

KANAWHA COUNTY

Multi-Jurisdictional Hazard Mitigation Plan

**KANAWHA COUNTY
MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN**

RELEASED 2015

**THIS PLAN COVERS ALL AREAS AND JURISDICTIONS WITHIN KANAWHA COUNTY,
WEST VIRGINIA ON TOPICS OF HAZARD MITIGATION**

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1.1 DOCUMENTATION OF THE PLANNING PROCESS

§201.6(b) and 201.6(c)(1)	<p>An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:</p> <ol style="list-style-type: none">(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information. <p>[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.</p>
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This plan was developed in accordance with Part 201.6 of Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as enacted by Section 104 of the Disaster Mitigation Act of 2000. Several resources were used during the development of the plan, including the US Department of Homeland Security's Federal Emergency Management Agency (FEMA) *Mitigation Planning How-To Series*, the governing regulations in the Code of Federal Regulations (CFR), and documents provided by the WV Division of Homeland Security and Emergency Management.

To guide the completion of the plan at the local level, a multi-jurisdictional core planning team was established. This team was comprised of key officials with a stake in mitigation and included the following.

- Mr. David Armstrong, Kanawha Co. Planning
- Mr. Chuck Grishaber, Kanawha Co. Planning
- Mr. Grant Gunnoe, Charleston OES/HS
- Ms. Roberta Jones, Charleston OES/HS
- Mr. Dale Petry, Kanawha County OES
- Mr. Dan Vriendt, Charleston Planning
- Mr. Mark Snuffer, Charleston Planning
- Mr. Adam Cottrell, Charleston Planning
- Mr. Matt Blackwood, KPEPC
- Deputy Chief Bob Sharp, Charleston FD
- Mayor – Belle
- Mayor – Cedar Grove
- Mayor – Chesapeake
- Mayor – Clendenin
- Mayor – Dunbar
- Mayor – East Bank
- Mayor – Glasgow
- Mayor – Handley
- Mayor – Marmet
- Mayor – Nitro
- Mayor – Pratt
- Mayor – St. Albans
- Mayor – South Charleston
- Mr. Jeffery Harvey, JH Consulting, LLC
- Mr. Michael Chase, JH Consulting, LLC

1.1.1. Original Plan Development Process

During the original development of the plan, the Kanawha County Commission served as the lead agency. The key people involved in overseeing the process of the writing the plan were the Kanawha County OES Director, Floodplain Manager for Kanawha County, and Planning Director for Kanawha County. A committee was formed to provide input for the plan and the needs of each municipality and agency involved. Key members involved in the development of the plan included planning staff from the City of Charleston and Kanawha County as well as the appropriate individuals from each of the municipalities within the county. Two town meetings were conducted, with team representatives present, to conduct public hearings involving the citizens of Kanawha County.

1.1.2. First Plan Update Process

The first mitigation plan update was completed in the latter half of 2008 and early portions of 2009. A consultant, JH Consulting, LLC of Buckhannon, was selected to assist with the update. The basic core planning committee was reformed and was comprised of representatives from the Kanawha County Office of Emergency Services (OES), Kanawha County Planning, City of Charleston Office of Emergency Services and Homeland Security, and City of Charleston Planning Department. This committee provided primary oversight of the update.

The core planning committee also recognized the importance of municipal participation. One of the tasks completed during the update (that was not completed during the original plan development) was a comprehensive survey of critical facilities and other community assets. Municipalities were involved in this process. The consultant contacted each municipality to request information regarding the critical facilities in that municipality (such as the town hall, police department, fire department, etc.). A survey form was submitted along with that call. In addition to the information on facilities, municipalities were encouraged to discuss their thoughts on hazard vulnerability and present a mitigation project that could address risks and vulnerabilities in their jurisdiction.

1.1.3. Second Plan Update Process

The second mitigation plan update was completed in during the conclusion of 2014 to the beginning of 2015. Again, JH Consulting, LLC of Buckhannon, WV was brought in to assist with the update. The basic core planning committee was reformed and was comprised of representatives from the Kanawha County Homeland Security and Emergency Management (KCHSEM), Kanawha County Planning, City of Charleston Department of Homeland Security and Emergency Management, and City of Charleston Planning Department. This committee provided primary oversight of the update. Municipal participation is still recognized as an important portion of the planning process, therefore, municipal input is requested at all stages to include the determination of current hazards and vulnerabilities to what mitigation goals and projects shall be the focus for each municipality.

Additional participation was sought for this update, from sectors such as business and industry, higher education, and neighboring jurisdictions. Business and

industry participation was incorporated via the Kanawha-Putnam Emergency Planning Committee's (KPEPC) regularly-updated hazard analysis for Kanawha and Putnam Counties. The analysis was utilized as a contributing source for the risk assessment portion of this plan. That hazard analysis is compiled by the Hazard Assessments and Planning committee within the KPEPC and presented for approval by the full KPEPC (including its business/industry members). Further, the second stakeholder committee meeting (for the purpose of reviewing mitigation project status) was held immediately following the December 2015 KPEPC meeting. During the meeting, members were invited to approach the committee after the meeting to ask any questions or otherwise contribute to the project status discussion. (Only the chairperson of the KPEPC attended.)

The Kanawha County portion of the KPEPC's membership includes the following (and as such, represents those organizations in Kanawha County that had an opportunity to participate in the process).

Emergency Services

- Charleston Area Medical Center
- Charleston Fire Department
- Charleston Police Department
- Dunbar Fire Department
- Dunbar Police Department
- Institute Volunteer Fire Department
- Jefferson Volunteer Fire Department
- Kanawha County Emergency Ambulance Authority
- Kanawha County Sheriff
- Nitro Fire Department
- Rand Volunteer Fire Department
- St. Albans Fire Department
- St. Francis Hospital
- South Charleston Police Department
- Thomas Memorial Hospital
- Tyler Mountain Volunteer Fire Department
- West Virginia Capitol Police
- West Virginia State Police

Government

City of Charleston Homeland Security and Emergency Management
Kanawha-Charleston Health Department
Kanawha County Commission
Kanawha County Emergency Management
National Weather Service
West Virginia Air National Guard
West Virginia Conservation Agency
West Virginia Department of Agriculture
West Virginia Department of Environmental Protection
West Virginia Department of Military Affairs and Public Safety

Business/Industry

Ann Green Communications
Arrow Material Services
Bayer CropScience
Bayer MaterialScience
Brenntag Mid-South, Inc.
Chemours
Clearon
Dow Chemical
Electronic Communications
Elementis Specialties
G4S
Marathon Petroleum
Mountaineer Gas
NGK Spark Plug
Pitt Ohio Express, Inc.
Preiser Scientific, Inc.
Security America
Terradon Communication
Total Distribution, Inc.
Walker Machinery

Education

Kanawha County Schools
West Virginia State University

Other

American Red Cross
Appalachian Center for Independent Living
Dunbar Care & Rehab
Federal Bureau of Investigation
Highland Hospital
Kanawha-Putnam Emergency Planning Committee
Kanawha Regional Transit
Meadowbrook Acres Nursing
Pristera Center
West Virginia American Water Company
West Virginia Board of Risk and Insurance Management
West Virginia K-9 Search and Rescue
Yeager Airport

Moving forward, input from higher education will be sought by sending notification to relevant institutions (e.g., University of Charleston, West Virginia State University) and inviting them to review the updated copy of the plan. Any comments received from these entities will be incorporated into the next updating process.

Finally, input from neighboring jurisdictions will come in the form of the next Regional Intergovernmental Council (RIC) regional mitigation plan update. As a participating jurisdiction in that process, this updated document will be provided to RIC and integrated into a regional framework including jurisdictions in Boone, Clay, and Putnam Counties.

Public Involvement

In addition to including the mitigation project review at a public KPEPC meeting, the City of Charleston and Kanawha County have posted copies of the mitigation plan on their websites, along with a comment form, to invite the public to

participate in the planning process. The comment form contains instructions for submitting comments via email. Additionally, copies of Kanawha County-specific information are available at the Kanawha County Emergency Management and City of Charleston Homeland Security and Emergency Management offices. An advertisement was published in the newspaper to direct members of the public to the websites and/or appropriate offices.

Mitigation planning in Kanawha County (and the municipalities therein) is also a part of a regional mitigation planning effort that includes Boone, Clay, and Putnam Counties. The regional effort is coordinated by the B-C-K-P Regional Intergovernmental Council and includes public outreach efforts.

Integration of Existing Planning Efforts

A variety of existing plans were consulted for specialty data throughout the second plan update process. The following table lists those plans and indicates how they were used.

Plan	Purpose
Imagine Charleston Comprehensive Plan	Demographics and land use data
Charleston Riverfront Master Plan	Data on riverfront projects (specifically to mitigate river erosion)
City of Charleston Floodplain Ordinance	Data on floodplain management efforts in the City of Charleston
City of Charleston Zoning Map	Identification of land use areas in the city
City of Dunbar Floodplain Ordinance	Data on floodplain management efforts in the City of Dunbar
City of Nitro Floodplain Ordinance	Data on floodplain management efforts in the City of Nitro
City of St. Albans Floodplain Ordinance	Data on floodplain management efforts in the City of St. Albans
City of South Charleston Floodplain Ordinance	Data on floodplain management efforts in the City of South Charleston
Town of Pratt Floodplain Ordinance	Data on floodplain management efforts in the Town of Pratt
Flood Mitigation Plan Unincorporated Areas of Kanawha County, West Virginia	Overview of historical flood mitigation planning efforts for the county jurisdiction
Kanawha County Floodplain Ordinance	Data on floodplain management efforts in the unincorporated areas of Kanawha County

Plan	Purpose
20-20 Vision: Kanawha County Comprehensive Plan (Revised 2014)	Demographics and land use data Identification of areas targeted for development
KPEPC Emergency Management Plan	Basic overview information regarding emergency services capabilities in Kanawha County
KPEPC Hazard Vulnerability Survey	Research-based hazard vulnerability information for Kanawha County (to supplement profile data) Utilized as a means of incorporating business/industry comments in the planning process
Kanawha County-City of Charleston Evacuation Plan	Risk area data
B-C-K-P Regional Intergovernmental Council Hazard Mitigation Plan	Regional incorporate of mitigation plan and risk assessment data Ultimately utilize process as additional means of incorporating public review into the Kanawha County mitigation planning process
Kanawha-Charleston Health Department Health Risk Assessment	Public health impacts associated with flooding

1.2 DESCRIPTION OF THE PLANNING AREA

1.2.1. Kanawha County

Kanawha County, formed in 1789, is located in south-western West Virginia. Kanawha County's temperature is varied with four distinct seasons, averaging 35-40°F in the winter and 75°F during the peak of summer (<http://nowdata.rcc-acis.org/>). The mean annual snowfall range is 25-40 inches (http://nowdata.rcc-acis.org). The highest point in Kanawha County is 2,524 feet above sea level. Kanawha County has a total area of 911 square miles, and of that amount, 902 square miles of the space is land with the other 9 sq. miles being water. Kanawha County has an average elevation of just 654 feet above sea level.

Kanawha County contains 14 municipalities: Belle, Cedar Grove, Charleston, Chesapeake, Clendenin, Dunbar, East Bank, Glasgow, Handley, Marmet, Nitro, Pratt, St. Albans, and South Charleston. There are nine counties that surround Kanawha County and those are: Roane to the north, Clay to the northeast, Nicholas and Fayette to the east, Raleigh to the southeast, Boone to the south, Lincoln to the southwest, Putnam to the west, and Jackson to the northwest as seen in figure 1.2.1.1.

HISTORY

Kanawha County was formed from parts of Greenbrier County and Montgomery County in 1789 by an act of the Virginia General Assembly. The county is named in honor of the Great Kanawha River that runs through it which was in turn named after the Native American Kanawha tribe. Charleston, the county seat, was chartered in 1794 and became the permanent state capitol in 1885. Charleston stands on land that was originally owned by Colonel Thomas Bullitt. Having been passed through various hands, the land was eventually sold to the Clendenin family whose house served as the county courthouse. Eventually the town grew into the City of Charleston becoming the most populous city in West Virginia. Salt was a very large part of the county's economy in the late 1800's and when the output faltered, coal then became the Kanawha Valley's revenue generator. After the C&O Railway was built through the Valley, coal production continued to grow to over 9 million tons per year by the 1970's.

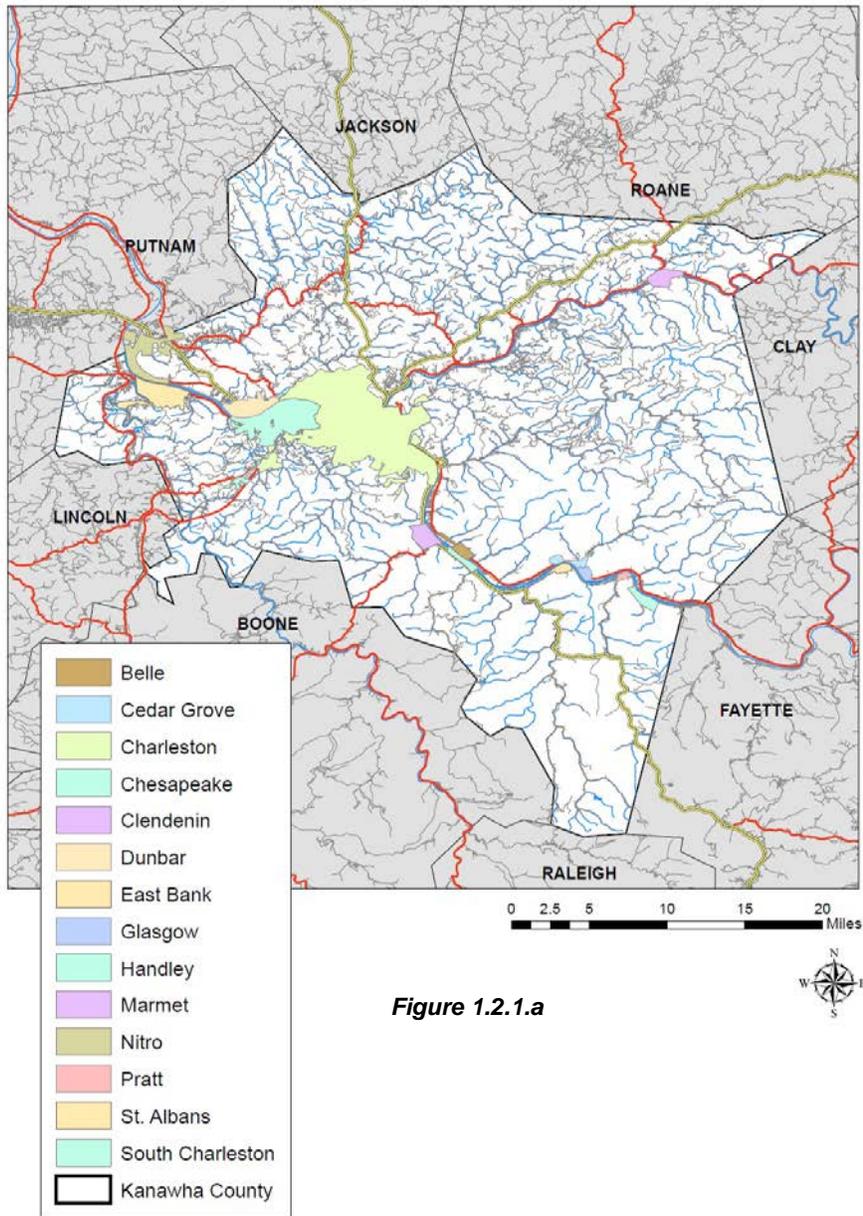


Figure 1.2.1.a

DEMOGRAPHICS

Kanawha County’s population is 200,073 (Census 2000). The 2006 Census estimate shows a slight population decline to 192,419. Population increased slightly to 193,058 for the 2010 U.S. Census but has since decreased once more to an estimated 191,275 in 2013 as seen in table 1.2.1.1.

Year	Population	Change (%)
2000	200,073	-----
2006	192,419	-3.98%
2010	193,058	+0.33%
2013	191,275	-0.93%

Table 1.2.1.1

As for the U.S. Census 2000 data, there were 86,226 households in Kanawha County of which, 55,960 are family households. This number decreased to 82,961 households in 2012 averaging 2.29 people per household. The population density decreased from 222 to 212 people per square mile with 91,953 housing units in the county. The median household income estimated for 2012 was \$45,642 which is significantly higher (+13.0%) than the West Virginia state average of \$40,400 for the same time period. Even with the median household income at over \$45,000, 14.2% of the population were below the poverty level. The racial composition of Kanawha County, as estimated by the U.S. Census in 2013 (<http://quickfacts.census.gov/qfd/states/54/54039.html>), is 88.9% White; 7.6% Black or African American; 0.2% Native American; 1.1% Asian; 1.0% of Hispanic or Latino of any race; and 2.1% from two or more races as seen in Figure 1.2.1.b.

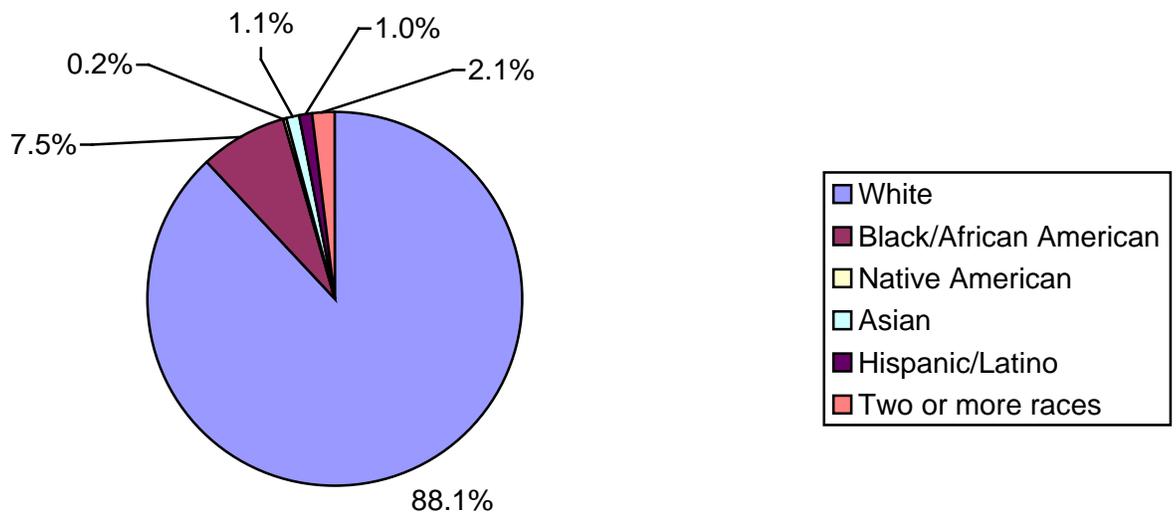


Figure 1.2.1.b

CURRENT AND FUTURE LAND USE

There are five locations of industrial and business development in the Charleston-Kanawha County area. These locations provide room for various companies who seek to expand their market in West Virginia and surrounding states. Peerless Industrial Park, Fork-of-Coal Industrial Park, South Charleston Technology Park, NorthGate Business Park, and Washington Heights Business Park are all located within easy access to various transportation methods such as Yeager Airport, Conrail, the Chesapeake and Ohio Railroad (C & O), and the Baltimore & Ohio Railroad (B & O).

UTILITIES

Electric power for Kanawha County is provided by Allegheny Power Company, American Electric Power Company, and Appalachian Power Company. Gas service is provided by Mountaineer

Gas Company. There are seventeen (17) water plants and treatment facilities that provide services to Kanawha County residents. There are many choices in both landline and cellular phone services within the county and the City Charleston to include but not is limited to AT&T, Frontier, Verizon, US Cellular, and T-Mobile.

1.2.2. City of Charleston

The City of Charleston is located in central Kanawha County, as seen in Figure 1.2.1.a, on the banks of the Kanawha River, see Figure 1.2.2.a for a visual representation. As the capital and largest city of the State of West Virginia, the US Census estimates the 2013 population at 50,821, a slight decrease from the 2010 U.S. Census at 51,347 and measurably less than the 2000 U.S. Census which showed a population of 53,421 (<http://quickfacts.census.gov/qfd/states/54/5414600.html>). The city contains approximately 26,205 housing units; a decrease from the 2000 US Census which



Figure 1.2.2.a

(3) major roadways provide easy access to Charleston: I-79, I-77, and I-64. In addition US 60 and 119 pass through the city center. Chuck Yeager Airport is located to the northeast of the city. The West Virginia Power minor league baseball team and the West Virginia Wild minor league basketball

showed 27,131 housing units of which 29.7% are within multi-unit structures. The actual number of households listed as 23,483 giving an average of 2.11 persons per household. Charleston boasts a median household income of \$47,582, significantly above the state average of \$40,400 but 18.5% of the population is considered below poverty level. Three

teams call Charleston home. An Air National Guard unit, the 130th Air Lift Wing, shares the Chuck Yeager Airport complex with the passenger terminal. Charleston educational opportunities come from the University of Charleston and the Clay Center for the Arts and Sciences along with varied performing artists and exhibitions. Shopping is bolstered by the Charleston Town Center and a variety of smaller shops, restaurants, and specialized services in the downtown area. In addition, a multitude of festivals have been created, drawing crowds to the Charleston area to include the Multifest, Vandalia Festival, Sternwheel Regatta, and the FestivALL. These festivals offer a variety of performances, exhibits, and different entertainment over multiple days.

1.2.3. City of Dunbar

The City of Dunbar is located in the east-central portion of the county as seen in Figure 1.2.1.a. The city was incorporated in 1921 on lands formerly occupied by Native Americans resulting in 11 known burial mounds within the residential areas. According to the 2010 U.S. Census the population was 7,907, a 3.1% decrease from Dunbar's population of 8,154 in 2000. Covering a total area of 2.81 sq. miles, of which 0.01 sq. miles are covered by water, the population density was 2,823.9 people/sq. mile. With 4,175 housing units, a 1.1% increase from the 2000 US Census, Dunbar's average household size was 2.05 which is consistent with Kanawha County's average. Dunbar's median household income was listed as \$43,039. I-64 and State Route 25 provide ample roadway access to the city as seen in Figure 1.2.3.a.

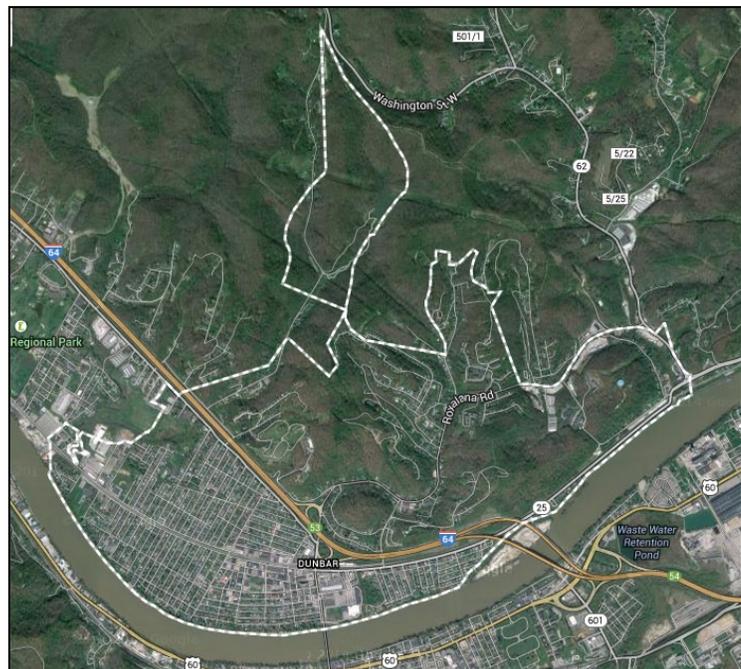


Figure 1.2.3.a

1.2.4. City of Marmet

Marmet is located just south of Charleston along the Kanawha River as seen in Figure 1.2.1.a. According to the 2010 U.S. Census, Marmet had a population of 1,503, a 12.6% decrease from the 2000 U.S. Census population at 1,693. The city has a land area of 1.27 sq. miles which is supplemented by 0.14 sq. miles of water coverage. Based upon the 2010 U.S. Census data, the population density was 1,183.5 people/sq. mile. The City of Marmet contains approximately 700 housing units, of which 616 are occupied with an average of 2.29 persons per household. Marmet boasted a median household income of \$33,490. Marmet is accessed by I-64/77 and State Route 61 as seen in Figure 1.2.4.a.



Figure 1.2.4.a

1.2.5. City of Nitro

The City of Nitro, named from the production of the ammunition chemical known as nitrocellulose during World War I, is located on the northwestern edge of Kanawha County as seen in Figure 1.2.1.a with a small portion of the city being in Putnam County. Nitro has a total land area of 4.28 sq. miles with 0.39 sq. miles covered by water giving a total area of 4.67 sq. miles. According to the 2010 U.S. Census (<http://quickfacts.census.gov/qfd/states/54/5459068.html>), the population of Nitro was 7,178 a 4.7% increase from the 2000 U.S. Census which was 6,842. With this population, the density within Nitro was 1,677.1 people/sq. mile. The City of Nitro contained approximately 3,507 housing units (22.3% were in multi-unit structures) of which 2,974 were households giving an average of 2.42 persons per household. Nitro had a median household income of \$47,619, significantly higher than the WV state average of \$40,400 and approximately half the WV percentage with those living below the poverty line at only 8.3%. State Route 25 connects Nitro to I-64. The Kanawha River also runs along the western edge of the city as seen in Figure 1.2.5.a.

