes were associated with this line, in addition to scattered pockets of wind damage. A microburst wind near 90 mph struck the Hickory area. Numerous large tree limbs and trees were down. An empty semi-truck was overturned at a large chicken processing plant at Hickory. A large section of the east wall of a metal building was blown out after garage doors on the west side were opened by the wind. The damaged swath was approximately 1.3 miles long and up to 250 yards wide. In Fancy Farm the National weather service found scattered tree damage in and near Fancy Farm. Several trees had large broken limbs or were uprooted. One house sustained gutter and roof damage from falling limbs with estimated peak winds at 80 mph.

- On May 3, 2020, there were numerous reports of wind damage accompanying a squall line of thunderstorms that moved rapidly east-southeast. The wind damage was mainly alone and south of a line from Clinton to Murray. A mesoscale convective vortex which turned eastward along the Kentucky/ Tennessee border helped sustain the storms and about one mile north of the Tennessee border near Dukedom, numerous trees were down. A tree landed on a home and on an SUV, along with several power lines being downed.

SUMMARY AND CONCLUSIONS OF THUNDERSTORM WIND PROFILE

During the period covered by the update (04/01/2017 – 03/31/2022) there have been 24 occurrences of Thunderstorm Wind Events in Graves County reported by the NCEI. There was one reported fatality and no reported injuries. These occurrences produced $340,000 of reported damages in personal property.

Graves County experienced 24 Reported Events over the 5-year update period, which divides out to 4.8 reported events per year, a more than 100% probability that such an event will occur in any given year. Based on recorded events and reported damages in Graves County, the cost of a Thunderstorm Wind Event could be calculated as:

- $340,000 in damages / 24 events = $14,166.67 per event on average.
- $14,166.67 damage per event x 4.8 events per year = $2951.39 damage per year.

Of critical concern to the Graves County MPT and the main contributing factor in their consideration of risks and vulnerability, is the human cost of Thunderstorm Wind Events.

Flash Flood / Flood

As can be seen Table 6.8, Flooding is the most common (7/13) form of flooding in Graves County. The cause being too an overflow of water onto normally dry land or ponding water at or near the point where the rain fell. However, rather than steep slopes and narrow valleys channeling and concentrating the runoff from heavy rains, the runoff is too great in volume for the county's characteristic low lying, meandering streams, to carry away. This slow drainage is often exacerbated by stream blockages of tree limbs and trunks, which form effective check dams and barrages.

River basin flooding is common among Kentucky's major streams and bodies of water during the winter and early spring months. There are no major rivers or river basins in Graves County. The problematic streams in Graves County are Clarks River, Mayfield Creek, Red Duck Creek, and Brush Creek. These streams are all susceptible to flash flooding.

Periodic flooding of land adjacent to rivers, streams and shorelines is natural and can be expected to take place at fairly regular intervals. The recurrence interval of a flood is defined as the average time interval, in years, expected between a flood event of a particular magnitude and an equal or larger flood. 100 Year Flood: as determined by the Federal Emergency Management Agency (FEMA), is a flood event of a magnitude expected to be equaled or exceeded once on the average during any 100-year period. The term "100-year flood" is misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1- percent chance of being equaled or exceeded each year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood is also used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance.

Table 6.8 Flash Flood / Flood Events and Impacts in Graves County April 1, 2017 – March 31, 2022

Location	Date	Time	Time Zone	Event Type	Deaths	Injuries	Property Damage	Crop Damage
SYMSONIA	02/21/2018	13:30	CST-6	Flood	0	0	1.000 M	0.00K
FARMINGTON	02/23/2018	07:40	CST-6	Flood	0	0	250.00K	0.00K
SYMSONIA	03/01/2018	00:00	CST-6	Flood	0	0	25.00K	0.00K
DUKEDOM	04/23/2018	14:30	CST-6	Flood	0	0	5.00K	0.00K
MAYFIELD	03/14/2019	03:22	CST-6	Flash Flood	0	0	25.00K	0.00K
MAYFIELD	07/22/2019	13:30	CST-6	Flash Flood	0	0	0.00K	0.00K
MAYFIELD	12/16/2019	15:36	CST-6	Flood	0	0	0.00K	0.00K
FANCY FARM	01/11/2020	12:00	CST-6	Flood	0	0	0.00K	0.00K
WINGO	07/01/2020	14:15	CST-6	Flood	0	0	0.00K	0.00K
HICKORY	07/17/2020	11:58	CST-6	Flash Flood	0	0	0.00	0.00K
SEDALIA	02/28/2021	09:20	CST-6	Flash Flood	0	0	25.00K	0.00K
WEYMOUTH	07/18/2021	12:15	CST-6	Flash Flood	0	0	0.00K	0.00K
MAYFIELD	02/17/2022	12:00	CST-6	Flash Flood	0	0	35.00K	0.00K
TOTALS					**0**	**0**	**1.365 M**	**0.00K**

Source: National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information Storm Events Database: https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=21%2CKENTUCKY

The following event descriptions are typical of the type of flooding experienced in Graves County:

- On February 21, 2018, a flood event occurred causing $1,000,000 worth of property damage. When several rounds of widespread heavy rainfall tracked northeast across western Kentucky. These rounds of heavy rain produced localized flood of roads, along with long-term flooding along creeks and tributaries of the Ohio River. In Graves County several roads were flooded and closed in the river bottoms of the Clarks River and its tributaries, water was over Kentucky Highway 131 at Graves / McCracken County Line. A secondary road was washed out at the intersection of Whitis and Watkins Road northeast of Hickory, with the total road damage in Graves County estimated to be over 1 million dollars.

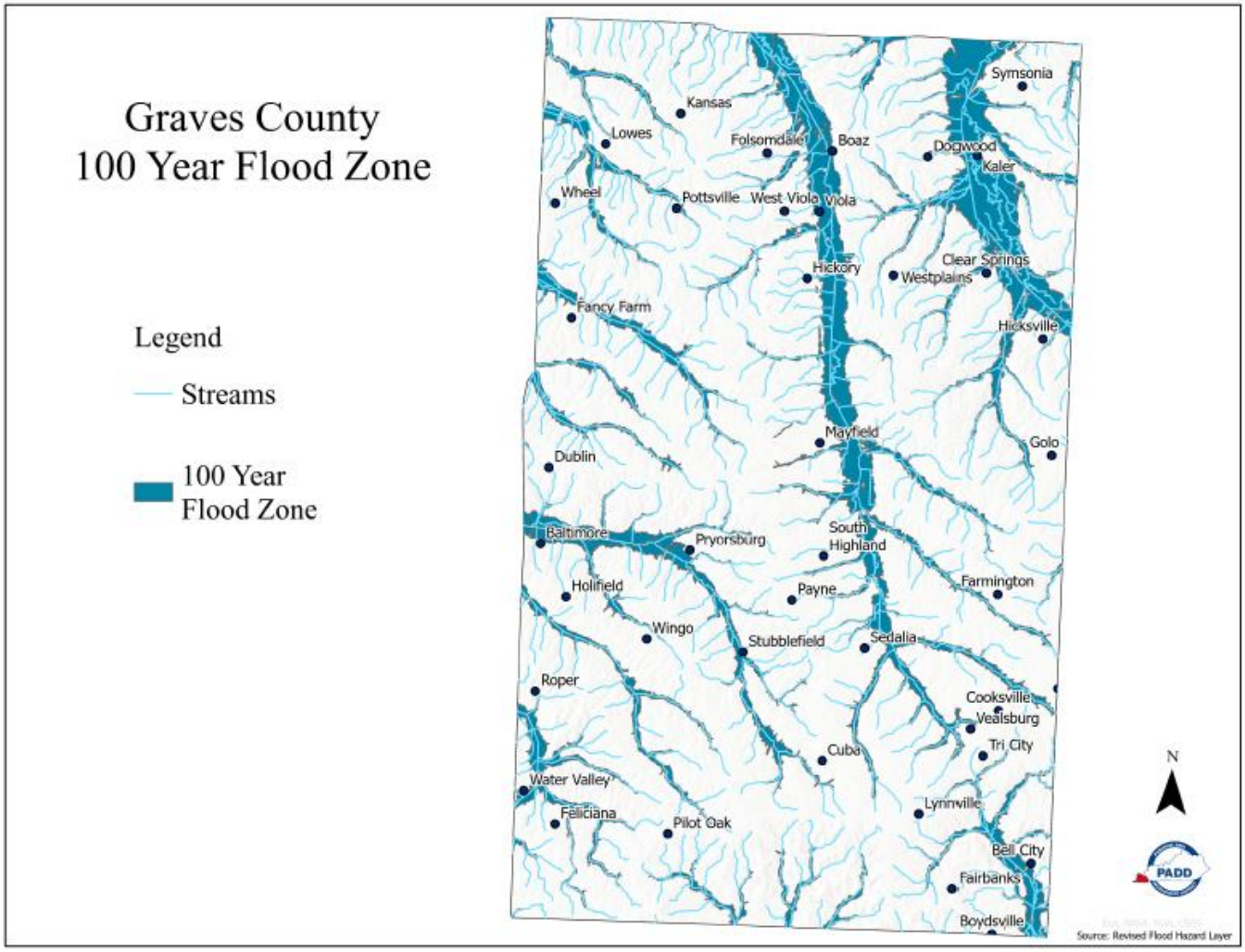
- On February 23, 2018, several rounds of widespread heavy rainfall tracked northeast across western Kentucky. These rounds of heavy rain produced localized flooding of roads, along with longer-term flooding along creeks and tributaries of the Ohio River. In the Farmington community roads were covered in water.

The following event descriptions are typical of the type of flash flooding experienced in Graves County:

- On February 28, 2022, a major flash flooding event occurred in the Tennessee border counties from Fulton east to Elton. The heaviest rain occurred across southern portions of western Kentucky during the Morning and afternoon hours on the 28th. Water was flowing swiftly across Highway 202 near Sedalia and a portion of Wingo Road was completely washed away.

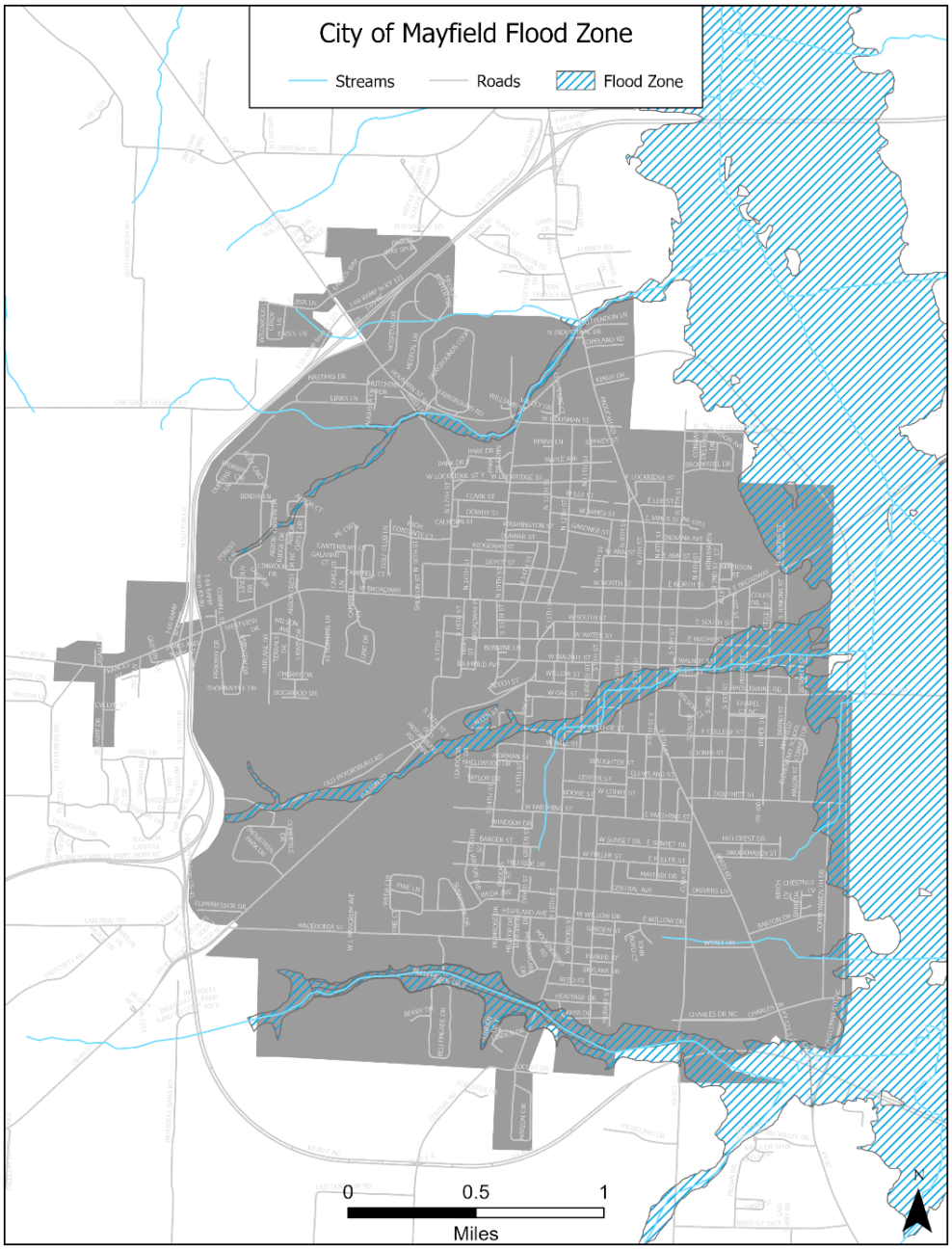
- On February 17, 2022, several rounds of heavy rain and thunderstorms moved across the region on the 17th, with 3 to 5 inches of rainfall causing pockets of road flooding, along with flash flooding of creeks that affected several dwellings. In Mayfield Street flooding was common and Red Duck Creek overflowed its banks, inundating an apartment complex and some surrounding properties.

Figure 6.2 Graves County 100 Year Floodplain



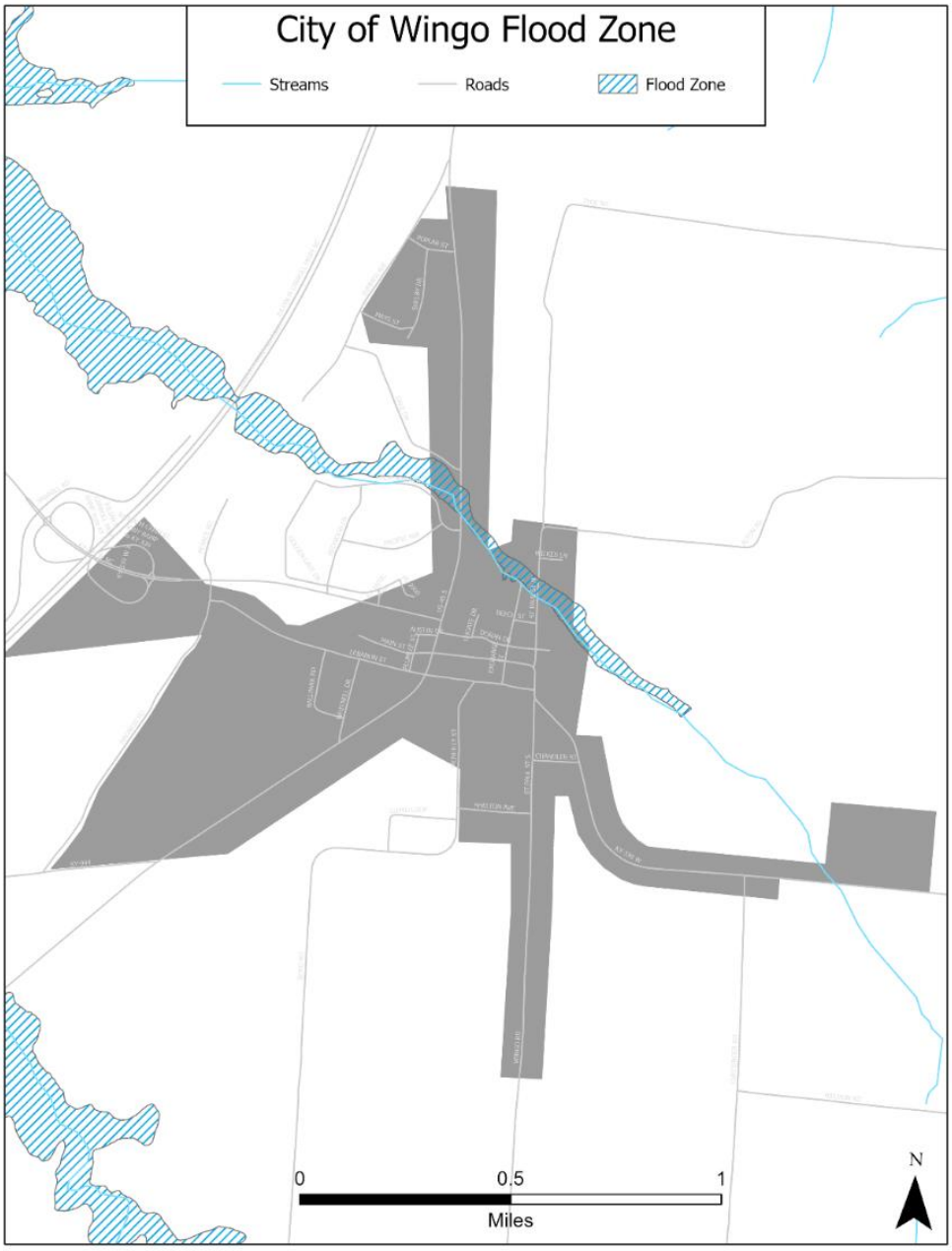
Source: FEMA National Flood Hazard Layers, 2016

Figure 6.3 City of Mayfield Flood Hazard Zone



Source: FEMA National Flood Hazard Layers, 2016

Figure 6.4 City of Wingo Flood Hazard Areas



Source: FEMA National Flood Hazard Layers, 2016

Table 6.9 National Flood Insurance Program Participation by Jurisdiction

Jurisdiction	Floodplain Management Ordinance	SFHA in Jurisdictional Limits	Comments	City Class
Ballard County	X	X		
City of Barlow			No mapped SFHA	6
City of Kevil			No mapped SFHA	6
City of La Center		X	SFHA mapped in 2009, NFIP under consideration	5
City of Wickliffe	X	X		5
Calloway County	X	X		
City of Murray	X	X		3
City of Hazel			No mapped SFHA	6
Carlisle County	X	X		
City of Bardwell	X	X		5
City of Arlington	X	X		6
Fulton County	X	X		
City of Fulton	X	X		4
City of Hickman	X	X		4
Graves County	**X**	**X**		
City of Mayfield	**X**	**X**		**3**
City of Wingo		**X**		**6**
Hickman County		X	Mapped SFHA, non-participant	
City of Clinton	X	X		5
City of Columbus			No mapped SFHA	5
Marshall County	X	X		
City of Benton	X	X		4
City of Calvert City	X	X		4
City of Hardin	X	X		5
McCracken County	X	X		
City of Paducah	X	X		2

Information from the FEMA Community Status Book as of 6-13-17

SUMMARY AND CONCLUSIONS OF FLOODING PROFILE

Information from the tables and maps related to flooding can be used to define the frequency of Flood Events and the impact of these events. Data on flood event magnitude was not available.

The frequency of occurrence that can be derived from this data is 13 Flood Events in 5-year period, which divides out to 2.6 Reported Flooding Events per year, or a probability greater than 100% for the occurrence of a Flood Event in any given year. Based on recorded events and reported damages in Graves County, the cost of a Flood Event could be calculated as:

- 13 events / 5-year period = 2.6 events per year
- $1,365,000 property damage / 13 events = $105,000 average damage per event
- $105,000 x 2.6 events/year = $273,000 average per year

Winter Storm / Ice Storm

Winter Storms can produce an array of hazardous weather conditions that include heavy snow, freezing rain, sleet, high winds, and extreme cold. Ice Storms occur when freezing rain accumulates on surfaces and the ground. When a quarter inch or more of ice builds up, severe impacts can result. Winter storms are fueled by strong temperature gradients and an active upper-level cold jet stream. An Ice Storm can develop when warmer air above the freezing mark above the ground moves over subfreezing air near the ground. Snow aloft falls through the warmer air and melts into rain, then the rain droplets fall into the subfreezing air and freeze upon contact creating a glaze of ice. Winter and Ice storms can paralyze a community by shutting down normal everyday operations. Accumulating snow and ice can result in downed trees and power lines and may block transportation routes or make them hazardous. Heavy snow can lead to the collapse of weak roofs or unstable structures. Often, the loss of electricity results in the loss of heat in some homes and buildings. This presents a threat to human life, especially the elderly population.

The level of impact Winter Storms have is greatly determined by a community's ability to manage and control the affect, for example, the rapid mobilization of snow removal equipment. Because winter storms are sporadic in western Kentucky, many communities cannot afford the expensive equipment and maintenance of snow removal. This increases the potential damage a Winter Storm may cause. Depending on the severity of Ice Storms, impacts can persist for days. If more than a half-inch of accumulation occurs and damage is widespread, it can take a while to remove trees and repair power lines. This can result in a loss of electricity and heat for several days. During the planning period for this update there have been seven Winter Storms recorded in Graves County and zero ice storms. The last Ice Storm on record happened in January 2009.

Table 6.10 Winter Storm / Ice Storm Events and Impacts in Graves County
April 1, 2017 – March 31, 2022

Location	Date	Time	Time Zone	Event Type	Deaths	Injuries	Property Damage	Crop Damage
GRAVES (ZONE)	01/12/2018	03:00	CST-6	Winter Storm	0	0	0.00K	0.00K
GRAVES (ZONE)	02/15/2019	18:00	CST-6	Winter Storm	0	0	0.00K	0.00K
GRAVES (ZONE)	02/10/2021	01:00	CST-6	Winter Storm	0	0	0.00K	0.00K
GRAVES (ZONE)	02/14/2021	20:00	CST-6	Winter Storm	0	0	0.00K	0.00K
GRAVES (ZONE)	02/17/2021	08:00	CST-6	Winter Storm	0	0	0.00K	0.00K
GRAVES (ZONE)	02/02/2022	20:00	CST-6	Winter Storm	0	0	10.00K	0.00K
TOTALS					**0**	**0**	**10.00K**	**0.00K**

Source: National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI), Storm Events Database
https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=21%2CKENTUCKY

The following event descriptions are typical of winter events experienced in Graves County:

- An event from February 2, 2022, lead to $10,000 in property damage when a major winter storm dumped significant amounts of sleet and freezing rain across western Kentucky. There were isolated power outages in Mayfield. In the Ohio River counties from Henderson to Paducah, as well as the Purchase area from Mayfield westward, one-tenth inch to one-quarter inch of ice was under an inch of sleet. Widespread major travel impacts were reported across the region. Roads were covered with an icy mix that resulted in traffic accidents.

- On February 15, 2019, a low-pressure system tracked east-northeast from the lower Mississippi Valley to the Carolinas. One the north side of this low, widespread rain changed to snow, sleet and freezing rain on the afternoon and evening of the 15th. Around one-quarter inch of ice glazed trees and power lines across far western Kentucky, including Paducah, Mayfield, Benton, and Murray areas. Elsewhere across western Kentucky, the wintry precipitation was mostly in the form of sleet and snow, accumulations were generally an ich or less.

SUMMARY AND CONCLUSIONS OF WINTER STORMS / ICE STORM PROFILE

From April 1, 2017, through March 31, 2022, there have been seven occurrences of Winter Storms in Graves County reported by the NCEI. These occurrences totaled approximately $10,000 in reported personal property damage and there were no injuries or fatalities recorded.

The six reported Winter Storm Events over the 5-year plan update period, divides out to 1.2 reported Winter Storm Events per year, or a more than 100% probability that such an event will occur in any given year. Based on recorded events and reported damages in Graves County, the cost of a Winter Storm Event could be calculated as:

- $10,000 divided by 6 events = $1666.67 average damage per event.
- $1666.67 damage x 1.2 events/year = $1388.9 per year.

Ice Storm Events, such as the one in 2009, have had a major impact on the region in the past; however, for this reporting period this specific type of event had no impact. While no Ice Storm Events have been recorded, due to the 2009 Ice Storm producing significant damage to the entire Purchase Region, such events are considered a significant risk.

Earthquake

An earthquake is a geologic event that involves movement or shaking of the earth's crust. Earthquakes are usually caused by the release of stresses accumulated as a result of the rupture of rocks along borders of the earth's ten tectonic plates. Earthquakes can affect hundreds of thousands of square kilometers, causing damage to property, resulting in loss of life and injury, and disrupting the social and economic functioning of the affected area.

According to the New Madrid Seismic Zone Catastrophic Earthquake Response Planning Project Volume 1 all Purchase Region counties will be severely impacted:

"The largest number of damaged buildings occurs in McCracken County where 24,100 structures are damaged. Graves and Marshall Counties also incur substantial building damage at 9,000 and 5,100 buildings, respectively. Conversely, over 90% of all buildings in Ballard and Hickman Counties are expected to experience damage. Additionally, 80% to 90% of buildings in McCracken and Carlisle Counties are damaged."

Based on the scenario conducted in the study

"Various modes of transportation are also compromised in western Kentucky following the NMSZ scenario event. Over 250 bridges are damaged; numerous bridges along US-51, US-60 and US-45 are heavily damaged and likely impassible the day after the earthquake. Additionally, damage to major river bridges during the event severely limits traffic between Kentucky and Illinois, Tennessee and Missouri."

To review more information regarding this study, refer to appendix 3.

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends on the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology. Earthquakes may also cause landslides and liquefaction. Landslides are the down-slope movement of soil and rock in mountainous regions and along hillsides. Liquefaction occurs when the ground soil loses the ability to resist shear and flows much like quicksand. When liquefaction occurs, anything relying on the substrata for support can shift, tilt, rupture, or collapse.

Earthquakes are measured in terms of their magnitude and intensity. Magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude. Each unit increase in magnitude on the Richter Scale corresponds to a ten-fold increase in wave amplitude, or a 32-fold increase in energy. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale. It is a twelve-level scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, with an "I" corresponding to imperceptible Table 6.11 provides the Mercalli Intensity scale for earthquake compared to the Richter Scale.

Table 6.11 Modified Mercalli Intensity Scale for Earthquakes Compared to the Richter Scale

Scale	Intensity	Description of Effects	Maximum Acceleration (mm/sec)	Richter Scale
I	Instrumental	Detected only on seismographs	<10	
II	Feeble	Some people feel it	<25	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	<50	
IV	Moderate	Felt by people walking	<100	
V	Slightly Strong	Sleepers awake; church bells ring	<250	<4.8
VI	Strong	Trees sway: suspended objects swing, objects fall off shelves	<500	<5.4
VII	Very Strong	Mild alarm: walls crack; plaster falls	<1000	<6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged	<2500	
IX	Ruinous	Some houses collapse; ground cracks; pipes break	<5000	<6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread	<7500	<7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes, and cables destroyed; general triggering of other hazards	<9800	<8.1
XII	Catastrophic	Total Destruction: trees fall; ground rises and falls in waves	>9800	>8.1

The New Madrid Seismic Zone is located in southeastern Missouri, northeastern Arkansas, Western Tennessee, Western Kentucky and Southern Illinois. This area is the most active seismic area east of the Rocky Mountains.

Every Year hundreds of small earthquakes occur in the New Madrid Seismic Zone but are typically too small to be felt by humans and can only be detected by sensitive instruments. The last major earthquake in the state of Kentucky was in 1812. The probability of a large magnitude earthquake impacting the Purchase Region is about 10% based on 50 years of research. Though Earthquakes

are hard to predict, and scientists are taking great strides to understand the New Madrid Seismic Zone.
Due to the nature of the bedrock that is present in the New Madrid Seismic Zone the geographic impact in the asking of the ground and be 20 times larger than the earthquakes that impact California. If a large magnitude Earthquake is to occur in the Purchase Region area the damages will be significant.
The primary cause for damage and injuries during an earthquake is because of the destruction of manmade structures. These structures are particularly susceptible 1. Tall Structures (Buildings, Bridges, Dams), 2. Large Open Structures, 3. Brittle Structures, 4. Complex Structures with odd shapes and lots of corners, and 5. Unanchored building contents. Damage will vary depending on the magnitude, zone location, geologic nature of material and degree of urbanization. More information can be found on the Missouri Department of Natural Resources facts page of the New Madrid Seismic Zone https://dnr.mo.gov/land-geology/hazards/earthquakes/science/facts-new-madrid-seismic-zone.

Figure 6.5 collected from the Kentucky Geological Survey interprets ground motion.

Figure 6.5 KGS Ground Motion

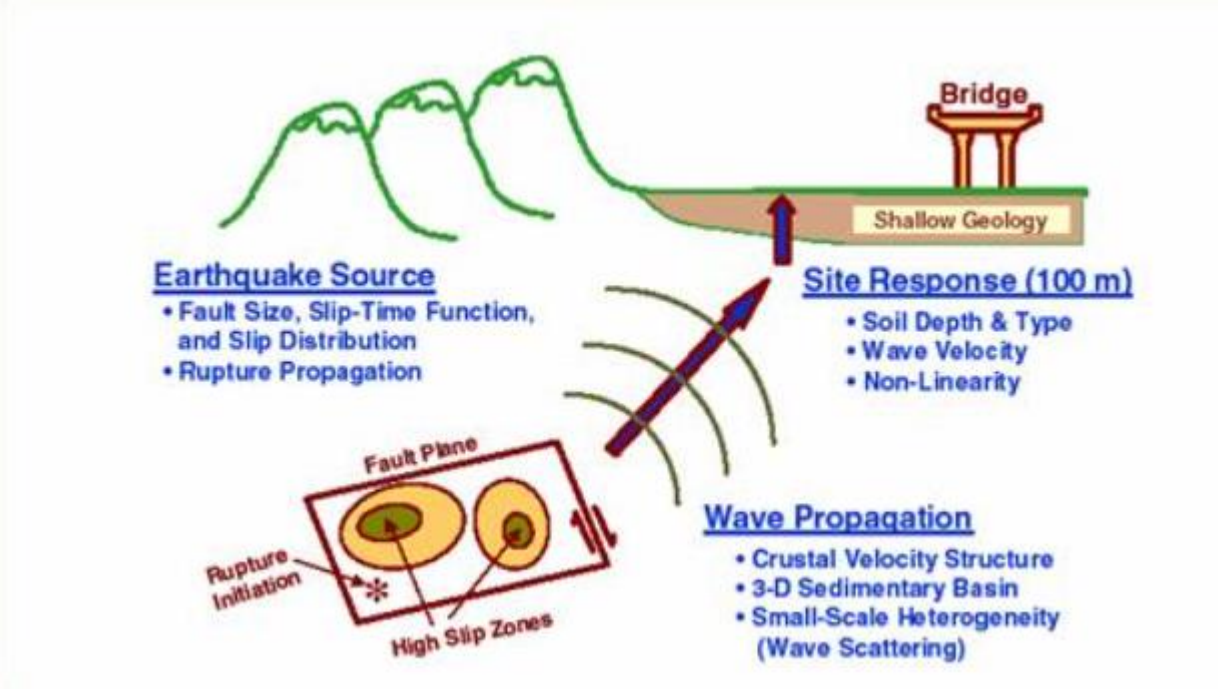
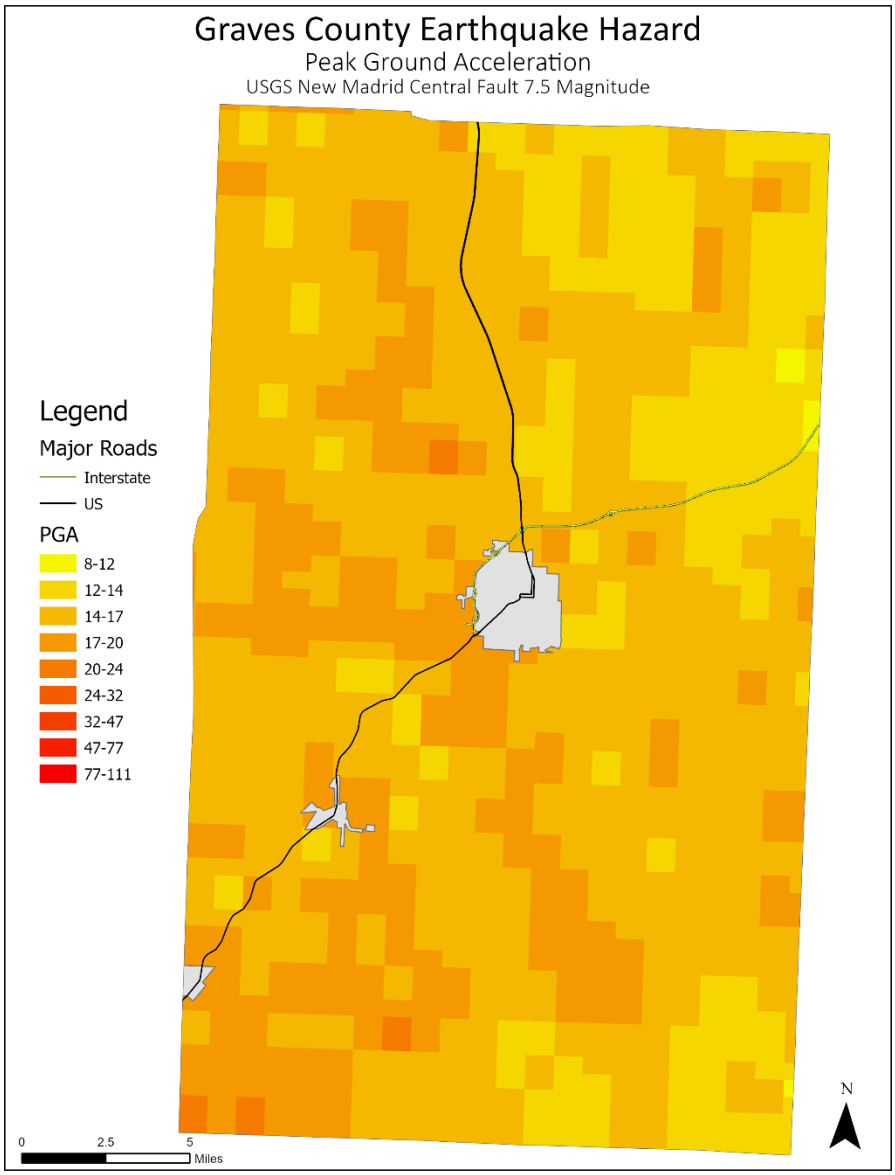


Figure 6.6 shows the Peak Ground Acceleration for Graves County based on the USGS Shake map simulator at an earthquake of 7.5 magnitude. Figure 6.7 shows the Peak Ground Velocity for Graves County based on the USGS Shake Map simulator for an earthquake of 7.5 magnitude.

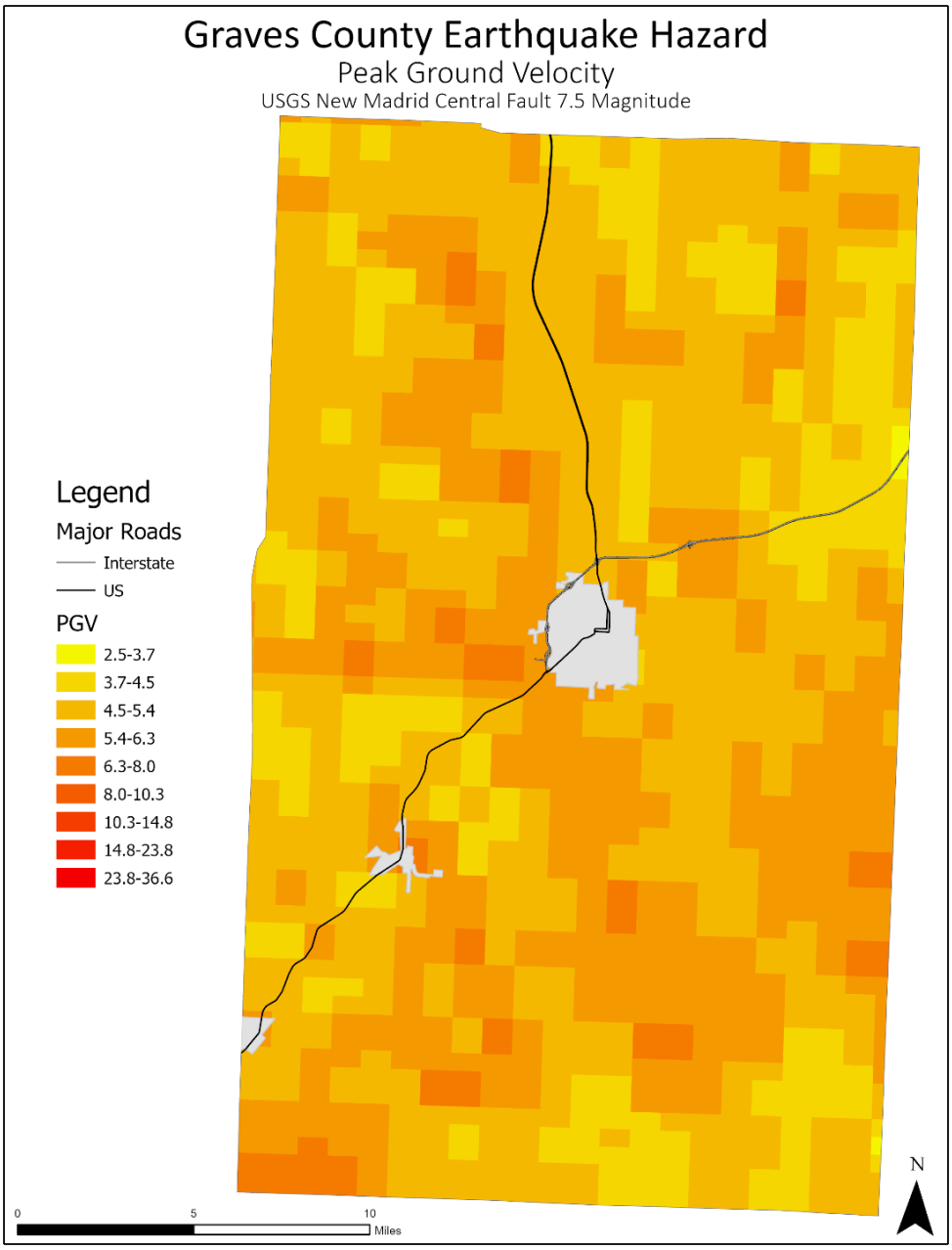
Figure 6.6 USGS New Madrid Central Fault 7.5 Magnitude Peak Ground Acceleration



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

Figure 6.7 USGS New Madrid Central Fault 7.5 Magnitude Peak Ground Velocity



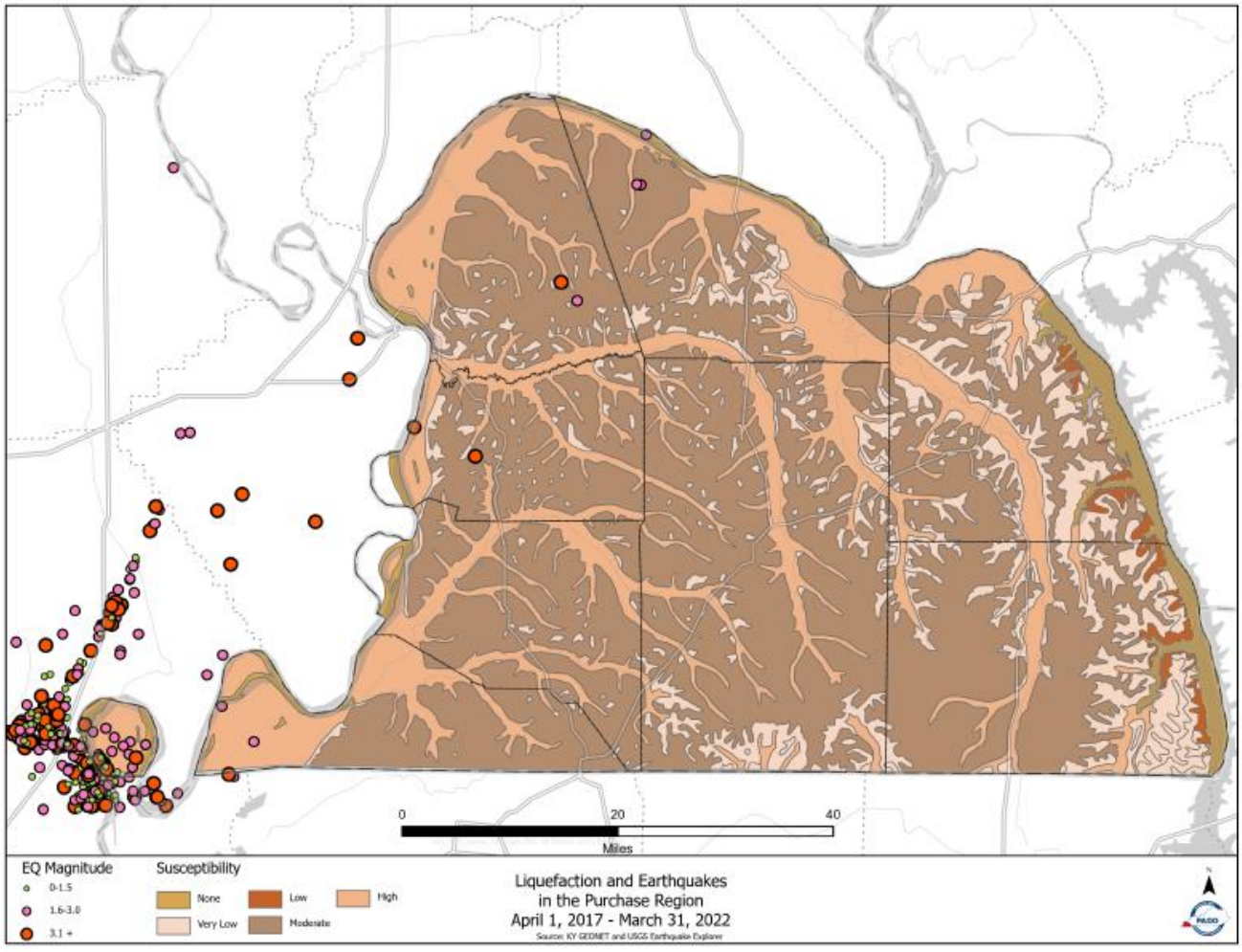
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking. The level of damage depends on the amplitude and duration of the shaking, which are directly related to the earthquake size, distance from the fault, site and regional geology. Earthquakes may also cause liquefaction. Liquefaction occurs when the ground soil loses the ability to resist shear and flows, much like quicksand. When liquefaction occurs, anything relying on the substrate for support can shift, tilt, rupture, or collapse.

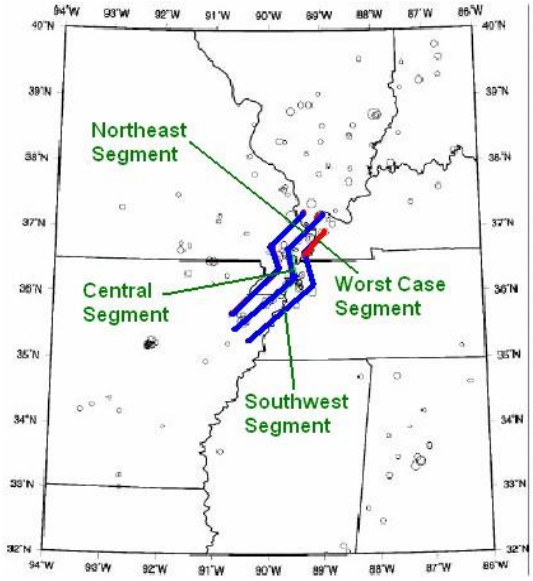
Figure 6.8 illustrates the underlying soil structure for Graves County. It indicates that virtually the entire county is underlain by beds of sediment, not bedrock. This increases the potential for ground shaking and liquefaction.

Figure 6.8 Generalized Liquefaction Susceptibility & Earthquake Magnitude of the Purchase Region



Source: USGS Map was derived from the USGS Earthquake Catalog, Available at: https://earthquake.usgs.gov/earthquakes/search/

Figure 6.9 Scenario Fault Location for the State of Kentucky



SUMMARY AND CONCLUSIONS OF EARTHQUAKE HAZARD PROFILE

Low magnitude earthquakes occur constantly in the New Madrid Seismic Zone. Depending on the depth and magnitude, some of the stronger tremblors, 3 and above, are felt throughout the entire region. Damages amount to the rare instance of a picture being knocked off a wall or items shaken from shelves.