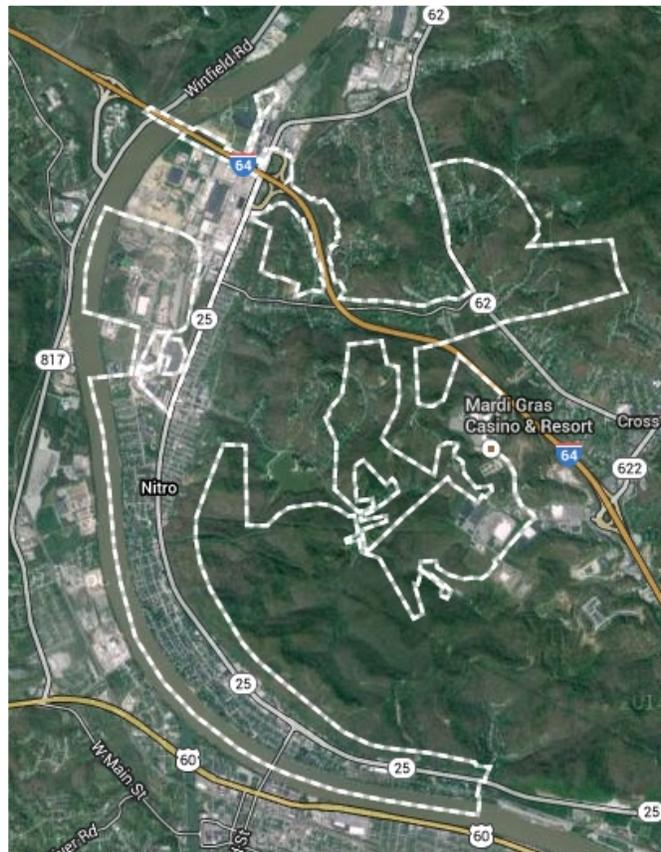


Figure 1.2.5.a

1.2.6. City of St. Albans

St. Albans is located along the southern side of the Kanawha River in the western portion of Kanawha County as seen in figure 1.2.1.a. The total land area is 3.70 sq. miles which is separated into 3.62 sq. miles of land and 0.08 sq. miles water respectively. With a documented population in the 2010 U.S. Census as 11,044 (<http://quickfacts.census.gov/qfd/states/54/5471212.html>), there had

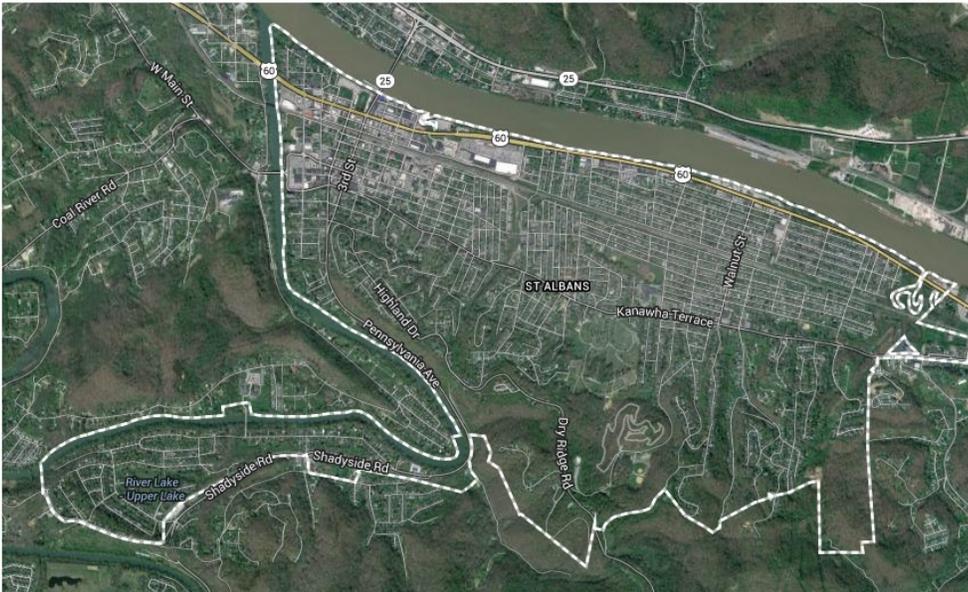


Figure 1.2.6.a

been only a slight decrease from 2000 at 11,567 and the population density being 3,050.8 people/ sq. mile. St. Albans contains approximately 4,771 households, a significant decrease (8.7%) decrease from the 2000 U.S. Census which listed 5,185 households. There are 5,436 housing units within the city, of which 13.9% are within multi-unit structures. St. Albans' media household income is listed as \$47,131 within only 7.7% below the poverty level. Primary access into the city is via I-64, US Route 60, State Route 817, and rail transportation as seen in Figure 1.2.6.a.

There are 5,436 housing units within the city, of which 13.9% are within multi-unit structures. St. Albans' media household income is listed as \$47,131 within only 7.7% below the poverty level. Primary access into the city is via I-64, US Route 60, State Route 817, and rail transportation as seen in Figure 1.2.6.a.

1.2.7. City of South Charleston

South Charleston is located on the west side of the Kanawha River just to the south of Charleston as seen in Figure 1.2.1.a. Covering 7.61 sq. miles of land and 0.9 sq. miles of water, South Charleston has a total area of 8.51 sq. miles. As per the 2010 U.S. Census, the population was 13,450 (<http://quickfacts.census.gov/qfd/states/54/5475292.html>), slightly higher (2.6%) than the population in 2000 which was listed as 13,100. As a result, South Charleston's population density is 1,767.4 people/ sq. mile. The number of housing units within South Charleston is listed as 6,819 (27.6% are in multi-unit structures), of which 6,308 are occupied and average household size staying consistent from 2000 to 2012 at 2.12 persons. A median household income of \$41,590 was reported with 12.5% living below the poverty line. I-64 and U.S. Route 60 are the major roadways that supply access to the city. In addition U.S. Route 119 and State Route 601 support transportation as seen in Figure 1.2.7.a.

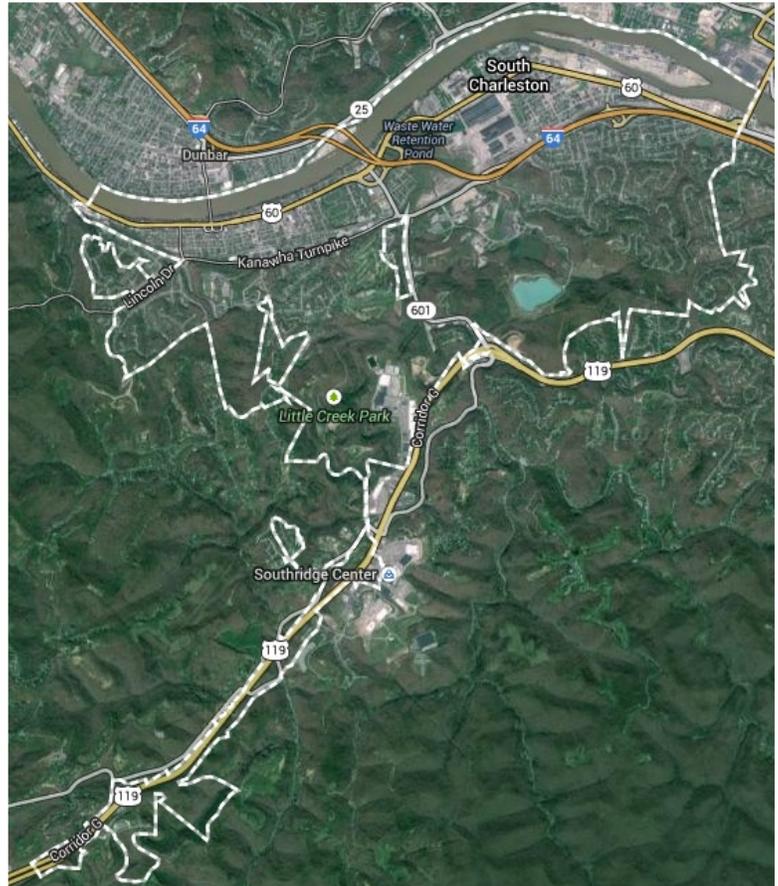
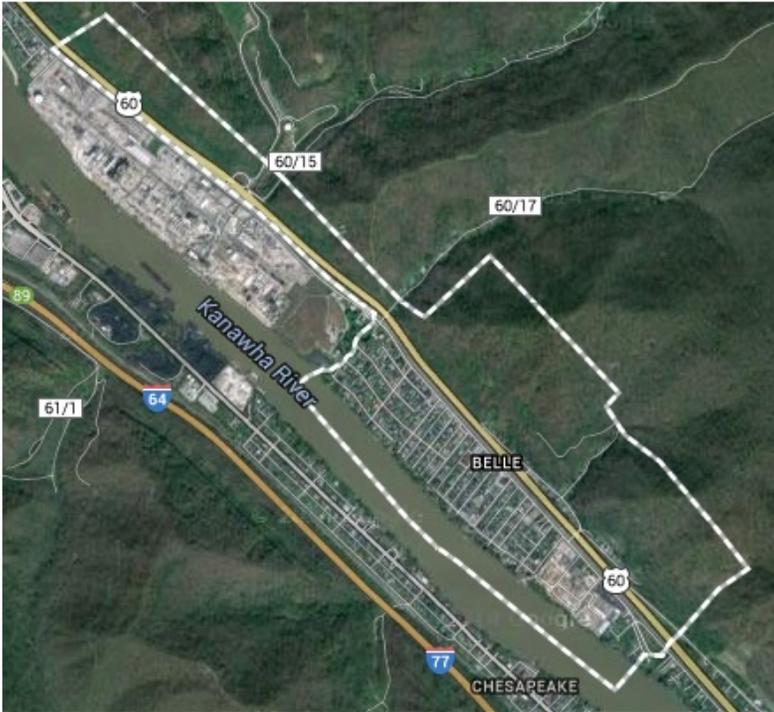


Figure 1.2.7.a

1.2.8. Town of Belle

Belle is located to the southwest of Charleston along the north bank of the Kanawha River as seen in Figure 1.2.1.a. Having a total land area of 0.69 sq. miles, supplemented by an additional 0.09 sq. miles of water, Belle covers a total area of 0.78 sq. miles. The population in 2010 was 1,260 (<http://factfinder2.census.gov>) which is constant with the 1,259 according to the 2000 U.S. Census



thereby maintaining a population density of 1,826.1 people/sq. mile. Belle contains 639 housing units, of which 571 are occupied staying consistent with the 2000 U.S. Census which listed 569 households at an average size of 2.21 persons. A median household income of \$33,824 (www.usacityfacts.com) was reported which is slightly down from the \$34,118 listed in 2000. U.S Route 60 provides access to the town as seen in Figure 1.2.8.a.

Figure 1.2.8.a

1.2.9. Town of Cedar Grove

Cedar Grove is located along the Kanawha River on U.S. Route 60 as seen in Figure 1.2.9.a. It is located in the southeastern portion of Kanawha County, near the towns of East Bank and Pratt as

seen in Figure 1.2.1.a. The town is known to have been the first settlement in the Kanawha Valley since it is the site of Fort Kelley. With no water area, Cedar Grove covers an area of 0.72 sq. miles. According to

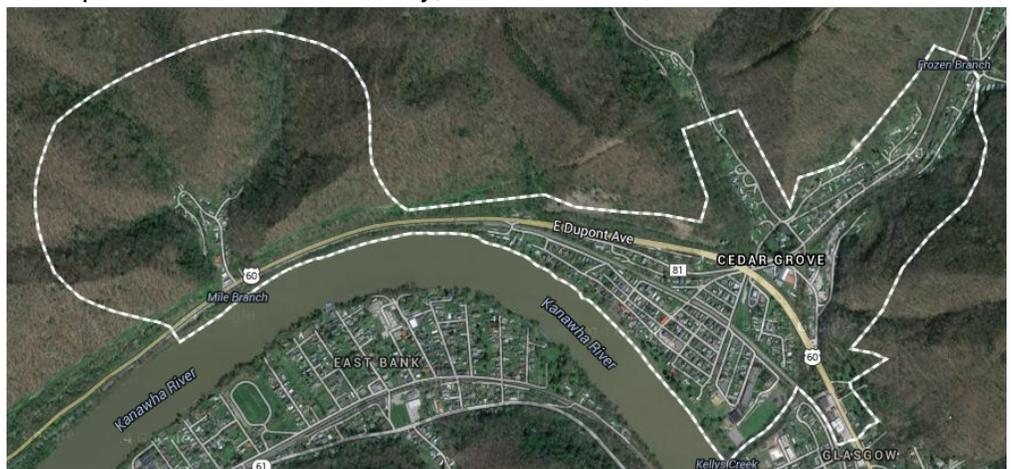


Figure 1.2.9.a

the 2010 U.S. Census (<http://factfinder2.census.gov>) the population of Cedar Grove is 997, a 13.8% increase from the 2000 U.S. Census where there were 862 residents. This population level results in a population density being 1,364.7 people/sq. mile. As of 2010, there were 447 housing units within the town, of which 400 are occupied households averaging 2.48 persons. The average median income per household was \$30,370 (www.usacityfacts.com).

1.2.10. Town of Chesapeake

Named after the Chesapeake and Ohio Railroad, the town of Chesapeake is located in the south central portion of Kanawha County north of Glasgow and east of East Bank as seen in Figure

1.2.1.a. It covers a total area of 0.64 sq. miles of which 0.16 sq. miles are covered by water. The 2010 U.S. Census (<http://factfinder2.census.gov>)

lists the population at 1,554 a slight decrease from 2000 which lists the population at 1,643 people resulting in a population density of 3,237.5 people/sq. mile. Households numbered 691 occupying the 809 housing units in Chesapeake averaging 2.25 persons. Median household incomes were listed in 2010 as \$36,958 (www.usacityfacts.com).

State Route 61 passes through the town with I-77 nearby as seen in Figure 1.2.10.a.



Figure 1.2.10.a

1.2.11. Town of Clendenin

Clendenin is located in the northern part of Kanawha County along the Elk River. State Route 4 and U.S. Route 119 are the access roads to the town as seen in Figure 1.2.11.a. Covering a total area of 1.51 sq. miles, Clendenin has land area of 1.44 sq. miles. As per the 2010 U.S. Census (<http://factfinder2.census.gov>) the total population is 1,227, a slight increase from 2000 which lists Clendenin at 1,116 people and therefore a population density of 852.1 people/sq. mile. 576 housing units are within the Town of Clendenin of which 524 are occupied resulting in an average household size consistent with 2000 at 2.34 persons per household with a median income at \$32,045 (www.usacityfacts.com), again consistent with the 2000 U.S. Census.



Figure 1.2.11.a

1.2.12. Town of East Bank

East Bank, named so because it is located east of Coalburg and old terminology for a coal mine, is located in the western part of Kanawha County along the Kanawha River. The town is accessed by State Route 61 which leads to I-64/77 as seen in figure 1.2.12.a. The 2010 U.S. Census lists the population of 959 (<http://factfinder2.census.gov>) which is slightly higher than in 2000 with 933 residents. Having a total area of 0.48 sq. miles, all of which is land even though it is located next to the Kanawha River, the population density is therefore 1,997.9 people/sq. mile. The average household



Figure 1.2.12.a

size is 2.42, slightly less than in 2000, with 392 occupied households out of the 440 housing units available. The median household income significantly increased from \$35,341 in the 2000 U.S. Census to \$45,938 in 2010 (www.usacityfacts.com).

1.2.13. Town of Glasgow

Located to the southeast of Cedar Grove along U.S. Route 60 in the southeastern portion of Kanawha County as seen in Figure 1.2.13.a, Glasgow is along the Kanawha River with 905 residents as of the 2010 U.S. Census (<http://factfinder2.census.gov>). This is an increase of 13.5% since the

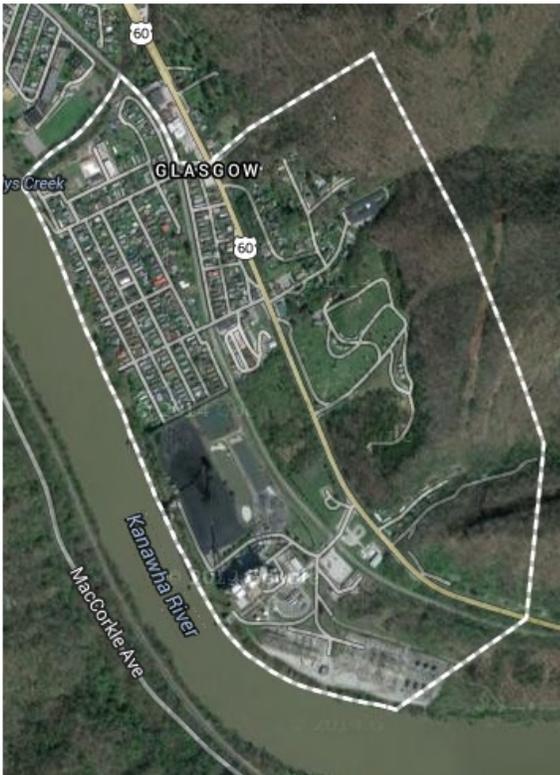


Figure 1.2.13.a

2000 U.S. Census which lists the population at 783. The total area of Glasgow is 0.47 sq. miles, all land, resulting in a population density of 1,925.5 people/sq. mile. The number of households remained the same between 2000 and 2010 at 327 households with a total of 352 housing units available in 2010. As a result, the average household size is slightly higher at 2.46 and the median household income at \$31,458 (www.usacityfacts.com).

1.2.14. Town of Handley

Handley is located along State Route 61 just east of Montgomery in the southeastern portion of Kanawha County near the Fayette County border as seen in Figure 1.2.14.a. Handley has a total area of 0.97 sq. miles of which 0.02 sq. miles is water. The population in 2010 was 349 (<http://factfinder2.census.gov>), slightly less than the 362 reported in 2000. This results in a population density of 367.4 people/ sq. mile. 156 housing units exist in the Town of Handley of which 131 are occupied making the average household size to be 2.66 with a median household income at \$23,000

(www.usacityfacts.com) which is significantly less than the West Virginia State average of \$40,400 but higher than the average listed in the 2000 U.S. Census at \$21,429.

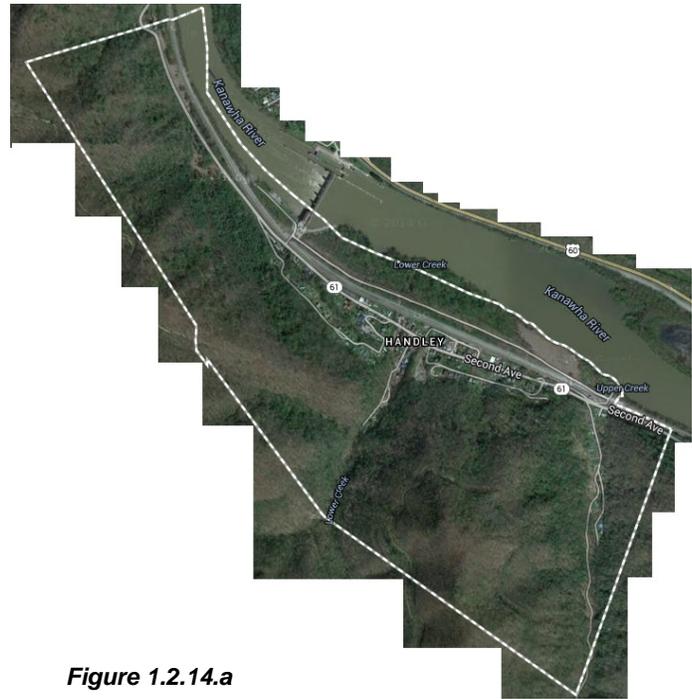


Figure 1.2.14.a

1.2.15. Town of Pratt

Renamed Pratt after Charles Pratt of the Charles Pratt Coal Company in 1905 from Clinton, it is located in the southeastern portion of Kanawha County, just slightly northwest of the Town of Handley as seen in Figure 1.2.1.a. Pratt had a population of 602 in the 2010 U.S. Census (<http://factfinder2.census.gov>). This is an increase of 8.5% from the 2000 U.S. Census. Pratt has a total land area of 0.29 sq. miles and an additional 0.01 sq. miles of water area resulting in the population density to be

2,075.9 people/sq. mile. There are 280 housing units within the Town of Pratt with 248 households occupied and a slight increase in household size to 2.43 from the 2.31 in the 2000 U.S. Census. The median household income increased significantly to \$51,111

(www.usacityfacts.com) from the \$37,500 listed in the 2000 U.S. Census and 21% higher than the West Virginia State average Pratt is nestled

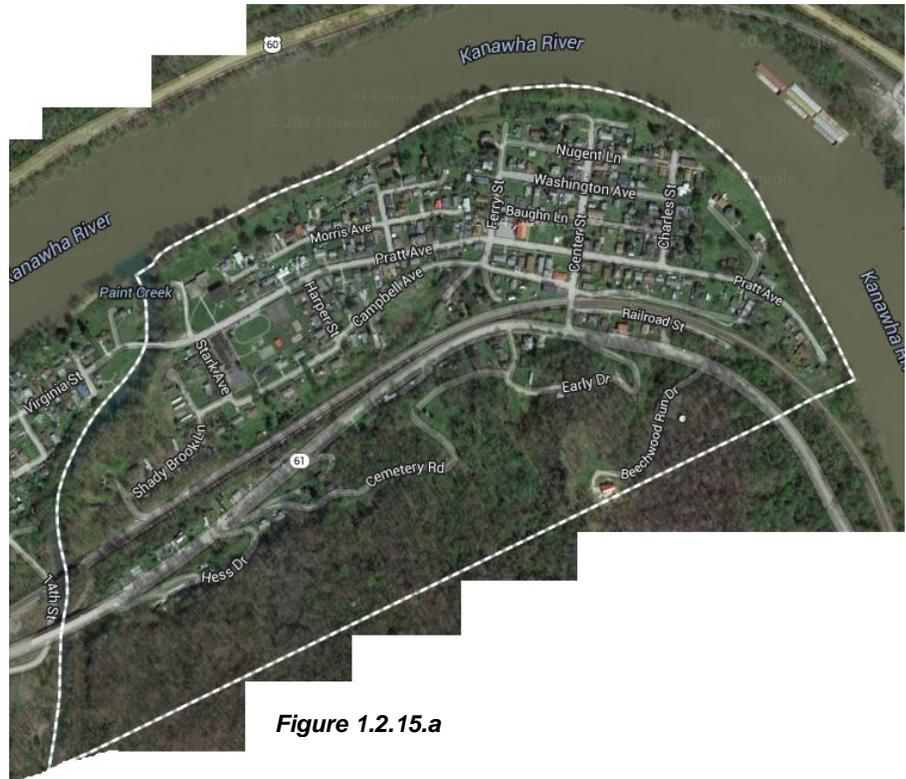
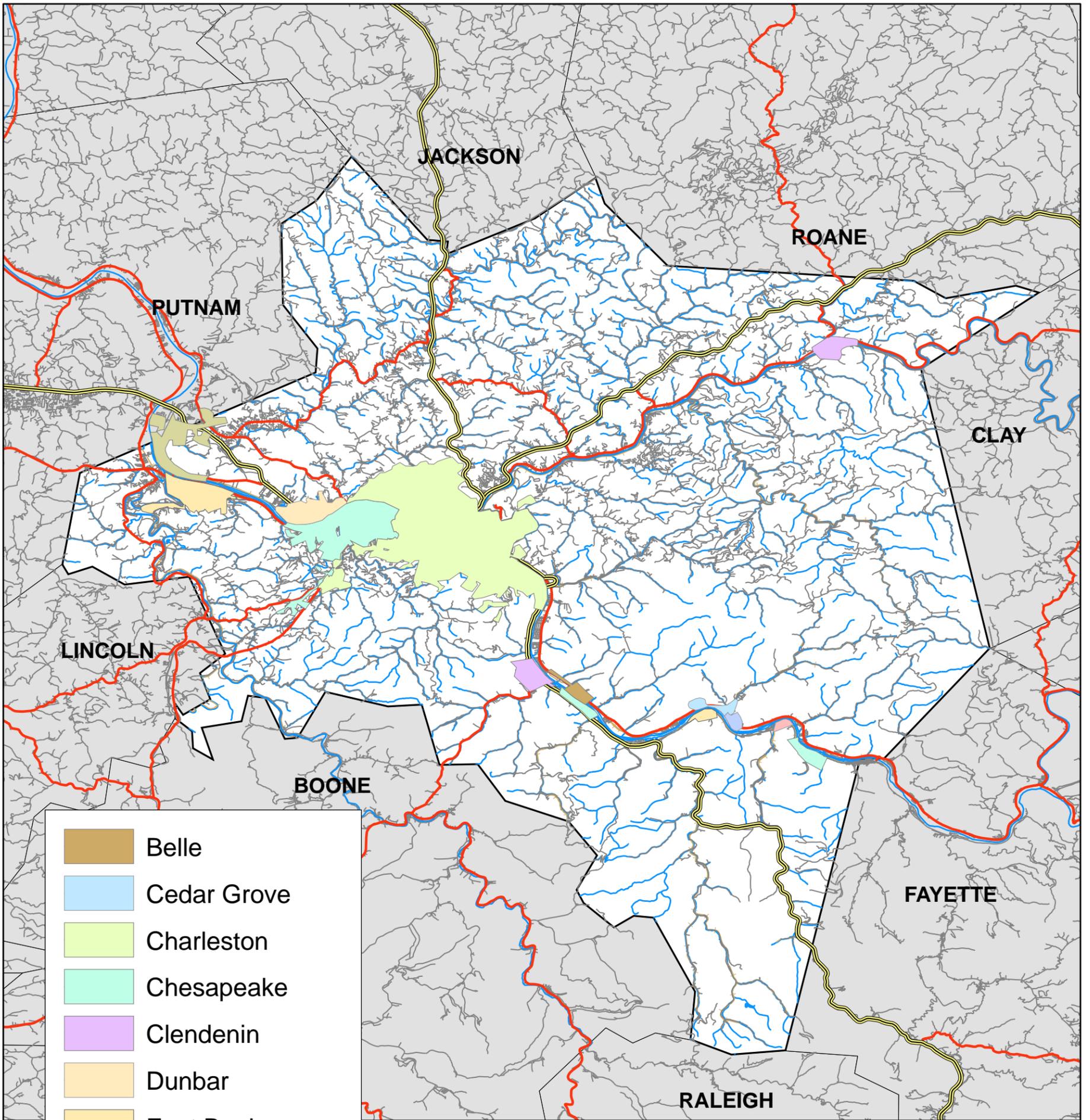


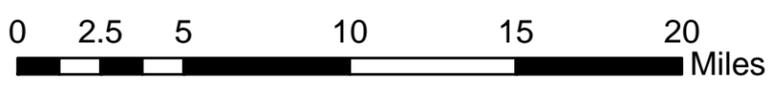
Figure 1.2.15.a

between the Kanawha River and State Route 61 as seen in Figure 1.2.15.a.