The potential for an earthquake of catastrophic proportions is not open to debate. Historic and geologic evidence are proof. However, the probability of such an event in any given time frame is open to interpretation and the effects are still a matter of discussion.

Graves experienced zero earthquakes between April 1, 2017 – March 31, 2022. Most of the earthquakes that occurred were near or in Fulton County. A full figure of earthquake occurrences will be found in the appropriate county annex.

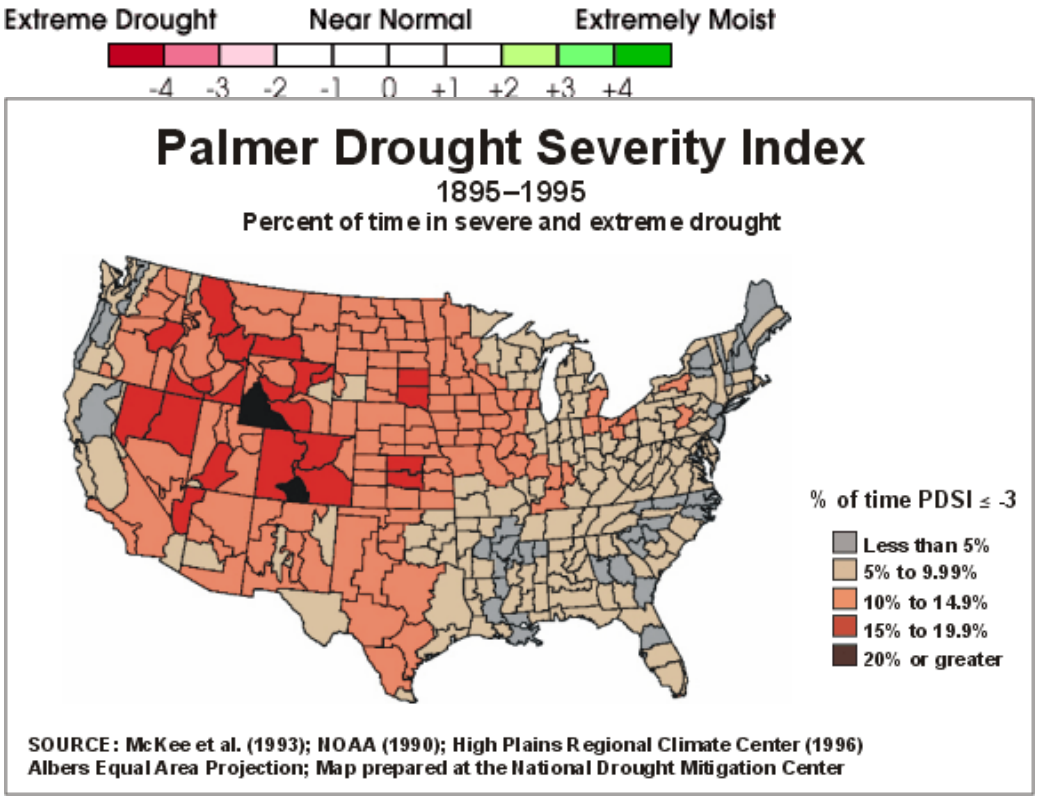
Excessive Heat / Drought

Excessive heat is defined as temperatures that hover 10 degrees or more above the average high temperatures for the region and last for several weeks. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms and low visibility.

Droughts occur when a long period passes without substantial rainfall. Drought conditions can cause significant crop damage, but there is little property damage from excessive heat. Due to the historical occurrences of drought and excessive heat in the Purchase Region, these hazards present a threat not only to the agriculture of the region, but to the aged, and chronically ill population.

The Palmer Drought Severity Index (PDSI) is used to show the relative dryness or wetness in an area and indicates prolonged and abnormal moisture deficiency or excess. The PDSI is used for evaluating the scope, severity and frequency of prolonged periods of abnormally wet or dry weather (see Figure 6.10). The PDSI scale follows below.

Figure 6.10 Palmer Drought Severity Index



During the planning period for this update there have been a combined total of three events recorded in Graves County. Of those three events, three have been Excessive Heat and zero Drought. There were no injuries / fatalities or damage (property or crop) recorded during these events.

Table 6.12 Excessive Heat / Drought Events and Impacts in Graves County April 1, 2017– March 31, 2022

Location	Date	Time	Time Zone	Event Type	Deaths	Injuries	Property Damage	Crop Damage
GRAVES (ZONE)	07/21/2017	00:00	CST-6	Excessive Heat	0	0	0.00K	0.00K
GRAVES (ZONE)	07/05/2018	00:00	CST-6	Excessive Heat	0	0	0.00K	0.00K
GRAVES (ZONE)	07/14/2018	00:00	CST-6	Excessive Heat	0	0	0.00K	0.00K
TOTALS					**0**	**0**	**0.00K**	**0.00K**

Source: National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI), Storm Events Database
https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=21%2CKENTUCKY

The excessive heat and drought events recorded below are an example of the type of heat event that occurs in Graves County:

- On July 21, 2017, an excessive heat event occurred when a large upper-level high resulted in two to three days of dangerously high heat indices from 105 to 115 degrees. The large high in the upper levels of the atmosphere expanded over much of the southern two-thirds of the United States for a few days. The daily peak heat indices at Paducah during the hot weather were 109 degrees on the 21st and 107 degrees on the 22nd. Several Kentucky mesonet sites and automated airport sites reported peak heat indices from 110 to 115 on the 21st and 22nd.

- Another excessive heat event occurred on July 14, 2018, when several days of oppressive heat and humidity were experienced across parts of west Kentucky. The extreme western end of the state was impacted the most. From Paducah south and west, heat indices peaked in the triple digits on five consecutive days. The highest heat indices were observed on the 14th when values from 110 to 115 were recorded.

SUMMARY AND CONCLUSIONS OF EXCESSIVE HEAT / DROUGHT PROFILE

Combined there have been three heat related events in the county during the 5-year planning period. This divides out to 0.6 events every other year. Common sense would dictate that the conditions that generated a heat type event in one county could have generated a heat type event in another. One in every ten events could prove deadly and almost four heat injuries result from every event. From a county perspective the cost of an Excessive Heat Event is difficult to assess as there are no monetary damages available. Of critical concern to the Graves County MPT was the potential for human casualties in the form of heat stroke and heat exhaustion causing injury and even deaths.

Information from the above table can be used to define the frequency of Drought Events and the impact of these events throughout the region. Graves County experienced zero droughts over the 5-year update period. Drought is mainly a threat to the agricultural segment of the county economy, but it is also having a significant impact on water and wastewater systems.

Based on historic records, there have been no deaths or injuries attributed to excessive heat in Graves County. Likewise, there has been no drought impact recorded for individuals or property over this same period. As there are no reported damages or injuries for the planning update period, the annualized cost of a heat related event could not be calculated.

Hail

Hail is one of four types of precipitation that falls from the sky. It's also the most dangerous, damaging type, occurring during severe storms. If hail measuring larger than ¾ inches in diameter falls during a thunderstorm, it is classified as severe weather. Sometimes damaging winds accompany this type of storm as well. According to the National Oceanic and Atmospheric Administration, hail causes over one billion dollars of damage in the United States each year.

Generally, hail must be 1 ¼ inches in diameter (Half-Dollar size) before it causes damage to heavy composite shingles or wood shake shingles. Lightweight composite shingles may show damage after being struck by 1-inch diameter (Quarter size) hail. Only deteriorated composite shingles will show hail damage due to hail less than 1 inch in diameter, and the hail generally must be more than ¾ inch in diameter (Dime size).

TORRO Hailstorm Intensity Scale

The Torro Hailstorm Intensity Scale was introduced by Jonathan Webb of Oxford, England, in 1986 as a means of categorizing hailstorms. The scale extends from H0 to H10 (See Table 6.13) with its increments of intensity or damage potential related to hail size, texture, numbers, fall speed, speed of storm translation, and strength of the accompanying wind.

An indication of equivalent hail kinetic energy ranges (in joules per square meter) has now been added to the first six increments on the scale, and this may be derived from radar reflectivity or from hail pads. The International Hailstorm Intensity Scale recognizes that hail size alone is insufficient to accurately categorize the intensity and damage potential of a hailstorm, especially towards the lower end of the scale. For example, without additional information, an event in which hail of up to walnut size is reported (hail size code 3: hail diameter of 21-30 mm) would be graded as a hailstorm with a minimum intensity of H2-3. Additional information, such as the ground wind speed or the nature of the damage the hail caused, would help to clarify the intensity of the event. For example, a fall of walnut-sized hail with little or no wind may scare fruit and sever the stems of crops but would not break vertical glass and so would be ranked H2-3. However, if accompanied by strong winds, the same hail may smash many windows in a house and dent the bodywork of a car, and so be graded an intensity as high as H5.

However, evidence indicates that maximum hailstone size is the most important parameter relating to structural damage, especially towards the more severe end of the scale. It must be noted that hailstone shapes are also an important feature, especially as the "effective" diameter of non-spheroidal specimens should ideally be an average of the co-ordinates. Spiked or jagged hail can also increase some aspects of damage.

Table 6.13

?	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m^2	Typical Damage Impacts
H0	Hard Hail	5	0-20	No damage
H1	Potentially Damaging	5-15	>20	Slight general damage to plants, crops
H2	Significant	10-20	>100	Significant damage to fruit, crops, vegetation
H3	Severe	20-30	>300	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	>500	Widespread glass damage, vehicle bodywork damage
H5	Destructive	30-50	>800	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	40-60		Bodywork of grounded aircraft dented; brick walls pitted
H7	Destructive	50-75		Severe roof damage, risk of serious injuries
H8	Destructive	60-90		(Severest recorded in the British Isles) Severe damage to aircraft bodywork
H9	Super Hailstorms	75-100		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	>100		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Size codes are presented in Table 6.14. The size code is accepted as consistent with other reports and evidence.

Table 6.14

Hail size and diameter in relation to TORRO Hailstorm Intensity Scale		
Size code	**Maximum Diameter mm**	**Description**
0	5-9	Pea
1	10-15	Mothball
2	16-20	Marble, grape
3	21-30	Walnut
4	31-40	Pigeon's egg > squash ball
5	41-50	Golf ball > Pullet's egg
6	51-60	Hen's egg
7	61-75	Tennis ball > cricket ball
8	76-90	Large orange > Soft ball

From April 1, 2017, through March 31, 2022, there have been eight occurrences of Hail Events in Graves County reported by the NCEI. There were no reported injuries and $10,000 reported property damages associated with one of the events occurring March 16, 2018.

Table 6.15 Hail Events and Impacts in Graves County April 1, 2017 – March 31, 2022

Location	Date	Time	Time Zone	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
KANSAS	03/16/2018	23:16	CST-6	1.75 in	0	0	10.00K	0.00K
SYMSONIA	03/16/2018	23:34	CST-6	1.00 in	0	0	0.00K	0.00K
FARMINGTON	03/19/2018	12:35	CST-6	0.75 in	0	0	0.00K	0.00K
MAYFIELD	03/24/2019	23:26	CST-6	0.88 in	0	0	0.00K	0.00K
WINGO	06/26/2019	18:09	CST-6	0.88 in	0	0	0.00K	0.00K
MAYFIELD	04/08/2020	18:43	CST-6	1.00 in	0	0	0.00K	0.00K
BOAZ	05/06/2021	13:45	CST-6	0.75 in	0	0	0.00K	0.00K
MAYFIELD	12/10/2021	21:24	CST-6	1.75 in	0	0	0.00K	0.00K
TOTALS					**0**	**0**	**10.00K**	**0.00K**

Source: National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Information (NCEI), Storm Events Database
https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=21%2CKENTUCKY

SUMMARY AND CONCLUSIONS FOR HAIL PROFILE

Graves County has experienced 8 Reported Hail Events during the 5-year plan update period, which divides out to 1.6 events per year or a probability of over 100% for an event with Hail occurrence in any given year. Based on recorded events and reported damages in Graves County, the cost of a Hail Event could be calculated as:

- $10,000 divided by 8 events = $1,250 average damage per event.
- $1,250 damage x 2.10 events/year = $2,000 per year.

Wildfire

A wildfire is an uncontrollable burning of grasslands, brush or woodlands. The potential for wildfire depends on surface fuel characteristics, weather conditions, recent climate conditions, and topography and fire behavior. There are three different types of wildfire classes:

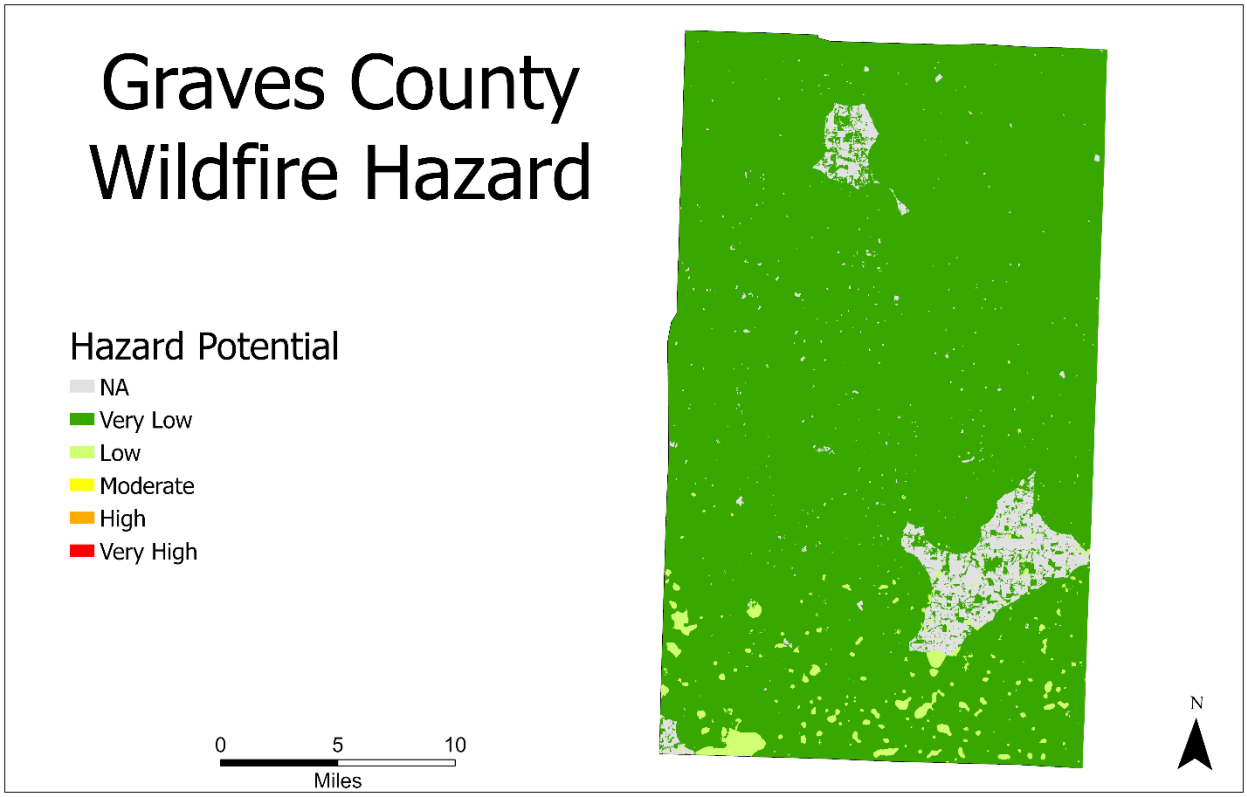
- *Surface fires* are the most common type. These fires burn along the forest floor moving slowly and will damage and kill trees.
- *Ground fires* are usually started by lightning. These fires burn on or below the forest floor.
- *Crown fires* spread quickly by wind. These fires will move quickly by jumping along treetops.
  - *Spotting* can be produced by crown fires as well as wind and topography conditions. Large burning embers are thrown ahead of the main fire. Once spotting begins, the fire will be very difficult to control.

Kentucky has two defined wildfire seasons: in the spring, February 15 – April 30 and in the fall, October 1 – December 16. These two seasons are separated by periods of higher moisture and colder, less conducive fire weather. When leaves begin to fall from deciduous hardwood trees a thick litter layer forms in wooded areas creating a fuel source for rapidly expanding wildfires. Also, during the fall season, or periods of drought, tall grasses can become very flammable. It is possible for wildfires to occur outside the defined fire seasons during prolonged periods of drought.

Specific outdoor burning laws have been established to lessen the wildfire occurrence during these fire seasons. Kentucky Revised Statute 149.400 prohibits outdoor burning during the defined fire seasons between 6 am and 6 pm unless at a distance of at least 150 feet from woodlands or brushland. In Kentucky, wildfire risks are compounded by the state's extremely high arson rate. Sixty-two percent of Kentucky's wildfires are deliberately set by arsonists.

In the State Hazard Mitigation Plan, the Purchase Region is shown as having a moderate fire danger class, but there are no significant historical occurrences. Wildfires have not been a threat to the Purchase Region as a whole. Nowhere in the region is there higher than "Low" Wildfire danger.

Figure 6.11 Wildfire Probability and Impacts in Graves County



The United States Department of Agriculture, United States Forestry Service data indicates that Graves County has a low wildfire probability threat. This is supported by the fact that there are no significant historical occurrences. Wildfires have not been a threat to the Purchase Region as a whole. Nowhere in the region is there higher than "Low" Wildfire danger.

Graves County has a low risk of wildfires in the county lower risk than 67% of counties in the United States. Figure 6.12 represents the wildfire exposure Graves County communities face.

Figure 6.12 Graves County Wildfire Exposure

Source : *https://wildfirerisk.org/explore/overview/21/21083/*

SUMMARY AND CONCLUSIONS FOR WILDFIRE PROFILE

From April 1, 2017, through March 31, 2022, there have been zero occurrences of Wildfire Events reported in Graves County by the NCEI and likewise zero events for the entire Purchase Region. In a search of the NCEI Storm Events Database there are only 11 reported events for the entire region. These occurred between February 1996 and January 2006. The last and only NCEI recorded event in Graves County occurred on February 20, 2004. The complete history of wildfire events in the Purchase Region can be reviewed in Appendix 1.

With no historic data for damages to support wildfire as a hazard in Graves County, does not mean that there have not been instances of brush fires that had or will have the potential to grow out of control, especially during periods of drought events. It is therefore included as a Hazard in the risk assessment, albeit a low risk, but a risk that needs to be continually assessed and planned for and perhaps anticipated.

The ice storm of 2009 generated massive amounts of fuel, in the form of fallen limbs, and that this risk is greatly diminished at this time. It is likely that there were some number of small field fires during this period however that expense was not documented. According to information found in the 2018 State Hazard Mitigation Plan, Graves County has an estimated loss of $1,886,576304.00.

Dam Failure

There are around 80,000 dams in the United States. The Kentucky Division of Water has surveyed 81 dams in the Purchase Region. Dams are classified based on the evaluation of damage possible downstream. The FEMA guide to dam classifications is listed in Table 6.16.

Table 6.16 FEMA Classification of Dams

Classification	Description
Class A (Low)	No loss of human life is expected, and damage will only occur to the dam owner's property.
Class B (Moderate/Significant)	Loss of human life is not probable, but economic loss, environmental damage, and/or disruption of lifeline facilities can be expected.
Class C (High)	Loss on one or more human life is expected.

Source: FEMA 333; Federal Guidelines for Dam Safety

Table 6.17 Existing Dams in the Purchase Region by Classification

County	Class A (low)	Class B (moderate)	Class C (high)
Ballard	4	1	0
Calloway	7	1	0
Carlisle	22	0	1
Fulton	0	0	0
Graves	**22**	**2**	**5**
Hickman	4	1	0
Marshall	2	1	2
McCracken	2	1	0
Total	**63**	**7**	**8**

Source: United States Army Corps of Engineers, National Inventory of Dams

Table 6.18 list the high hazard dams within Graves County

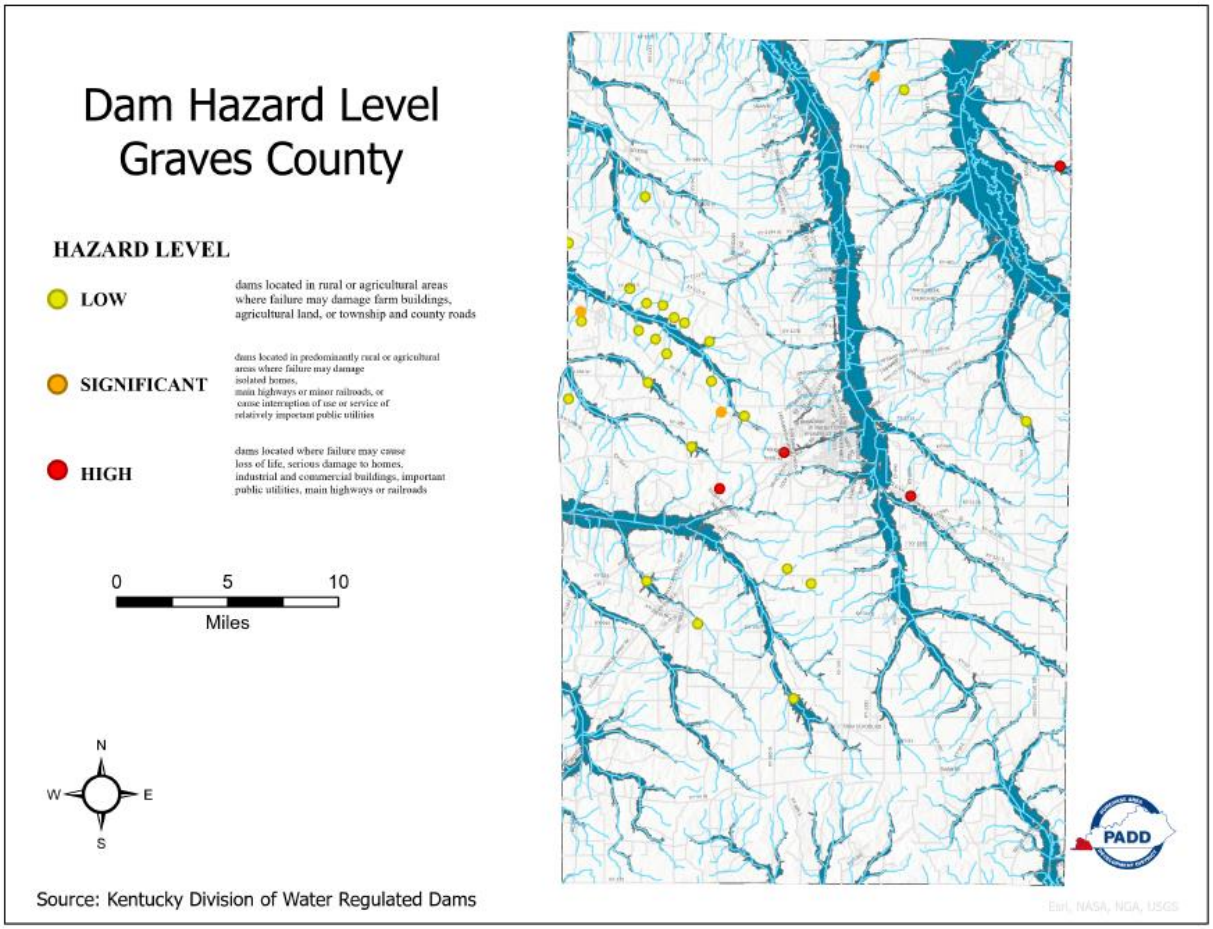
Table 6.18 High Hazard Dams in Graves County

Dam Name	Dam ID	Agency	Jurisdiction Affected
East Ralph Waldrop Lake Dam	00674	Graves County Lake Corporation	Graves County
West Forks Clarks River FRS NO 20	00082	Graves County Soil Conservation District	Graves County
Obion Creek SRS 44	00636	Obion Creek Watershed District	Graves County
West Ralph Waldrop Lake Dam	00885	Graves County Lake Corporation	Graves County

Source: National Inventory of Dams

Figure 6.13 identifies the approximate location of the state rated dam in Graves County. Please note that due to scaling, multiple dams may appear as a single structure.

Figure 6.13 Location of the dams in Graves County, symbolized by hazard class.



SUMMARY AND CONCLUSIONS FOR DAM FAILURE PROFILE

There is no historical occurrence of damage or injury due to a dam failure in Graves County however it is still considered a hazard. The main question regarding dam failure in Graves County is the concern for a possible catastrophic failure of Kentucky Dam on the Tennessee River resulting in significant bank destabilization. Inundation maps or projections for the effects for this scenario are not available to the public and are not included in this plan.

6:4.3 Assessing Vulnerability: Identifying Assets Overall Summary Vulnerability

The vulnerability of structures to Severe Weather and Earthquake Hazards in Graves County is equal to the total structure value of the county. These hazards are not limited to a particular geographic region. All critical facilities in the county were determined to be vulnerable to Severe Weather and Earthquake Hazards.

Graves County's vulnerability to flooding was determined by GIS analysis. A GPS derived database of Critical Facilities, and the Kentucky Infrastructure Authority database for Water and Wastewater facilities were brought into the GIS. FEMA revised Flood Hazard Areas were added as an overlay and where the data intersected those structures/facilities were deemed vulnerable to a 100-year flood. The vulnerability of residential structures was determined by a similar method, laying the Flood Hazard Areas over PVA provided GPS Structure Point Data, and imagery, to determine which structures were in the flood plain.

Impact & Frequency

The impact and frequency of each hazard is identified in each hazard profile in the previous section through maps frequency tables and graphs. Impact is addressed further in the charts and narrative discussions found in the following asset identification and vulnerability sections of this plan.

Identification of Assets

This section of the plan identifies what can be affected in each jurisdiction by the different hazard events that affect the Purchase Region. The information to complete this section was collected from a variety of sources using the HAZUS 4.0 Kentucky Data, the NOAA NCEI, the 2020 Census, U.S. Census Bureau 2020 American Community Survey 5 Year Estimates and the Kentucky Revenue Cabinet. The information was collected, mapped and summarized by the PADD staff and reviewed and analyzed by the JPHMC for inclusion in the plan.

This section was prepared using the best available data for identifying the number of buildings, infrastructure and critical facilities and costs associated with them. Local structure point data was available to identify the types and numbers of structures in each hazard area.

Graves County MPT members reviewed the following information to determine the vulnerability in each community. Tables were created by the PADD staff to estimate the numbers of existing buildings located in mapped Flood Hazard, Landslide and Wildfire Hazard areas. For the other identified hazards, Tornado, Thunderstorm Wind, Earthquake, and Winter Storm, MPT members were not able to identify specific hazard areas for those hazards which were determined to potentially affect anything within Graves County. These hazards and their occurrence are not limited to any particular area based on past historical events and documentation as provided in the hazard profiles for the hazards.

Critical Facilities and Infrastructure

For the purpose of this plan, the JPHMC adopted the definitions of the FEMA HAZUS Loss Estimation Model according to FEMA publication 386-1, version 4.0, pages 3-9 that state the following definitions of critical facilities and infrastructure. HAZUS separates critical facilities into five categories based on their loss potential.

For the purpose of this plan, all of the following elements are considered critical facilities except Hazardous Materials Facilities. It was determined by the regional council that Hazardous Materials Facilities would not be addressed as critical facilities. Rationale: Hazardous Materials facilities are addressed in existing Emergency Operations Plans at the Facility and jurisdictional level, which are deemed by the committee as being both sufficient and beyond the expertise of the committee.

FEMA Critical Facilities Definitions

- Transportation Facilities include airways – airports, heliports; highways – bridges, tunnels, roadbeds, overpasses, transfer centers; railways – track segments, tunnels, bridges, rail yards, depots; waterways – canals, locks, seaports, ferries, harbors, docks, and piers.

- Lifeline Utility Systems such as potable water, wastewater, oil, natural gas, electric power and communication systems.

- Essential Facilities are essential to the health and welfare of the whole population and are especially important following hazard events. Consider not only their structural integrity and content value, but also the effects on the interruption of their functions because the vulnerability is based on the service, they provide rather than simply their physical aspects. Essential Facilities include hospitals and other medical facilities, police and fire stations, emergency operations systems, evacuation shelters, schools, and health and human services to the PADD.

- High Potential Loss Facilities are facilities that would have a high loss associated with them, both physical and economical, such as nuclear power plants, dams, and military installations.

- Hazardous Materials Facilities include facilities housing industrial/hazardous materials, such as corrosives, explosives, flammable materials, radioactive materials, and toxins. (Note: Not considered in this Plan)

Critical Facilities Estimated Replacement Value Methodology

Due to a software compatibility problem between FEMA's HAZUS Program, ESRI's Arc and MS Windows, PADD staff were unable to generate complete critical facilities values for the region. FEMA and KYEM have acknowledged this issue and have committed to resolving this problem. However, this process will not be complete before the regional plan expires.

As a result, staff have supplemented updated HAZUS information when available with local data to establish the estimated value of critical facilities. As a last result, data generated during the

2018 update cycle has been utilized to complete tables. For purposes of the update to the 2023 JPHM Plan, this combination of data sources constitutes the best data available.

PADD staff used a combination of GIS data sources and local GIS data layers to build a map of the critical facilities and infrastructure for each jurisdiction found in the hazard area. Estimates were done on a county basis.

Types and Numbers of Buildings for Severe Weather and Earthquake Hazards

Severe Weather Hazards and Earthquakes have been determined to potentially affect anything within each jurisdiction depending on the path of the hazard event. Severe Weather Events and the potential of Earthquake Events are the top five priorities identified and ranked by the Graves County MPT. These hazards and their occurrences are not limited to any particular area based on past historical events and documentation is provided in the hazard profiles.

Refer to Table 6.19 for the total number of structures vulnerable to these hazards. This table represents residential structures only and was derived from U.S Census Bureau 2020 American Community Survey 5 Year Estimates. Due to data limitations, the numbers of other types of structures were not available at the time of this plan. Future updates of the plan will include numbers of other types of structures as data becomes available.

Table 6.19 Severe Weather/Earthquake Hazard Vulnerable Assets

County	Number of Residential Structures		
	Structures in County	Structures in Hazard Area	% in Hazard Area
Ballard	7,041	7,041	100%
Calloway	22,328	22,328	100%
Carlisle	4,476	4,476	100%
Fulton	4,091	4,091	100%
Graves	25,720	25,720	100%
Hickman	3,777	3,777	100%
Marshall	24,216	24,216	100%
McCracken	36,549	36,549	100%
Total	128,198	128,198	100%

Sources: https://github.com/Microsoft/USBuildingFootprints, PADD GIS

Critical Facilities and Infrastructure at Risk to Severe Weather and Earthquake Hazards

Using the HAZUS MH definition for critical facilities and infrastructure, the County and Cities helped the PADD staff identify types and numbers of critical facilities (see Table 6.20) and infrastructure that are vulnerable to storm, tornado, and earthquake vulnerability in Graves County. These hazards have been determined to potentially affect anything within each jurisdiction, depending on the path of the hazard event. These hazards are not limited to any particular area based on past events and documentation as provided in the hazard profiles.

During the December 2021 tornado multiple critical facilities were destroyed including (courthouse, police stations, fire stations, etc.) these buildings are being rebuilt and noted as upcoming buildings as reconstruction is hoped to be completed by the next update.

Table 6.20 Graves County Critical Facilities & Infrastructure Storm, Tornado, Earthquake Vulnerability

Type of Facility	# of Existing Buildings	Current Replacement Value Value	# in Hazard Area
County EOC	1	$2,488,910	1
Communication-Radio	1	$490,000	1
Fire Stations	22	$59,467,110	22
Police Stations	3	$19,088,910	3
Railways			
Government Buildings	10	$60,167,820	10
Hospitals	1	$12,956,760	1
Electric Power Plants	1	$153,961,000	1
Sewage Plants	7	$885,718,190	7
Package Treatment Plants	4		4
Water Plants	9	$1,138,780,530	9
Pump Stations	5		5
Lift Stations	37	$6,903,298.00	37
Storage Tanks	15	$2,152,028	15
Wells	16	$1,650,000	16
Schools	13	$167,288,433	13
Airport	1	$4,424,170	1
Natural Gas Facilities			
Warming Center	4		4
Dams	29		29
Bridges	141	$50,624,045	141
TOTAL	**303**	**$2,566,161,204**	**303**

Sources: When available local data was used, and all other values were determined using HAZUS MH. The numbers of water treatment facilities are derived from Kentucky Infrastructure Authority, Water Resource Information System and the costs were calculated based on standard planning costs.
*** If values were not provided the best estimate was given based on other facilities in Graves, and the HAZUS Program.*
*** Cost replacement values left blank were hard to determine due to many factors involved*
*** Graves County has numerous buildings that are critical being rebuilt*

Critical Facilities and Infrastructure at Risk to Flooding

The PADD GIS staff reviewed the best available information to provide an estimated number of residential structures and Critical Facilities that are vulnerable to flooding. GPS structure points, overlain with the Flood Hazard Areas were the primary source of at-risk data, and Water Information System database were used to determine at risk Critical Facilities.

Table 6.21 summarizes the numbers of residential structures in the flood hazard area for each county. The highlighted areas indicate the data for Graves County.

Table 6.21 Flood Hazard Vulnerable Assets

County	Estimated Number of Residential Structures in Flood Hazard Areas		
	Number of Structures in County	Percentage of Structures in Flood Hazard Area	Number of Structures in Flood Hazard Area
Ballard	7,041	4.6%	327
Calloway	22,328	1.6%	359
Carlisle	4,476	2.4%	108
Fulton	4,091	4.7%	193
Graves	**25,720**	**1.6%**	**404**
Hickman	3,777	2.3%	85
Marshall	24,216	6.7%	1624
McCracken	36,549	4.3%	1586
Total	128,198	3.7%	4686

Sources: https://github.com/Microsoft/USBuildingFootprints; Purchase Area Development District GIS Database

The following maps indicate the location of critical facilities in each jurisdiction relative to the flood hazard areas. These maps were presented to JPHMC for public comment for review during the identification of vulnerable assets for each jurisdiction. Figure 6.14 and Figure 6.15 depict the location of Graves County's critical and transportation facilities in relation to the mapped 100-year flood zones.

Figure 6.14 Graves County Flood Zones and Structures

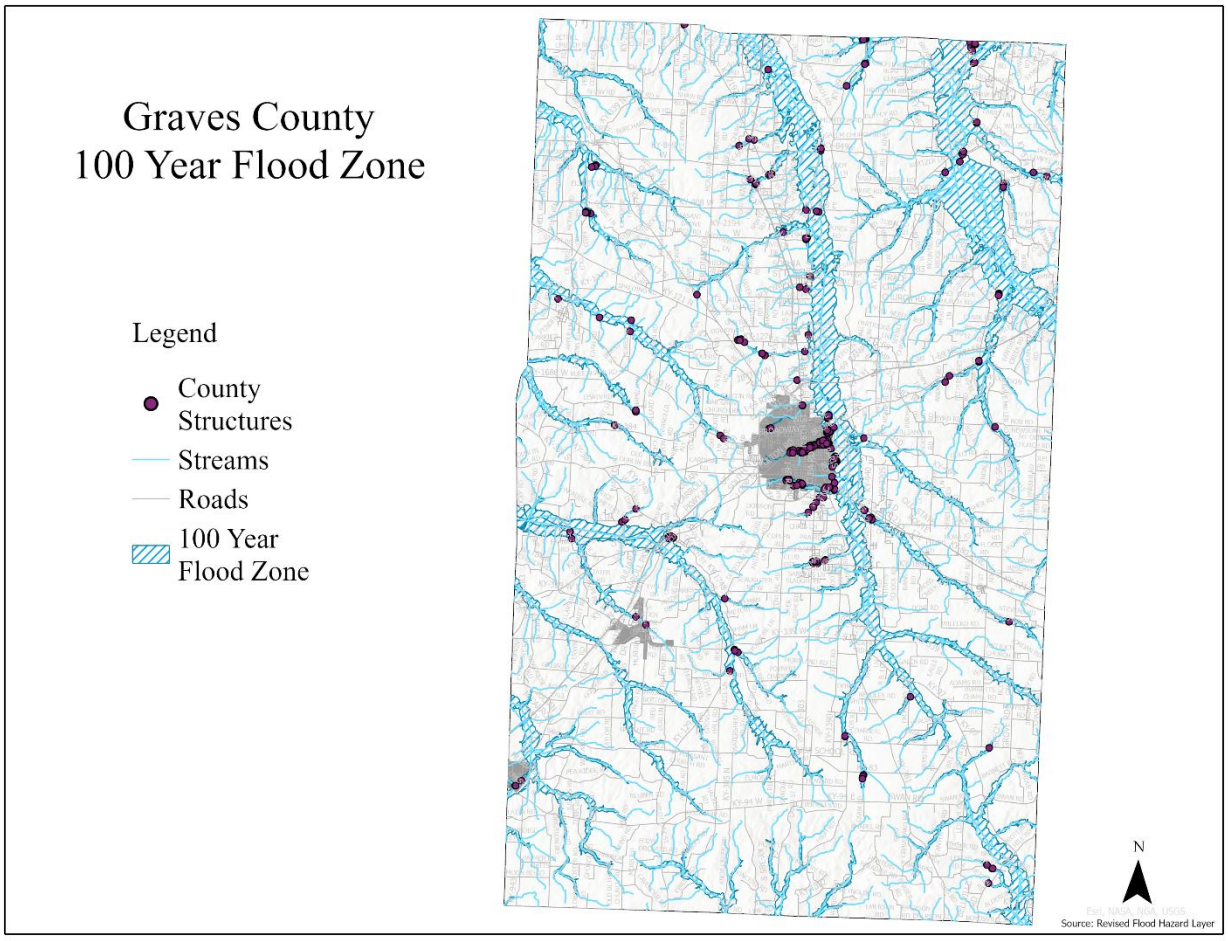
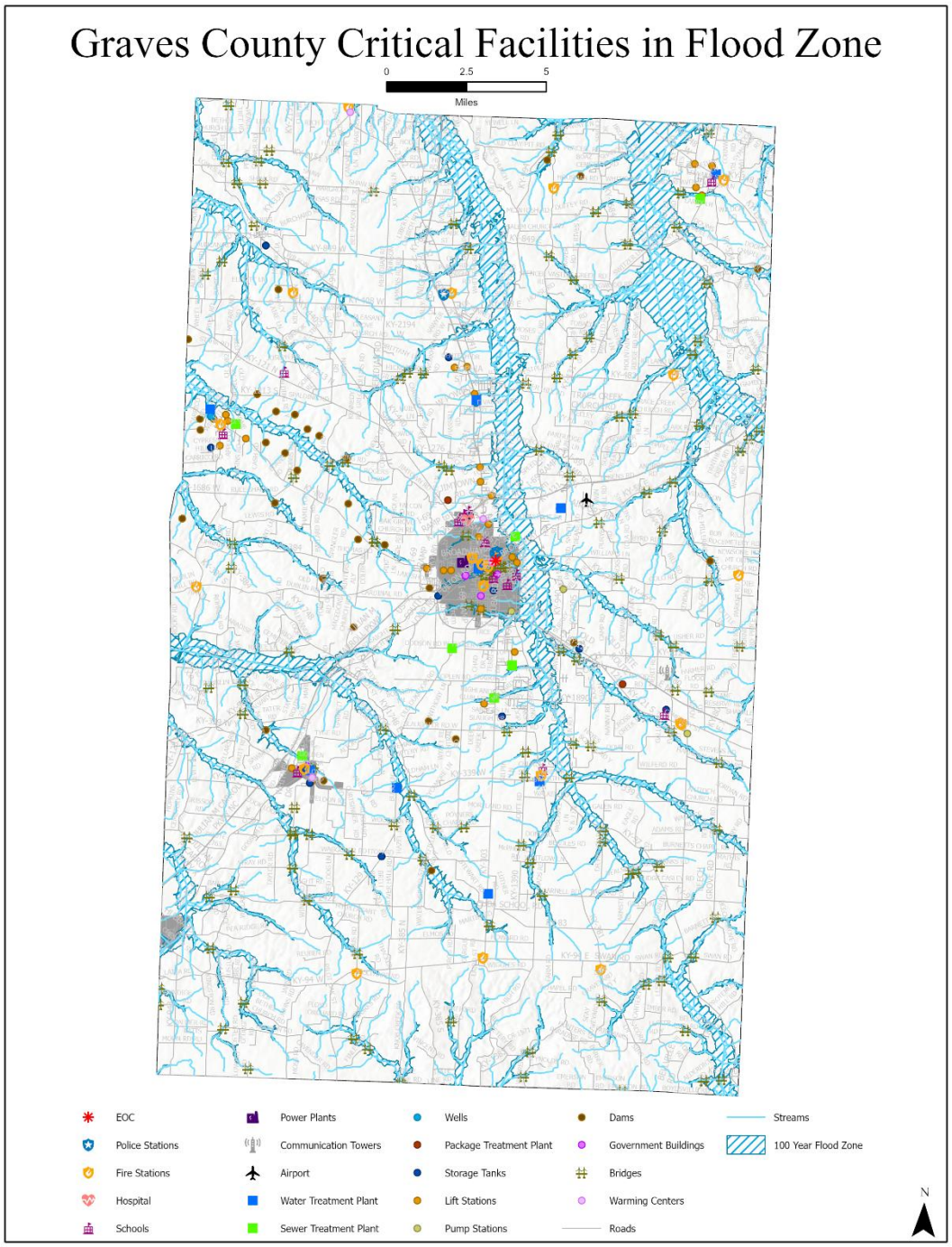


Figure 6.15 Graves County Critical Facilities in Flood Zone



Figures 6.16 and 6.17 indicate the location of critical facilities in the cities of Mayfield and Wingo relative to the Flood Hazard areas. These maps were presented to the JPHMC and to the public comment for review during the identification of vulnerable assets for each jurisdiction.