KANAWHA COUNTY MUNICIPAL AREAS



- Belle
- Cedar Grove
- Charleston
- Chesapeake
- Clendenin
- Dunbar
- East Bank
- Glasgow
- Handley
- Marmet
- Nitro
- Pratt
- St. Albans
- South Charleston
- Kanawha County



1.3 RECORD OF CHANGES

This “Record of Changes” document lists each section of the *Kanawha County Hazard Mitigation Plan* and indicates if it was updated as part of the 2014/2015 revision.

Section	Description of Change
INTRODUCTION	
1.1 Documentation of the Planning Process	<ul style="list-style-type: none"> • Updated to represent new Hazard Mitigation Committee (HMC) members. • Updated narrative description of process used to update the plan. <ul style="list-style-type: none"> ○ Held additional HMC meetings. ○ Provided on-going public review process. ○ Involved public and jurisdictions by collecting asset data.
1.2 Description of the Planning Area	<ul style="list-style-type: none"> • Updated and expounded upon demographic data. • Updated “Municipal Areas Map”.
1.3 Record of Changes	<ul style="list-style-type: none"> • Updated to show changes in 2014/2015 revision
RISK ASSESSMENT	
2.1 Identify Hazards	<ul style="list-style-type: none"> • Added the following hazard River Erosion • Renamed Epidemics to Biological Incidents • Combined windstorms and hail in with, thunderstorms, lightning naming the hazard as “Severe Storms” • Combined Urban Fires and Wildfires into hazard “Fire Emergencies” • Listed research methods utilized to determine hazard presence. • Listed hazards not present in any of the participating jurisdictions per 201.6 requirements. • Compared municipal vulnerabilities in chart form.
2.2 Profile Hazards	<ul style="list-style-type: none"> • Created hazard profiles for newly-identified hazards. • Added mapping to graphically represent each hazard profile. • Updated NFIP detail to flooding profile • Updated FEMA repetitive loss information to flooding profile.
2.3 Inventory Assets	<ul style="list-style-type: none"> • Updated the existing Created asset inventory maps for each participating jurisdictions. • Listed assets on worksheet #3b for all participating jurisdictions. • Added Hazard level for each asset to worksheet #3b
2.4 Estimate Losses	<ul style="list-style-type: none"> • Estimated losses for all hazards identified by the updated plan • Described methodology for loss estimates in all categories
2.5 Analyze Development Trends	<ul style="list-style-type: none"> • Updated based on 20-20 Vision Plan (2014) and 2012 Census of Agriculture information

2.1 IDENTIFY HAZARDS

§201.6(c)(2)(i) [The risk assessment shall include a] description of the type...of all natural hazards that can affect the jurisdiction.

Several methods of research were utilized to identify the hazards to which Kanawha County and the municipalities of Belle, Cedar Grove, Charleston, Chesapeake, Clendenin, Dunbar, East Bank, Glasgow, Handley, Marmet, Nitro, Pratt, St. Albans, and South Charleston. Reviews of related plans/studies, reviews of local media archives, and interviews with local officials were used to ensure accurate data and events were identified. The following plans were consulted as part of this project:

- *Kanawha County 20/20 Vision Comprehensive Plan*, Kanawha County Planning Commission, 2014.
- *Kanawha County All Hazards Mitigation Plan*, Kanawha County Commission, 2008.
- *Emergency Operations Plan*, Kanawha Putnam Emergency Planning Committee, as amended.
- *2011 Hazard Vulnerability Survey*, Kanawha Putnam Emergency Planning Committee, 2011.

The following local officials were interviewed as part of this project:

- Mr. Dale Petry – Kanawha County HSEM Director
- Mr. Grant Gunnoe – City of Charleston DHSEM Director
- Mr. Dan Vriendt – City of Charleston Planning Director
- Mr. Jacque Gumm – Kanawha-Putnam Emergency Planning Committee Administrator
- Representatives from the county and municipal assets were polled to gather facility-specific information as well as their thoughts on their facilities hazard susceptibility.

The following chart (Table 2.1.1) illustrates the hazards to which the county and its municipalities are susceptible. The intent of this chart is to justify the inclusion of

these hazards in the plan; more detailed information about how they affect the areas within all participating jurisdictions can be found in the hazard profiles in Appendix 1.

Table 2.1.1

<i>Hazard</i>	<i>How Identified</i>	<i>Why Identified</i>
Avalanche	<ul style="list-style-type: none"> • Research indicates that these jurisdictions are not susceptible to this hazard. 	<ul style="list-style-type: none"> • The general contour of the land in the county is mountainous, but they are not steep enough to cause avalanche activity. • Further, the amount of snowfall the county receives is insufficient for any kind of avalanche.
Biological Incidents	<ul style="list-style-type: none"> • 2011 Kanawha-Putnam Emergency Planning Committee (KPEPC) Hazard Vulnerability Survey • Center for Disease Control (CDC) • World Health Organization (WHO) • Current event search • Web search 	<ul style="list-style-type: none"> • Biological incidents include outbreaks, epidemics, and pandemics. • The 2011 KPEPC reports high risks associated with biological incidents rankings
Civil Disturbance	<ul style="list-style-type: none"> • 2011 KPEPC Hazard Vulnerability Survey • WV Encyclopedia • Internet search 	<ul style="list-style-type: none"> • Charleston is home to a multitude of high-profile social events, including inaugurations, sporting events, festivals, dignitary visits, etc. • The KPEPC reports a medium to low probability of such events with a moderate associated risk.
Coastal Erosion	<ul style="list-style-type: none"> • See also “River Erosion” 	<ul style="list-style-type: none"> • Coastal erosion is not a significant risk as the county is more than 450 miles from the Atlantic Ocean.
Coastal Storm	<ul style="list-style-type: none"> • See also “Thunderstorm/Lightning” 	<ul style="list-style-type: none"> • Coastal storms are not a threat to the county as the county is more than 450 miles from the Atlantic Ocean. • The only hazard associated with this hazard that is experienced by the county is rain, which is addressed elsewhere.
Continued on next page		

Hazard	How Identified	Why Identified
Dam Failure	<ul style="list-style-type: none"> • US Army Corps of Engineers (USACE), Huntington District Website • West Virginia Dept. of Environmental Protection(WVDEP) • 2011 KPEPC Hazard Vulnerability Survey • Internet search • Interviews with local officials 	<ul style="list-style-type: none"> • A dam failure may result in loss of life and property
Debris Flow	<ul style="list-style-type: none"> • See also "Land Subsidence" 	<ul style="list-style-type: none"> • See "Land Subsidence"
Drought	<ul style="list-style-type: none"> • Palmer Drought Severity Index (PDSI) • FEMA website • NCDC Storm Event Database • 2011 KPEPC Hazard Survey • Internet search 	<ul style="list-style-type: none"> • Fourteen drought events have been recorded by the NCDC over since 1996. • Consistently measured dry seasons in the area • Area dependent on water for economic stability.
Earthquake	<ul style="list-style-type: none"> • US Geological Survey • FEMA <i>State and Local Mitigation Planning How-To Guide: Understanding Your Risks</i>, 386-2 • 2011 KPEPC Hazard Vulnerability Survey • Internet search 	<ul style="list-style-type: none"> • USGS rates the county as having an 8 to 12%g Peak Ground Acceleration (PGA). • FEMA states that areas with 4 to 6%g PGAs have relatively low risks of earthquakes, but earthquakes should still be considered a natural hazard. • The KPEPC reports a low probability of earthquakes but a relatively high risk.
Expansive Soils	<ul style="list-style-type: none"> • See also "Land Subsidence" 	<ul style="list-style-type: none"> • See "Land Subsidence"
Extreme Heat	<ul style="list-style-type: none"> • NCDC 	<ul style="list-style-type: none"> • Temperatures in the county seldom exceed 100 degrees. • If the temperature meets or exceeds 100 degrees, it has not been hot enough for the amount of time appropriate to denote "extreme heat".
Continued on next page		

Hazard	How Identified	Why Identified
Flooding	<ul style="list-style-type: none"> • FEMA repetitive loss database • FEMA Disaster Declarations • NFIP floodplain mapping • NOAA National Satellite and Information Service, National Climatic Data Center (NCDC) • 2011 KPEPC Hazard Vulnerability Survey • Interviews with local officials • Public response • Internet research 	<ul style="list-style-type: none"> • Based on mapping, both incorporated and unincorporated communities within the county contain 100-year floodplains. • The KPEPC has determined a high probability and risk for flooding in Kanawha and Putnam Counties. • During the period studied, the NCDC reported sixteen (16) flooding and flash flooding events.
Hailstorm	<ul style="list-style-type: none"> • See Thunderstorms 	<ul style="list-style-type: none"> • Kanawha County has a documented history of hailstorms. • The entire county is at a higher risk of hailstorms. • The NCDC has reported 76 hailstorms since 1950. • Multiple events causing over \$1 Million in damages each
Hazardous Materials Incident	<ul style="list-style-type: none"> • <i>Kanawha County Emergency Operations Plan</i>, Kanawha County OEM, as amended • 2011 KPEPC Hazard Vulnerability Survey • 2014 KPEPC Commodity Flow Study, as amended • Interviews with local officials 	<ul style="list-style-type: none"> • Technological hazards that can arise from manufacturing, transportation, storage, and/or use of hazardous materials are present in Kanawha County. • There are approximately 76 facilities/locations in Kanawha County that file Tier II reports. • The KPEPC reports relatively high probabilities and very high risks to hazardous materials incidents, including: <ul style="list-style-type: none"> ▪ Chemical spills, ▪ Industrial chemical releases, and ▪ Radiological/nuclear events.
Continued on next page		

Hazard	How Identified	Why Identified
Hurricane	<ul style="list-style-type: none"> • See also “Thunderstorm/Lightning” 	<ul style="list-style-type: none"> • The county does not experience the hurricane conditions of extremely high winds, rains, and hail. In some instances, the county may be affected by rainfall brought about by the remnants of a hurricane, which are addressed elsewhere. • Kanawha County was involved in a federal emergency declaration for West Virginia’s role in housing Hurricane Katrina evacuees.
Land Subsidence	<ul style="list-style-type: none"> • USGS National Maps • FEMA Disaster Declarations • FEMA: <i>State and Local Mitigation Planning How-To Guide: Understanding Your Risks</i>, 386-2 • USDA Soil Conservation Service: <i>Kanawha County Soil Survey</i> • 2011 <i>KPEPC Hazard Vulnerability Survey</i> • NCDC Storm Events • Internet search 	<ul style="list-style-type: none"> • Kanawha County is located in a "high risk" area according to <i>USGS Landslide Overview Map</i>. • The KPEPC reports a relatively low probability of land subsidence but does report a moderate risk associated with it.
Landslide	<ul style="list-style-type: none"> • See “Land Subsidence” 	<ul style="list-style-type: none"> • See “Land Subsidence”
River Erosion	<ul style="list-style-type: none"> • 2011 <i>KPEPC Hazard Vulnerability Survey</i> • Internet search 	<ul style="list-style-type: none"> • Kanawha County has over 400 rivers, creeks, and streams. • Economic dependence on waterway
Terrorism	<ul style="list-style-type: none"> • Federal Emergency Management Agency Website • 2011 <i>KPEPC Hazard Vulnerability Survey</i> • <i>National Infrastructure Plan</i> • National Consortium for the Study of Terrorism and the Responses to Terrorism (START) • Internet search 	<ul style="list-style-type: none"> • The KPEPC reports relatively low probabilities of terrorist incidents but a high risk associated with these incidents. • Terrorism will be discussed generally in this plan due to its sensitive nature coupled with the fact that this plan will become public.
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Hazard	How Identified	Why Identified
Thunderstorm/ Lightning	<ul style="list-style-type: none"> • NCDC • 2011 KPEPC Hazard Vulnerability Survey 	<ul style="list-style-type: none"> • The NCDC has reported seven lightning events and 130 severe thunderstorms and/or high winds associated with thunderstorms since 1950. • The KPEPC reports moderately high probability of and risk associated with thunderstorm events.
Tsunami	<ul style="list-style-type: none"> • MapQuest 	<ul style="list-style-type: none"> • The Atlantic Ocean is approximately 450 miles from the county. • The Appalachian Mountains will most likely protect the area from a tsunami affecting the US east coast.
Urban Fire	<ul style="list-style-type: none"> • See also "Wildfires" 	<ul style="list-style-type: none"> • The KPEPC reports high probability and very high risk to fire incidents. • Incidents such as the Dunbar tire fire, Clendenin downtown fire, and Charleston Woolworth Building occur periodically (and have been shown to occur throughout recorded history).
Utility Failure	<ul style="list-style-type: none"> • 2011 KPEPC Hazard Vulnerability Survey • Media archives 	<ul style="list-style-type: none"> • The KPEPC reports a moderate probability but high risk for utility outages in Kanawha County. • Sources such as the Charleston Gazette report frequent utility outages – both large and small – in its paper and on its website.
Volcano	<ul style="list-style-type: none"> • USGS 	<ul style="list-style-type: none"> • No volcanoes exist on the east coast.
Wildfire	<ul style="list-style-type: none"> • NCDC Storm Events • National Fire Protection Association • WFAS-MAPS: National Interagency Fire Center • 2013 <i>West Virginia Hazard Mitigation Plan</i> • WV Division of Forestry • 2011 <i>KPEPC Hazard Vulnerability Survey</i> • WV State Fire Commission's FY 2014 Annual Report • Internet search 	<ul style="list-style-type: none"> • Wildfire maps do not show the extent or range of where a wildfire will occur because wildfires are dependant on the fuel available, weather conditions, and wind speed and direction. • Due to the large amount of development forested land in Kanawha County is reduced, however wildfires are still a concern.
Continued on next page		

Hazard	How Identified	Why Identified
Wind Storm/Tornado	<ul style="list-style-type: none"> • NCDC Event Records • National Weather Service • FEMA <i>State and Local Mitigation Planning How-To Guide: Understanding Your Risks</i>, 386-2 • 2011 <i>KPEPC Hazard Vulnerability Survey</i> • Public response • Internet search 	<ul style="list-style-type: none"> • Kanawha County has a history of high wind and can expect wind-related problems in the future. • Risks from high winds are equally distributed throughout the county. • NCDC records indicate one (1) tornado event during the past 5 years. • The KPEPC reports both a high probability and risk to high wind events as well as a high risk for tornado events.
Winter Storm	<ul style="list-style-type: none"> • NCDC Event Records • 2011 <i>KPEPC Hazard Vulnerability Survey</i> • Public response • Internet search 	<ul style="list-style-type: none"> • Data from NCDC shows few instances of severe winter storms. • Over the past five (5) year period, a total of 4 winter storm or snow events have been reported by the NCDC. • The KPEPC reports high risk to blizzard conditions, heavy snows, and ice storms.

MULTI-JURISDICTIONAL REQUIREMENTS

§201.6(c)(2)(iii) For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

While it is true that the municipalities of Belle, Cedar Grove, Charleston, Chesapeake, Clendenin, Dunbar, East Bank, Glasgow, Handley, Marmet, Montgomery, Nitro, Pratt, St. Albans, and South Charleston can be said to be susceptible to the above hazards by virtue of their location in Kanawha County, it is stressed that they may be more or less susceptible to these hazards than each other and the balance of Kanawha County. The following chart (Figure 2.1.2) determines if the municipalities are equally (=), more (>), or less (<) susceptible to these hazards than the balance of the county. (Only those hazards affecting the county are listed below.)

Figure 2.1.2

<i>Hazard</i>	<i>Belle</i>	<i>Cedar Grove</i>	<i>Charleston</i>	<i>Chesapeake</i>	<i>Clendenin</i>	<i>Dunbar</i>	<i>East Bank</i>	<i>Glasgow</i>	<i>Handley</i>	<i>Marmet</i>	<i>Nitro</i>	<i>Pratt</i>	<i>St. Albans</i>	<i>South Charleston</i>
Biological Incidents	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Civil Disturbance	=	=	>	=	=	=	=	=	=	=	=	=	=	=
Dam Failure	=	=	=	>	=	=	=	=	=	>	=	=	=	>
Drought	=	=	<	=	=	=	=	=	=	=	=	=	=	<
Earthquake	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Fire Emergencies	=	=	>	=	=	=	=	=	=	=	=	=	=	>
Flooding	=	=	>	=	>	>	=	=	=	>	=	>	=	>
Hazardous Materials Incident	>	=	>	=	=	>	=	=	=	>	>	=	>	>
Land Subsidence	=	=	=	=	=	=	=	=	=	=	=	=	=	=
River Erosion	=	=	>	=	=	=	=	=	=	>	=	=	=	>
Severe Storms	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Terrorism	=	=	>	=	<	=	=	=	=	=	=	=	=	>
Tornado	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Utility Emergencies	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Winter Storm	=	=	=	=	=	=	=	=	=	=	=	=	=	=

Section	Description of Change
ACTION PLAN	
3.0 Local Hazard Mitigation Goals	<ul style="list-style-type: none"> • Added new projects per request of HMC. • Added municipal projects per request of participating municipalities. • Ensured that each municipality had at least one (1) mitigation project. • Updated “status matrix” to depict progress on projects identified in 2004 version of plan. • Added matrix to show each hazard had at least one project. • Consolidated coordinating agency and timeframe components from existing “Plan Implementation & Maintenance Procedures” section. • Denoted affected jurisdictions on a per-project basis. • Updated name change for Kanawha County OES to Kanawha County Homeland Security and Emergency Management • Updated name change for Charleston OES to Charleston Department of Homeland Security and Emergency Management. • Identified a cost estimate and potential funding source for each project (also, consolidated “Capability Assessment” and “Funding Sources” sections from existing plan).
4.1 Identification and Analysis of Mitigation Measures	<ul style="list-style-type: none"> • Updated mitigation projects by affected jurisdiction. • Summarized the total number of mitigation projects per participating jurisdiction.
4.2 Implementation of Mitigation Actions	<ul style="list-style-type: none"> • Updated priority for mitigation projects. • Addressed “Cost Benefit Analysis” (CBA) per 201.6 requirements.
5.0 Plan Maintenance Process	<ul style="list-style-type: none"> • Included a discussion of how agencies participating in a variety of planning efforts should coordinate to ensure mitigation objectives are met. • Discussed the agencies responsible for the maintenance of this document. • Discussed on-going public participation measures.
APPENDICES	
Appendix 1: Hazard Profiles, Loss Calculations, Mapping	<ul style="list-style-type: none"> • Added River Erosion Profile • Combined Hailstorm, Thunderstorm, Lightning, and Windstorm in to one category “Severe Storm” • Combined “Urban Fire” and “Wildfire” into “Fire Emergencies” • Renamed “Epidemics” as “Biological Incidents” • Updated information in all sections • Utilized worksheets 3a and 3b to inventory assets and calculate estimated losses.
Appendix 2: Evidence of Public Involvement	<ul style="list-style-type: none"> • Added section to give evidence of public involvement
Appendix 3: Glossary	<ul style="list-style-type: none"> • Updated terms as needed

2.2 PROFILE HAZARDS

§201.6(c)(2)(i) [The risk assessment shall include a] description of the...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Several hazards affect Kanawha County, as noted in the previous section. However, those hazards may not affect the county in ways that residents and planners may typically think. This section references detailed descriptions of how the identified hazards affect Kanawha County and the municipalities therein. Refer to Appendix 1 of this plan for detailed hazard profiles (including scholarly discussions of the hazard and historical occurrences).

2.3 INVENTORY ASSETS

§201.6(c)(2)(ii)	[The risk assessment shall include a] description of the jurisdiction's vulnerability of the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.
§201.6(c)(2)(ii)(A)	The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

This risk assessment identifies “at-risk” community assets such as critical facilities, critical infrastructure, historical properties, commercial/industrial facilities, etc. “Assets” contribute directly to the quality of life in the community as well as ensure its continued operation. As such, government facilities are often listed, as are water/wastewater and transportation infrastructure. “Assets” can also be irreplaceable items within the community, such as historical structures or even vulnerable populations (including the elderly or youths).

METHODOLOGY

Inventorying assets first involves determining what in the community can be affected by a hazard event. The hazard profiles contained in Appendix 1 each contain a

The core planning committee maintains a specific list of community assets as part of this plan. (For flood mitigation concerns, estimates of the number of these facilities subject to a flood risk are listed on the form “Worksheet #3a” contained behind the flooding tab.) These assets are grouped into the following categories.

- **Critical Facilities:** Governmental facilities, water/wastewater facilities, dams, emergency services facilities, medical facilities (hospitals/clinics), and the transportation infrastructure.
- **Vulnerable Populations:** Schools, nursing homes, and senior centers.
- **Economic Assets:** Large commercial/industrial facilities or large employers (not covered in other categories).
- **Special Considerations:** Residences, community outreach facilities, post offices, and libraries.
- **Historical Considerations:** Areas/structures listed on the National Register of Historic Places.

While inventorying assets, much information can be gathered that will assist in the upcoming loss estimations. Each specific asset is listed with its size, replacement value (structure only), contents value, function use or value (annual operating budget), displacement cost (\$ per day), and occupancy. These values are utilized to compute loss estimates, which is why it is critical to carefully consider all the facilities that are listed in the asset inventory. Following is a brief description of how the above numbers are derived.

- **Replacement Value:** County assessor data or by directly contacting the facility.
- **Contents Value:** Directly contacting the facility.
- **Function Use or Value:** Directly contacting the facility.
- **Displacement Cost:** Function Use or Value divided by 365.
- **Occupancy:** Directly contacting the facility.

ASSET INVENTORY

The above information for the complete asset inventory is listed on Figure 2.3.1 below. Figure 2.3.1 is a replica of Worksheet #3b from the *State and Local Mitigation Planning How-To Guide: Understanding Your Risks* (FEMA 386-2). Following is a key for the acronyms found on Figure 2.3.1.

- **EMS:** Emergency Medical Services
- **ES:** Elementary School
- **FD:** Fire Department
- **HS:** High School
- **MS:** Middle School
- **PO:** Post Office
- **VFD:** Volunteer Fire Department

Municipal asset lists are shown as follows. The assets listed on Figures 2.3.2 through 2.3.15 are *also* listed on the countywide asset inventory, Figure 2.3.1.

- Figure 2.3.2: Belle
- Figure 2.3.3: Cedar Grove
- Figure 2.3.4: Charleston
- Figure 2.3.5: Chesapeake
- Figure 2.3.6: Clendenin
- Figure 2.3.7: Dunbar
- Figure 2.3.8: East Bank
- Figure 2.3.9: Glasgow
- Figure 2.3.10: Handley
- Figure 2.3.11: Marmet
- Figure 2.3.12: Nitro
- Figure 2.3.13: Pratt
- Figure 2.3.14: St. Albans
- Figure 2.3.15: South Charleston

2.4 ESTIMATE LOSSES

§201.6(c)(2)(ii)(B) [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

Estimating the losses that may arise from a hazard event both educates local officials as to how to prioritize mitigation projects and speeds up the recovery process. Those community assets at risk of sustaining significant hazard-related losses will likely be higher priorities to protect with mitigation projects. Also, when disaster strikes, loss estimation data can be provided to recovery and damage assessment teams to help in categorizing the losses sustained and assistance needed.

The following figures are *loss estimates* and are only intended to guide the development and prioritization of mitigation strategies. These figures should not replace official damage assessments. Further, the figures are subject to change based on inflation, facility upgrades/additions, staff increases/reductions, etc.

METHODOLOGY

2.4.1 Biological Incidents

Using the average cost for chronic diseases generated by the Center for Disease Control's (CDC's) Chronic Disease Cost Calculator Ver. 2 (CDC, 2013) a value of \$12.84/person/day of medical assistance for both hospital and outpatient was developed. Using CDC's FluAid 2.0, computer software designed to assist in influenza planning, an estimated 94-217 residents would most likely die from an influenza strain and 15,603 to 36,407 would need medical assistance. Using the rate generated by the Chronic Disease Cost Calculator and an average of 1 week of medical care needed per person, an estimated economic cost of \$1.4 million to \$3.3 million would occur. This value excludes the storage and maintenance of the deceased.

2.4.2 Civil Disturbance

To determine the economic loss for civil disturbances, a review of the factors put forth within DAWN.com's article "Economic Cost of Protests" (2014) should be used. The cost would be dependent on the type of protest, the size of the population participating, where the protest is occurring, and the level of criminal activity that happens. As a result it becomes difficult to determine an average value for a loss from a civil disturbance.