Figure 6.16 City of Mayfield 100 Year Flood Zone Structure Map

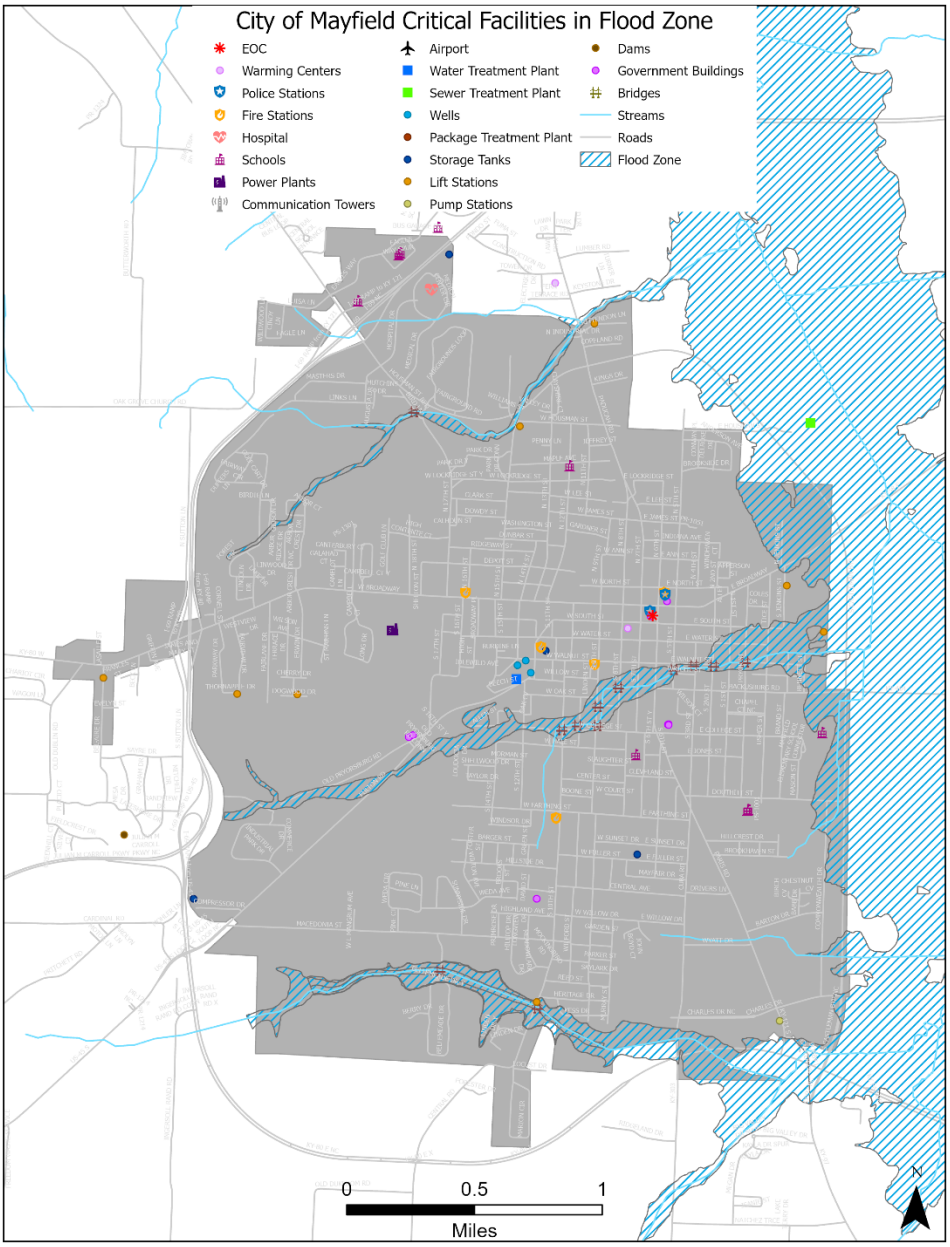


Figure 6.17 City of Wingo 100 Year Flood Zone Structure Map

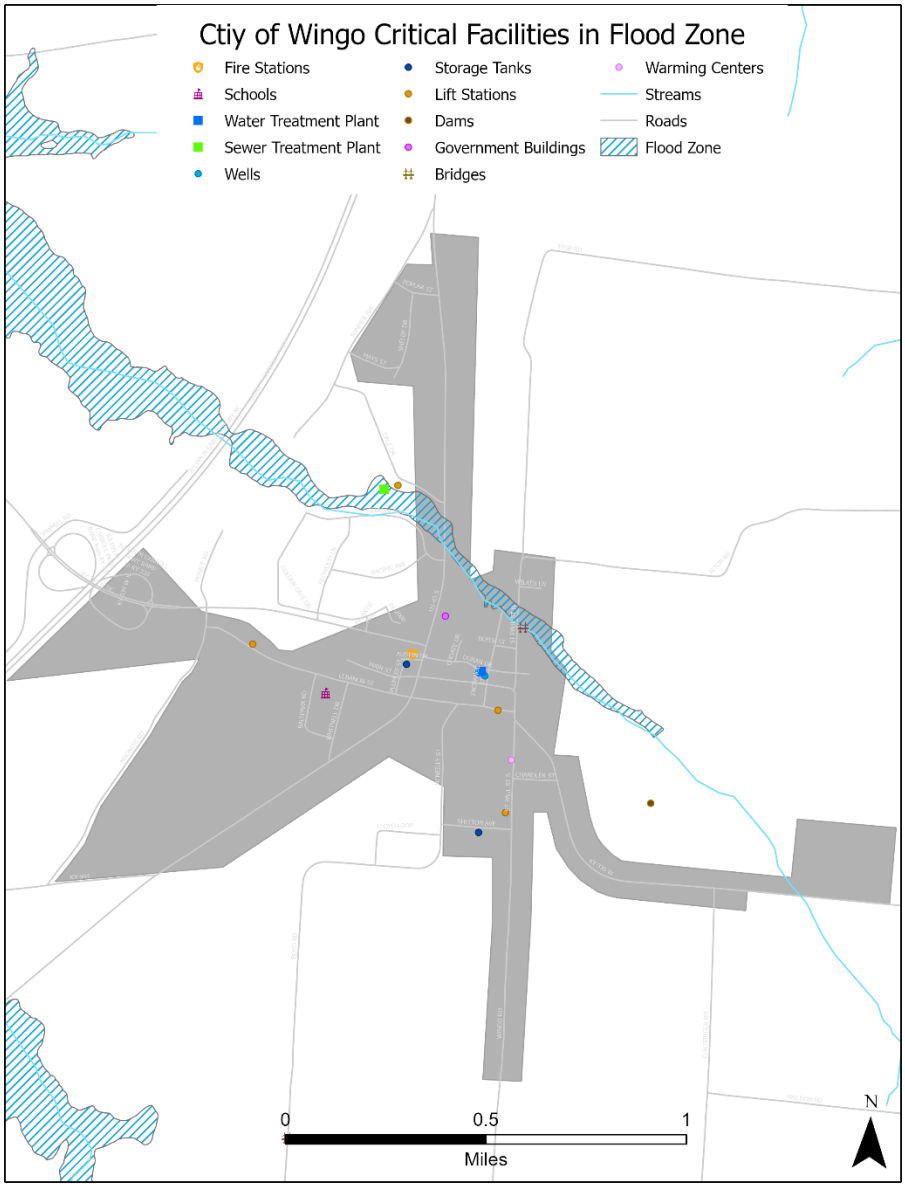


Table 6.22 summarizes the types and number of critical facilities and infrastructure in the identified flood hazard areas. These charts were created using the mapped information above. Ownership issues provided some limitation in distinguishing what critical facilities belonged to a particular jurisdiction; therefore, asset vulnerability was determined on a county level.

Table 6.22 Graves County Flood Vulnerability: Critical Facilities and Infrastructure

Type of Facility	# of Existing Buildings	Current Replacement Value	# in Hazard Area
County EOC	1	$2,488,910	0
Communication-Radio	1	$490,000	0
Fire Stations	22	$59,467,110	0
Police Stations	3	$19,088,910	0
Railways			
Government Buildings	10	$60,167,820	0
Hospitals	1	$12,956,760	0
Electric Power Plants	1	$153,961,000	0
Sewage Plants	7	$885,718,190	3
Package Treatment Plants	4		1
Water Plants	9	$1,138,780,530	0
Pump Stations	5		0
Lift Stations	37	$6,903,298.00	8
Storage Tanks	15	$2,152,028	0
Wells	16	$1,650,000	0
Schools	13	$167,288,433	0
Airport	1	$4,424,170	0
Natural Gas Facilities			
Warming Centers	4		4
Dams	29		8
Bridges	141	$50,624,045	112
TOTAL	**303**	$2,566,161,204	**132**

Sources: When available local data was used, and all other values were determined using HAZUS MH. The numbers of water treatment facilities are derived from Kentucky Infrastructure Authority, Water Resource Information System and the costs were calculated based on standard planning costs.
*** If values were not provided the best estimate was given based on other facilities in Graves, and the HAZUS Program.*
*** Cost replacement values left blank were hard to determine due to many factors involved*
*** Graves County has numerous buildings that are critical being rebuilt*

Graves County, City of Mayfield and City of Wingo are members of the NFIP. They each have a Flood Plain Management Ordinance IAW the appropriate State Revised Statutes. As a consequence, development is not likely to occur in flood regions identified on the FIRMS and by the flood data used in this plan.

Wildfire

Types and Numbers of Buildings for Wildfire Hazard

Wildfire was rated by the Graves County MPT as a Low-Risk Hazard. Portions of the County are heavily forested. These areas are being encroached upon by urban growth, creating a danger area known as the Wildland/Urban Interface.

Figure 6.18 Wildfire Probability and Impact in Graves County

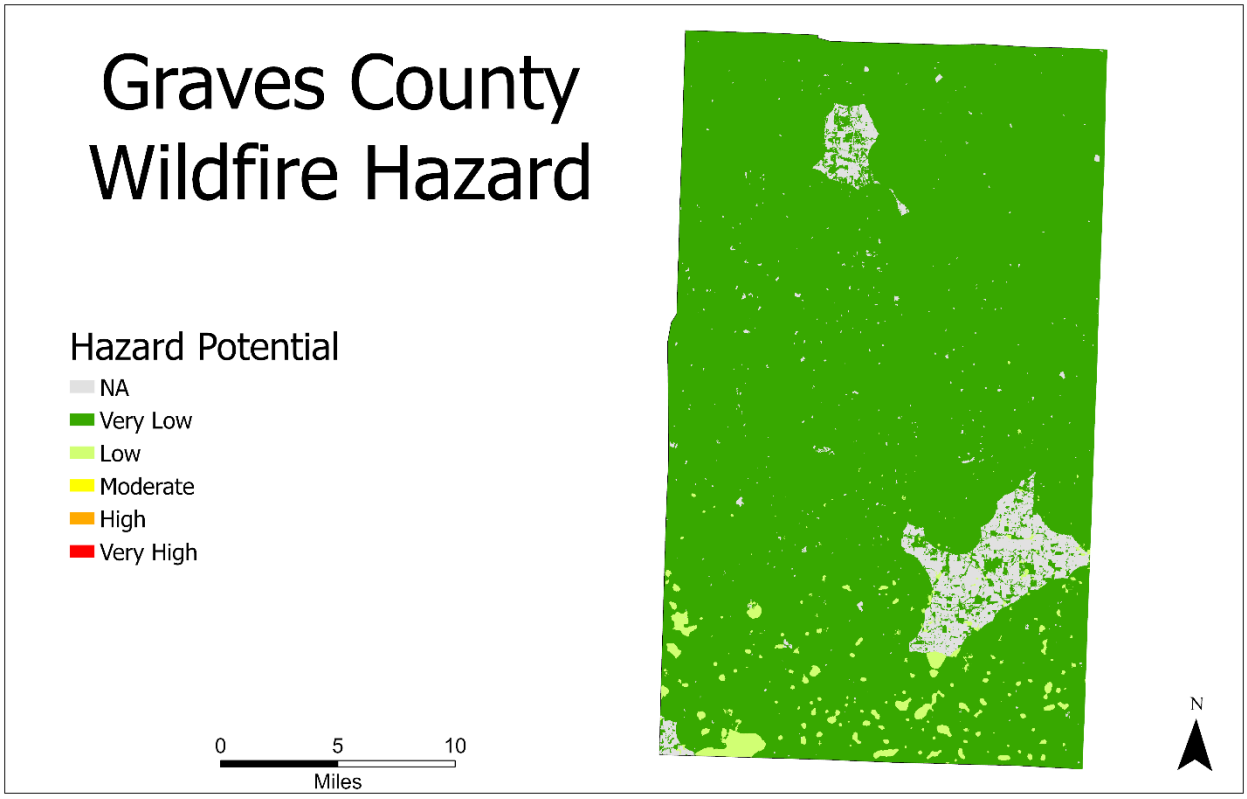


Table 6.23 identifies the structures only within the wildfire potential areas in Graves County was derived from U.S. Building Blueprint shapefile. Due to data limitations, the types of building structures were not available at the time of this plan.

Table 6.23 Graves County Wildland/Urban Interface Wildfire Risk:

County	Structures in County	Structures in None to Very Low	Structures in Low	Structures in Moderate	Structures in High
Ballard	7,041	7,041	0	0	0
Calloway	22,328	22,175	153	0	0
Carlisle	4,476	4,476	0	0	0
Fulton	4,091	4,060	31	0	0
Graves	**25,720**	**25,522**	**198**	**0**	**0**
Hickman	3,777	3,764	13	0	0
Marshall	24,216	24,214	2	0	0
McCracken	36,549	36,549	0	0	0
Purchase	128,198	127,801	397	0	0

Sources: USDA Wildfire Hazard Potential and PADD GIS Staff

Critical Facilities and Infrastructure at Risk in the Wildland/Urban Interface

Using the HAZUS MH definition for critical facilities and infrastructure, the PADD staff identified types and numbers of critical facilities and infrastructure that are in or adjacent to the Wildland/Urban interface, and consequently at risk of wildfires. (See Table 6.24)

Table 6.24 Graves County Wildfire Vulnerability

Type of Facility	# Of Existing Buildings	Current Replacement Value	# In None to Very Low Hazard Area	#In Low Hazard Area
County EOC	1	$2,488,910	1	
Communication-Radio	1	$490,000	1	
Fire Stations	22	$59,467,110	22	
Public Safety Buildings	3	$19,088,910	3	
Railways				
Government Buildings	10	$60,167,820	10	
Hospitals	1	$12,956,760	1	
Electric Power Plants	1	$153,961,000	1	
Sewage Plants	7	$885,718,190	7	
PTP	4		4	
Water Plants	9	$1,138,780,530	9	
Lift Stations	5		5	
Pump Station	37	$6,903,298.00	37	
Wells	15	$2,152,028	15	
Storage Tanks	16	$1,650,000	16	
Schools	13	$167,288,433	13	
Airport	1	$4,424,170	1	
Natural Gas Facilities				
Warming Centers	4		4	
Dams	29		29	
Bridges	141	$50,624,045	141	
TOTAL	303	$2,566,161,204	303	

Sources: When available local data was used, and all other values were determined using HAZUS MH. The numbers of water treatment facilities are derived from Kentucky Infrastructure Authority, Water Resource Information System and the costs were calculated based on standard planning costs.
*** If values were not provided the best estimate was given based on other facilities in Graves, and the HAZUS Program.*
*** Cost replacement values left blank were hard to determine due to many factors involved*
*** Graves County has numerous buildings that are critical being rebuilt*

Future Development: Types and Numbers of Future Buildings, Critical Facilities, and Infrastructure

Graves County is projected to decrease slowly in population over the next ten years. Many Graves County residents left after the December 2021 tornado due to their homes being destroyed. Some residents will return, and others will not. There will be significant changes in residential, critical facilities and infrastructure as the county and the City of Mayfield begin to rebuild. Those changes will be included in future updates to the plan.

Table 6.25 Population Projections for the Purchase Region of Kentucky

County	Census 2000	Census 2010	Census 2020	Census Projections		
				2030	2040	2050
Kentucky	4,041,769	4,339,367	4,505,836	4,461,150	4,721,118	4,785,233
Ballard	8,286	8,249	7,728	7,180	6,558	5,979
Calloway	34,177	37,191	37,103	38,298	38,626	38,424
Carlisle	5,351	4,874	4,826	4,445	4,090	3,765
Fulton	7,752	6,238	6,515	6,132	5,697	5,349
Graves	**37,028**	**37,421**	**36,649**	**36,582**	**36,163**	**35,758**
Hickman	5,262	4,612	4,521	4,094	3,621	3,139
Marshall	30,125	31,101	31,659	31,430	30,794	30,218
McCracken	65,514	65,018	67,875	69,450	70,529	71,761
Purchase	**193,495**	**195,819**	**196,876**	**197,611**		

Source: Kentucky State Data Center Projection Report for 2022 http://ksdc.louisville.edu/

County Structures – Tornado, Earthquake, Severe Weather

PADD staff collected household projections from the Kentucky State Data Center. The data is represented in Table 6.26. These numbers would represent the approximate number of new future residential structures vulnerable to Tornados, Earthquakes, Thunderstorm Wind and Winter Storms.

Table 6.26 Household Projections

County	2010	2020	Projections		
			2030	2040	2050
Ballard	3,397	3,228	3,060	2,772	2,478
Calloway	15,530	15,108	16,126	16,569	16,616
Carlisle	2,116	2,003	1,845	1,681	1,532
Fulton	2,864	2725	2,578	2,368	2,157
Graves	**14,978**	**14,742**	**14,697**	**14,396**	**14,180**
Hickman	2,028	1,916	1,725	1,512	1,290
Marshall	13,073	13,359	13,301	13,003	12,693
McCracken	28,227	28,932	30,250	30,563	30,828
Purchase Region	**82,2213**	**82,013**	**83,582**	**82,864**	**81,774**

Source: Kentucky State Data Center https://louisville.box.com/s/rh39adf5ou0cd0aduxe5dnodanj3ftf0

Over the next ten years Graves County will experience an increase or possibly decrease in residential structure growth. The impact the December 2021 tornado has on Graves County is still being understood and therefore cannot be determined at this time. During the next update more information will be available for development in Graves County.

6:4.4 Assessing Vulnerability: Estimating Potential Losses

Tornado, Earthquake, Thunderstorm Wind, Winter Storm

The total valuation of adjusted property as provided by the Kentucky Department of Revenue was used to estimate the potential dollar loss for all vulnerable structures for the following hazards: Tornado, Thunderstorm Wind including Hail, Winter Storm, and Earthquake.

Table 6.27 summarizes the total value of adjusted property as provided by the Kentucky Department of Revenue, and the population for each county as provided by 2020 American Community Survey 5 Year Estimate. These values were used to determine potential dollar losses and the number of people at risk in a county and all its jurisdictions, for those hazards that have no defined area: Tornado, Thunderstorm Wind, Winter Storm, and Earthquake. The figures for Graves County are highlighted. Table 6.28 is specifically focused on the number of residential structures in hazard areas.

Table 6.27 Total Value of Adjusted Property for the Purchase Region

County	County Square Miles	Population 2020 Census	Total Property Value 2021($)
Ballard	246.7	7,728	562,799,918
Calloway	385.0	37,103	2,670,699,673
Carlisle	189.4	4,826	268,513,078
Fulton	205.9	6,515	285,685,821
Graves	**551.8**	**36,649**	**2,221,703,207**
Hickman	242.3	4,521	295,853,256
Marshall	301.3	31,659	2,801,935,108
McCracken	248.7	67,875	5,629,613,526
Purchase Region	**2,371.1**	**196,876**	**14,736,803,587**

Source: United States Census Bureau County Summary, 2020 Census Data, Kentucky Revenue Cabinet, Year Estimate, Kentucky Revenue Cabinet, https://revenue.ky.gov/Property/Pages/default.aspx , Statewide Certified Property Values 2021

Table 6.28 Severe Weather/Earthquake Hazard Vulnerable Asset

County	Structures in County	Structures in Hazard Area	% in Hazard Area
Ballard	7,041	7,041	100%
Calloway	22,328	22,328	100%
Carlisle	4,476	4,476	100%
Fulton	4,091	4,091	100%
Graves	**25,720**	**25,720**	**100%**
Hickman	3,777	3,777	100%
Marshall	24,216	24,216	100%
McCracken	36,549	36,549	100%
Purchase Region	**128,198**	**128,198**	**100%**

Source: U.S. Census Bureau, ACS 2020

PADD staff and the Graves County MPT determined that all 25,720 residential structures in the county are vulnerable to the "area" threats of weather and earthquake. According to the 2020 American Community Survey 5-Year Estimates, the median house value for Graves County is $48,187.

Critical Facilities and Infrastructure for Severe Weather and Earthquakes

Table 6.29 summarizes vulnerable critical facilities and infrastructure to the non-geo specific hazards of Severe Weather and Earthquakes, as well as the potential dollar losses associated with structures in the high priority hazard areas. It was the determination of PADD staff that the best way to estimate the potential dollar loss associated with critical facilities and infrastructure was to use insurance replacement values, when available, for those structures provided by the jurisdictions, or default to values from the HAZUS tables.

Table 6.29 Graves County Critical Facilities & Infrastructure Severe Weather and Earthquake

Type of Facility	# of Existing Buildings	Current Replacement Value Value	# in Hazard Area
County EOC	1	$2,488,910	1
Communication-Radio	1	$490,000	1
Fire Stations	22	$59,467,110	22
Police Stations	3	$19,088,910	3
Railways			
Government Buildings	10	$60,167,820	10
Hospitals	1	$12,956,760	1
Electric Power Plants	1	$153,961,000	1
Sewage Plants	7	$885,718,190	7
Package Treatment Plants	4		4
Water Plants	9	$1,138,780,530	9
Pump Stations	5		5
Lift Stations	37	$6,903,298.00	37
Storage Tanks	15	$2,152,028	15
Wells	16	$1,650,000	16
Schools	13	$167,288,433	13
Airport	1	$4,424,170	1
Natural Gas Facilities			
Warming Center	4		4
Dams	29		29
Bridges	141	$50,624,045	141
TOTAL	**303**	**$2,566,161,204**	**303**

Sources: When available local data was used, and all other values were determined using HAZUS MH. The numbers of water treatment facilities are derived from Kentucky Infrastructure Authority, Water Resource Information System and the costs were calculated based on standard planning costs.
*** If values were not provided the best estimate was given based on other facilities in Graves, and the HAZUS Program.*
*** Cost replacement values left blank were hard to determine due to many factors involved*
*** Graves County has numerous buildings that are critical being rebuilt*

Flood

County Structures: After the vulnerability maps were created for the flood hazard areas, the cost associated with replacing those structures was evaluated. It was the determination of the PADD staff that the best way to estimate the potential dollar loss associated with the flood hazard areas was to use Total Property value in the county and the 1.6% of structures within the Hazard Area.

Table 6.30 summarizes the total number of structures in the county were determine by the Microsoft U.S. Building Blueprint. This value allowed us to determine 404 structures in the county were within the flooding hazard area. Table 6.30 shows the total property value for the Purchase Region counties from the Kentucky Revenue Cabinet and the property value within the flood Hazard Areas. Fulton County is highlighted.

Table 6.30 Flood Hazard Vulnerable Structures by County

County	Number of Structures			Total Property Value	
	Structures in County	Structures in Hazard Area	% In Hazard Area	Total Value in County	Value in Hazard Area
Ballard	7,041	327	4.6%	$562,799,918	$25,888,796
Calloway	22,328	359	1.6%	$2,670,699,673	$42,731,194
Carlisle	4,476	108	2.4%	$268,513,078	$6,444,313
Fulton	4,091	193	4.7%	$285,685,821	$13,427,233
Graves	**25,720**	**404**	**1.6%**	**$2,221,703,207**	**$35,547,251**
Hickman	3,777	85	2.3%	$295,853,256	$6,804,624
Marshall	24,216	1624	6.7%	$2,801,935,108	$187,729,652
McCracken	36,549	1586	4.3%	$5,629,613,526	$242,073,381
Total	**128,198**	**4686**	**3.7%**	**$14,736,803,587**	**$545,261,843**

Sources: Kentucky Revenue Cabinet, https://revenue.ky.gov/Property/Pages/default.aspx , Statewide Certified Property Values 2021 and Microsoft U.S. Building Blueprint

Table 6.31 shows the 2020 ACS selected housing characteristics for the area with Graves County highlighted.

Table 6.31 2020 Selected Housing Characteristics

Subject	Ballard	Calloway	Carlisle	Fulton	Graves	Hickman	Marshall	McCracken	Purchase Region
Total Housing Units	3,915	18,924	2,471	3,336	**16,862**	2,367	16,229	32,237	96,341
Occupied Housing Units	3,052	15,942	1,925	2,550	**14,402**	1,724	13,119	27,787	80,501
Vacant Housing Units	863	3,432	546	786	**2,460**	643	3,110	4,450	16,290
Mobile Homes	676	2,555	512	164	**2,508**	307	2,370	3,005	12,097
Owner- occupied	2,403	9,730	1,573	1,680	**10,690**	1,383	10,926	17,930	56,315
Renter- occupied	649	5,762	352	870	**3,712**	341	2,193	9,857	23,736
Household Size – Owner	2.60	2.44	2.45	2.19	**2.56**	2.34	2.39	2.46	2.43
Household Size– Renter	2.39	1.99	2.34	2.24	**2.47**	3.21	2.04	2.03	2.34
Median House Value -	$103,800	$141,200	$83,200	$63,800	**$109,000**	$85,000	$138,000	$145,200	$106,638

Source: U.S. Census Bureau 2020 ACS 5-Year Estimates Data Profile Table DP04

Table 6.31 shows the 2020 ACS selected housing characteristics for the area with Graves County highlighted.

Critical Facilities and Infrastructure for Flood Hazards

It was the determination of the PADD staff that the best way to estimate the potential dollar loss associated with critical facilities and infrastructure was to use the insurance replacement values for those structures provided by the jurisdictions to the maximum extent possible, or values from the HAZUS data tables. Table 6.32 summarizes the potential dollar loss of vulnerable critical facilities and infrastructure in flood hazard areas by county.

Table 6.32 Graves County Critical Facilities & Infrastructure Flood Vulnerability

Type of Facility	# of Existing Buildings	Current Replacement Value	# in Hazard Area
County EOC	1	$2,488,910	0
Communication-Radio	1	$490,000	0
Fire Stations	22	$59,467,110	0
Police Stations	3	$19,088,910	0
Railways			
Government Buildings	10	$60,167,820	0
Hospitals	1	$12,956,760	0
Electric Power Plants	1	$153,961,000	0
Sewage Plants	7	$885,718,190	3
Package Treatment Plants	4		1
Water Plants	9	$1,138,780,530	0
Pump Stations	5		0
Lift Stations	37	$6,903,298.00	8
Storage Tanks	15	$2,152,028	0
Wells	16	$1,650,000	0
Schools	13	$167,288,433	0
Airport	1	$4,424,170	0
Natural Gas Facilities			
Warming Centers	4		0
Dams	29		8
Bridges	141	$50,624,045	112
TOTAL	**303**	**$2,566,161,204**	**132**

Sources: When available local data was used, and all other values were determined using HAZUS MH. The numbers of water treatment facilities are derived from Kentucky Infrastructure Authority, Water Resource Information System and the costs were calculated based on standard planning costs.
*** If values were not provided the best estimate was given based on other facilities in Graves, and the HAZUS Program.*
*** Cost replacement values left blank were hard to determine due to many factors involved*
*** Graves County has numerous buildings that are critical being rebuilt*

Wildfire

After determining the vulnerability of critical facilities to wildfire hazard the wildfire relative risk and exposure risk in Graves County were collected from the USDA and US Forestry Service. Table 6.33 represents the wildfire risk Graves County faces compared to the United States. Table 6.34 represent homes exposure percentage to wildfires in Graves County compared to the United States.

Table 6.33 Graves County Wildfire Risk

Relative Wildfire Risk	
Statewide Percentile Rank	
Risk to Homes	**43**
Wildfire Likely Hood	**41**
Nationwide Percentile Rank	
Risk to Homes	**33**
Wildfire Likely Hood	**33**

Source : https://wildfirerisk.org/explore/exposure-type/21/21083/

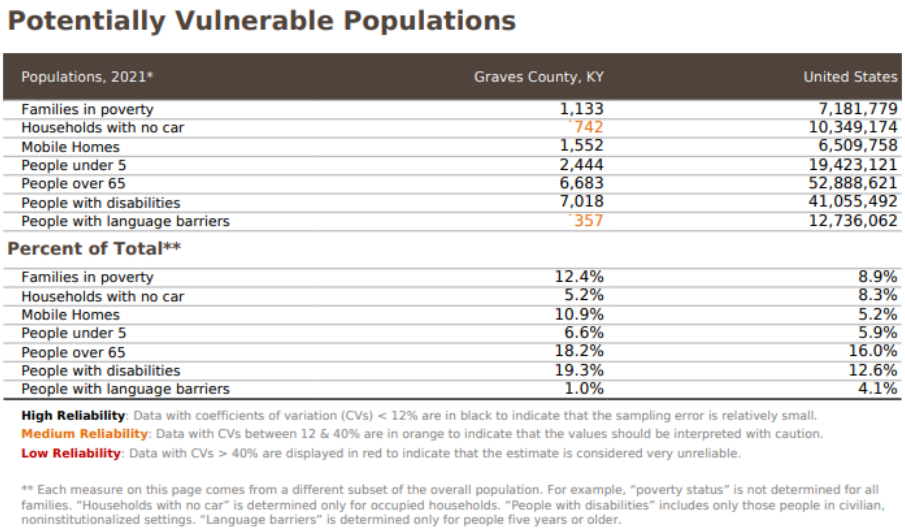
Table 6.34 Graves County Wildfire Exposure

Wild Fire Exposure		
	Graves County	**United State**
Percent Total		
Homes Directly Exposed	**58.0%**	**33.0%**
Homes Indirectly Exposed	**40.0%**	**30.0%**
Homes not Exposed	**2.0%**	**37.0%**

Source : https://wildfirerisk.org/explore/exposure-type/21/21083/

Figure 6.19 Represents the Vulnerable Populations in Graves County at risk if a wildfire hazard was to occur. Collected from the USDA and US Forestry Service wildfire risk to community's database.

Figure 6.19 Wildfire Hazard: Graves County Vulnerable Population



Potentially Vulnerable Populations

Populations, 2021*	Graves County, KY	United States
Families in poverty	1,133	7,181,779
Households with no car	742	10,349,174
Mobile Homes	1,552	6,509,758
People under 5	2,444	19,423,121
People over 65	6,683	52,888,621
People with disabilities	7,018	41,055,492
People with language barriers	357	12,736,062
Percent of Total**		
Families in poverty	12.4%	8.9%
Households with no car	5.2%	8.3%
Mobile Homes	10.9%	5.2%
People under 5	6.6%	5.9%
People over 65	18.2%	16.0%
People with disabilities	19.3%	12.6%
People with language barriers	1.0%	4.1%

High Reliability: Data with coefficients of variation (CVs) < 12% are in black to indicate that the sampling error is relatively small.
Medium Reliability: Data with CVs between 12 & 40% are in orange to indicate that the values should be interpreted with caution.
Low Reliability: Data with CVs > 40% are displayed in red to indicate that the estimate is considered very unreliable.

** Each measure on this page comes from a different subset of the overall population. For example, "poverty status" is not determined for all families. "Households with no car" is determined only for occupied households. "People with disabilities" includes only those people in civilian, noninstitutionalized settings. "Language barriers" is determined only for people five years or older.

6:4.5 Assessing Vulnerability: Analyzing Development Trends

The Purchase Region grew 1.2% in population between 2010 and 2020 compared to a growth of 3.8% for the state of Kentucky. Graves County is projected to decrease by approximately 0.18% percent between 2020 and 2030.

Graves County is primary rural in nature. Most residential development occurs on property that fronts primary and secondary roads. The county can expect only a slight increase in residential development over the next ten years to replace existing housing shock. Again, the December 2021 tornado's full impact has not been known during this update period. Table 6.35 outlines growth trends in the PADD as reported by the Kentucky State Data Center using Census Information.

Table 6.35 Population Projections for the Purchase Region

County	Census 2000	Census 2010	Census 2020	Census Projections		
				2030	2040	2050
Kentucky	4,041,769	4,339,367	4,505,836	4,461,150	4,721,118	4,785,233
Ballard	8,286	8,249	7,728	7,180	6,558	5,979
Calloway	34,177	37,191	37,103	38,298	38,626	38,424
Carlisle	5,351	4,874	4,826	4,445	4,090	3,765
Fulton	7,752	6,238	6,515	6,132	5,697	5,349
Graves	**37,028**	**37,421**	**36,649**	**36,582**	**36,163**	**35,758**
Hickman	5,262	4,612	4,521	4,094	3,621	3,139
Marshall	30,125	31,101	31,659	31,430	30,794	30,218
McCracken	65,514	65,018	67,875	69,450	70,529	71,761
Purchase	**193,495**	**195,819**	**196,876**	**197,611**	**196,078**	**194,393**

Source: Kentucky State Data Center Projection Report for 2022 http://ksdc.louisville.edu/

Land Use

Farmland is the principal land use in Graves County. Land use for commercial purposes is primarily concentrated in or near the downtown areas of incorporated cities. Industrial development primarily takes place in industrial parks. Graves County also makes use of land for recreation and greenspace. Graves County has both city and county parks for recreational purposes.

Economic and Social Growth Trends

The economy in the Purchase Region is experiencing trends like those of the state averages, both in growth and decline. There have been new businesses and industries opening in the region, but in turn there have been layoffs and closures within the market. Especially during the COVID-19 pandemic which is addressed in the 2022 – 2027 Comprehensive Economic Development Strategy (CEDS) where it was listed as a threat to the region, and the Disaster Resiliency Plan is supplement to that update. The CEDS update mentioned some of the impacts of COVID-19 on the Purchase Region communities while the Disaster Resiliency Plan goes into greater depth and addresses short-term and long-term approaches to rebuild resilient and sustainable communities throughout the Purchase Region. Data for this portion of plan was collected from the US Census and from Graves County Economic Development.

The vision of Graves County and its incorporated cities is to rebuild for a vibrant and robust place to nourish commerce, industry and sense of community with the enhancement of workforce development, housing and amenities. Over the past 2 decades the community has experienced the loss of major employees, a pandemic and an EF4 tornado and yet still endures to be a resilient community.

Table 6.36 represents the recent locations and expansions in Graves County

Table 6.36 Summary of Recent Locations and Expansions

		Reported	
	Companies	**Jobs**	**Investment**
Manufacturing Location	1	32	$5,489,000
Manufacturing Expansion	4	346	$53,900,000
Service & Technology Location	1	4	$5,400,000
Service & Technology Expansion	3	190	$8,286,110

Source: Graves County Economic Development

Table 6.37 Employment by Major Industry by Place of Work

	Graves County		Labor Market Area	
	Employment	**Percent**	**Employment**	**Percent**
Total All Industries	**13,072**	**100.00**	**221,170**	**100.00**
Natural Resources and Mining	815	6.00	9,335	4.00
Construction	723	6.00	13,154	6.00
Manufacturing	2,359	18.00	29,211	13.00
Trade, Transportation and Utilities	2,844	22.00	51,031	23.00

Information	112	1.00	1,985	1.00
Financial Activities	336	3.00	5,739	3.00
Professional and Business Services	1,637	13.00	30,584	14.00
Education and Health Services	2,372	18.00	47,858	22.00
Leisure and Hospitality	1,273	10.00	22,291	10.00
Other Services and Unclassified	601	5.00	9,980	5.00

Source: JobsEQ, Graves County Economic Development

Table 6.38

Manufacturing & Service and Technology Firms Only			
Firm	Products/Services	Employees	Year Established
Pilgrim's	Poultry processing & packing	1350	1988
Progress Rail	Locomotive remanufacturing and diesel engine rebuild facility; supplier of products and services for the rail industry	185	2007
Mayfield Consumer Products	Manufacture and distribute scented candles	173	1998
Ingram's Water & Air Equipment, LLC	HVAC equipment, air equipment; headquarters and warehouse	130	2015
JU Kevil Industries	Sheltered workshop; Industrial wipes, rags, assembly, order fulfillment & custom packaging	117	1968
Old Hickory Clay	Ball clay, slurry and air floated koolins for sanitary ware industry	53	1918
Centrifugal Technologies Inc	Parts & services for centrifugal air compressors	42	2002
Kendoor Wood	Cabinet drawers & fronts	40	1982
World Tower	Radio, TV, microwave, and cell communication	35	1958

ACE Compressor Parts & Service, Inc.	Remanufactured air compressors, parts and service	32	2009
Power Truss	Structural floor and roof trusses	30	1979
Mid-America Machine, Inc.	Machine Shop: cylindrical grinding, lathe and mill work, small plate & structural metal fabricating & hand chrome plating	24	1987
PSI Control Solutions	Electronic industrial control panels and wiring harness	21	1962
Universal Technologies Inc.	Machine Shop: arc, gas, MIG, TIG, heliarc and specialized welding; rebuilding rubber industry mill guides and fab shop	21	1985
Mayfield Printing Inc.	Offset printing: labels, tags, forms & envelopes; typesetting, glue binding, 4 color separation, flexographic printing; labels pressure sensitive, color process & UV capable, commercial printing	18	1933
Applegate Insulation, LLC	Cellulose insulation and hydroseeding mulch	15	1998
Mayfield Machine & Tool, Inc.	Machine shop: CNC machining, honing, grinding, welding lathe & mill work	13	1979
America SednAir	Air compressor parts	12	2004
Atlas Equipment Services, Inc.	Bulk material handling systems. Manufacturer and service, parts provider	10	2001
LSK, Inc.	Aftermarket air compressor parts	6	2018

Table 6.39 represents the Employment Percent Rate for Graves County in 2010 and 2020. Table 6.40-6.41 represents data collected from the PADD 2022-2027 CEDS plan.

Table 6.39 Employment Rate for 2010 and 2020 for the Purchase Region

Employment Rate	2010	2020
Kentucky	55.3 %	55.90 %
Ballard	52.10 %	49.50 %
Calloway	57.30 %	55.10 %
Carlisle	47.30 %	46.50 %
Fulton	47.30 %	46.50 %
Graves	**52.00 %**	**53.30 %**
Hickman	45.9 %	44.50 %
Marshall	54.9 %	51.30 %
McCracken	53.8 %	55.90 %

Source: U.S. Census 2010 and 2020 Table DP03

Table 6.40 Graves County Labor Force

GRAVES COUNTY LABOR FORCE	
Labor Force	Unemployment Rate
15,891	4.6%

Source: Purchase Area CEDS 2022-2027

Table 6.41 Graves County Income Data

INCOME	
Per Capita Income	$25,5257
Median Household	$45,614
Poverty Rate	18.2%

Source: Purchase Area CEDS 2022-2027

While manufacturing and service sectors are important to the region's economy, agriculture proves to be a vital part of the economy as a whole. The changes, both hazards related, and non-hazard related, that affect farming greatly impact the Purchase Region. Hazards such as hail, flooding, tornadoes, and high wind damage crops and thus have an effect on the economy of the region. As previously stated, farming is the most prevalent land use in Graves County. Table 6.42 is a summary of the farmland located in the Purchase Region and the land use for those acres. This data was retrieved from the United States Department of Agriculture.

Table 6.42 Total Farmland Located in Purchase Region

County	Number of Farms	Land in Farms(acres)	Avg. Farm Size(acres)
Ballard	295	94,340	320
Calloway	710	135,521	191
Carlisle	273	88,015	322
Fulton	146	97,615	669
Graves	**1,104**	**251,192**	**228**
Hickman	246	118,474	482
Marshall	699	84,676	121
McCracken	318	62,082	195
Total	**3,791**	**931,915**	**2,528**

Source: U.S. Department of Agriculture, National Agricultural Statistics Service
2017 Census of Agriculture
https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Kentucky/

Social growth trends also play a key role in the economy of the Purchase Region. Median income and housing characteristics of the region are valuable tools in analyzing these growth trends. Tables 6.43 and 6.44 describe the median income and housing characteristics retrieved from the Kentucky State Data Center Census 2020 information.

Little to no population growth (0.4%) is expected to occur in the Purchase Region between 2020 and 2030. Graves County is projected to decrease by -0.18% during that same time period. Development is not likely to occur in flood regions identified in each jurisdiction, because the threat of flooding is known and occurs on an annual basis. Industrial expansion that takes place will be in existing industrial parks. Graves County is a member of the NFIP and enforces its Flood Plain Ordinance IAW the applicable paragraphs of the Kentucky Revised Statues.

Table 6.43 2020 Census and ACS 2020 5-Year Median Household Income

	Median Household Income		
Area	2010 ACS	ACS 2020	Percent Change
Kentucky	$41,476	$52,238	25.64
Ballard	$41,228	$45,517	10.40
Calloway	$39,194	$41,841	6.75
Carlisle	$33,909	$41,222	21.57
Fulton	$31,965	$31,587	-1.18
Graves	**$35,277**	**$45,614**	**29.30**
Hickman	$31,836	$44,063	38.41
Marshall	$43,326	$57,348	32.36
McCracken	$41,630	$47,011	12.93

*Source: Kentucky State Data Center; **U.S. Census Bureau, 2020 American Community Survey 5 Year Estimate and 2020 ACS 5-year estimates*

Table 6.44 2020 ACS Census: Selected Housing Characteristics for the Purchase Region

Subject	Ballard	Calloway	Carlisle	Fulton	Graves	Hickman	Marshall	McCracken
Total Housing Units*	3,915	18,924	2,471	3,336	**16,862**	2,367	16,229	32,237
Occupied Housing Units*	3,052	15,942	2,550	2,550	**14,402**	1,724	13,119	27,787
Vacant Housing Units*	863	3,432	546	786	**2,460**	643	3,110	4,450
Mobile Homes*	676	2,555	512	164	**2,508**	307	2,370	3,005
Owner- occupied*	2,403	9,730	1,573	1,680	**10,690**	1,383	10,926	17,930
Renter- occupied*	649	5,762	352	870	**3,712**	341	2,193	9,857
Household Size – Owner*	2.60	2.44	2.45	2.19	**2.56**	2.34	2.39	2.46
Household Size – Renter*	2.39	1.99	2.34	2.24	**2.47**	3.21	2.04	2.03
Median House Value – Owner Occupied*	$103,800	$141,200	$83,200	$63,800	**$109,000**	$85,000	$138,000	$145,200

*Source: Source * U.S. Census Bureau, 2020 5-Year Estimates table DP04*

Non-Ambulatory / Communal Living Facilities

During the update process PADD staff met with the JPMC and agreed upon recognizing Non-Ambulatory / Communal Living Facilities as vulnerable populations. The facilities under this category are important to communities during a disaster but do not fall under FEMA's definition of a critical facility.
While critical facilities keep the government functioning and benefit the community, Non-Ambulatory / Communal Living Facilities protect a percentage of the population that relies on assistance.
The facilities listed below are funded locally or by the state, no private entities were included. The list below includes nursing homes, non-urgent care medical facilities, senior centers, etc.

Table 6.45 Non-Ambulatory / Communal Living Facilities in Graves County

Name of Facility	Type of Facility
Graves County Senior Center	**Senior Center**

Climate Change and Kentucky

Kentucky's climate is changing. Although the average temperature did not change much during the 20th century, most of the commonwealth has warmed in the last 20 years. Average annual rainfall is increasing, and a rising percentage of that rain is falling on the four wettest days of the year. In the coming decades, the changing climate is likely to reduce crop yields and threaten some aquatic ecosystems. Floods may be more frequent, and droughts may be longer, which would increase the difficulty of meeting the competing demands for water in the Ohio, Tennessee, and Cumberland rivers. Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet by about one degree (F) during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others. Natural cycles and sulfates in the air prevented much of Kentucky from warming during the last century. Sulfates are air pollutants that reflect sunlight back into space. Now sulfate emissions are declining, and the factors that once prevented Kentucky from warming are unlikely to persist.

Kentucky Issues due to Climate Change

- Precipitation and Water Resources
    - Annual precipitation in Kentucky has increased approximately 5 percent since the first half of the 20th century. But rising temperatures increase evaporation, which dries the soil and decreases the amount of rain that runs off into rivers. Although rainfall during spring is likely to increase during the next 40 to 50 years, the total amount of water running off into rivers or recharging ground water each year is likely to decline 2.5 to 5 percent, as increased evaporation offsets the greater

rainfall. Droughts are likely to be more severe because periods without rain will be longer and very hot days will be more frequent.

- Flooding
    - Flooding is becoming more severe in the Southeast. Since 1958, the amount of precipitation during heavy rainstorms has increased by 27 percent in the Southeast, and the trend toward increasingly heavy rainstorms is likely to continue. The Tennessee Valley Authority (TVA) and the U.S. Army Corps of Engineers operate Kentucky Dam, Wolf Creek Dam, and other dams to prevent serious floods on the Ohio, Tennessee, and Cumberland rivers. The agencies release water from the reservoirs behind these dams before the winter flood season. By lowering water levels, these releases provide greater capacity for the reservoirs behind those dams to prevent flooding. Nevertheless, dams and other flood control structures cannot prevent all floods. The Ohio River has flooded Louisville several times, for example, and flash floods have caused property destruction and deaths throughout Kentucky.

- Agriculture
    - Longer frost-free growing seasons and increased concentrations of atmospheric carbon dioxide tend to increase yields for many crops during an average year. But more severe droughts and more hot days are likely to reduce yields, especially in the western half of Kentucky, which in seventy years is likely to have 15 to 30 more days with temperatures above 95°F than it has today. Even on irrigated fields, higher temperatures are likely to reduce yields of corn, and possibly soybeans. Higher temperatures are also likely to reduce livestock productivity: hot weather causes cows to eat less, grow more slowly, and produce less milk, and it can threaten their health.

- Human Health
    - Hot days can be unhealthy—even dangerous. High air temperatures can cause heat stroke and dehydration, and affect people's cardiovascular and nervous systems. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. Higher temperatures can also increase the formation of ground-level ozone, a key component of smog. Ozone has a variety of health effects, aggravates lung diseases such as asthma, and increases the risk of premature death from heart or lung disease. EPA and the Kentucky Department for Environmental Protection have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will require even more reductions in the air pollutants that contribute to ozone.

-

Actionable Climate Change responses, in the Purchase Region, for reducing the impacts of climate change.