2.4.3 Dam Failure

The United States Bureau of Reclamation (USBR) Construction Cost indexing (www.usbr.gov/pmts/estimate/cost_trend.html) is able to supply the 2014 cost indexes of 341 (October 2014) for earthen dams and 363 (October 2014) for concrete dams to determine dam replacement costs. These values are used in conjunction with the original cost for dam construction with a base index of 1977=100. USBR recommends creating updated designs for older structures increasing the cost by an average of \$20,000 - \$40,000. So, for example, a \$10,000,000 earthen dam built in 1977 would estimate cost \$34,100,000 in 2014 to replace while a concrete dam constructed in the same year would cost approximately \$36,300,000. This does not include the benefit losses from irrigation supplies, municipal and industrial (M & I) water supply, power generation, recreation, fish and wildlife, or water navigation as described in the Department of Homeland Security's (DHS's *Dam Sector: Estimating Economic Consequences for Dam Failure Scenarios* (September 2011), which will vary from dam to dam.

2.4.4 Drought

National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center (NCDC) lists 23 events to include excessive heat for Kanawha County between 1997 and 2013. No events had reported damages associated with them. As for the *2013 WV Statewide Standard Hazard Mitigation Plan Update*, list's the entire state's accumulated NCDC annualized crop damage at \$1,990,868 with no separation by county. To accurately estimate a loss from a drought an economic analysis of market fluctuations should occur resulting from destroyed crops or increased livestock feed and watering costs.

2.4.5 Earthquake

There are no reportable events between 1994 and 2013. By applying HAZUS-MH, using an arbitrary earthquake scenario of Magnitude 5.00 at Latitude 38.38/Longitude -81.53, the \$19,222,000,000 in building value had no recordable damage. Within the *2013 WV Statewide Standard Hazard Mitigation Plan Update* a probabilistic annualized loss was created using HAZUS-MH creating an estimated value of \$722,629 for Kanawha County. In attempts to duplicate the scenario, no losses were determined.

2.4.6 Fire Emergencies

Within the NCDC, two wildfire events were listed, both with no property or crop damages listed. As for the *2013 WV Statewide Standard Hazard Mitigation Plan Update*, it lists 1389 state facilities at risk with a total building and content value of \$2,259,622,898. Fires though affect more than just buildings, so by using again from the *2013 WV Statewide Standard Hazard Mitigation Plan Update* Kanawha County had 2,161 wildfires from 1987-2012 (25 years) an average of 86.44 fires/year can be deduced. From the Department of Forestry's (WVDOF's) SERC (September, 2010), a five year average of 17.6 acres/fire was deduced leading into 2010. Combining these averages, Kanawha County averages 1,521 acres/year lost to wildfires. Using \$300/acre value as used within the WVDOF's SERC 2010, Kanawha County averages \$456,403 in damages annually from wildfires.

2.4.7 Flooding

Within NCDC, a total of 55 events as either flooding or flash flooding occurred between January 1996 and December 2013 totaling \$36,243,000 in property damage.

By using HAZUS-MH, an estimated \$3,529,000,000 in total property loss occurred with \$1,772,000,000 being in property damage from a 100-year event in Kanawha County. See Figure 2.4.7.1 for the Quick Assessment Report obtained on February 4, 2015. In comparison, the *2013 WV Statewide Standard Hazard Mitigation Plan Update* evaluates the damages only to critical facilities which accounts for 78 of the facilities within Kanawha with a maximum damage in Kanawha County at \$30,000,000. When this number is compared to the 9,580

buildings (which include residential, commercial, industrial, and critical facilities) that were at least moderately damaged in the February 4, 2015 run of HAZUS-MH, a difference factor of 122 is created. Using this factor to extrapolate the value put forth in the 2013 WV Statewide Standard Hazard Mitigation Plan Update, a maximum value of \$3,660,000,000 is deduced.

Quick Assessment Report	
<i>February 4, 2015</i>	
Study Region :	Kanawha County WV
Scenario :	part of flooding
Return Period:	100
Analysis Option:	0
Regional Statistics	
Area (Square Miles)	903
Number of Census Blocks	6,537
Number of Buildings	
Residential	89,527
Total	96,584
Number of People in the Region (x 1000)	200
Building Exposure (\$ Millions)	
Residential	14,576
Total	19,224
Scenario Results	
Shelter Requirements	
Displaced Population (# Households)	13,754
Short Term Shelter (# People)	33,744
Economic Loss	
Residential Property (Capital Stock) Losses (\$ Millions)	1,772
Total Property (Capital Stock) Losses (\$ Millions)	3,529
Business Interruptions (Income) Losses (\$ Millions)	22
Disclaimer:	
Totals only reflect data for those census tracts/blocks included in the user's study region.	
The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific flood. These results can be improved by using enhanced inventory data and flood hazard information.	

Figure 2.4.7.1

2.4.8 Hazardous Materials Incidents

The 2013 WV Statewide Standard Hazard Mitigation Plan Update does not rank or provide an analysis for the economic impact associated with the release of hazardous materials. To guide where there are large clusters of possible hazardous material incidents and thereby most likely larger medical costs and business disruptions, the United States Environmental Protection Agency's (USEPA's) Toxic Release Inventory (TRI) can be used. Within Kanawha County, there are 56 facilities in or near Kanawha County listed. For these 56 facilities, a total of 6,152 toxic releases had been submitted. Because of the large quantity of submissions, 55 of the 56 facilities have subsequently had Risk-Screening Environmental Indicator (RSEI) reports created so as to compare each site's risk release against industry, county, state, and national medians. As stated, this will guide planners to areas of high concentration of possible indirect medical cost increases and business disruptions which can then be evaluated.

2.4.9 Land Subsidence

NCDC contained one event occurring in 2009 as a landslide causing \$100,000 in property damage and no crop damage. As for the 2013 WV Statewide Standard Hazard Mitigation Plan Update, no value estimates had been established due to the lack of data. By combining the Coal Mine Subsidence section from the 2013 WV Statewide Standard Hazard Mitigation Plan Update though Kanawha County becomes a medium risk with \$531, 733,718 in state facilities near areas of coal mine subsidence. When this is expanded to include residential, commercial, and industrial facilities a factor similar to the one used within the HAZUS-MH for flooding can be used comparing the total number of buildings within coal mine subsidence areas to the number of state facilities. This will place estimates in the billions of dollars.

2.4.10 River Erosion

This topic was not discussed within the 2013 WV Statewide Standard Hazard Mitigation Plan Update or does it exist within NCDC. To determine the economic loss from river erosion, a methodology demonstrated in the Community Erosion Assessment: Kwigillingok, Alaska (www.alaskaerosion.com, January 2009) at can

be used. An average erosion rate can be determined for various sections of rivers determining the total land area lost due to erosion. Due to the urbanized construction along the rivers in Kanawha County, building loss should be accounted for as well. Since the level of erosion and factors that affect each segment of river vary greatly across Kanawha County there is no average loss that can be determined. A study for major waterways in Kanawha County (i.e., Kanawha River and Elk River) would be recommended.

2.4.11 Severe Storms

Severe Storms is an umbrella title for many different storm types to include hail, thunderstorms, lightning, heavy rain and straight wind gusts. NOAA's NCDC listed 76 hail events for a total of \$15,213,000 in property damages between 1958 and 2013 (55 years). Of these 76 events, four of them accounted for \$15,000,000 in damages leaving on \$213,000 for the remaining 72 events or approximately \$3,000 per hail event that has caused damage. With an average of 1.38 damaging hail events per year, Kanawha County can estimate \$4,140 annual losses from hail. As for Thunderstorms, lightning, and wind gusts, a total of 161 events occurred between 1957 and 2013 (56 years) for a total of \$9,244,000 in property damages. Only 8 of the 161 events were lightning strikes totaling \$113,500 in property damages leaving \$9,130,500 for the remaining 153 events which included thunderstorms and high wind gusts. An average of \$59,676 in damages per event can then be deduced as well as 2.73 events per year for an annual loss of \$162,915 from thunderstorms storms and high winds. Combining these totals, Kanawha County can estimate \$167,055 annually in losses from severe storms.

2.4.12 Terrorism

Economic loss determination from terrorism is dependent on the type of attack, the dispersal method, and where the attack occurs. The General Accounting Office (GAO) developed in *Terrorism Insurance: Status Coverage Availability for Attacks Involving Nuclear, Biological, Chemical, or Radiological Weapons* (2008) estimates for New York City as seen in Figure 2.4.2. To create comparative values for Kanawha County relationship factors for population and total surface area should be developed. To compare death counts a population factor of 0.028 can be created by dividing the 2013 estimated US Census population for Kanawha County by that of New York City. For area of affect, thereby estimated losses, New York City covers only 468.9 sq. miles to Kanawha County at 903 sq. miles. Thereby Kanawha County is more dispersed and a factor of (0.519) can be used along with the population factor to compensate for the lower population density. These values are also listed in Figure 2.4.12.1 for each of the weapons types.

Attack type	Agent		Estimated losses (\$)	
			NYC	Kanawha County
Chemical	Sarin		34,000,000,000	494,088,000
Radiological	Dirty Bomb		43,000,000,000	624,876,000
Biological	Anthrax	1kg	118,000,000,000	1,714,776,000
		10kg	254,000,000,000	3,691,128,000
		75kg	501,000,000,000	7,280,532,000
Nuclear	Powerplant Sabotage		217,000,000,000	3,153,444,000
	Bomb	1kton	205,000,000,000	2,979,060,000
		5kton	584,000,000,000	8,486,688,000
Estimated fatalities				
Attack type	Agent		Estimated fatalities	
			NYC	Kanawha County
Chemical	Sarin		6,000	168
Radiological	Dirty Bomb		A few	negligible
Biological	Anthrax	1kg	34,000	952
		10kg	80,000	2,240
		75kg	207,000	5,796
Nuclear	Powerplant Sabotage		A few	negligible
	Bomb	1kton	1,300,000	36,400
		5kton	3,000,000	84,000

Figure 2.4.12.1

2.4.13 Tornado

NOAA's NCDC reports six events between 1969 and 2008 (39 years) totaling \$227,500 in damages. All events caused property damage but the median and mode damage level for Kanawha County's \$25,000 per event. Kanawha County averages 0.15 tornados annually, at \$5,800 in property damage annually from tornados.

2.4.14 Utility Emergencies

According to Allianz Global Corporate & Specialty (www.allianz.com) a short black out (as short as 30 minutes in length) can average \$15,709 for medium and large industrial clients and nearly \$94,000 for an 8-hr disruption within their Expert Risk Article segments titled "Power Trip." Using 100 employees as the average size for a medium company, \$157.09 can be estimated per person in economic loss from a blackout lasting only 30 minutes or \$30,047,390 for the entire population of Kanawha County. Using the same methodology, \$940 per person would be lost for an 8-hr day or \$179,798,500 in economic losses for Kanawha County.

2.4.15 Winter Storm

NOAA's NCDC lists twelve winter storm events in Kanawha County between 1996 and 2013 (17 years) for a total of \$1,828,000 in property damages but \$1,800,000 occurred in a single event in 2003 leaving only \$28,000 over the remainder of the eleven events or \$2,545 per event or \$1,647 annually. This though does not account for road maintenance, cancelled flights, and auto repairs. New York City's Comptroller stated that \$130,700,000 was spent in clear New York City in 2014 as reported by www.Accuweather.com in their article "Winter Storms Cost US Economy Billions Annually" (February 6, 2015). Using the same comparison factors as used within the terrorism section above between New York City and Kanawha County, Kanawha County can estimate \$67,800,000 in road maintenance costs annually. Additionally, masFlight, in the same article, estimates an average of \$6,000 in economic losses per flight cancelled. It is difficult to estimate the amount of losses associated with vehicle repairs due to the ability to determine the true cause of any damage.

Further, the hazard mitigation planning committee has agreed to refine the loss estimates on a more facility-by-facility basis. Such an estimate will be built directly from the asset inventory developed under section 2.3 of this document (i.e. Figure 2.3.1). Information gleaned from this analysis will be included in future updates to this plan.

2.5 ANALYZE DEVELOPMENT TRENDS

§201.6(c)(2)(ii)(C) [The plan should describe vulnerability in terms of] providing a general discussion of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Kanawha County is located south-central West Virginia and contains the state capitol. The county's municipalities are located along the primary US routes and take advantage of these locations to the extent possible. Land uses in Kanawha County generally conform to the following:

- **Agricultural:** According to the 2012 Census of Agriculture (NASS USDA), Kanawha County contains 210 active farms covering approximately 26,009 acres which is an increase of 6,031 acres being used by farms since the 2002 Census of Agriculture. Most farms (51%) yield less than \$2,500 in annual sales, a drop from 76% in the 2002 Census of Agriculture but since there are the same number of farms, it would appear that a large number of farms have grown in market value thereby making agriculture a larger portion of Kanawha County's economy. Farms are located sporadically throughout the rural (non-municipal) areas of the county.
- **Commercial:** Commercial areas are prominent in Kanawha County and are located primarily along I-79, I-64, and US 119 (as well as US 60) within the corporate boundaries of the "river cities". Significant commercial development is present in Charleston, South Charleston, Dunbar, and Nitro. Other, small commercial developments are located in the municipalities.
- **Industrial:** Areas paralleling the Kanawha River are developed heavily with industry.
- **Park or Open Land:** Parks and open land (that are publicly accessible) are primarily contained to a variety of municipal parks and the Kanawha State Forest.
- **Residential:** Residential areas are located throughout the county. The greatest population densities are found along the Charleston-Dunbar-Nitro corridor to the north side of the Kanawha River and along the Charleston-South Charleston-St. Albans corridor to the south of the Kanawha River. According to Kanawha County's 20/20 Vision comprehensive plan, much of the affordable housing stock

in Kanawha County is older and deteriorating. (23% of the housing was constructed before 1940.)

- **Specialized Land Use Designation(s):**
 - Kanawha State Forest: Southwestern portion of the county
 - South Ridge and Associated Developments: Southern portions of county
 - State Capitol Complex: Central portions of City of Charleston
 - Tri-State Racetrack and Casino: Located in Cross Lanes
 - University of Charleston: Portions located throughout City of Charleston
 - Yeager Airport: Central portion of the county

By reviewing the Kanawha County *20-20 Vision Plan* (May 2014), the number of households has remained steady from 2000 to 2010 at approximately 92,700 with the type of households (i.e., single family, mobile home, renter/owner occupied, etc.) also staying constant. The difference has been in the increase in owners and members of the population within the 65+ age category. This population often has established itself and is not looking to develop industrial and commercial opportunities. Also, because of this age group most likely has an unwavering income level, a 65+ age person is most likely not looking to move to a new residential home, build a new home, or increase Kanawha County's residential value.

It is significant to note it is difficult to predict where developers are looking. Local governments know where development is occurring, but not precisely where trends are likely to occur in the future. Further, conditions change as do overall development trends. In other words, what looks attractive in a given year may not look attractive during the next.

Historically, development has occurred with little understanding of its effects on countywide hazard susceptibility or the vulnerabilities a new development faces in terms of natural, technological, and man-made hazards. In many instances, the premier developable areas in Kanawha County are located in or near flood hazard areas. As a result, many municipalities have adopted floodplain management ordinances that allow them to meet minimum standards for the National Flood Insurance Program (NFIP). As the mitigation planning process continues, local leaders should look at a variety of hazard mitigation options to guide not only commercial and industrial development, but also residential development.

3.0 LOCAL HAZARD MITIGATION GOALS

§201.6(c)(3)(i) [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Several hazard mitigation projects have been developed by Kanawha County's core planning team. This section includes the *entire list* of mitigation projects considered by the county and the municipalities therein. In the list below, the status of projects is noted. Status is classified by new, on-going, completed, deleted, or deferred. If a project is listed as completed, deleted, or deferred, a description of activities associated with the project is included. Those projects listed as new or on-going are discussed in more detail in Section 4.1.

These projects address many of the hazards identified in the preceding risk assessment. Many of these strategies (such as the development of information displays) also address multiple hazards. For the purposes of this document, each project is listed with the hazard it *primarily* addresses.

Project	Biological Incidents	Civil Disturbance	Dam Failure	Drought	Earthquake	Fire Emergencies	Flooding	Hazardous Materials Incident	Land Subsidence	River Erosion	Severe Storms	Terrorism	Tornado	Utility Emergencies	Winter Storm
1.1.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.1.10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.2.1							X			X	X				X
1.2.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.2.3							X								
1.3.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.3.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.4.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.4.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.4.3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.4.4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.4.5							X				X		X		X
1.4.6											X		X		
1.5.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1.5.2											X		X		
2.1.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2.1.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2.1.3							X								
2.2.1							X								
2.3.1							X								
2.4.1							X								
2.5.1							X								
2.5.2			X				X	X	X	X	X				X
2.5.3			X				X			X	X				X
2.5.4							X								
2.5.5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2.5.6							X	X			X				
2.5.7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

<i>Project</i>	<i>Biological Incidents</i>	<i>Civil Disturbance</i>	<i>Dam Failure</i>	<i>Drought</i>	<i>Earthquake</i>	<i>Fire Emergencies</i>	<i>Flooding</i>	<i>Hazardous Materials Incident</i>	<i>Land Subsidence</i>	<i>River Erosion</i>	<i>Severe Storms</i>	<i>Terrorism</i>	<i>Tornado</i>	<i>Utility Emergencies</i>	<i>Winter Storm</i>
3.1.1							X								
3.1.2							X								
3.1.3							X								
3.1.4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.1.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.1.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.2.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.2.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.1.1							X				X				X
5.2.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.1.1				X											
6.1.2				X				X						X	X
6.2.1						X									
6.2.2						X									
6.2.3				X		X									
7.1.1									X						
7.1.2									X						
7.1.3									X	X					
7.1.4									X	X					
8.1.1					X										
9.1.1	X											X			
10.1.1		X							X			X		X	
10.1.2		X							X			X		X	
10.1.3		X	X						X			X		X	
10.2.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10.2.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Goal 1. Improve upon the protection of the citizens of Kanawha County from all natural and man-made hazards.

Objective 1.1. Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.

Project 1.1.1: Create displays for use at public events (e.g. health fair, public awareness day, etc.).

Status: On-going

Project 1.1.2: Create materials that are targeted towards the tourist population.

Status: On-going

Project 1.1.3: Utilize the media for the distribution and publication of hazard information.

Status: On-going

Project 1.1.4: Create a public speaking series on hazard-related topics, such as what to do in the event of an emergency and who to contact.

Status: On-going

Project 1.1.5: Ensure that the American Red Cross Citizen's Disaster Course is held on a frequent basis.

Status: On-going

Project 1.1.6: Update the Kanawha County website to provide hazard-related information that is easily accessible.

Status: On-going

Project 1.1.7: Continue to work with the Kanawha County School Board to promote hazard mitigation education and awareness and to discuss better ways to integrate mitigation into the curriculum, as well as using the school board as a means to distribute information to homes via students.

Status: On-going

Project 1.1.8: Continue to work with non-governmental organizations (youth, service, professional, etc.) to promote mitigation education and awareness.

Status: On-going

Project 1.1.9: Distribute information on hazard related topics to local libraries, hospitals, city halls, insurance agencies, banks, and churches.

Status: On-going

Project 1.1.10: Work with the tax office to insert emergency information into monthly bills.

Status: On-going (due to periodic nature of dissemination)

Objective 1.2: Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness.

Project 1.2.1: Distribute information to all property owners in Kanawha County regarding potential flood hazards as required for participation in the Community Rating System.

Status: On-going

Project 1.2.2: Establish all-hazard resource centers to be located in the Kanawha County Courthouse and the municipalities in the county. The centers should act as a repository for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders.

Status: Completed and On-going

Associated Activities: Information is placed in all county buildings with notification to the public that it is available at these locations. As for the City of Charleston, information is maintained and distributed from the Homeland Security and Emergency Management and the Charleston Planning offices.

Project 1.2.3: Continue to hold local courses on the National Flood Insurance Program (NFIP) for land-use organizations (e.g., realtors, bankers, construction companies, surveyors, and insurers).

Status: On-going

Objective 1.3: Evaluate existing shelters to determine adequacy for current and future populations.

Project 1.3.1: Establish a protocol for the sharing of annual shelter survey information between the local Red Cross chapter and the local emergency services.

Status: Completed

Associated Activities: ETeam, the State of WV web-based resource request system, is where Kanawha County and the City of Charleston maintain, update, and share shelter information. The American Red Cross shelters are maintained, updated, and shared through ETeam as well.

Project 1.3.2: Develop adequate emergency shelter and evacuation plans for animals (domestic pets, livestock, and wildlife).

Status: Completed

Associated Activities: Kanawha County, through a Memorandum of Understanding, used funding received by Putnam County to plan and obtain resources for animal rescuing and sheltering.

Objective: 1.4: Ensure adequate training and resources for emergency organizations and personnel.

Project 1.4.1: Teach Community Emergency Response Team (CERT) classes in Kanawha County.

Status: Deleted

Associated Activities: Efforts to create a CERT program have not been supported by residents in Kanawha County and Charleston. Where possible, residents are encouraged to support other volunteer organizations through Volunteer WV.

Project 1.4.2: Increase the number of trained citizen emergency responders.

Status: Deleted

Associated Activities: Efforts to create a CERT program have not been supported by the residents in Kanawha County and the City of Charleston. Where possible, residents are encouraged to support other volunteer organizations through Volunteer WV.

Project 1.4.3: Conduct annual disaster exercises with local law enforcement, emergency personnel, city and county officials, and other disaster response agencies.

Status: On-going

Project 1.4.4: Provide information about local, regional, state, and federal training opportunities to fire departments, EMS, ambulance services, and other emergency responders.

Status: Deleted

Associated Activities: Training opportunities are more often associated with other planning initiatives to include hazardous materials, operational planning, COOP, etc.

Project 1.4.5: Become certified by the National Weather Service (NWS) as Storm Ready thereby offers Storm Spotter classes.

Status: On-going

Project 1.4.6: Promote awareness training for wind hazards to include training in standards and building codes.

Status: On-going

Objective 1.5: Undertake general mitigation projects to address a variety of hazards.

Project 1.5.1: Implement a Geographic Information System with an emphasis on hazard analysis.

Status: On-going

Project 1.5.2: Join the National Weather Service's Storm Ready Community.

Status: Deleted

Associated Activities: This project was merged with Project 1.4.5 above

<p>Goal 2: Reduce the current and future risks from hazards in Kanawha County.</p>

Objective 2.1: Direct new development away from high hazard areas.

Project 2.1.1: Review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.

Status: On-going

Project 2.1.2: Review all comprehensive plans, cities and county, to ensure that designated growth areas are not in high hazard areas.

Status: Completed

Updates to the Floodplain ordinance, the Comprehensive Plan, and the 20-20 Vision Technical Supplement occurred as well as the

Associated Activities: implementation of enhanced subdivision regulations specifying design standards to include drainage specifications, road curvatures, and sewage disposal.

Project 2.1.3: Review all capital improvement plans to ensure that infrastructure improvements are not directed towards hazardous areas.

Status: Completed

Associated Activities:

Updates to the Floodplain ordinance, the Comprehensive Plan, and the 20-20 Vision Technical Supplement occurred so as to regulate the construction of buildings so as to be in hazard areas or create new ones for the future.

Objective 2.2: Evaluate and update, if necessary, existing floodplain ordinances to meet or exceed the NFIP standards.

Project 2.2.1: Work with the municipalities to update all floodplain ordinances adopted prior to 1987.

Status: On-going

Objective 2.3: Improve the enforcement of existing floodplain regulations.

Project 2.3.1: Provide additional training to county and municipal personnel responsible for the enforcement of the floodplain regulations.

Status: On-going

Objective 2.4: Ensure that flood insurance policies remain affordable through county and municipal government programs.

Project 2.4.1: Participate in the Community Rating System (CRS).

Status: On-going

Objective 2.5: Minimize the negative effects of flooding.

Project 2.5.1: Separate combined storm and sewer drain lines.

Status: On-going

Project 2.5.2: Create a storm water management plan.

Status: On-going

Project 2.5.3: Routinely remove trash and debris from stream beds, culverts, storm grates, and storm drains.

Status: On-going

Project 2.5.4: Use flood mitigation grants to fund property buyouts in the lowest lying areas of Charleston (both RL and non-RL properties).

Status: On-going (contingent upon availability of funds)

Project 2.5.5: Support CAMC's Pre-Disaster Mitigation Grant application.

Status: Completed

Associated Activities: Through a Memorandum of Understanding, the City of Charleston obtained funding for CAMC to enhance their flood protection by placing a floodwall, flood gates back-up generators, gauges, and back-flow valves. In addition, back-flow valves were put into residential sewer lines within Charleston.

Project 2.5.6: Obtain back-flow control valves for septic systems within the county's floodplain.

Status: On-going

Project 2.5.7: Construct a new municipal building in Clendenin that is not located in a hazard area.

Status: On-going

Goal 3: Develop and maintain a database of all hazardous risk properties.

Objective 3.1: Ensure that adequate records and information are maintained regarding hazard prone properties.

Project 3.1.1: Maintain information on the number and location of all repetitive loss properties throughout Kanawha County and the municipalities.

Status: Completed

Associated Activities: Both the City of Charleston and Kanawha County maintain an MS Excel spreadsheet listing all Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties. The list includes all municipalities in the county.

Project 3.1.2: Maintain a database of information on all repetitive loss properties, including maps.

Status: Completed

Associated Activities: Using the RL and SRL list created in MS Excel, the GIS departments within both the City of Charleston and Kanawha County have created maps of these locations.

Project 3.1.3: Identify property owners of RL and non-RL properties that may be willing to participate in future property acquisition projects.

Status: On-going

Project 3.1.4: Continue to update asset inventory data, to include interface with assets and compilation of asset-by-asset loss estimates.