- Restoration of natural systems, increases in the use of green infrastructure, and targeted conservation efforts, especially of groundwater aquifers, can help protect people and nature from climate change impacts.
- Improving urban storm water infrastructure to deal with the increase of flooding, as well as limiting nonporous surfaces. Using Green infrastructure is reducing some of the negative impacts by using plants and open space to absorb storm water.
- Improved basic health services and increased public health measures—including surveillance and monitoring of local trends—can prevent or reduce the impacts of the anticipated increased frequency and intensity of poor air quality days. Establishing cooling and heating stations through the year at a local level for extreme high temperature events.
- Integrating climate adaptation into planning Local processes offers an opportunity to better manage climate risks now. Developing knowledge for decision-making in cooperation with vulnerable communities will help to build adaptive capacity and increase resilience. Scaling unban development and Industrial farming that’s sustainable for local aquifers

6:5 Graves County Mitigation Strategy

6:6.1 Capability Assessment

Mitigation strategies were developed in response to the hazard profiles and vulnerability of the assets in each jurisdiction. These strategies provide each jurisdiction with a blueprint for reducing potential losses identified in the risk assessment. These strategies are based on existing authorities, policies, programs, resources, and the ability to expand on and improve the existing tools.

The capability assessment has been divided into three sections:

(A) Existing Authorities, Policies, Programs, and Resources
(B) Existing Governmental Structure
(C) Existing Professional Staff Departments

The purpose of the capability assessment is to identify potential hazard mitigation opportunities available to each jurisdiction through daily operations as a local unit of government. This assessment will highlight the positive measures already in place in the jurisdiction as well as identify weaknesses that could increase vulnerability in a jurisdiction. Capability assessment serves as the foundation for an effective hazard mitigation strategy by establishing goals and objectives for jurisdictions.

(A) Existing Authorities, Policies, Programs, and Resources

The PADD, along with MPT members, evaluated existing authorities, policies, programs, and resources in each jurisdiction. The following chart is a summary of each jurisdiction and the current status of these authorities. Local committee members evaluated this information to determine what goals, objectives, and actions would be necessary to effectively mitigate the vulnerability of a jurisdiction and what resources they currently have that can be used to implement the mitigation strategies identified in this plan.

Table 6.46 Existing Authorities, Policies, Programs, and Resources in the Purchase Region

Jurisdiction	Floodplain Management Ordinance	CRS & FMA Plans	Zoning Regulations	Subdivision Regulations	Land Development Plans	Fire Prevention Code	Comprehensive Plan	Capital Improvement Plan	Stormwater Management Plan	CERT Team	NWS Storm Ready Program	Local Economic Development	Regional Economic Development	City Class
Ballard County	X							X		X		X	X	
City of Barlow								X				X	X	6
City of Kevil								X				X	X	6
City of La Center					X		X	X				X	X	5
City of Wickliffe	X							X				X	X	5
Calloway County	X		X	X						X	X	X	X	
City of Murray	X		X	X	X		X		X			X	X	3
City of Hazel												X	X	6
Carlisle County	X									X	X	X	X	
City of Bardwell	X											X	X	5
City of Arlington	X											X	X	6
Fulton County	X									X	X	X	X	
City of Fulton	X		X	X	X		X	X				X	X	4
City of Hickman	X		X		X		X					X	X	4
Graves County	**X**									**X**		**X**	**X**	
City of Mayfield	**X**		**X**	**X**	**X**		**X**		**X**			**X**	**X**	**3**
City Wingo												**X**	**X**	**6**
Hickman County										X	X	X	X	
City of Clinton	X											X	X	5
City of Columbus												X	X	5
Marshall County	X					X				X	X	X	X	
City of Benton	X		X	X	X	X	X		X			X	X	4
City of Calvert City	X		X	X	X		X	X	X			X	X	4
City of Hardin	X											X	X	5
McCracken County	X		X	X	X	X	X			X	X	X	X	
City of Paducah	X		X	X	X	X	X	X	X			X	X	2

All jurisdictions are members of the PADD. Services are provided by the district in GIS/GPS, Economic Development, Community Development, Aging Services, Workforce Development, and Fiscal Management.

The existing authorities, policies, and programs are further explained in relation to the existing governmental structure and powers of the local jurisdiction. It is the responsibility of each local jurisdiction to develop, enact, and enforce the above referenced authorities and programs.

(B) Existing Governmental Structure

Tables 6.47 (county government) and 6.48 (city government) summarize the governmental structure for each jurisdiction in the PADD. Each jurisdiction is responsible for the implementation of mitigation strategies in their community. These governmental structures were reviewed by the JPHMC to determine the capability of implementing and enforcing existing and future authorities, policies, programs, and resources.

Table 6.47 County Government Structure in the Purchase Region

County	Type of Government
Ballard County	Judge/Executive and 5 magistrates
Calloway County	Judge/Executive and 4 magistrates
Carlisle County	Judge/Executive and 3 magistrates
Fulton County	Judge/Executive and 4 magistrates
Graves County	**Judge/Executive and 3 commissioners**
Hickman County	Judge/Executive and 3 magistrates
Marshall County	Judge/Executive and 3 commissioners
McCracken County	Judge/Executive and 3 commissioners

Table 6.48 Governmental Structure and Class of Incorporated Cities

City	Class	County	Type of Government
City of Barlow	6	Ballard	Mayor and 4 commissioners
City of Kevil	6	Ballard	Mayor and 6 council members
City of La Center	5	Ballard	Mayor and 4 commissioners
City of Wickliffe	5	Ballard	Mayor and 6 council members
City of Murray	3	Calloway	Mayor and 12 council members
City Hazel	6	Calloway	Mayor and 6 council members
City of Bardwell	5	Carlisle	Mayor and 6 council members
City of Arlington	6	Carlisle	Mayor and 4 commissioners
City of Hickman	4	Fulton	Mayor and 4 commissioners
City of Fulton	4	Fulton	Mayor and 4 commissioners
City of Mayfield	**3**	**Graves**	**Mayor and 10 council members**
City of Wingo	**6**	**Graves**	**Mayor and 4 commissioners**
City of Clinton	5	Hickman	Mayor and 6 council members
City of Columbus	5	Hickman	Mayor and 6 council members
City of Benton	4	Marshall	Mayor and 6 council members
City of Calvert City	4	Marshall	Mayor and 6 council members
City of Hardin	5	Marshall	Mayor and 6 council members
City of Paducah	2	McCracken	Mayor and 4 commissioners

Legal Authority of Local Jurisdictions

There are many tools available to local governments in Kentucky that may help them implement mitigation programs, policies and actions. Any hazard mitigation program can utilize any or all of the five types of government powers granted by the State of Kentucky: Regulation; Acquisition; Taxation; Spending, and Education.

Regulation

- Police Power: Local governments have been granted broad regulatory powers in their jurisdictions. Kentucky Revised Statutes grant the general police power to local governments, allowing them to enact and enforce ordinances and laws that define, prohibit, regulate or abate acts, omissions, or conditions detrimental to the health, safety and welfare of the citizens of their jurisdiction. The general police power also has the ability to define and abate nuisance ordinances, including those related to public health.

- Jurisdictions can include hazard mitigation requirements in their ordinances as protection of public health, safety and welfare. They may also use this power to enforce nuisance ordinances identifying nuisances that threaten the general health and safety of the public.

- Building Codes and Inspection: The construction and rehabilitation of homes, business and other structures according to standards that will make the structures more resistant to the

impact of natural hazards is a big part of mitigation activity in a jurisdiction. These standards can be enforced in a jurisdiction through building codes. Through the adoption and enforcement of building codes in each jurisdiction, it can be assured that mitigation strategies are in place for the planning area.

- Land Use: Local governments can control the use of land in the jurisdiction through regulatory powers granted to them by the State of Kentucky. Jurisdictions can control certain aspects of development under these powers. The amount and type of growth in a jurisdiction can greatly affect the vulnerability of the community in the event of a natural hazard. Land use powers include the power to enact and enforce zoning ordinances, floodplain ordinances, and subdivision controls, as well as the power to engage in planning.

  - Acquisition**:** The State of Kentucky Revised Statutes allows for jurisdictions to acquire property for public purposes. Acquisition can be a useful tool for mitigation goals in that property in hazard prone areas may be acquired so that future development is prohibited in a hazardous area.

  - Taxation**:** Local governments have been given the power to levy taxes and special assignments by the State of Kentucky. Taxation extends beyond the collection of revenue and can provide the means by which the community develops in the future.

  - Spending**:** Local governments have also been given the power to make expenditures on behalf of the public in their interest. Hazard mitigation principles should be incorporated in the spending decisions made by the local government in a jurisdiction.

- Education**:** Although most residents in a jurisdiction have some knowledge of the natural hazards that potentially threaten their community, most of them have had little formal education about what they as individuals can do to reduce their vulnerability to a natural hazard event. Education involving mitigation strategies and potential vulnerability will be essential for all jurisdictions in the planning area.

(C) Existing Professional Staff Departments

Members of Graves County MPT reviewed their existing capabilities based on their current professional staff departments. During the public input meetings, participants determined that the implementation of Mitigation Strategies and Projects would depend on the capability of that department in each jurisdiction.

Table 6.49 Capabilities Assessment: Existing Professional Staff Departments

Jurisdiction	Board of Education	Building Inspectors	Court Clerk	Emergency Management	County/City Treasurer	Mayor /County Judge/Executive	Health Department	Road Department	Sheriff Department	City Police Department	PVA (Tax Assessment)	Social Services	Utilities Department	Churches	Fire Departments	Kentucky State Police
Ballard County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Wickliffe				X	X	X							X	X	X	X
Barlow				X	X	X							X	X	X	X
Kevil				X	X	X							X	X	X	X
LaCenter				X	X	X							X	X	X	X
Calloway County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Murray	X	X		X	X	X		X		X			X	X	X	X
Hazel				X	X	X			X				X	X	X	X
Carlisle County	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**
Bardwell		X		X	X	X		X		X			X	X	X	X
Arlington		X		X	X	X		X					X	X	X	X
Fulton County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Hickman				X	X	X		X		X			X	X	X	X
Fulton	X			X	X	X		X		X			X	X	X	X
Graves County	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	**X**	**X**
Mayfield	**X**	**X**		**X**	**X**	**X**		**X**		**X**			**X**	**X**	**X**	**X**
Wingo				**X**	**X**	**X**							**X**	**X**	**X**	**X**
Hickman County	X		X	X	X	X	X	X	X		X	X	X	X	X	X
Clinton				X	X	X				X			X	X	X	X
Columbus				X	X	X							X	X	X	X
Marshall County	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Benton		X		X	X	X		X		X			X	X	X	X
Calvert City		X		X	X	X		X		X			X	X	X	X
Hardin				X	X	X							X	X	X	X
McCracken County	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
Paducah	X	X		X	X	X		X		X			X	X	X	X

The following definitions summarize the duties and responsibilities of the professional staff departments listed in Table 6.49.

The **Board of Education** maintains the operations of the county school system. This board is elected at large by the people of the community. County funds usually maintain the buildings and provide for other capital projects. State funds usually pay for salaries and the purchase of textbooks and supplies.

The **Building Inspectors** are responsible for enforcing the State Building Code, the NFIP, the Community Rating System, and other applicable local codes. These items are enforced through an inspection and permitting program.

The **PVA, Court Clerk,** and **Sheriff** are elected every four years by the citizens in the county. The PVA is responsible for the valuation of property for tax purposes. The Court Clerk is the custodian of the court system in each county. This office is financed through the State of Kentucky. The Sheriff operates on a budget approved annually by the magistrates (fiscal court) of each county and is responsible for the enforcement of state and local laws.

The **City Police Departments** are responsible for enforcing local and state laws in their designated jurisdiction.

The **Kentucky State Police** are responsible for enforcing local and state law in the entire state of Kentucky.

The **Fire Departments** are responsible for responding to emergencies / medical emergencies, helping with search and rescue after and extinguishing fires in areas where fires have occurred.

The **Road Departments** are responsible for the care and maintenance of the public roadways in their designated jurisdiction.

The **Utility Departments** are responsible for providing water, gas, electric and sewer services to the public.

The **Emergency Management Service** is responsible for the mitigation, preparedness, response and recovery operations for both natural and man-made disasters. The formation of an emergency management office in each county is mandated under the Kentucky Revised Statutes.

The **County/City Treasurers** are responsible for the management of the budget and fiscal programs for their jurisdiction. This also includes the administration of state and federal grants.

The **Mayor or County Judge/Executive** is responsible for overseeing the daily operations of County or City government in their respective jurisdictions. They are also responsible for the enforcement of County/City policies and regulations.

The **Health Departments** and **Social Services** have separate boards appointed by commissioners. Employment in these departments is approved by the commissioners with state personnel policies applying. These agencies protect and promote public health and provide social services for medical care and governmental social programs for displaced families.

The **Churches** provide shelters, food and water to community members. Churches in the Purchase Region opened their doors during a time of disaster and provided locations for emeregcny response teams to set up, helped with search and rescue, helped with clean up, etc. They are a fundamental part of the communities in the Purchase Region.

The **Emergency Management, Road Department, Building Inspectors, and Utilities Department** have been identified as the specific departments that will be responsible for carrying out mitigation activities. Each of these departments has been involved in the hazard mitigation planning process by participating in the JPHMC meetings.

It has been determined by the committee that each of these departments has limited available staff that are responsible for multiple duties within their departments. All jurisdictions have limited funding resources available to hire additional staff. Each staff member is adequately trained to cover their current workload. Increase in work activities, including hazard mitigation activities, will increase the need for additional staff to effectively perform tasks.

The PADD, as a regional planning agency, has become a primary resource for technical assistance for all jurisdictions in the region. The PADD staff are trained in planning, GIS/GPS, financial management and project development.

SUMMARY: Capability Assessment

The available staff and financial resources of the departments in each jurisdiction determine the ability for expansion and improvement of existing authorities, policies, programs, and resources to reduce potential losses. Each county in the PADD has equal ability to enforce and implement mitigation strategies.

The capability of cities in the Purchase Region varies so communities often work cooperatively with county government to perform projects that improve the quality of life for residents, including mitigation projects and activities. Because counties have more resources available to implement mitigation activities, it has been suggested that the goals and objectives be prioritized at a county level. City jurisdictions will have the opportunity at any given time to implement mitigation activities if their capabilities expand and the opportunity exists.

The jurisdictions that have participated in the mitigation planning process are identified in this plan. In addition to local participation, the PADD staff has provided professional assistance in GIS and plan development to help enhance the ability of the local jurisdictions to implement mitigation activities. Based on the above information, the local Hazard Mitigation Goals, Objectives and Actions were compiled at a county level, taking city jurisdiction public input into consideration.

6:6.2 Hazard Mitigation Goals

The PADD staff, along with Graves County MPT analyzed the loss estimates in the risk assessment to establish goals and objectives for loss reduction. The goals were established on a regional basis with input from local city participants. The goals and objectives will serve as a guide to develop specific actions to reduce potential losses caused by hazard events. These goals and objectives were determined to concur with existing community goals and the goals set forth by the Kentucky State Hazard Mitigation Plan.

Mitigation Goals – The mitigation goals were set to be general, long-term guidelines for hazard mitigation in jurisdictions.

Mitigation Objectives – The mitigation objectives define the strategies and process of implementation to achieve the identified goals. The objectives are specific, measurable, and have a defined completion.

Goal 1: Improve the survivability of critical facilities and infrastructure in order to preserve their capabilities to provide essential services during a hazard event, by reducing the vulnerability of these facilities.

Purpose of Goal in Relation to the Risk Analysis: It is understood that there will be a certain level of vulnerability to critical facilities and infrastructure depending on the nature of the hazard event. Loss of these capabilities directly affects public health and public safety in part or all of Graves County. During a natural hazard event, roadways can be damaged and utility services knocked out. These types of damages hinder emergency first responders from being able to effectively get help from those in need.

The following objectives have been developed as a result of this goal:
1.1: Enhance the rapid restoration of transportation systems.
1.2: Enhance the rapid restoration of utility systems.
1.3: Where possible, move the critical facilities out of flood prone areas.
1.4: Enhance the resistance of/harden critical facility structures to the effects of natural hazards.
1.5: Enhance the capability to maintain essential public health and public safety services by providing back-up sources of power and redundant communications to critical facilities.

Goal 2: Reduce the potential damaging effects of natural hazards through development policies without limiting the goals for growth of the community.

Purpose of Goal in Relation to the Risk Analysis: It has been determined that potential losses associated with development in the Graves County may be greatly reduced by enforcing or developing county and city policies that regulate development in hazard prone areas. Policies that regulate and guide the development of future infrastructure, residential, and industrial projects will reduce the vulnerability of these facilities.

The following objectives have been developed as a result of this goal:

2.1 Enforce existing policies and authorities.
2.2 Develop new policies such as ordinances and building codes that require new structures to meet standards that will resist natural hazards.
2.3 Develop land use planning policies that restrict development in hazard prone areas such as flood zones.
2.4 Develop subdivision requirements to protect utilities, such as buried power and phone lines.

Goal 3: Protect public health and safety by increasing public awareness of natural hazards that affect Graves County and by fostering a sense of responsibility within the public for mitigating risks associated with those natural hazards.

Purpose of Goal in Relation to the Risk Analysis: It has been determined that the general public in Graves County needs to be aware of the high-risk areas, and potential harm associated with the natural hazards that affect their area. While policies can be developed to reduce the development in hazard prone areas, public education will ensure that those policies are utilized to their fullest to reduce the number of existing and future structures in those areas. Through public education, individuals may realize the seriousness of potential hazards and act upon this realization by taking steps to secure their property and protect their families against the risks of natural hazards.

The following objectives have been developed as a result of this goal:

3.1 Educate the public on potential natural hazards that affect Graves County.
3.2 Increase public understanding and support of the hazard mitigation process.
3.3 Educate the public on how they can take personal responsibility for their own health, safety and property protection.
3.4 Develop and maintain emergency evacuation routes. Educate the public about the location and use of evacuation routes.
3.6 Storm Ready: Pursue Graves County's status as a Storm Ready Community.
3.7 Pursue Firewise Community status for Graves County, City of Mayfield, and City of Wingo.

Goal 4: Efficiently make use of public and private funds to increase the capabilities of local jurisdictions to reduce potential losses associated with flood hazard events.

Purpose of Goal in Relation to the Risk Area: It has been determined that potential losses can be reduced in Graves County by their ability to effectively communicate, plan, and implement mitigation projects. Efficiently using public or private money to improve communication,

planning, and implementation capabilities for the general public as well as key critical facilities can reduce the impact a hazard has on Graves County.

The following objectives have been developed as a result of this goal:

4.1 Promote inter-agency and inter-local cooperation for the use of mitigation funds and activities.

4.2 Take advantage of State Hazard Mitigation grants associated with Disaster Declarations, Pre-Hazard Mitigation Grant announcements, and other grants to fund Mitigation Projects.

4.3 Leverage State and local funding, local match sources and in-kind match resources to get the maximum utility from available Mitigation Funds.

Goal 5: Protect Graves County's most vulnerable populations, buildings and critical facilities and infrastructure through the implementation of cost-effective and technically feasible mitigation projects.

Purpose of Goal in Relation to the Risk Area: During the review of the risk analysis, council members determined several structures and critical facilities and infrastructure that will need to have specific mitigation actions taken in order to be effective in reducing the vulnerability. Some identified structures and critical facilities and infrastructure need to be removed from the flood hazard area completely or built to appropriate standards to reduce the potential losses.

The following objectives have been developed as a result of this goal:

5.1 Increase the availability of adequate shelters and community shelters for protection from the direct and indirect effects of severe weather events.

5.2 Continue to improve early warning of impending severe weather events.

5.3 Reduce the number of critical facilities and infrastructure in identified flood hazard areas.

5.4 Utilize available mitigation measures to reduce the number of vulnerable structures in the flood hazard areas.

5.5 Utilize available mitigation measures such as structure elevation to reduce the vulnerability of structures in flood hazard areas.

5.6 Identify and remove stream blockages of tree limbs and trunks, form effective check dams and barrages, and result in the pooling of water during flood events.

Goal 6: Protect dwellings, structures and their occupants along the Wildland/Urban interface from the potential of Wildfire.

Purpose of Goal in Relation to the Risk Area: While there is not historical data to support damaging wildfires in Graves County, small field fires and brush fires do occur, especially during periods of drought events. These events, historically, have been very small threats and generally not considered a risk. Although considered a low risk, it should be continually planned for and perhaps anticipated.

The following objectives have been developed as a result of this goal:

6.1. Ensure the protection of first responders.

6.2. Enhance the response capability for response to brush fires to mitigate their growth into wildfires.

6.3. Facilitate communities/neighborhoods participation in the State's "Firewise" program.
6.4. Reduce the quantity of available wildfire fuels in proximity to critical facilities and to any/all structures in Graves County
6.5. Incorporate fire buffer planning into the design considerations for any new critical facility.

Goal 7: Support and participate in regional Hazard Mitigation Planning

Purpose of Goal in Relation to the Risk Area: Graves County, the City of Mayfield, the City of Wingo, and representatives of various groups and organizations represented the county and participated in the JPHMC and the development of the regional portion of the plan. Because a regional authority does not exist, the realization of the goals and objectives of the JPHMC Multi-Jurisdictional Plan depends on the support and cooperation of Graves County, City of Mayfield, and the City of Wingo. This is especially true in that; the regional goals and objectives affect all jurisdictions in the Purchase Region, damage to or destruction of the regional critical facilities identified in the plan affect all jurisdictions in the region, the strategies and mitigation projects that will evolve from these goals require the participation of all the jurisdictions in the region and the results will benefit all the participants. In the same vein Graves County, City of Mayfield, and the City of Wingo will require the cooperation and assistance of other jurisdictions, both neighboring and region wide, and the assistance of regional organizations such as the PADD, the Kentucky State Police, KYTC District One, Purchase District Health Department to help plan, fund and implement Hazard Mitigation projects.

The following objectives have been developed as a result of this goal:
7.1. Request agencies such as the Kentucky Geological Survey and the University of Kentucky to conduct/expand further studies into seismicity, soil and ground shaking potential within the region.
7.2. Develop a regional high resolution, spatially accurate imagery data base from which to extract precise point locations and structure footprints for buildings and other critical facilities.
7.3. Adopt an All-Hazard Week public awareness campaign to include earthquakes, floods, tornados and severe storms.

Goal 8: Obtain the best data and analysis available to assess the downstream hazard posed by existing dams in the event of their failure.