Status: On-going

Goal 4: Reduce the potential impact of natural and man-made disasters on Kanawha County’s historic structures and landmarks.

Objective 4.1: Improve coordination of mitigation efforts between the National Park Service and Kanawha County.

Project 4.1.1: Establish a formal process for the county and the park service to coordinate disaster-related efforts, which should include defining boundaries and establishing responsibilities.

Status: Deleted

Associated Activities: Due to the different levels of response between national and county entities as well as pre-existing roles on federal versus county property, this project is not needed and therefore deleted.

Project 4.1.2: Conduct training exercises that include representatives from the County and the Park Service to facilitate increased coordination.

Status: Deleted

Associated Activities: This project is covered under project 1.4.3 therefore can be deleted as a separate project.

Objective 4.2: Identify and protect other historic structures throughout the county that are at risk from hazards.

Project 4.2.1: Conduct a survey of all historic sites that are located in hazard-prone areas.

Status: Completed

Associated Activities: Through historical societies, National Historical Registry, and the WV Division of Culture and History, a list is maintained of current historical structures with Kanawha County and the City of Charleston. Survey assessments have been completed of all locations located in hazard-prone areas.

Project 4.2.2: Develop mitigation strategies to protect any at-risk historic properties.

Status: On-going

Goal 5: Develop better hazard data for Kanawha County and the municipalities located within the county.

Objective 5.1: Assess vulnerability of transportation systems and assets located in hazardous areas.

Project 5.1.1: Work with the West Virginia Department of Transportation to identify areas of frequent roadway flooding and develop mitigation strategies.

Status: On-going

Objective 5.2: Assess vulnerable communications infrastructure throughout the county.

Project 5.2.1: Upgrade and improve communications in the rural areas of the county by creating back-up communication lines.

Status: On-going

Goal 6: Reduce the negative effects of drought in Kanawha County.

Objective 6.1: Increase public awareness of the effects of droughts on the water supply.

Project 6.1.1: Develop an information brochure to distribute to residents focusing on the benefits of conserving water.

Status: On-going

Project 6.1.2: Continue construction of public water systems to eliminate wells.

Status: On-going

Objective 6.2: Decrease the impacts of side-effects resulting from drought conditions.

Project 6.2.1: Strengthen enforcement of burning bans with the U.S. Forestry Service.

Status: On-going

Project 6.2.2: Initiate fire department training programs to enhance response capabilities to wildfires.

Status: Completed

Associated Activities: There are annual training events held by the Division of Forestry on eastern forest fires. In addition, through project 1.4.3 and 1.4.4, training exercises and notification about training events are given to fire departments to partake in.

Project 6.2.3: Continue to educate the general public on risks during drought conditions.

Status: On-going (contingent upon present of hazard)

Goal 7: Reduce the effects of land subsidence.

Objective: 7.1: Minimize future damage from land subsidence by increasing control over construction activities.

Project 7.1.1: Institute county-wide building codes that will regulate the intensity of use and materials used in construction.

Status: Deleted and Completed

Associated Activities: While initially this project involved county-wide building codes, Kanawha County does not have building codes to enforce. The City of Charleston has created an updated building code system which includes regulations on construction.

Project 7.1.2: Apply for additional Abandoned Mine Lands funding to take care of existing problems.

Status: On-going

Project 7.1.3: Shore up the north side of the Kanawha River from the 35th Street Bridge to the Elk River.

Status: Completed

Associated Activities: As the initial phase of the Riverfront Project, it has been completed

Project 7.1.4: Shore up the north side of the Kanawha River from the Elk River to the Patrick Street Bridge.

Status: Deferred

Associated Activities: As Phase 2 of the Riverfront Project, it has currently been deferred until further funding

Goal 8: Reduce the negative effects of an earthquake in Kanawha County.

Objective: 8.1: Minimize possibility of earthquake damage to new structures within the county.

Project 8.1.1: Continue to enforce International Building Codes and continue to update them as required.

Status: On-going

Goal 9: Protect the citizens of Kanawha County from an infectious disease.

Objective: 9.1: Increase public awareness and knowledge after an infectious disease has been declared.

Project 9.1.1: Participate in public awareness campaigns on the local television stations.

Status: On-going

Goal 10: Protect the general public in Kanawha County and in the municipalities from hazardous material incidents.

Objective 10.1: Study and evaluate transportation systems for problems that could lead to hazard material spills and other incidents.

Project 10.1.1: Assess high traffic intersections for potential problems.

Status: Deleted

Associated Activities: This project is completed through the periodic assessment of a Commodity Flow Study within Kanawha County and the City of Charleston thereby falling outside the purview of this plan.

Project 10.1.2: Evaluate railroad crossings for appropriate warning systems.

Status: On-going

Project 10.1.3: Evaluate the locks on the Kanawha River to ensure necessary warning systems are in place.

Status: On-going

Objective 10.2: Increase public awareness and public education regarding hazardous material incidents.

Project 10.2.1: Publicize evacuation plans in public places, such as libraries, schools, hospitals, the courthouse, city halls, banks, and churches.

Status: Completed

Associated Activities: Links have been created on the KPEPC website to the Kanawha County evacuation plan. Additionally, the City of Charleston has placed their evacuation plan on their website with separate hyperlinks for each zone.

Project 10.2.2: Increase public awareness by upgrading the emergency information available in the phone directory.

Status: Deleted

Associated Activities: With increased use of websites, Facebook, Twitter, public and notification systems this project has become obsolete.

4.1 IDENTIFICATION AND ANALYSIS OF MITIGATION ACTIONS

§201.6(c)(3)(ii) [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

This portion of the plan builds on the strategies list presented in Section 3.0. Whereas Section 3.0 simply lists Kanawha County's mitigation goals, objectives, and strategies, this section analyzes those strategies as projects and discusses how they should be implemented. Each strategy is listed along with a timeframe, primary coordinator, support agencies, potential funding source (and cost estimate), and any activities that have been associated with the project to date. Strategies are also categorized by six different types of mitigation projects. (*NOTE: "Strategies" are considered mitigation "projects".)

1. Prevention,
2. Property protection,
3. Natural resource protection,
4. Structural projects,
5. Emergency services, and
6. Public education and awareness.

It is important to note that the cost estimates are tentative and meant as a starting point for research on project feasibility. More specifically, these cost estimates are only ranges of probable project costs; all figures are approximations. At the time the implementation of any strategy is considered, a full cost estimate should be sought prior to securing funding. The Benefit-Cost Review was emphasized in the prioritization process. Mitigation actions were evaluated by their pros and cons, which are represented as costs and benefits.

Finally, as a navigational note, this section only contains *current* mitigation projects (organized by jurisdiction). If the status indicator in Section 3.0 classified as project as "Completed", "Deleted", or "Deferred", it will *not* be listed below (unless the Hazard Mitigation Core Planning Committee chose to re-list the project because of a

future benefit). As a result, the strategy numbers may not run consecutively (e.g., Strategy X.1.5 may follow Strategy X.1.3).

Goal 1. Improve upon the protection of the citizens of Kanawha County from all natural and man-made hazards.

Objective 1.1. Develop and distribute public awareness materials about natural hazard risks, preparedness, and mitigation.

Project 1.1.1: Create displays for use at public events (e.g. health fair, public awareness day, etc.).

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): \$500 - \$1,000 (Local funds, EMPG)

Project Type: Public Education & Awareness
Kanawha County Homeland Security and
Emergency Management (KCHSEM),

Coordinating Agency: Charleston Department of Homeland Security
and Emergency Management (CDHSEM),
American Red Cross

Associated Activities: As information changes, new and relevant
information is placed at public events to
include water safety and Ebola. A removal of
the county fair occurred from the previous
plan's list of example events.

Project 1.1.2: Create materials that are targeted towards the tourist population.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): \$500 - \$1,000 (Local funds)

Project Type: Public Education & Awareness
Charleston Conference & Visitors Bureau
(CVB), Kanawha County Homeland Security

Coordinating Agency: and Emergency Management, Charleston
Department of Homeland Security and
Emergency Management

Associated Activities: Currently the Coordinating Agencies are
working to include preparedness information
in commercials inviting people to the area.

Project 1.1.3: Utilize the media for the distribution and publication of hazard information.

Affected Jurisdictions: All
Timeframe: On-going
Cost Estimate (Funding Source): N/A (Media may be willing to disseminate emergency information – at the time of an emergency – at little or no cost.)
Project Type: Public Education & Awareness
Coordinating Agency: Local media, Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management
Associated Activities: Frequent broadcasts of Public Service Announcements (PSAs) via local media outlets.

Project 1.1.4: Create a public speaking series on hazard-related topics, such as what to do in the event of an emergency and who to contact.

Affected Jurisdictions: All
Timeframe: On-going
Cost Estimate (Funding Source): \$5,000 - \$15,000 (Local funds)
Project Type: Public Education & Awareness
Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management, Kanawha-Putnam Emergency Planning Committee
Associated Activities: A continuation to provide speaking series on hazard-related and safety topics. In review of costs to hire speakers on these topics, the cost estimate has been updated.

Project 1.1.5: Ensure that the American Red Cross Citizen's Disaster Course is held on a frequent basis.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (ARC may provide training as part of its regular budget and may recoup costs per registration fees.)

Project Type: Emergency Services

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston
Department of Homeland Security and Emergency Management, American Red Cross

Associated Activities Constant coordination with the American Red Cross as to when training can be available and scheduling venues for the course.

Project 1.1.6: Update the Kanawha County website to provide hazard-related information that is easily accessible.

Affected Jurisdictions: Kanawha County

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Agreements for website maintenance are in place; therefore, significant additional funds would not be necessary.)

Project Type: Public Education & Awareness

Coordinating Agency: Kanawha County Commission, Kanawha County Homeland Security and Emergency Management, County IT Dept. and/or Contractor(s)

Associated Activities: Expansion on the KPEPC website includes information for public preparedness (e.g., making a go-kit, making a family disaster plan, sheltering in place, etc.), emergency management information (e.g., the All-Hazard Plan, Evacuation Plan, and the KanPlan) finally, maintaining a section for current events, available seminars, and activities. Through the Metro911 website, residents can sign up for Swift911, a public information emergency system. By signing up information can be sent to more than just listed residential numbers such as cell phones and unlisted numbers.

Project 1.1.7: Continue to work with the Kanawha County School Board to promote hazard mitigation education and awareness and to discuss better ways to integrate mitigation into the curriculum, as well as using the school board as a means to distribute information to homes via students.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)

Project Type: Public Education & Awareness

Coordinating Agency: Kanawha County Schools, Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management

Associated Activities: Continued coordination as the need arises from current events such as potable water safety and Ebola.

Project 1.1.8: Continue to work with non-governmental organizations (youth, service, professional, etc.) to promote mitigation education and awareness.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)

Project Type: Public Education & Awareness

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management

Associated Activities: Continued coordination with civic, spiritual, youth, and business organizations to provide speaker activities and preparedness awareness education.

Project 1.1.9: Distribute information on hazard related topics to local libraries, hospitals, city halls, insurance agencies, banks, and churches.

Affected Jurisdictions: All
Timeframe: On-going
Cost Estimate (Funding Source): \$1,000 - \$2,500, if such items as brochures, etc. are created (Local funds, EMPG)
Project Type: Public Education & Awareness
Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston
Department of Homeland Security and Emergency Management
Associated Activities: Copies of all the Kanawha County and City of Charleston plans have placed in the libraries for review as well as they can be obtained through the KPEPC and City of Charleston websites.

Project 1.1.10: Work with the tax office to insert emergency information into monthly bills.

Affected Jurisdictions: All
Timeframe: On-going (due to periodic nature of dissemination)
Cost Estimate (Funding Source): \$1,000 - \$2,500, for printing of insertable items (Local funds, EMPG)
Project Type: Public Education & Awareness
Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston
Department of Homeland Security and Emergency Management
Associated Activities: Preparedness is reminded with all tax billing statements by the public.

Objective 1.2: Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness.

Project 1.2.1: Distribute information to all property owners in Kanawha County regarding potential flood hazards as required for participation in the Community Rating System.

Affected Jurisdictions: Kanawha County. City of Charleston

Timeframe: On-going

Cost Estimate (Funding Source): Up to \$80,000 for postage to entire county (PDM)

Project Type: Public Education & Awareness

Coordinating Agency: Kanawha County Planning, Charleston Planning

Associated Activities: Information is distributed through the websites for KPEPC and the City of Charleston. It is also distributed through brochures available at post offices, libraries, schools, and insurance companies.

Project 1.2.2: Establish all-hazard resource centers to be located in the Kanawha County Courthouse and the municipalities in the county. The centers should act as a repository for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders.

Affected Jurisdictions: All

Timeframe: Completed and On-going

Cost Estimate (Funding Source): N/A (Placing materials in these locations will cost little to no funds.)

Project Type: Public Education & Awareness

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston
Department of Homeland Security and Emergency Management, Municipal Administrators

Associated Activities: Information is placed in all county buildings with notification to the public that it is available at these locations. As for the City of Charleston, information is maintained and distributed from the Homeland Security and Emergency Management and the Charleston Planning offices.

Project 1.2.3: Continue to hold local courses on the National Flood Insurance Program (NFIP) for land-use organizations (e.g., realtors, bankers, construction companies, surveyors, and insurers).

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (If coordinated with the state and interest is high, there is a chance that training would be of no cost to county.)

Project Type: Property Protection

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston
Department of Homeland Security and Emergency Management, WVDHSEM

Associated Activities: NFIP courses are conducted by the state of WV. To date, Kanawha County has held courses for a surveyors association and for insurance companies in Kanawha County and the City of Charleston. Both Kanawha County and the City of Charleston are planning to continue to work with the state of WV to hold NFIP courses within the area on a periodic basis.

Project 1.4.3: Conduct annual disaster exercises with local law enforcement, emergency personnel, city and county officials, and other disaster response agencies.

Affected Jurisdictions: All
Timeframe: On-going
Cost Estimate (Funding Source): Up to \$5,000 contingent upon size and type of event (Local funds, HMEP, EMPG, SERC)
Project Type: Emergency Services
Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management, Kanawha-Putnam Emergency Planning Committee
Associated Activities: Emergency management agencies in both the Charleston and Kanawha County coordinate exercises of all levels. They perform larger planned exercises as well as smaller unplanned exercise with schools, health departments, responders, and hospitals.

Project 1.4.5: Become certified by the National Weather Service (NWS) as Storm Ready thereby offer Storm Spotter classes.

Affected Jurisdictions: All
Timeframe: On-going
Cost Estimate (Funding Source): Contingent upon availability of NWS resources.
Project Type: Emergency Services
Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management, NWS (Charleston), WVDHSEM
Associated Activities: To become Storm Ready certified, Kanawha County and the City of Charleston have offered and will continue to offer Storm Spotter classes in association with the NWS.

Project 1.4.6: Promote awareness training for wind hazards to include training in standards and building codes.

Affected Jurisdictions: City of Charleston
Timeframe: On-going
Cost Estimate (Funding Source): N/A (Promotion and education require little to no funds.)
Project Type: Public Education & Awareness
Coordinating Agency: City of Charleston Planning, Charleston Department of Homeland Security and Emergency Management
Associated Activities: Because Kanawha County does not maintain building codes this project has been deleted for them. However, the City of Charleston continues to maintain and enforce both fire and building codes.

Objective 1.5: Undertake general mitigation projects to address a variety of hazards.

Project 1.5.1: Implement a Geographic Information System with an emphasis on hazard analysis.

Affected Jurisdictions: Kanawha County, Charleston
Timeframe: On-going
Cost Estimate (Funding Source): \$2,500 - \$5,000, contingent upon need to upgrade GIS capabilities (Local funding)
Project Type: Emergency Services
Coordinating Agency: Kanawha County Planning, Charleston Planning
Associated Activities: Both the City of Charleston and Kanawha County have developed a more robust GIS capability by increasing the tools and hiring new GIS employees to perform analyses. These capabilities are shared through KCHSEM, Kanawha County planning, and city planning.

Goal 2: Reduce the current and future risks from hazards in Kanawha County.

Objective 2.1: Direct new development away from high hazard areas.

Project 2.1.1: Review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.

Affected Jurisdictions: Kanawha County, City of Charleston

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Development of regulations requires no funding; enforcement, though, may require budgeting.)

Project Type: Prevention

Coordinating Agency: Kanawha County Planning, Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management, Charleston Planning
Both the City of Charleston and Kanawha County through both the planning and emergency management offices monitor and implement possible changes recommended by

Associated Activities: national organizations in emergency management, trade organizations, and organizations with an interest in mitigating hazards.

Objective 2.2: Evaluate and update, if necessary, existing floodplain ordinances to meet or exceed the NFIP standards.

Project 2.2.1: Work with the municipalities to update all floodplain ordinances adopted prior to 1987.

Affected Jurisdictions: Municipalities

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)

Project Type: Property Protection

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management (for Charleston only)

Associated Activities: The City of Charleston has updated their floodplain ordinance to match the state of WV's current building codes. Kanawha County Planning is working with municipalities (i.e., Belle, Cedar Grove, Chesapeake, Clendenin, Dunbar, East Bank, Glasgow, Handley, Marmet, Nitro, Pratt, and South Charleston) to update their floodplain ordinances to the same levels.

Objective 2.3: Improve the enforcement of existing floodplain regulations.

Project 2.3.1: Provide additional training to county and municipal personnel responsible for the enforcement of the floodplain regulations.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): Up to \$1,000 per course to cover instructor costs and materials (Local funding, HMGP, PDM)

Project Type: Property Protection

Coordinating Agency: Kanawha County Planning, Charleston Planning, Municipal Floodplain Coordinators (if appropriate)

As changes occur in floodplain ordinances,

Associated Activities: provide changes to building inspection personnel.

Objective 2.4: Ensure that flood insurance policies remain affordable through county and municipal government programs.

Project 2.4.1: Participate in the Community Rating System (CRS).

Affected Jurisdictions: Kanawha County, City of Charleston

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Requirements for inclusion into the CRS can be met with little to no funds.)

Project Type: Property Protection

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Planning, WVDHSEM

The City of Charleston completed this project in 2011. Kanawha County is completing the

Associated Activities: requirements for themselves to become CRS certified to include participation and completion of this Hazard Mitigation Plan.

Objective 2.5: Minimize the negative effects of flooding.

Project 2.5.1: Separate combined storm and sewer drain lines.

Affected Jurisdictions: Charleston

Timeframe: On-going

Cost Estimate (Funding Source): Up to \$5,000,000 contingent upon scope of project (CDBG)

Project Type: Structural Projects

Coordinating Agency: Charleston Public Works

The City of Charleston's Sanitary Board has mapped out a system to separate the separate the storm and sewer drainage lines.

Associated Activities: As funding allows, a process to physically separate the lines has begun by replacing some sewer lines.

Project 2.5.2: Create a storm water management plan.

Affected Jurisdictions: Charleston

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Planning can be done in-house.)

Project Type: Prevention

Coordinating Agency: Charleston Planning, Charleston Public Works

A Storm Water Management Team was developed in 2012 with a Long Term Storm

Associated Activities: Water Management Comprehensive Plan Project beginning in 2013. Public awareness activities have continued into 2014.

Project 2.5.3: Routinely remove trash and debris from stream beds, culverts, storm grates, and storm drains.

Affected Jurisdictions: All
Timeframe: On-going
Cost Estimate (Funding Source): \$50,000 (Local funds)
Project Type: Prevention
Natural Resource Protection
Coordinating Agency: Kanawha County Planning
Associated Activities: Having identified target areas where excess debris accumulates, the City of Charleston routinely sends personnel from Public Works to these locations before expected heavy rains. Kanawha County has implemented a clean-up program for 25 years from waterways throughout the county especially those that could detrimentally effect the population or disrupt commerce.

Project 2.5.4: Use flood mitigation grants to fund property buyouts in the lowest lying areas of Charleston (both RL and non-RL properties).

Affected Jurisdictions: Charleston
Timeframe: On-going (depends on funds availability)
Cost Estimate (Funding Source): Up to \$1,000,000 contingent upon number of properties involved (FMA, HMGP, PDM)
Project Type: Prevention
Coordinating Agency: Charleston Planning, Charleston Department of Homeland Security and Emergency Management
Associated Activities: The City of Charleston attempted a project in 2011 with a cost estimate of \$3.2 Million. This project did not meet the Cost-Benefit Analysis regulations at that time. Being that regulations have since been amended, the City of Charleston is resubmitting on a smaller scale.

Project 2.5.6: Obtain back-flow control valves for septic systems within the county's floodplain.

Affected Jurisdictions: Kanawha County
Timeframe: On-going
Cost Estimate (Funding Source): \$1,000,000 (PDM)
Project Type: Structural Projects
Coordinating Agency: Kanawha County Planning, Kanawha County
Homeland Security and Emergency
Management
As funding becomes available with an interest
Associated Activities: in mitigating hazards associated with
Kanawha County's septic systems

Project 2.5.7: Construct a new municipal building in Clendenin that is not located in a hazard area.

Affected Jurisdictions: Clendenin
Timeframe: On-going
Cost Estimate (Funding Source): Up to \$1,000,000 (Local funding, CDBG,
USDA Rural Development)
Project Type: Structural Projects
Coordinating Agency: Clendenin Town Council
Associated Activities: There have been no updates at this time due
to funding priorities.

Goal 3: Develop and maintain a database of all hazardous risk properties.

Objective 3.1: Ensure that adequate records and information are maintained regarding hazard prone properties.

Project 3.1.3: Identify property owners of RL and non-RL properties that may be willing to participate in future property acquisition projects.

Affected Jurisdiction: Kanawha County, Charleston, Clendenin, Dunbar, Marmet, Pratt, South Charleston

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Repetitive loss information can be provided by FEMA.)

Project Type: Prevention

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Kanawha County Planning, Charleston Department of Homeland Security and Emergency Management, Charleston Planning, Municipal Councils

Associated Activities: By creating a MS Excel spreadsheet with repetitive loss and severe repetitive loss properties, a list of owners who may be willing to participate in future acquisitions projects was developed as well. Through Project 2.5.4 of this Hazard Mitigation Plan, requisitions can then occur.

Project 3.1.4: Continue to update asset inventory data, to include interface with assets and compilation of asset-by-asset loss estimates.

Affected Jurisdiction: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)

Project Type: Property Protection

Coordinating Agency: Kanawha County Planning, Charleston Planning

Associated Activities: By updating this Hazard Mitigation Plan, an update of assets within Kanawha County is occurring. To increase the effectiveness of loss estimates, an increase in the use of HAZUS-MH has been injected into this plan using available assessor data from Kanawha County and information from the GIS personnel in the City of Charleston.

Goal 4: Reduce the potential impact of natural and man-made disasters on Kanawha County's historic structures and landmarks.

Objective 4.2: Identify and protect other historic structures throughout the county that are at risk from hazards.

Project 4.2.2: Develop mitigation strategies to protect any at-risk historic properties.

Affected Jurisdictions: Kanawha County, Charleston

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Development would require little to no funding; implementation of strategies may require funding, however.)

Project Type: Property Protection

Coordinating Agency: Kanawha County Planning, Charleston Planning

Associated Activities: Through developing this plan, strategies to mitigate hazards that could affect at-risk historic properties are being developed.

Goal 5: Develop better hazard data for Kanawha County and the municipalities located within the county.

Objective 5.1: Assess vulnerability of transportation systems and assets located in hazardous areas.

Project 5.1.1: Work with the West Virginia Department of Transportation to identify areas of frequent roadway flooding and develop mitigation strategies.

Affected Jurisdiction: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)

Project Type: Prevention

Coordinating Agency: WVDOT

Associated Activities: Continue discussions with WVDOT to determine which roadways throughout Kanawha County, more specifically within which municipalities, are most prone to flooding. Then through projects associated with this Hazard Mitigation Plan create mitigation strategies to include changes from construction and future developments.

Objective 5.2: Assess vulnerable communications infrastructure throughout the county.

Project 5.2.1: Upgrade and improve communications in the rural areas of the county by creating back-up communication lines.

Affected Jurisdiction: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost. Implementation, however, may result in significant cost.)

Project Type: Emergency Services

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston
Department of Homeland Security and Emergency Management

Associated Activities: Sirens throughout Kanawha County have been expanded to all communities and updated to include voice broadcast capabilities in some locations. A reverse 911 styled system has been added to the Kanawha County and City of Charleston notification networks allowing emergency management personnel to identify and target notifications to specific areas.

Goal 6: Reduce the negative effects of drought in Kanawha County.

Objective 6.1: Increase public awareness of the effects of droughts on the water supply.

Project 6.1.1: Develop an information brochure to distribute to residents focusing on the benefits of conserving water.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): \$500 - \$1,000 (Local funds, EMPG, PDM)

Project Type: Public Education & Awareness

Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management

Associated Activities: Brochures and public awareness activities are done on an as-needed basis such as the during the January 2014 chemical spill that affected the Kanawha County water supplies or when there is a significant drought conditions thereby increasing the interest from the population.

Project 6.1.2: Continue construction of public water systems to eliminate wells.

Affected Jurisdictions: Kanawha County

Timeframe: On-going

Cost Estimate (Funding Source): Up to \$3,000,000 contingent upon scope of project (CDBG, USDA)

Project Type: Structural Projects

Coordinating Agency: Various municipal systems and public service districts

Associated Activities: As funding becomes available or development expansions into more rural areas of Kanawha County occur, additional public systems can be constructed thereby reducing well systems.

Objective 6.2: Decrease the impacts of side-effects resulting from drought conditions.

Project 6.2.1: Strengthen enforcement of burning bans with the U.S. Forestry Service.

Affected Jurisdictions: All
Timeframe: On-going
Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)
Project Type: Prevention
Coordinating Agency: Kanawha County Commission, Municipal Councils
Associated Activities: Continued efforts between Kanawha County, municipalities, and the U.S. Forest Service (USFS) to educate and enforce burning bans throughout Kanawha County and the municipalities.

Project 6.2.3: Continue to educate the general public on risks during drought conditions.

Affected Jurisdictions: All
Timeframe: On-going (contingent upon present of hazard)
Cost Estimate (Funding Source): \$500 - \$1,000 (Local funds, PDM)
Project Type: Public Education & Awareness
Coordinating Agency: Kanawha County Homeland Security and Emergency Management, Charleston Department of Homeland Security and Emergency Management
Associated Activities: Due to the lack of severe drought conditions within Kanawha County, efforts to educate the public have been deferred to more pressing hazards to educate about. This project works in conjunction with project 6.1.1

Goal 7: Reduce the effects of land subsidence.

Objective: 7.1: Minimize future damage from land subsidence by increasing control over construction activities.

Project 7.1.2: Apply for additional Abandoned Mine Lands funding to take care of existing problems.

Affected Jurisdictions: Kanawha County

Timeframe: On-going

Cost Estimate (Funding Source): Up to \$2,000,000 contingent upon project scope (AML)

Project Type: Natural Resource Protection

Coordinating Agency: Kanawha County Commission (as potential recipient of funding)

Associated Activities: As funding is available, continued efforts in association with state agencies to drain mines are occurring. At the current time efforts are being made along Hughes Creek, a tributary to the Kanawha River, to drain abandoned mines.

Goal 8: Reduce the negative effects of an earthquake in Kanawha County.

Objective: 8.1: Minimize possibility of earthquake damage to new structures within the county.

Project 8.1.1: Continue to enforce International Building Codes and continue to update them as required.

Affected Jurisdictions: City of Charleston

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Passage of codes requires little to no funding; enforcement, however, may require budgeting.)

Project Type: Prevention

Coordinating Agency: Kanawha County Commission, Municipal Councils

Associated Activities: The City of Charleston continues to maintain and enforce both fire and building codes following the state guidelines and applying the 2012 International Building Codes.

Goal 9: Protect the citizens of Kanawha County from an infectious disease.

Objective: 9.1: Increase public awareness and knowledge after an infectious disease has been declared.

Project 9.1.1: Participate in public awareness campaigns on the local television stations.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): \$500 - \$1,000 (Local funds, EMPG, TP funds)

Project Type: Public Education & Awareness

Coordinating Agency: Kanawha-Charleston Health Department

Associated Activities: On an as-needed basis create public awareness campaigns to educate the public about current infectious diseases. Current endeavors include measles and Ebola.

Goal 10: Protect the general public in Kanawha County and in the municipalities from hazardous material incidents.

Objective 10.1: Study and evaluate transportation systems for problems that could lead to hazard material spills and other incidents.

Project 10.1.2: Evaluate railroad crossings for appropriate warning systems.

Affected Jurisdictions: All

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)

Project Type: Prevention

Coordinating Agency: CSX, Norfolk Southern, Kanawha-Putnam Emergency Planning Committee

Associated Activities: Continued coordination between the railroad systems and Kanawha County and the City of Charleston maintains knowledge of current warning systems in place.

Project 10.1.3: Evaluate the locks on the Kanawha River to ensure necessary warning systems are in place.

Affected Jurisdictions: Kanawha County, Belle, Cedar Grove, Charleston, Chesapeake, Dunbar, East Bank, Glasgow, Handley, Marmet, Nitro, Pratt, South Charleston

Timeframe: On-going

Cost Estimate (Funding Source): N/A (Coordination between agencies requires little to no cost.)

Project Type: Emergency Services

Coordinating Agency: USACE, Kanawha-Putnam Emergency Planning Committee

Associated Activities: Continued coordination between the USACE and Kanawha County and the City of Charleston to maintain knowledge of current warning systems in place.

4.2 IMPLEMENTATION OF MITIGATION ACTIONS

§201.6(c)(3)(iii) [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

This section identifies the priority for implementing the projects identified in Sections 3.0 and 4.1. Each current project is listed with a “primary coordinator” in Section 4.1 that should be responsible for the overall implementation of the project.

Project (i.e., strategy) prioritization occurred using the *2011 Hazard Vulnerability Survey* as a guide. The Kanawha-Putnam Emergency Planning Committee (KPEPC) created the *2011 Hazard Vulnerability Survey* ranking the hazards they felt Kanawha County was most susceptible to or were of the highest concern. Within this hazard mitigation plan, the 54 possible hazards within the *2011 Hazard Vulnerability Survey* were combined into 15 major hazard categories. Using the more specific *2011 Hazard Vulnerability Survey* as a guide, the mitigation projects outlined in this plan were ranked with “1” being the one to which they felt the county was most vulnerable and “43” being the hazard to which they felt the county to be least vulnerable.

In prioritizing items within the *2011 Hazard Vulnerability Survey*, the following items were considered

- **Social Impacts:** Consider whether the public would support implementation of the project. If so, priority likely rises.
- **Technical Feasibility:** Consider whether the project can be done and if it will yield the intended outcomes. If yes, priority would likely rise.
- **Administrative Requirements:** Consider the staffing, funding, and maintenance requirements of the project. If current capabilities can successfully manage and sustain the project, priority would be strengthened.
- **Political Impacts:** Consider the acceptability of the project from the political frame. If it is likely to cause political upheaval, it would receive a lower priority.
- **Legal Ramifications:** Consider whether the project can be lawfully implemented. If not, the project cannot be listed.

- **Environmental Impacts:** Consider whether there would be negative consequences to environmental assets should the project be implemented. If assets are impact, priority would be likely to fall.
- **Economic Impacts/Cost Benefit:** A brief “benefit cost review” per *FEMA Publication 386-5: Using Benefit Cost Review in Mitigation Planning* was conducted for each project to determine the “pros” and “cons” of each project as it related to project prioritization. Maximizing the use of available funds would positively affect a project’s priority.

Kanawha County and the Municipalities Prioritized Project List		
<i>Project Number</i>	<i>Mitigation Project</i>	<i>Priority</i>
1.1.1	Create displays for use at public events (e.g. health fair, public awareness day, etc.).	1
1.1.10	Work with the tax office to insert emergency information into monthly bills.	4
1.2.1	Distribute information to all property owners in Kanawha County regarding potential flood hazards as required for participation in the Community Rating System.	6
1.1.2	Create materials that are targeted towards the tourist population.	8
1.1.3	Utilize the media for the distribution and publication of hazard information.	10
1.2.2	Establish all-hazard resource centers to be located in the Kanawha County Courthouse and the municipalities in the county. The centers should act as a repository for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders.	13
1.2.3	Continue to hold local courses on the National Flood Insurance Program (NFIP) for land-use organizations (e.g., realtors, bankers, construction companies, surveyors, and insurers).	9
1.1.4	Create a public speaking series on hazard-related topics, such as what to do in the event of an emergency and who to contact.	28
1.1.5	Ensure that the American Red Cross Citizen’s Disaster Course is held on a frequent basis.	21
1.5.1	Implement a Geographic Information System with an emphasis on hazard analysis.	25
1.1.6	Update the Kanawha County website to provide hazard-related information that is easily accessible.	2
1.4.3	Conduct annual disaster exercises with local law enforcement, emergency personnel, city and county officials, and other disaster response agencies.	22

Kanawha County and the Municipalities Prioritized Project List		
<i>Project Number</i>	<i>Mitigation Project</i>	<i>Priority</i>
1.1.7	Continue to work with the Kanawha County School Board to promote hazard mitigation education and awareness and to discuss better ways to integrate mitigation into the curriculum, as well as using the school board as a means to distribute information to homes via students.	12
1.4.5	Become certified by the National Weather Service (NWS) as Storm Ready thereby offer Storm Spotter classes.	11
1.1.8	Continue to work with non-governmental organizations (youth, service, professional, etc.) to promote mitigation education and awareness.	14
1.1.9	Distribute information on hazard related topics to local libraries, hospitals, city halls, insurance agencies, banks, and churches.	15
1.4.6	Promote awareness training for wind hazards to include training in standards and building codes.	20
2.1.1	Review existing regulations to ensure adequacy in reducing the amount of future development in identified hazard areas.	27
2.2.1	Work with the municipalities to update all floodplain ordinances adopted prior to 1987.	17
2.3.1	Provide additional training to county and municipal personnel responsible for the enforcement of the floodplain regulations.	23
2.4.1	Participate in the Community Rating System (CRS).	5
2.5.1	Separate combined storm and sewer drain lines.	26
2.5.2	Create a storm water management plan.	24
2.5.3	Routinely remove trash and debris from stream beds, culverts, storm grates, and storm drains.	7
2.5.4	Use flood mitigation grants to fund property buyouts in the lowest lying areas of Charleston (both RL and non-RL properties).	16
2.5.6	Obtain back-flow control valves for septic systems within the county's floodplain.	19
2.5.7	Construct a new municipal building in Clendenin that is not located in a hazard area.	43
3.1.3	Identify property owners of RL and non-RL properties that may be willing to participate in future property acquisition projects.	18
3.1.4	Continue to update asset inventory data, to include interface with assets and compilation of asset-by-asset loss estimates.	37
4.2.2	Develop mitigation strategies to protect any at-risk historic properties.	30
5.1.1	Work with the West Virginia Department of Transportation to identify areas of frequent roadway flooding and develop mitigation strategies.	29

Kanawha County and the Municipalities Prioritized Project List		
<i>Project Number</i>	<i>Mitigation Project</i>	<i>Priority</i>
5.2.1	Upgrade and improve communications in the rural areas of the county by creating back-up communication lines.	31
6.1.1	Develop an information brochure to distribute to residents focusing on the benefits of conserving water.	41
6.2.1	Strengthen enforcement of burning bans with the U.S. Forestry Service.	38
6.1.2	Continue construction of public water systems to eliminate wells.	40
6.2.2	Initiate fire department training programs to enhance response capabilities to wildfires.	39
6.2.3	Continue to educate the general public on risks during drought conditions.	42
7.1.1	Institute county-wide building codes that will regulate the intensity of use and materials used in construction.	34
7.1.2	Apply for additional Abandoned Mine Lands funding to take care of existing problems.	32
8.1.1	Continue to enforce International Building Codes and continue to update them as required.	33
9.1.1	Participate in public awareness campaigns on the local television stations.	3
10.1.2	Evaluate railroad crossings for appropriate warning systems.	36
10.1.3	Evaluate the locks on the Kanawha River to ensure necessary warning systems are in place.	35

5.0 PLAN MAINTENANCE PROCESS

§201.6(c)(4)(i)	[The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
§201.6(c)(4)(ii)	[The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
§201.6(c)(4)(iii)	[The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

MONITORING, EVALUATING, AND UPDATING THE PLAN

The jurisdictions adopting this plan have established a method for the systematic and periodic review of this document. The plan will be reviewed at a minimum of every five (5) years (or following major disaster events) to gauge its effectiveness in predicting hazard susceptibility areas, update the asset inventory, and update the timelines assigned to mitigation projects. During the review process, the following factors should be reviewed (similarly to the way in which these items were addressed during the original development of the plan).

- **Ease of Implementation:** How smoothly has implementing the project (or similar types of projects) been? Have programs been readily available to assist in funding the implementation of the project (or similar types of projects)?
- **Cost Effectiveness:** Have sufficient funding sources been available to implement the project at a cost manageable by the local government? Have the costs of implementing the project been significantly less than the cumulative future costs potentially incurred by an un-corrected situation?
- **Social Impacts:** Has the public perceived that the project has positively lessened hazard-related losses? Has implementing the project adversely affected any segment of the population?
- **Political Impacts:** Has implementing a particular project (or type of project) been delayed due to the political consequences of its implementation?
- **Economic Impacts:** Has the cost/benefit ratio of implementing the project been acceptable? Has implementing a project adversely affected a particular segment of the local economy?

- **Overall Positive Impacts:** Have local leaders generally agreed that implementing a particular project was beneficial to the community?

As such, Kanawha County Homeland Security and Emergency Management will update the action plan components of this plan (i.e. mitigation projects) as and if necessary. During future review processes, Kanawha County Homeland Security and Emergency Management will thus provide information critical to the success of the update.

In general, local policies have not hindered hazard mitigation efforts. The jurisdictions participating in this planning process have used a variety of funding to complete mitigation projects in the past, including the Hazard Mitigation Grant Program (HMGP), Homeland Security Grant Program (HSGP), Emergency Management Performance Grant (EMPG), Community Development Block Grant (CDBG), and local funding. Local government policies and programs have supported the use of this funding and, thus, the implementation of mitigation projects. Further, all participating government jurisdictions have demonstrated a capability to successfully implement and administer mitigation projects.

The monitoring of this plan also includes methods for ensuring that projects are successfully implemented and contribute to the achievement of the mitigation goals outlined in Section 3.0. All of the individual projects listed in this plan are accompanied by a series of potential funding sources. Many of these funding sources employ stringent project administration requirements including performance measures and close-out procedures, all of which will be followed by the jurisdiction affected by the implementation of the project. Adherence to these requirements will ensure the successful implementation of projects funded by such programs. For projects funded locally, existing purchasing policies will be followed, including competitive bidding, maintenance of invoice copies, regular departmental budget reviews, etc. All files associated with purchasing at the local level are maintained. This procedure has been successful while implementing mitigation projects since the original development of this plan and will continue to be followed.

INCORPORATION INTO EXISTING PLANNING MECHANISMS

The members of the core planning team are leaders within the communities and agencies that they represent. They are often involved in the overall community,

economic development, and capital improvements planning efforts of their jurisdictions. As members of the mitigation planning team, these individuals will carry mitigation concepts into other planning areas.

All jurisdictions represented in this plan have floodplain ordinances. In conjunction with the addition of this plan, the City of Charleston is working towards being CRS certified.

The Kanawha County Homeland Security and Emergency Management incorporates mitigation principles into its emergency operations planning in an effort to predetermine the hazards to which responders may respond. Kanawha County Homeland Security and Emergency Management's operations plan works to primarily address the negative effects of natural, technological, and man-made hazards.

Through the *20-20 Vision Plan (2014)* for Kanawha County, land use and future plans for Kanawha County are reviewed such as population changes, industry changes, and the needs for the county

CONTINUED PUBLIC INVOLVEMENT

All adopting jurisdictions maintain copies of this plan. Citizens will be able to review the plan and provide comments at any time from these locations. Citizens may also access the plan through the Kanawha County Homeland Security and Emergency Management. Following the completion of the planning process, a newspaper advertisement will be published inviting the public to review the plans at the above locations. These copies will be accompanied by a "Public Participation Form" so that comments can be recorded and included in future updating processes.

Further, the Kanawha County Homeland Security and Emergency Management intends to notify neighboring counties of the adoption of updated copies of this plan. Initially, this notification will be by letter with an offer to send an electronic copy of the plan upon request.

This plan is updated at a minimum of every five (5) years. The updating process will begin with the core planning committee and also involve the general public. The planning committee will meet as often as is necessary during a review year to revise, add, or remove mitigation projects. The final committee meeting will be properly advertised and open to the public to provide the public with an opportunity to comment on the proposed changes.

APPENDIX 1: HAZARD PROFILES

This appendix contains hazard-specific information created as a result of the comprehensive risk assessment that was completed as part of this project.

2.2 PROFILE HAZARDS

2.2.1. Biological Incidents (Outbreaks/Epidemics/Pandemics)

An biological incidents are diseases, usually contagious, that recurs in a community and attack large numbers of people at the same time. The potential impacts of biological incidents are illness or fatalities, disruption or closing of schools, or the forced closure of businesses and industrial operations.

RESEARCH

- 2011 Kanawha-Putnam Emergency Planning Committee (KPEPC) Hazard Vulnerability Survey
- KCHD 2012 Health Risk Assessment
- Centers for Disease Control and Prevention (CDC)
- World Health Organization (WHO)
- Internet research

Period of Occurrence:	At any time
Number of Events to Date (1950-2014):	1
Probability of Event:	1.56% chance of occurring in any single year (based on number of occurrences over date range analyzed)
Warning Time:	Days to Months
Potential Impacts:	Widespread illness can force the closure of business/government operations; emergency services could be strained through inoculation efforts.
Cause Injury or Death:	Injury
Potential Facility Shutdown:	Moderate

HAZARD EFFECTS

Biological incidents can affect all parts of Kanawha County, but are more likely to occur in densely populated areas, particularly large, multi-unit residential developments as are found within Charleston and the more industrialized areas along the Kanawha River. Biological incidents are classified into three levels, outbreaks, epidemics, and pandemics. Within the *2011 Kanawha-Putnam Emergency Planning Committee (KPEPC) Hazard Vulnerability Survey*, outbreaks were not reviewed, but epidemics and pandemics were both listed within the bottom third of risks for the jurisdiction. Pandemics were listed at 36 and epidemics were ranked 44 out of 54. Which level is currently happening depends on what is making people sick (<http://pediatrics.about.com/od/inthenews/a/outbreak.htm>). For example, a few thousand people contracting influenza during the cold and flu season is expected but the 603

confirmed cases of measles by the Center for Disease Control (CDC) as of October 31, 2014 can be classified as an outbreak or worse since it is the highest number of cases since measles elimination was documented in the United States in 2000 (<http://www.cdc.gov/measles/cases-outbreaks.html>). While West Virginia did not have any reported cases, Virginia, Pennsylvania, and Ohio (377 of the confirmed cases) all are nearby with easy transmission from a commutable disease such as measles.

The World Health Organization (WHO) defines an outbreak as an “occurrence of cases of disease in excess of what would normally be expected in a defined community, geographical area or season.” (http://www.who.int/topics/disease_outbreaks/en/). Common outbreaks that occur are viral infections that cause diarrhea, bacteria that cause food poisoning (i.e., E. coli, Salmonella, and Listeria), and influenza viruses (i.e., seasonal flu, avian flu, and swine flu). Outbreaks can occur within a geographical region regularly, such as these common occurring outbreaks, with little more than additional alertness but if the virus is not common such as the Chikungunya Virus was on July 1, 2014 within West Virginia (<http://www.kchdvw.org/getattachment/Home/Epidemiology/Health-Advisories/WV-HAN-Advisory-Chikungunya.pdf.aspx>), it is an outbreak. The same can be said for the Enterovirus D68 (EV-D68) which has been transmitting in August and September 2014 (http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6336a4.htm?s_cid=mm6336a4_w) near West Virginia. One case of either of these viruses is excess of what would normally be expected for the geographical area therefore an outbreak has occurred

When a disproportionately large number of people within a given population become infected, then an epidemic occurs, often spreading rapidly to many people. (<http://www.webmd.com/cold-and-flu/what-are-epidemics-pandemics-outbreaks>). These are the same biological occurrences that cause outbreaks. One of the more notable epidemics was in 2003 with the severe acute respiratory syndrome (SARS) epidemic which sickened 8,098 people and 774 deaths (29 in the United States) (<http://pediatrics.about.com/od/inthenews/a/outbreak.htm>).

If the number affected and the area widens even more than a pandemic has occurred. (<http://www.discovery.com>). It is often thought of as a globally occurring disease outbreak (<http://www.webmd.com/cold-and-flu/what-are-epidemics-pandemics-outbreaks>) such as the 1918 Spanish influenza that killed 40-50 million people, the Asian influenza in 1957 which killed an estimated 2 million people, and the 1968 Hong Kong influenza which killed an estimated 1 million people. While influenza viruses are most

associated with pandemics, they are not the only diseases that can reach this level since it is based on the area effected and the overwhelmingly large numbers of people within that effected area that are affected which defines a pandemic. To further classify pandemics, the CDC created a Pandemic Severity Index as seen in Figure 2.2.1.a. It is similar to the rating index for hurricanes with categories 1 to 5, 5 being the most severe. It uses a ratio to estimate the number of expected deaths by looking at the number of known deaths and comparing that to the total number of known cases. From that Case Fatality Ratio a severity category is determined and population loss can be extrapolated. Being that a pandemic is associated with a global area,

Category	Death Count	
	Min	Max
1	0	57
2	57	287
3	287	574
4	574	1,148
5	1,148	191,275

Figure 2.2.1.1

deaths are often described in country level values but the same proportions can be used at a more local level. For example, using the US Census Bureau's (USCB) 2013 population estimates of 191,275 (<http://quickfacts.census.gov/qfd/states/54/54039.html>) for Kanawha County, the Pandemic Severity Index levels would return death estimates listed in Table 2.2.1.1 if there was a 30% illness rate.

As for warning time for a biological incident, any level can develop with little or no warning and quickly erode the capacity of local medical care providers. At the outbreak level, a single case in which the medical facilities are ill-prepared to diagnose, isolate, and care for can cause this and very quickly transform into an epidemic level because the number of affected are disproportionate to the population. With proper

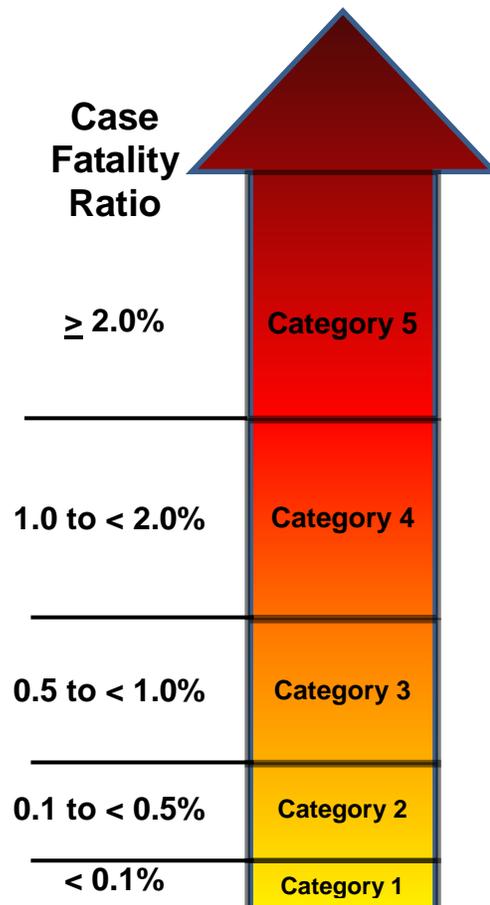


Figure 2.2.1.a

vigilance by the medical and public health communities though the warning time can be lengthened as travel patterns and biological developments are observed in other cities, counties, states, and nations. A fast developing biological incident can last several days and extend into several weeks. In some extreme cases, they can last for several months and occur in waves appearing to diminish and then return because of travel patterns or mutations of the biological agent. An epidemic can occur at any time of the year, but the warm summer months, when bacteria and microorganism growth are at their highest, present the greatest risk.

In addition, as populations age, an area can become more susceptible to biological incidents. Within Kanawha County the 65 and over population has grown by approximately 2.0% with estimated populations of 32,423 in 2010 to 33,079 in 2013 respectively.

http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_3YR_CP05&prodType=table). At the same time the City of Charleston has decreased by approximately 6.3% in the number of residents 65 and over http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_3YR_CP05&prodType=table). While this benefits the City of Charleston, the denser population areas and the presence of more external, transient, populations (i.e., dignitaries, commuters, and tourists) which easily traverse the I-64 and 77 corridors, a higher risk of unfamiliar incidents can be expected.

The Kanawha Charleston Health Department has taken many steps to ensure a base level of preparedness for biological incident conditions at any of the three levels, outbreak, epidemic, or pandemic. Initiatives surrounding general preparedness for Avian flu (beginning in 2006), H1N1 (swine flu), and, more recently, measles and Ebola have led other local governments to create and adopt business continuity plans. Even so, an estimated 40% absenteeism is expected in a large scale event because of either the person is ill or must care for someone that is ill such as a child or a parent. This will decrease the available response force as medical workers, police, and fire personnel are unable to perform their duties.

Finally, a decrease in the economic welfare of the community can occur as businesses must cease operations temporarily due to lack of employees or, as in the tourism industry, close to protect the population.

2.2 PROFILE HAZARDS

2.2.2. Civil Disturbance and Protests

A civil disturbance involves many people, often in protest of something. They can develop in as little as a few minutes or over several days. Disturbances often involve violence, which is what differentiates them from “demonstrations”.

RESEARCH

- 2011 KPEPC Hazard Vulnerability Survey
- WV Encyclopedia
- Internet research

Period of Occurrence:	At any time
Number of Events to Date: (1950 – 2014)	5+
Probability of Event:	7.81% chance of occurring in any single year (based on number of occurrences over date range analyzed)
Warning Time:	None to Days
Potential Impacts:	Potential loss of human life, economic loss, disruption of lifeline facilities
Cause Injury or Death:	Injury and risk of multiple deaths
Potential Facility Shutdown:	N/A

HAZARD EFFECTS

Civil disturbances are defined within the *Dictionary of Military and Associated Terms* (Department of Defense, 2014)

as “group acts of violence and disorder prejudicial to public law and order.” Protests are defined within the by *Black’s Law Dictionary* 2nd edition as

A formal declaration made by a person interested or concerned in some act about to be done, or already performed, and in relation thereto, whereby he expresses his dissent or disapproval, or affirms the act to be done against his will or convictions, the object being generally to save some right which would be lost to him if his implied assent could be made out, or to exonerate himself from some responsibility which would attach to him unless he expressly negated his assent to or voluntary participation in the act.