Purpose of Goal in Relation to the Risk Area: Potential losses can be reduced in a jurisdiction by their ability to effectively plan and implement mitigation projects. In order to do so, an accurate assessment of the threat posed by Dam Failure must be made to determine the geographic extent of the hazard and the potential impact of the Hazard in terms of threat to the populace and property. The following objectives have been developed as a result of this goal:

8.1 Identify and map vulnerable structures, critical facilities, and risk prone areas.
8.2 Update County EOP as required.

8.3 Support and participate in ongoing studies simulations and preparedness exercises relating to dam failure.
8.4 Monitor other existing dams in cooperation with the Kentucky Division of Water.

6:6.3 Identification and Analysis of Mitigation Measures

The intention of this section is to identify, evaluate, and analyze a range of mitigation actions that will help reduce the potential effects of hazard events identified in the risk assessment of the plan. These actions were derived based on the analysis of the risk assessment and support the goals and objectives identified in the plan.

The following list describes potential loss reduction mitigation actions and techniques identified for mitigation of hazard events. These actions and objectives were determined to have the greatest influence on hazard loss reduction in Graves County. Hazard specific mitigation actions are listed in order of priority in accordance with the High-Risk Hazards for the county as identified and prioritized by the Graves County MPT.

- Prevention activities are designed to keep current problems from getting worse and to eliminate the possibility of future problems. Prevention activities reduce a jurisdiction's vulnerability to hazard events. This type of activity is especially effective in hazard prone areas where development has not occurred. Prevention activities include the following:
  - Planning and Zoning
  - Floodplain regulations
  - Stormwater management
  - Building codes
  - Capital improvement programs.
  - Open space preservation
  - Dam inspection and monitoring

- Property protection activities are designed to adapt existing structures to withstand natural hazards or to remove structures away from hazard prone areas. Property protection activities include the following:
  - Acquisition
  - Relocation
  - Foundation elevation
  - Insurance – flood and homeowner's
  - Retrofitting (includes activities such as wind-proofing, flood-proofing, and seismic design standards)

- Structural projects lessen the impact of a natural hazard by changing the natural progression of the hazard. These types of projects are usually designed by engineers. Structural projects include the following:
  - Storm sewers
  - Floodwalls
  - Highway Projects
  - Retention Basins
  - Reservoirs
  - Dams
  - Levees
  - Dredging
  - Minor flood control projects
  - Culvert resizing
  - Retaining walls
  - Safe rooms

- Emergency services minimize the impact that a natural hazard has on the residents of a jurisdiction. Usually, actions are taken by emergency response services immediately before, during, or in response to a hazard event. Emergency service activities include the following:
  - Warning systems: sirens / automated calling system
  - Evacuation planning and management
  - Sandbagging for flood protection
  - Emergency response services
  - Protection of critical facilities

- Emergency generators

- Public information and awareness activities are used to educate the residents of a jurisdiction about the potential hazards that affect their area, hazard prone areas, and mitigation strategies they can take part in to protect themselves and their property. Public information and awareness activities include the following:
  - Public speaking events
  - Outreach projects
  - Availability of hazard maps
  - School programs
  - Library materials
  - Hazard Awareness Weeks
  - Real estate disclosure
  - Storm Ready Community Program
  - Firewise Community Program
  - CERT Teams and CERT Training
  - Citizens Corps Organizations

- Natural resource protection activities include those that minimize hazard losses and preserve or restore the functions of natural systems. Natural resource protection actions include the following:
  - Sediment and erosion control
  - Stream corridor restoration
  - Watershed management
  - Forest and vegetation management
  - Wetlands preservation and management

Hazard Specific Actions

Hazard specific mitigation activities defined for each goal and objective are listed by priority of risk, and partly based on the capability of the county to acquire funding for such activities. Specific projects included in this plan are either under consideration or evolving during this planning process; enhanced early warning throughout the county or completed.

Table 6.50 Graves County Hazard Summary Table

HIGH RISK HAZARDS	TORNADO THUNDERSTORM WIND FLASH FLOOD / FLOOD WINTER STORM / ICE STORM EARTHQUAKE
MODERATE RISK HAZARDS	EXCESSIVE HEAT/DROUGHT HAIL
LOW RISK HAZARDS	WILDFIRE DAM FAILURE

SOURCE: Graves County MPT 2022

Tornado Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following:

- Develop a plan of action for a tornado event – including home, work, school, and outdoor situations.
- Have tornado drills on a regular basis.
- Encourage all households to maintain a disaster supply kit:
  - A three-day supply of water (1 gallon per person per day)
  - Non-perishable food items
  - One change of clothing and shoes per person
  - One blanket or sleeping bag per person.
  - A first-aid kit, including all prescription medicines.
  - A battery-powered NOAA weather radio with warning alarm and extra batteries
  - A flashlight and extra batteries
  - Special items for infants, elderly or disabled individuals
- Listen to the latest forecasts, especially when planning outdoor activities.
- Publicize multi-media access to tornado watches and warnings.
- Inspect designated tornado shelters for compliance with building codes to ensure their ability to withstand high winds.

- Install warning systems that are not completely dependent upon electricity.
- Pursue programs to provide or subsidize the provision of weather radios to low-income populations.
- Analyze the shelter requirements for temporary residents/visitors to the County's Elder Care facilities.
- Evaluate the need for tornado safe rooms, particularly for mobile home parks.
- Initiate mobile home anchoring program.
- Build tornado safe rooms were deemed necessary.
- Ensure all critical facilities have a backup source of power – generators.
- Train, equip and maintain Storm Spotter cadre.
- Build Community Shelters in critical locations.
- Update software systems to be able to communicate with community members during a disaster and power / cell coverage is scewed

Thunderstorm Wind/Hail Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Listen to the latest forecasts, especially when planning outdoor activities.
- Keep a NOAA weather radio with extra batteries nearby to listen for weather updates.
- Listen especially for severe thunderstorm watches and warnings.
- Practice lightning safety.
  - Outdoor activities should not take place when lightning is present.
  - Fully enclosed vehicles and large permanent buildings provide safe havens from lightning.
- Pursue programs to provide or subsidize the provision of weather radios to low-income populations.
- Promote trimming of tree limbs and debris, particularly in areas close to critical facilities and infrastructure such as power lines.
- Ensure all critical facilities have a backup source of power - generators.

Flash Flood / Flood Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Enforce City and County Floodplain Ordnances.
- Participation in the NFIP.
- Promote the purchase of flood insurance.
- Construct/Maintain a levee or flood wall.
- Elevate the lowest floor level of existing structures above the floodplain.
- Elevate flood prone roads.
- When feasible, relocate structures out of the floodplain.
- Acquire and demolish structures in the floodplain.
- Provide openings in foundation walls to allow water to flow in and out.
- Install backflow valves to drains, toilets, and other sewer connections.
- Maintain ditches and storm water drainage systems.
- Ensure all critical facilities have a backup source of power – generators.

- Sedimentation control (dredging)
- Wetland restoration.
- Stream re-alignment
- Increase culvert cross section.
- Dredge existing channels to maintain current depths and flows.
- Identification and removal of stream blockages of tree limbs and trunks forming effective check dams and barrages and resulting in the pooling of water during flood events.
- Continue the program/work to plan engineer, design and execute realignment of the Red Duck Creek.

Winter Storm / Ice Storm Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Make sure critical facilities have a backup source of heat.
- Provide public education as to the safe use of back up heat sources.
- Promote trimming of tree limbs and debris, particularly in areas close to critical facilities and infrastructure such as power lines.
- Evaluate subdivision regulations for inclusion of underground utilities for new development.
- Promote public education to individuals and families, business, and schools for Winter Storm Events and include the following:
  - Insulate the walls and attic structures.
  - Caulk and weather-strip doors and windows.
  - Allow water to slowly drip from faucets to prevent pipes from freezing.
  - Check the antifreeze and battery in vehicles.
  - Stay off snow- or ice-covered roads if possible.
  - Keep a supply of non-perishable food and water.
- Ensure all critical facilities have a backup source of power - generators.

Earthquake Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.

- Support, encourage, and lobby for the continuing study of the threat of ground shaking from the Wabash and New Madrid Seismic Zones.
- Evaluate public critical facilities and infrastructure to determine their resistance to ground movement.
- Replacement of brittle water and wastewater infrastructure specifically cast-iron pipe, asbestos cement pipe, and vitreous clay pipe.
- Ensure that all homes and other structures are secured to their foundations.
- Enforce existing seismic building standards (current building code)
- Identify “safe places” in structures that are vulnerable during an earthquake. A safe place might include space under a sturdy table or desk against an interior wall. Stay away from windows.
- Practice the “drop and cover” technique in each identified safe place. Drop, duck your head between your knees, and cover the back of your neck with your hands. Practice makes this process an automatic response in the event of an earthquake.
- Develop an action plan for an earthquake event – including home, work, school, and outdoor

situations.
  - Secure heavy furniture to walls. Brace or anchor high or top-heavy objects.
  - Purchase earthquake insurance if available.
  - Install strong latches on all cabinet doors. This will prevent them from spilling their contents in the event of an earthquake.
  - Secure items on shelves or bookcases that might fall and cause injury during an earthquake. Move large or heavy items to lower or bottom shelves.
  - Store breakable or glass items in cabinets with latches.
  - Brace overhead light fixtures.
  - Secure water heater to wall studs.
  - Install flexible pipe fittings. These fittings are less likely to break.
- Participate in any/all earthquake planning and exercises at the State and National level.

Excessive Heat/Drought Mitigation Activities: Promote public education to individuals and families, business, and schools for hazard events that may include the following.
- Programs focused on at-risk populations, senior citizens, and very young children.
- Air conditioner/fan loan or subsidized purchase program
- Identification of cooling shelters.
- Replacement of brittle water and wastewater infrastructure specifically cast-iron pipe.

Wildfire Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.
- Each community strives to be a "Firewise" Community.
- Promote public education to individuals and families, business, and schools for Wildfire Threat include the following:
  - Proper storage of flammables o Class Shingles or tin on roofs o Masonry construction
  - Remove plants with resins, waxes, or oils from landscaping.
  - Remove dead branches.
  - Reduce the amount of fuel around homes.
- Aggressively reduce available fuels in the vicinity of critical facilities
- Amnesty programs for hazardous materials/storage vessels
- Tire amnesty programs
- Removal of potential fuels from the vicinity of Critical Facilities.
- Pursue the acquisition of equipment and training to rapidly respond to brush fires to mitigate their becoming wildfires.

Dam Failure Mitigation Activities: Promote public education to individuals, businesses, and schools for hazard events that may include the following.
- Continue to participate in the State Department of Water monitoring Program for the 31 DOW identified dams in Graves County.
- Assess the structures at risk to inundation

6:6.4 Implementation of Mitigation Measures

The purpose of this section is to provide a road map on how the mitigation actions identified in this plan will be prioritized, implemented and administered in the Purchase Region.
All jurisdictions will adopt the JPHM Plan by January 2023. Each county in the PADD has equal ability to enforce and implement mitigation strategies. The smaller Cities in the Purchase Region depend greatly upon the county government, and the PADD for support and combine resources to perform projects that improve the quality of life for residents, including mitigation projects and activities.

Because counties have more resources available to implement mitigation activities, it has been suggested that the goals and objectives be prioritized at a county level. City jurisdictions will have the opportunity at any given time to implement mitigation activities if their capabilities expand and the opportunity exists.

The jurisdictions that have participated in the mitigation planning process are explained in this plan. In addition to local participation, the PADD staff has provided professional assistance in GIS and plan development to help enhance the ability of the local jurisdictions to implement mitigation activities.

Funding: The jurisdictions of the PADD will attempt to utilize the following funding sources in implementing goals, objectives and actions when possible: the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), the Pre-Disaster Mitigation Program (PDM), Hazard Mitigation Technical Assistance Programs (HMTAP), the National Earthquake Technical Assistance Program, the Wind and Water Technical Assistance Program, and local funding.

Project Prioritization: Graves County, the City of Mayfield, and the City of Wingo will maintain the list of set goals, objectives, and actions that have been identified in this plan. These items were prioritized based on a set of criteria located in the FEMA Multi-Hazard Mitigation Planning Guidance that includes social, technical, administrative, political, legal, economic, and environmental factors (STAPLE+E) within the county jurisdictions.

Each action was given a high, medium, or low priority based on those criteria. The mitigation actions with the highest priority were the most cost effective and most compatible with the jurisdiction's social and cultural values. The PADD staff reviewed each jurisdiction's priorities annually to ensure that they were properly prioritized. The designated council representative from each jurisdiction will be responsible for maintaining this list.

The STAPLE+E criteria guidelines for action prioritization that were given to the council members in order to analyze their actions were as follows:

Table 6.51 STAPLE+E Criteria Explanation

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 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. and 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 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, that comply with Federal, State, and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

Table 6.52-6.54 represents non-process actions requiring construction or acquisition related to the goals and objectives set forth in this plan, prioritized by each jurisdiction. The table identifies the hazard and the action addresses, the action, the action priority, the entity responsible for the action, the potential sources of funding for the action, and to which Community Rating System (CRS) action category each project belongs.

Table 6.55 represents process actions that, thusly, are of High priority to Graves County and to its incorporated jurisdictions equally: For example, it is expected that "adopting and enforcing building codes" applies with equally "High" priority to Graves County and to its incorporated cities Mayfield and Wingo.

Construction / Non-Process Projects to be Pursued by Each Jurisdiction: Table 6.52 Graves County, Unincorporated

Hazard	Action	Priority	STALPE + E	Responsible Entities	Potential Funding Sources	CRS Action Category	Completion Timeline
Flooding	Elevate segments of roads prone to flooding	High	S, T, A, P, L, E1, E2	Fiscal Court; KYTC	Local, State, Federal Grants Programs	Structural	On Going
Flooding	Acquire/Demolish Repetitive-Loss Properties	High	S, T, A, P, L, E1	Fiscal Court; KYEM; FEMA	Local, FEMA HMA	Property Protection	On Going
Flooding	Relocate Critical Facilities out of flood-prone areas or elevate them	Medium	S, T, P, L, E2	Fiscal Court; Owners of Facilities	Local, State, Federal Grants Programs	Property Protection	Immediate
Tornadoes	Purchase and Install Emergency Warning Sirens	Medium	S, T, A, P, E1	Local, FEMA HMA	Private, Local	Emergency Services Measures	Immediate
Tornadoes	Construct Large Community Safe Rooms	Medium	S, T, A, P, L, E1	FEMA HMA, Local	Non-Profit, Private, Local, Federal Grants	Structural; Emergency Services Measures	Immediate
All Identified Hazards	Purchase Generators for Critical Facilities	High	S, T, A, P, E1	Fiscal Court	Local, FEMA HMA	Emergency Services Measures	On Going
All Identified Hazards	Purchase Emergency Power Sources for rural areas' designated shelters	High	S, T, P, L, E1	Fiscal Court	Local, FEMA HMA	Emergency Services Measures	On Going
Flooding	Develop a Debris Removal Plan for Streams and Ditches	Medium	S, P, L, E1, E2	Fiscal Court; Public Works	Local, Federal Grants	Public Information ; Natural Resource Protection	On Going

Tornadoes; Severe Storms; Ice Storms	Trim trees and debris from overhead powerlines	Medium	S, P, L, E1	Utilities Providers	Private, Local	Preventative Activities	On Going
Wildfires	Purchase Equipment to suppress brush fires	Medium	S, P, E1	Fire Departments; Fiscal Court	Non-Profit, Private, Local, Federal Grants	Natural Resource Protection	On Going
All Identified Hazards	Upgrade Emergency Services Communication Equipment (for Critical Facilities)	Medium	S, T, P, E1	Emergency Management Agency	FEMA / DHS, Other Federal Grants, Local	Emergency Services Measures	On Going
All Identified Hazards	Establish a new County Emergency Operations Center	High	S, T, A, P, E1	County EM City of Mayfield	FEMA State, local or other	Emergency Services Measures	As soon as funding is available
All Identified Hazards	Energy/Grid Resilience	High	S, T, L, P, E1	Fiscal Court, EMA, Owners of Facilities	FEMA, HMA, Local, State, and Federal Grants	Emergency Services Measures	On Going

6.53 Mayfield, City of

Hazard	Action	Priority	STAPLE +E	Responsible Entities	Potential Funding Sources	CRS Action Category	Completion Timeline
Flooding	Study cause of flooding along Kess Creek, Red Duck Creek and Mayfield Creek and identify measures to alleviate flooding	High	S, T, A, P, L, E1, E2	City	Local, State, Federal Grant Programs	Structural	Immediate
Tornadoes	Purchase and Install Emergency Warning Sirens for portions of Mayfield that don't have adequate coverage	High	S, T, A, P, E1	City, Fiscal Court	Local, FEMA HMA	Emergency Services Measures	Immediate
Tornadoes	Construct Community Safe Room for the City of Mayfield	High	S, T, A, P, L, E1	City	FEMA HMA, Local	Structural; Emergency	Immediate

						Services Measures	
All Identified Hazards	Purchase Generators for Critical Facilities	High	S, T, A, P, L, E1	City	Local, FEMA HMA	Emergency Services Measures	On Going
Tornadoes; Severe Storms; Ice Storms	Trim Trees and Debris from Overhead Powerlines	Medium	S, P, L, E1	Utilities Providers	Private, Local	Preventative Activities	On Going
All Identified Hazards	Upgrade Emergency Services Communication Equipment (for Critical Facilities)	Medium	S, T, P, E1	Graves County Emergency Management Agency	FEMA / DHS, Other Federal Grants, Local	Emergency Services Measures	On Going
All Hazards Identified	Software for a Reverse 911 System to communicate with community during emergency / urgent messaging	High	S, T, L, E1	City	Local, FEMA HMA	Emergency Services Measures	Immediate
All Hazards Identified	Safety lighting for downtown Mayfield	High	S, P, E1,	City	Local, FEMA HMA	Structural	Immediate
All Identified Hazards	Updating security system for critical facilities (key card / keypad, security cameras)	High	S, T, L, E1	City	Local, FEMA HMA	Emergency Services Measures	Immediate
Tornadoes	Permanent Street Sign replacement after Tornado	High	S, T, L, E1	City	Local, FEMA HMA	Structural	Immediate
All Identified Hazards	Energy/Grid Resilience	High	S, T, L, P, E1	Fiscal Court, EMA, Owners of Facilities	FEMA, HMA, Local, State, and Federal Grants	Emergency Services Measures	On Going

6.54 Wingo, City of

Hazard	Action	Priority	STAP LE +E	Responsible Entities	Potential Funding Sources	CRS Action Category	Completion Timeline
Tornadoes	Purchase and Install Emergency Warning Sirens for the areas in Wingo that do not have adequate coverage	High	S, T, A, P, E1	City	Local, FEMA HMA	Emeregcny Services Measures	Immediate
Tornadoes	Construct Community Safe Room for the City of Wingo	High	S, T, A, P, L, E1	City	FEMA HMA, Local	Structural; Emeregcny Services Measures	Immediate
All Identified Hazards	Purchase Generators for Critical Facilities (Including Wingo Fire Station)	High	S, T, A, P, E1	City	Local, FEMA HMA	Emergency Services Measures	On Going
Tornadoes; Severe Storms; Ice Storms	Trim Trees and Debris from Overhead Powerlines	Medium	S, P, L, E1	Utilities Providers	Private, Local	Preventative Activities	On Going
All Identified Hazards	Upgrade Emergency Services Communication Equipment (for Critical Facilities)	Medium	S, T, P, E1	Graves County Emergency Management Agency	FEMA/DHS, Other Federal Grants, Local	Emeregcny Services Measures	On Going
All Identified Hazards	Energy/Grid Resilience	High	S, T, L, P, E1	Fiscal Court, EMA, Owners of Facilities	FEMA, HMA, Local, State, and Federal Grants	Emergency Services Measures	On Going

6.55 Process Mitigation Action That Apply to Graves County and Each of Its Incorporated Cities (Mayfield and Wingo) with Equally (i.e., "High") Priority

Hazard	Action	Priority	Responsible Entities	Potential Funding Sources	CRS Action Category
Flooding	Enforce NFIP Flood Ordinances	High	County, and City Executives; Floodplain Managers	Fiscal Court, City Councils	Preventative Activities
Flooding	Monitor, evaluate, Collect Damages Data to Determine	High	County EMAs; City-Appointed Designees;	Fiscal Court; City Councils	Preventative Activities; Property Protection

	additional and on existing Repetitive Loss Properties		Floodplain Managers		
All Identified Hazards	Promote the usage of NOAA Weather Radios	High	County and City EMA and EM Agents	Fiscal Court; City Councils	Preventative Activities; Public information
Flooding	Provide Updated Floodplain Mapping and other information regarding flood-prone areas to Public	High	County and City EMA and EM agents; Floodplain Managers	Fiscal Court; KYEM; KDOW	Preventative Activities; Public Information
Earthquakes, Flooding	Public Outreach regarding Importance of and Availability of Earthquake and Flood Insurance	High	County; City; County EMA and EM agents; Floodplain Managers; Insurance	Fiscal Court; City Councils; KYEM; KDOW; UK-KGS	Preventative Activities
All Identified Hazards	Adopt and Enforce Building Codes	High	County; City; Building Inspection Agents	Fiscal Court; City Councils; KYEM (through HMGP Initiative)	Preventative Activities; Public Information; Emergency Services Measures
All Identified Hazards	Public Outreach for the Development of Evacuation Plans and Procedures relevant to All Identified Hazards	High	County; City	Fiscal Court; City Councils; KYEM	Preventative Activities ; Natural Resource Protection
All Identified Hazards	Develop additional Zoning and Land-Use Ordinance to regulate development	High	County; City Developers	Fiscal Court; City Councils	Preventative Activities; Natural Resource Activities
All Identified Hazards	Develop and Implement a Protection Program for Critical Information Systems	High	County; City	Fiscal Court; City Councils	Preventative Activities; Emeregcny Services Measures
Earthquakes	Develop an Earthquake Command Center and work with surrounding counties Emergency Managers	High	County, City. Multiple Jurisdictions	FEMA HMA, Other Federal Grants	Emergency Service Measures
All Identified Hazards	Energy/Grid Resilience	High	Fiscal Court, EMA, Owners of Facilities	FEMA, HMA, Local State and Federal Grants	Emergency Service Measures

As funding becomes available, these projects will be pursued. However, this listing is not a commitment by the jurisdictions to pursue each project. Some projects may be cost prohibitive, not as desirable as initially thought, or overridden by competing priorities.