Both of these hazards are listed by the Kanawha-Putnam Emergency Planning Committee’s *2011 Hazard Vulnerability Survey*. In that document, these events are listed separately ranking 50 for civil disturbance and 54 for protests out of 54. These two levels of demonstrations are closely related and it is possible for a protest to escalate into a civil disturbance. Protests, while they can be a disruption to businesses and cause

disruptions in traffic flow, such as the demonstrations against a large energy corporation that occurred outside the Marriott Center in Charleston in 2004 (<http://www.flickr.com/photos/natinalmemorialforthemountains/229271271/>), are for the most part peaceful displays of opinion through the use of various media (i.e., signs, speeches, news broadcasts, etc.), marches, and congregating. These can happen regularly near government buildings and large venues. Within the City of Charleston and Kanawha County there are many such as the University of Charleston, West Virginia State University, Appalachian Power Park, and the Charleston Civic Center. In addition Charleston has the distinction of being the state capital. By being West Virginia's state capital, large influxes of people enter Charleston every year for the legislative sessions. This group includes not only elected officials, but also support staff, lobbyists, the general public, etc. bringing large congregations to voice their opinions to each other.

When a protest escalates to a civil disturbance, it usually occurs rapidly, threatening property and people. Events are often considered "leaderless resistance[s]". "While event organizers stress non-violent direct actions, criminal acts of violence and property destruction are *neither condoned nor condemned* [emphasis in original text]" (Civil Disturbance and Criminal Tactics of Protest and Extremists, 2003). Examples of this occurring have spanned decades within the Kanawha County area such as the textbook controversy that occurred in 1974-1975 which is arguably the "most violent protest over public school textbooks in our nation's history" (<http://www.wvencyclopedia.org/ExhibitHall/13>). The event divided the region into two distinct groups, the anti-textbook people who were predominately rural residents within the eastern end of the county and the textbook supporters who were mostly from the more urban areas such as Charleston. Beginning at the protest level, the anti-textbook camp created petitions and lead peaceful demonstrations with picket lines at many businesses and schools. In support, many miners staged strikes, disrupting the economic well-being of West Virginia and high school students staged a walk out against the perceived censorship. Escalation reached a civil disturbance level as anti-textbook forces vandalized and threatened schools with dynamite and Molotov cocktails (<http://www.wvencyclopedia.org/ExhibitHall/13>).

More recently, groups have attempted to spark conflict such as the April 2010 demonstrations performed by a religious group to promote its hate views in such a way to provoke an emotional response or in support of other organizations such as the 2011

demonstrations by the public sector workers in West Virginia supporting the Wisconsin public employee protests and the 2011 “Occupy West Virginia” in support of the “Occupy Wall Street” events.

Political statements are not the only way civil disturbances can occur though. Civil Disturbances could result as a secondary event in response to a fire, by an athletic rivalry, an emotionally provoking performance at one of the many areas and large venues within the area, or even a mass migration (large influx of evacuees from another area moving into and/or through Kanawha County) which could disrupt with large numbers of people, overtaxing the infrastructure of Kanawha County.

As for the length of warning time, ranges are from no warning to days, even weeks. For example, a sudden verdict in a highly publicized criminal case could provoke a rash response while expected and consistent protests to performances might allow for the designation of set “free speech zones” where protests can occur peacefully. Durations can vary in length as well. It is possible that a demonstration will only last for a few hours to days, weeks, or, and in the case of the 1974 textbook controversy, months. Damages can be insignificant with only negligible economic disruptions due to traffic impedance to large scale due to damage to properties, lives lost, and over taxation of civil services such as law enforcement, fire, and emergency medical personnel.

2.2 PROFILE HAZARDS

2.2.3. Dam Failure

A dam failure is when downstream flooding occurs as the result of the complete or partial inundation of an impoundment.

RESEARCH

- US Army Corps of Engineers (USACE), Huntington District Website
- West Virginia Dept. of Environmental Protection(WVDEP)
- 2011 KPEPC Hazard Vulnerability Survey
- Stanford University National Performance of Dams Program
- Internet research
- Interviews with local officials

Period of Occurrence:	At any time
Number of Events to Date (1997-2014):	1
Probability of Event:	5.88% chance of a dam incident occurring in any single year (based on number of occurrences over the date range analyzed)
Warning Time:	Minimal – Depends on frequency of inspection
Potential Impacts:	Potential loss of human life, economic loss, environmental damage, disruption of lifeline facilities
Cause Injury or Death:	Injury and risk of multiple deaths
Potential Facility Shutdown:	30 days or more

HAZARD EFFECTS

The 2011 KPEPC *Hazard Vulnerability Survey* ranks dam failure as the Number 1 hazard for Kanawha County. It is often the result of overtopping, seepage/piping, foundation defects and slope instability, and other causes such as inferior construction materials or inadequate maintenance (<http://www.damsafety.org>). The primary hazard surrounding dam failure is the swift, unpredictable flooding of those areas immediately downstream. While general inundation areas can be determined, it is often impossible to know exactly how and where water held back by a dam will flow during a rapid failure of the dam.

- **Overtopping (Hydraulic Failure):** Overtopping results from the uncontrolled flow of water over the dam, around the dam, and adjacent to the dam which then

erodes the dam and its foundation. Earthen dams are particularly vulnerable to overtopping since earth erodes at relatively small velocities. A further discussion of earth erosion can be seen in the river erosion (2.2.10) section. The excessive water could have resulted from heavy rainfall and flooding developed by an inadequate spillway design, debris blockage in the spillways, or settlement of the dam crest making the dam not be as tall as it was originally designed to be. Failure as a result of overtopping can have both short and long warning times. A short warning time might occur if a flash flood happens, quickly overpowering a taxed structure. A long time warning might be in place if water is observed flowing around the edges creating channels and eroding the dam itself.

- **Seepage/Piping Failure:** All dams exhibit some seepage that must be controlled in velocity and amount. Seepage occurs both through the dam and the foundation often around hydraulic structures such as pipes and spillways. Seepage can pass through animal burrows or even around roots of woody vegetation. Water

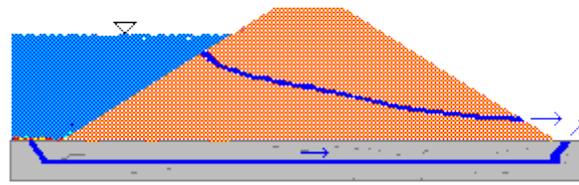


Figure 2.2.3.a

flows through these cracks/passages eroding and expanding the gap. It can pass fully through giving the appearance of a stream from the dam as seen in Figure 2.2.3.a or, if the structure is weak enough, cause a complete collapse.

- **Structural Failure:** Structural failures involve the rupture of the dam and/or its foundation. This type of failure can be the result of foundation defects, slope instability (often the case with earthen dams), inferior construction materials, and poor maintenance. This is particularly a hazard for large dams and for dams built of low strength materials such as silts, slag, fly ash, etc.

Dam failures generally result from a complex interrelationship of several failure modes. Uncontrolled seepage may weaken the soils and lead to a structural failure. Structural failure may shorten the seepage path and lead to a piping failure. Surface erosion may lead to structural or piping failures. Due to the complexity of causes and the intertwined dependence on each other to cause a dam failure, it might not even be possible to determine the true cause for a failure.

The West Virginia Department of Environmental Protection (WVDEP) classifies dams into four categories, which are the following:

- **Class 1 (High Hazard):** Dams located where failure may cause loss of human life or major damage to dwellings, commercial or industrial buildings, main railroads, important public utilities, or where a high risk highway may be affected or damaged.
- **Class 2 (Significant Hazard):** Dams located where failure may cause minor damage to dwellings, commercial or industrial buildings, important public utilities, main railroads, or cause major damage to unoccupied buildings, or where a low risk highway may be affected or damaged. Loss of human life from a failure of a Class 2 dam is unlikely.
- **Class 3 (Low Hazard):** Dams located in rural or agricultural areas where failure may cause minor damage to nonresidential and normally unoccupied buildings, or rural or agricultural land. Failure of a Class 3 dam would cause only a loss of the dam itself and a loss of property use, such as use of related roads, with little additional damage to adjacent property.
- **Class 4 (Negligible Hazard):** Dams where failure is expected to have no potential for loss of human life, no potential for property damage, and no potential for significant harm to the environment.

There are 609 dams within West Virginia with the majority being privately owned. Of these 609 dams, 14 reside in Kanawha County. Table 2.2.3.1 lists these dams giving the name, hazard class, the body of water is located on and the nearest city/town to the dam. Figure 2.2.3.b

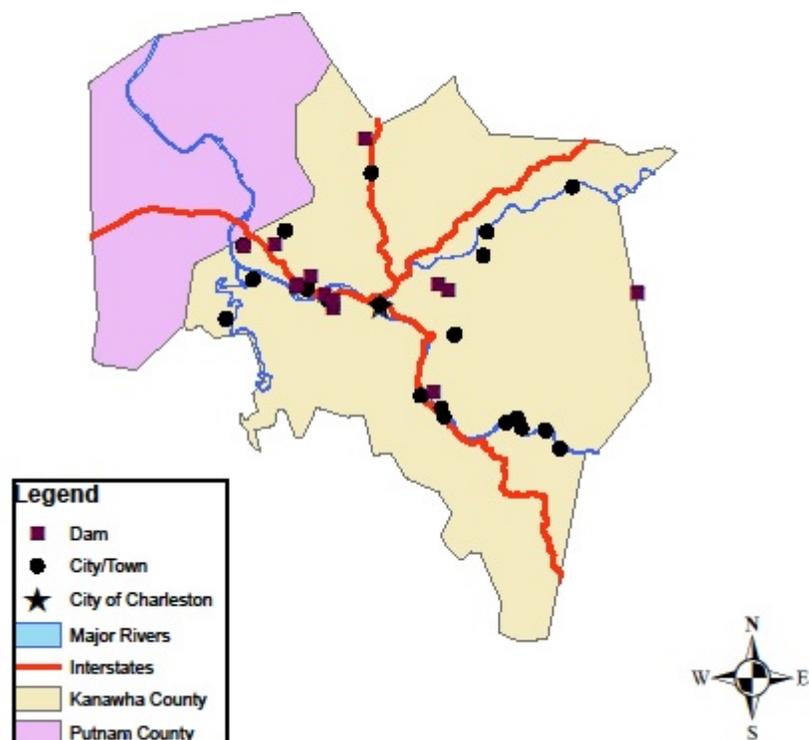


Figure 2.2.3.b

graphically locates these dams.

Kanawha County Dams

Name	Hazard Class	Body of Water	Nearest City/Town
Anderson Dam	1 (High)	Dutch Hollow	Dunbar
Blake's Creek Site No. 7	1 (High)	Ritenour Lake	Nitro
Cunningham Flyash Pond	2 (Significant)	Dutch Hollow	Dunbar
Don White	1 (High)	Tributary of Second Creek	Sissonville
Elk-Two Mile No. 12	1 (High)	Elk-Two Mile	Charleston
Elk-Two Mile No. 13	1 (High)	Elk-Two Mile	Charleston
Finney Branch Embankment	2 (Significant)	Finney Branch	Dunbar
FMC Waste Retention Basin	1 (High)	David Creek	South Charleston
Holz Dam	1 (High)	Sugar Camp Creek	South Charleston
Lake Chaweva Dam	1 (High)	Rocky Fork	Cross Lanes
Scott's Run Cinder Barrier	1 (High)	Scott's Run	Belle
Union Carbide H&F Club #3	3 (Low)	Blue Creek of Elk River	Sanderson
Ward Impoundment (Lower) Dam	2 (Significant)	Kanawha River	South Charleston
Ward Impoundment (Upper) Dam	1 (High)	Ward Creek	South Charleston

Table 2.2.3.1

Showing a higher risk, Dunbar has one Class 1 and two Class 2 dams in close vicinity of each other. South Charleston has four dams, three of which are Class 1. Finally, Charleston has two Class 1 dams along the Elk-Two Mile River.

Additionally, the US Army Corps of Engineers (USACE) maintains three lock and dam facilities along the Kanawha River that could affect the Kanawha County and Charleston areas as seen in Figure 2.2.3.c. The Marmet Lock and Dam is located in Kanawha County at Marmet, WV, 67.7 miles above the mouth of the river. A failure of this dam could impact communities downstream from Marmet, including: Charleston, Dunbar, Nitro, St. Albans, and South Charleston. Failure of this dam could disrupt the nationally ranked economic water transportation system of 9,813,000 tons (USACE, 2012) of raw materials. The London Lock and Dam is located near Fayette County just inside the Kanawha County border, two miles downstream of Montgomery, WV. A failure of the London facility could potentially affect all of the river communities in Kanawha County due to their location downstream. The primary impact from a failure at Winfield which is located in Putnam County, however, would likely be felt in the municipalities of Cedar Grove, Chesapeake, East Bank, and Pratt or from the loss of the hydroelectric power generation which has a capacity of 14,760 kW (USACE, 2014)

A failure of the USACE's Bluestone Dam in Hinton, West Virginia could impact Kanawha County as well. It dams the New River, primarily providing recreational opportunities in Summers County and the possibility of providing hydroelectric power. The Bluestone dam is a large facility where a catastrophic failure of that dam may significantly impact communities along the New River, a tributary of the Kanawha River. Communities along the Kanawha River as far north as Charleston may be affected. According to the USACE, water from the failure of the Bluestone dam could take as little as 24 hours to reach Charleston.

Failures at the other two dams that protect the Kanawha Valley – the Summersville and Sutton Dams – could also affect Kanawha County. The Sutton Dam is built along the Elk River which flows through northern Kanawha County on its way to its confluence with the Kanawha River in Charleston. The USACE states that the Summersville Dam, constructed along the Gauley River, provides flood protection for the heavily-industrialized Kanawha Valley. Together, the Bluestone, Summersville, and Sutton dams control 57% of the total water drainage in the Charleston area.

Historically, there have been very few dam incidents in Kanawha County. Stanford University maintains the National Performance of Dams Program (<http://npdp.stanford.edu/>), which keeps records of “dam incidents” that have been reported. According to these records, only one incident has occurred in Kanawha County. On February 21, 1997, an inspection recorded concrete deterioration that could be the precursor to a seepage/piping failure at the Lake Chaweva Dam on Rocky Fork. (NOTE: This incident did not result in a dam failure.) The downstream community from this dam is Cross Lanes. The NPDP's narrative for this incident is as follows.

Several sinkholes were observed on the downstream face of the embankment which were later determined to have a depth of up to 2.5'. These sinkholes were not observed during previous inspections. The concrete chute spillway exhibits open construction joints, leaning side walls, evidence of undermining and washout of foundation materials along with left spillway wall. The slumping of embankment materials exists in close proximity to the spillway channel. The drain pipe is rusted complete through at the outlet. The integrity of the drain pipe through the interior of the dam is suspect. A downstream valve maintains the interior pipe under constant reservoir pressure creating the potential for interior embankment saturation and erosion. These conditions represent a serious problem as defined in the Dam Safety Regulations of West Virginia. An order was issued requiring the owners of the dam to

begin draining the reservoir, submit an EAP, and to submit plans for repair of the dam. After the lake drawdown began, a landslide developed within the reservoir area. Dam Safety officials agreed to a reduced rate of drawdown. Plans for repair of the dam are currently being prepared by the owner's engineer. It is not known whether the drawdown or a subsequent rainfall event reactivated the slide.

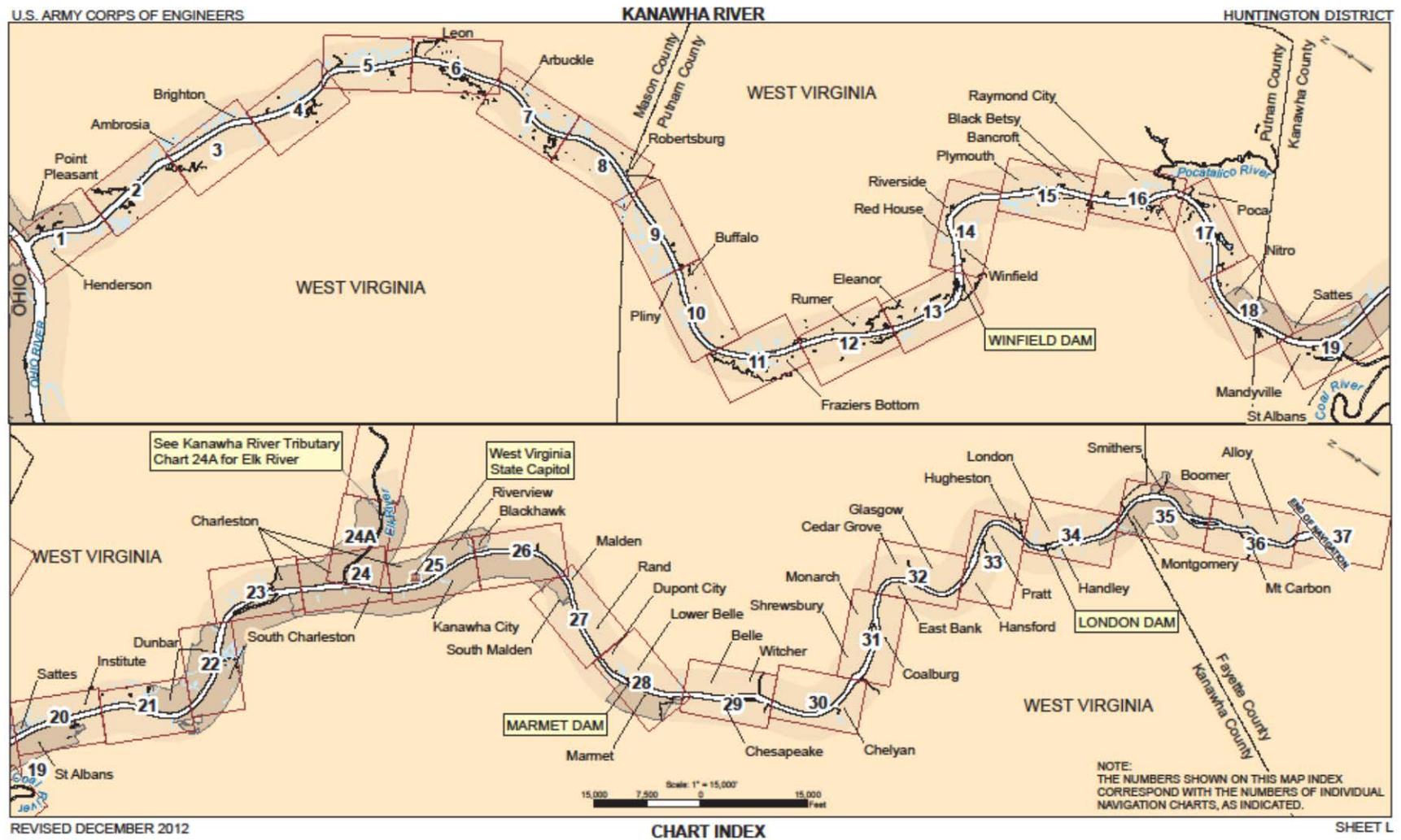


Figure 2.2.3.c

2.2 PROFILE HAZARDS

2.2.4. Drought

Drought is an extended period of deficient rainfall relative to the statistical mean for a region.

RESEARCH

- Palmer Drought Severity Index (PDSI)
- USDA National Agricultural Statistics Service
- FEMA website
- NCDC Storm Event Database
- 2011 KPEPC Hazard Survey
- Internet research

HAZARD EFFECTS

The 2011 KPEPC *Hazard Vulnerability Survey* ranked droughts at 51 out of 54. Droughts are defined according to meteorological,

hydrological, and agricultural criteria. Any significant deficit of precipitation is categorized as meteorological. Hydrological droughts result in noticeably reduced river and stream flow and critically low groundwater tables. Agricultural droughts are indicated by an extended dry period that results in crop stress and harvest reduction.

The Palmer Drought Severity Index (PDSI) is widely used throughout the United States as a measure of drought and to track moisture conditions. The PDSI is defined as “an interval of time, generally in months or years in duration, during which the actual moisture supply at a given place rather consistently falls short of the climatically

Period of Occurrence:	Summer months or extended periods with no precipitation
Number of Events to Date (1996-2014):	14
Probability of Event:	77.78% chance of occurring in a single year (based on number of occurrences over date range analyzed)
Warning Time:	Weeks
Potential Impacts:	Activities that rely heavily on high water usage may be impacted significantly, including agriculture, tourism, wildlife protection, municipal water usage, commerce, recreation, electric power generation, and water quality deterioration. Droughts can lead to economic losses such as unemployment, decreased land values, and agrobusiness losses. Minimal risk of damage or cracking to structural foundations, due to soils.
Cause Injury or Death:	None
Potential Facility Shutdown:	None

expected or climatically appropriate moisture supply”. The range of the PDSI, as seen in table 2.2.4.1, is from -4.0 (extremely dry) to +4.0 (excessively wet), with the central half (-2.0 to +2.0) representing normal or near normal conditions. Figure 2.2.4.a shows the PDSI for the City of Charleston from 1950 to 2013. In the 1950s there were five recorded negative PDSI years. The 1960s were a very dry decade with 7 out of 10 years with a negative PDSI. The 1970s though only had 1 year, 1970, with a negative PDSI. The 1980s had 7 negative PDSI, 1990s had 6 and 2000s claimed 5. From 2010 to 2013 there have not been any negative PDSI years yet; thereby, if holding to the pattern, many dry years are possible in the near future. It is difficult to estimate the actual extreme levels that will be reached but in every decade except the 2000s at least one PDSI was below -2.0. The driest year within that decade was 2007 whose PDSI was -1.95 (www.ncdc.noaa.gov).

PDSI for Charleston Area: 1950-2013

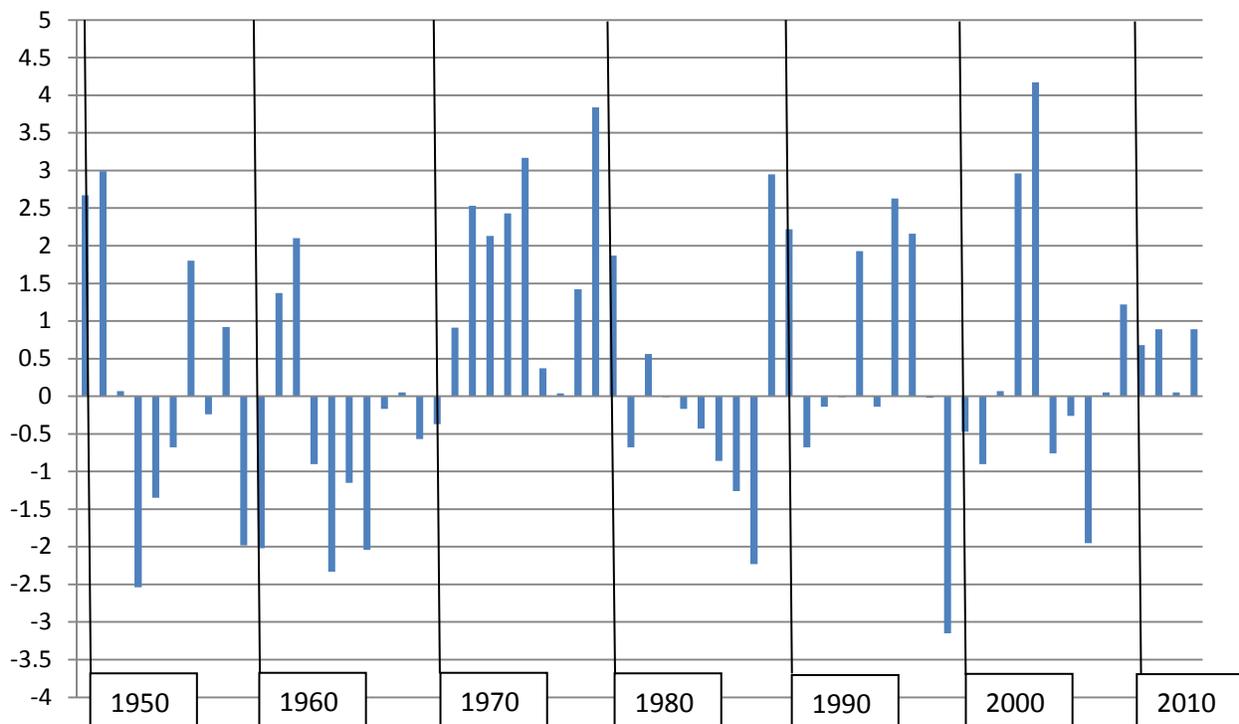


Figure 2.2.4.a

Within the National Climatic Data Center’s (NCDC) Storm Event Database, Kanawha County accounted for 14 drought events from 1996 to 2013. To be counted within the NCDC a drought must be of class D2, D3, or D4 as described within Table 2.2.4.2. Therefore, for a drought to be accounted for in NCDC it must be at least severe in

stature. Even though there were 14 severe or worse droughts since 1996, no deaths, no injuries, and no damages were reported for any of them. In comparison to the PDSI numbers, 1999 reported 6 drought events (May to October) and also the lowest PDSI at -3.15 during the study period. In 2007, which was previously mentioned as having a PDSI of -1.95, 5 drought events within the Kanawha County area (June 6 to November) occurred (www.ncdc.noaa.gov/stormevents/). These account for twelve drought events.

The thirteenth event occurred in February 1997 because little snow occurred even though that year averaged a PDSI of +2.16. The fourteenth event occurred in September 2002 where excessive heat lingered in the area with no rain until the end of the month as remnants from Hurricane Isadore reached the area. The PDSI for 2002 was noted at +0.07.

Drought Intensity Category	Description	PDSI range
D0	Abnormally Dry	0.0 to -0.99
D1	Moderate Drought	-1.0 to -1.99
D2	Severe Drought	-2.0 to -2.99
D3	Extreme Drought	-3.0 to -3.99
D4	Exceptional Drought	-4.0 or less

Table 2.2.4.2

A drought in Kanawha County affects the majority of the county's residents. Kanawha County is comprised of many rural areas with some residents relying on rain for crops, farms, and their water supply relying on rivers, creeks, and underground springs to provide water for crops and farm animals.

If a drought occurs in Kanawha County, it not only affects residents' private water supply, but it also could impact those whose primary income is in some way based on agriculture. In 1977 two Presidential Emergency Disaster Declarations were issued for West Virginia, January 19 and August 24 respectively (<http://www.fema.gov/disasters/grid/state-tribal-government/45>). In drastic contrast a Presidential Major Disaster Declaration occurred for West Virginia April 7, 1977 for flooding, nearly halfway between these two droughts. This helped make the overall PDSI be positive for 1977, but only slightly, at +0.04. This type of shift shows an increase in risk possibility because a drought can occur even in a year that appears to be normal in many other ways.

The municipalities that have water boards can also be impacted by droughts since droughts decrease the availability of public water supplies. Based on research, municipal areas are shown to be slightly more vulnerable to droughts due to the impacts

to the public water system. Communities along the Kanawha River could also be affected economically due to the impacts to waterborne commerce.

Droughts often have a long warning time as temperatures remain high with little precipitation. Water levels in rivers, creeks, and water tables usually can be visually seen as lower. Vegetation will have more difficulty in growing, affecting the rural portions of Kanawha County economically. It could affect both those that grow crops as well as those that herd livestock as prices for feed can increase drastically.

2.2 PROFILE HAZARDS

2.2.5. Earthquake

An earthquake is a sudden motion or trembling that is caused by a release of strain accumulation within or along the edge of the Earth's tectonic plates.

RESEARCH SOURCES

- US Geological Survey
- FEMA *State and Local Mitigation Planning How-To Guide: Understanding Your Risks*, 386-2
- 2011 KPEPC Hazard Vulnerability Survey
- Internet research

Period of Occurrence:	At any time
Number of Events to Date: (1969-2014)	2 Epicenters
Probability of Event:	4.44% chance of occurring in a single year (based on number of occurrences over date range analyzed)
Warning Time:	None
Potential Impacts:	According to FEMA, areas with a PGA of 2 to 4 (0.02 to 0.04) will incur little to no damage with no function loss.
Cause Injury or Death:	Minor risk of injury
Potential Facility Shutdown:	None

HAZARD EFFECTS

The 2011 KPEPC Hazard Vulnerability Survey ranks earthquakes at 53 out of 54. An earthquake is characterized by the sudden release of stored energy which may manifest itself by shaking or displacing of the ground. The severity of these effects is dependent on the amount of energy released from the fault or epicenter

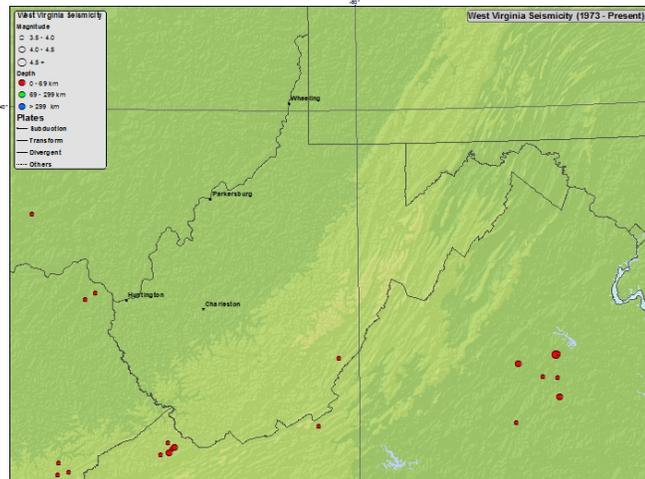


Figure 2.2.5.a

of the quake. The effects of an earthquake can be felt far beyond the site of its epicenter as can be seen in Figure 2.2.5.a. which shows only one event of at least 3.5 since 1973 within the West Virginia borders. Prior to that though, a magnitude 4.5 occurred in southern West Virginia on November 20, 1969. It is considered the largest earthquake in West Virginia's history (http://earthquake.usgs.gov/earthquakes/events/1969_11_20.php). This earthquake was

felt in nine states with broken windows, cracked chimneys, and broken plaster (Modified Mercalli Intensity Scale [MMI] VI). Then, in August 1970 a small earthquake was felt in a limited area (i.e., Charleston, Eskdale, Hamlin, Hurricane, and Saint Albans). These areas felt an MMI IV effect which is described in Table 2.2.5.1 (<http://www.geo.mtu.edu/UPSeis/Mercalli.html>) below. Two earthquakes occurred in the 1990s within Kanawha County, but neither was significant enough to be physically felt. In 1991 a magnitude 3.0 on the Richter scale occurred and then in 1998 a magnitude 2.5 (<http://www.wvgs.wvnet.edu/www/earthquakes/seismic.html>). See Table 2.2.5.1 to compare these Richter scale magnitudes with descriptive effects.

Earthquakes usually occur without warning and, after just a few seconds, can

cause massive damage and extensive casualties. Common effects of earthquakes are ground motion and shaking, surface fault ruptures, and ground failure. Peak ground acceleration (PGA) is a measure of strength of ground movements. The PGA measures the rate in change of motion relative to

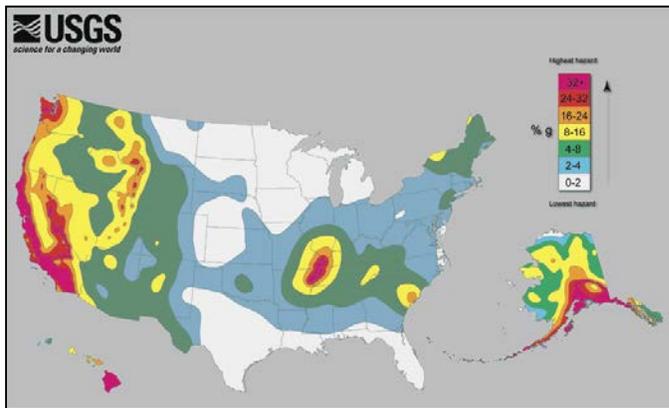


Figure 2.2.5.b

the established rate of acceleration due to gravity.

The map provided by the USGS (Figure 2.2.5.c) depicts the PGA values for areas with a 10% chance of being exceeded over the next 50 years. West Virginia has

an earthquake risk as it is located in the 2 and 4%g area (Kanawha County contains areas within the “3” and “4” zones). Figure 2.2.5.c shows the regional effects while Figure 2.2.5.d focuses on West Virginia. FEMA states that areas with 2 to 4%g PGA or more are considered to have a moderate or high earthquake hazard risk. As seen in Figure 2.2.5.d, Kanawha County is just outside the outer cusp of the higher-potential areas of West Virginia.

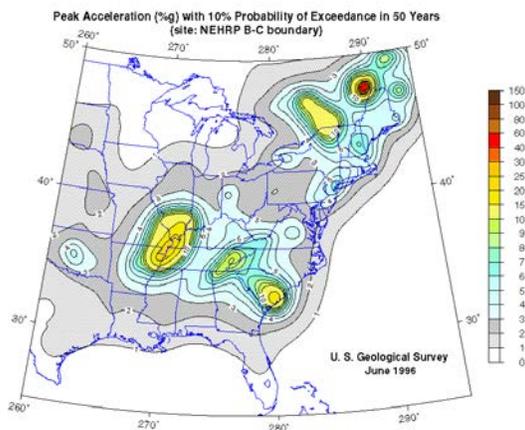


Figure 2.2.5.c

While the probability of an earthquake affecting Kanawha County is considered

moderate to high, the actual damage predicted by such an event would be very minor. As such, earthquake vulnerability is rated “low”.

The Central and Southeast U.S. region covers a large area of relatively diffuse, low rate seismicity as seen in Figure 2.2.5.c. Principle areas of activity include the New Madrid Seismic Zone of the central

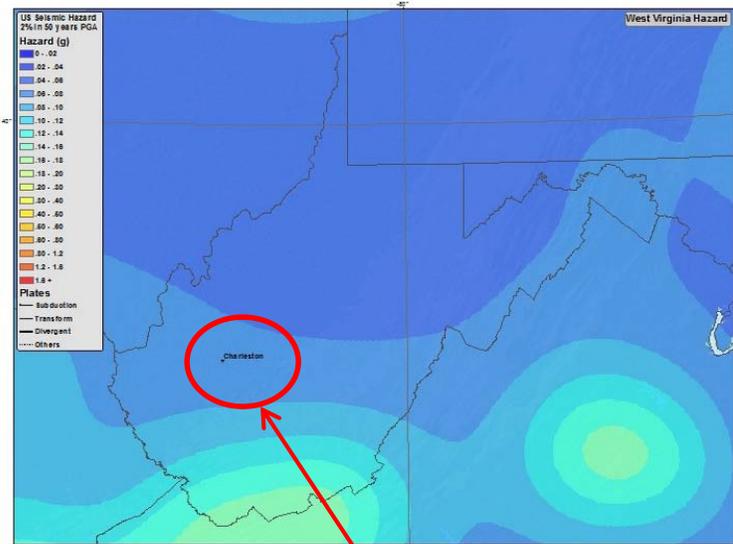


Figure 2.2.5.d Kanawha County

Mississippi Valley and the Southern Appalachian Seismic Zones, extending from Virginia to Alabama. These areas of continued seismic activity increase the likelihood of Kanawha County experiencing or being affected by an earthquake at some point in time even though there is only historical evidence of minor earthquakes occurring in the past. While, as stated earlier, the largest earthquake in West Virginia’s history was a 4.5, but with the increase in drilling within the Marcellus-Utica Shale which uses an injection of fluids to release the gas, new fissures can be created or unknown ones exacerbated causing more drastic shifts to occur and larger earthquakes possible.

Modified Mercalli Intensity Scale		
Mercalli Intensity	Equivalent Richter Magnitude	Witness Observations
I	1.0 to 2.0	Felt by very few people; barely noticeable.
II	2.0 to 3.0	Felt by a few people, especially on upper floors.
III	3.0 to 4.0	Noticeable indoors, especially on upperfloors, but may not be recognized as an earthquake.
IV	4	Felt by many indoors, few outdoors. May feel like heavy truck passing by.
V	4.0 to 5.0	Felt by almost everyone, some people awakened. Small objects moved. trees and poles may shake.
VI	5.0 to 6.0	Felt by everyone. Difficult to stand. Some heavy furniture moved, some plaster falls. Chimneys may be slightly damaged.
VII	6	Slight to moderate damage in well built, ordinary structures. Considerable damage to poorly built structures. Some walls may fall.
VIII	6.0 to 7.0	Little damage in specially built structures. Considerable damage to ordinary buildings, severe damage to poorly built structures. Some walls collapse.
IX	7	Considerable damage to specially built structures, buildings shifted off foundations. Ground cracked noticeably. Wholesale destruction. Landslides.
X	7.0 to 8.0	Most masonry and frame structures and their foundations destroyed. Ground badly cracked. Landslides. Wholesale destruction.
XI	8	Total damage. Few, if any, structures standing. Bridges destroyed. Wide cracks in ground. Waves seen on ground.
XII	8.0 or greater	Total damage. Waves seen on ground. Objects thrown up into air.

Table 2.2.5.1

2.2 PROFILE HAZARDS

2.2.6. Fire Emergencies

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures while an urban fire is any instance of uncontrolled burning which results in major structural damage to residential, commercial, industrial, institutional, or other properties in developed areas.

RESEARCH

- NCDC Storm Events
- National Fire Protection Association
- WFAS-MAPS: National Interagency Fire Center
- 2013 West Virginia Hazard Mitigation Plan
- WV Division of Forestry
- 2011 KPEPC Hazard Vulnerability Survey
- WV State Fire Commission's FY 2014 Annual Report
- Internet research

Period of Occurrence:	At any time – Primarily summer
Number of Events to Date (1996-2014):	2 wildfires 5+ Urban fires
Probability of Event:	38.89% chance of occurring in any single year (based on number of occurrences over date range analyzed)
Warning Time:	Minimal
Potential Impacts:	Impacts human life, health, and public safety. Loss of wildlife habitat, increased soil erosion, and degraded water quality. Utility damage and outages, infrastructure damage (transportation and communication systems), and damaged or destroyed critical facilities.
Cause Injury or Death:	Injury and risk death
Potential Facility Shutdown:	Days to weeks or more

HAZARD EFFECTS

The 2011 *KPEPC Hazard Vulnerability Survey* ranked forest/brush fires at 37 and fires (i.e., urban/structural) at 25 out of 54. Wildfires often begin unnoticed and spread quickly. They are usually signaled by dense smoke that fills the area for miles around. Grasses, bushes,

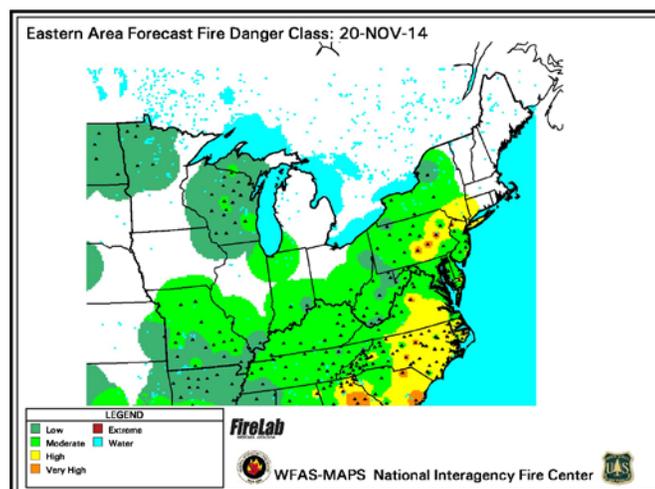


Figure 2.2.6.a

trees, and other vegetation supply fuel for the wildfire. The size of a wildfire is dependant on the amount of fuel available, weather conditions, and wind velocity. In Figure 2.2.6.a (http://wfas.net/images/firedanger/subsets/fdc_f_ea.png), a map from WFAS-MAPS, the



Figure 2.2.6.b

majority of West Virginia is labeled as being at moderate risk for wildfires. Looking specifically at West Virginia, the West Virginia Division of Forestry (WVDOF) created two areas within the state: "Hot" counties in the southern coal fields and the Eastern Panhandle. While WFAS-MAPS have designated all areas in the state as a moderate risk, these areas have a higher risk than other portions of the state as seen in Figure 2.2.6.c. Kanawha County

is within the "Hot" counties in the southern coal fields. Within the 2014 fall fire season, District V, in which Kanawha County is part of, has 66% of the state's acreage lost to fires since October 1, 2014. Extrapolating from the state as to causes, the majority of fires were stated by either debris burning (42%) or equipment use (32%) (<http://www.wvforestry.com/Fire%20Report.pdf>).

Further, the WVDOF created a composite value to compare West Virginia counties and the wildfire concern. Figure 2.2.6.c shows Kanawha County as a high priority county because of past occurrences, topography, and wildlife-urban interface (where cities meet forests). As for past occurrences, NCDC has listed two events in Kanawha County between 1996 and 2013. The first occurred between 11/09/1999 and 11/24/1999 and the WVDOF estimated 38,000 acres in southern West Virginia burned. Investigations suggested that most of the fires were set by arsonists (<http://www.ncdc.noaa.gov/stormevents/>).

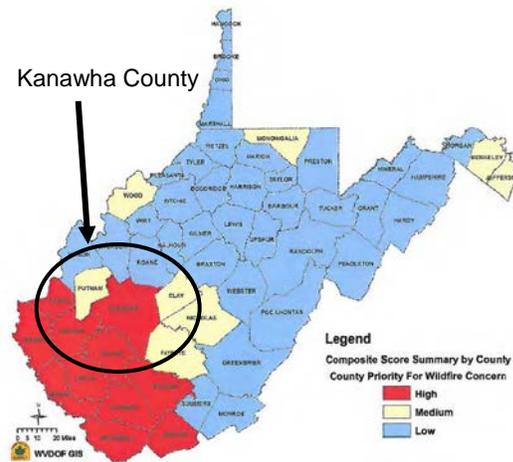


Figure 2.2.6.c

Kanawha County did not report any property damage or any deaths, but a 9-month pregnant nurse was killed by a burnt tree falling

from a 30 foot cliff in Mingo County. Due to the fire damage, the ground lost root support and gave way.

The second occurred in November 2001 in which approximately half of that season's total fires and acreage were lost with 450 fires destroying 37,600 acres. Figure 2.2.6.d shows the extreme southern portions of the county as slightly more vulnerable to wildfires. This is due in part because of the presence of the Kanawha State Forest. If a significant wildfire were to break out in the state forest (and, as stated above, spread quickly and unnoticed due to the sparse population in the state forest), it could spread quickly into other parts of southern Kanawha County.

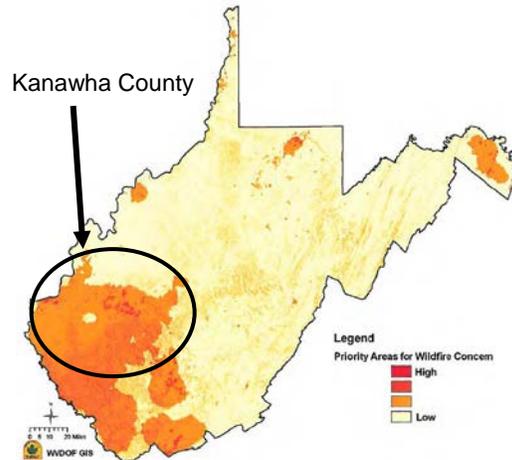


Figure 2.2.6.d

Urban fires, also known as non-wilderness fires, account for more fatalities and economic losses than wildfires. Historically, Kanawha County has had a few large scale instances to reinforce the effects of urban fires. For example, the August 2008 explosion and resulting fire at Bayer Crop Science in Institute (<http://www.csb.gov/bayer-cropscience-pesticide-waste-tank-explosion/>), many of Clendenin's downtown businesses were significantly damaged by a fire in December 2006 (<http://www.wsaz.com/home/headlines/5040451.html>), and Charleston's Woolworth Building fire in March 1949 (<http://www.firefightingnews.com/article.cfm?articleID=62983>). The West Virginia Fire Marshall's Office (WVSFMO) suggests that most are caused by arson or negligence (WV Hazard Mitigation Plan, 2013). These are structural fires, so the more structures within a jurisdiction, the more of a risk is this hazard. The West Virginia State Fire Commission (WVSFC) stated in the [Fiscal Year] FY 2014 Annual Report (<http://www.firemarshal.wv.gov/Documents/State%20Fire%20Commission%20Annual%20Report%20FY%202014%20FINAL.pdf>) that there were 937 requests for fire investigations, an increase of 99 from the previous year. 108 requests were not investigated, 95 were accidental, and 488 were at printing undetermined. The majority (67%) were residences being investigated. The large number of residences is possibly because of West Virginia being listed as a top ten state in four major factors for fire

deaths (poverty, smokers, education factors, and rural areas) as listed within the October 2012 National Fire Protection Association's publication "U.S. Unintentional Fire Death Rates by State" (<http://www.nfpa.org/~media/Files/Research/NFPA%20reports/Regional%20and%20Community%20Patterns/osstate.pdf>). The same report also lists West Virginia with an average of 16.8 fire deaths per capita, placing it as the tenth highest in the nation for 2010. This number was increased as stated within the FY 2014 Annual Report from the WV SFC that during FY 2014 West Virginia was expected to finish in the top three states for fire deaths per capita.

Additionally, urban fires could result in a large number of state facilities lost within Kanawha County. Kanawha County has 1,389 state facilities (WV State Hazard Mitigation Plan, 2013). The Insurance Services Office (ISO) classifies facilities through a Public Protection Classification rating between 1 and 10 where 1 has the best possible protection and 10 has no recognized protection. Within this system, only 17 (1.2%) state facilities within Kanawha County were Class 1. 586 (41.5%) of the state facilities were either Class 10 or unknown.

Warning time for either a wildfire or an urban fire can be very short. Both can start unnoticed and spread quickly, as stated before, based on fuel and wind velocities. These same factors can also determine the duration of a fire emergency since if fuel no longer exists a fire usually dies away and if wind velocities decrease flames are not fanned or receiving as much oxygen.

2.2 PROFILE HAZARDS

2.2.7. Flooding

Flooding is defined as a general temporary condition of partial or complete inundation of normally dry land areas from: overflow of inland or tidal waters; unusual and rapid accumulation of runoff of surface water from any source; mudflows; or the sudden collapse of shoreline land. A flash flood is a rapid flooding of low-lying areas, rivers, and streams that is caused by intense rainfall and is often associated with thunderstorms.

RESEARCH

- FEMA repetitive loss database
- FEMA Disaster Declarations
- DFIRM floodplain mapping (WV Flood Hazard Determination Tool)
- NOAA National Satellite and Information Service, National Climatic Data Center (NCDC)
- 2011 *KPEPC Hazard Vulnerability Survey*
- Interviews with local officials
- Public response
- Internet research

HAZARD EFFECTS

Flooding is arguably the highest priority natural hazard in Kanawha County. It

Period of Occurrence:	Primarily January through May (history shows incidents occurring year-round) Flash Flood – At any time depending on recent weather conditions Result of Dam Failure – At any time
Number of Events to Date (1996 – 2014):	56
Probability of Event:	3.1 flooding events can be expected annually (based on the number of historical occurrences over the date range analyzed)
Warning Time:	River Flood – 3 to 5 days Flash Flood – Minutes to hours Dam Failure – None
Potential Impacts:	Impacts to human life, health, and public safety. Utility damage and outages, infrastructure damage (transportation and communication systems), structural damage, fire, damaged or destroyed critical facilities, and hazardous material releases. Can lead to economic losses such as unemployment, decreased land values, and agrobusiness losses. Floodwaters are a public safety issue due to contaminants and pollutants.
Cause Injury or Death:	Injury and moderate risk of death
Potential Facility Shutdown:	Days to Weeks

is listed as the second highest hazard, but it is an obvious effect from the Number 1 hazard, dam failure within the *2011 KPEPC Hazard Vulnerability Survey*. Kanawha County is very susceptible to flooding largely due to the physical geography of the county, which includes over 400 rivers, streams, and creeks (<http://www.placenames.com/us/54039/stream/>) as well as varied topography. The worst floods usually occur when a river overflows its banks. Periodic floods occur naturally on most rivers, forming an area known as a floodplain. With enough rainfall, the rivers and creeks will rise up to and over the floodplain, thus causing a flood.

HISTORICAL HAZARD OCCURRENCES

With over 400 rivers, streams, and creeks, Kanawha County has a long history of flooding. Fifty-six events including flash flooding, have been reported to the National Climatic Data Center (NCDC) since 1996. Collectively, these floods have caused seven deaths and \$36.243 million in property damage over the same time period. Nine of the events since 1996 have also been declared as major Presidential Disaster Declarations.

As for the differences between flash flooding and regular flooding, flash floods have little to no warning time. They can be just as, if not more than, destructive than a regular flood though, such as the flash flood that occurred on June 16, 2003, in the Pocatalico and Sissonville area along Grapevine Creek and Legg Fork. Flooding expanded quickly, overflowing Elk Two Mile and its tributaries, filling businesses, the Kanawha County animal shelter, and a state and federal office building with upwards of four feet of water. While this event did not cause any deaths, \$7.00 million in property damage was sustained with an estimated 46 homes destroyed and 150 with major damage.

On March 13, 2010, flood concerns were present as rain started because of the water contained in snow pack following a cold and snowy February. Flooding occurred in Kanawha County, starting with small streams. Multiple impacts were felt, including submerged vehicles in Smith Creek and roads flooded by Rocky Fork and Fisher Branch northeast of Cross Lanes. The worst small stream flooding was at the mouth of Paint Creek in the Hansford area to Pratt vicinity. Rising waters on the Kanawha River compounded the problem. A mobile home park flooded, resulting in evacuations. Several cars were also flooded in this area. Ultimately, the Kanawha River crested at 29 feet. Approximately four feet of water was reported in the South Charleston Community

Center. This incident resulted in approximately \$700,000 in property damage (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=215596>).

At the other extreme, a flash flood on February 18, 2000, in Sissonville caused significantly less property damage, amounting to \$500,000, but three deaths. These three deaths occurred along Kanawha Two Mile Creek during a rescue attempt of five gas station employees. Without flotation devices, three of the rescued employees fell out of the rescue boat. The first was found in a nearby tree that night, the second in the stream the next day, and the third, due to rapid currents, was found 140 miles away, past 3 locks and dams, in the Ohio River near Scioto County, Ohio.

On and around May 17, 2010, rain over a five-day period caused the ground to be wetter than normal. As rain continued, flash flooding occurred. The most impact was along small tributaries to Rocky Fork, including Fishers Branch. An unnamed tributary creek along Route 501 flooded back yards and around homes east of Cross Lanes. Near the junction of Routes 501 and 622, two homes were severely flooded on a private road called Valley Hill Drive. A private culvert could not handle the water; the water could only flow around the culvert on one side. The high water knocked down fences, went over the road and straight through two rental homes (water was several feet deep in those two homes). Rocky Branch flooded sections of Route 622. The headwaters of Martins Branch flooded a few homes, outbuildings, and garages. Numerous streams between Pocatalico and Sissonville flooded, including Legg Fork. The Pocatalico Community Church had several feet of water in its basement. Even Flinn Elementary School got a few inches of water inside the building (the school is not near a stream). Ultimately, this event resulted in approximately \$1.2 million in property damage (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=229357>).

In addition to the massive amounts of water that builds during floods, other events can occur as well such as landslides, mudslides, severe storms, wind events (both straight line and tornados), and hail. For example, six of the Major Presidential Disaster Declarations included areas with severe storms and landslides (<http://www.fema.gov/disasters/grid/state-tribal-government/45>). The July 1, 1998, Major Presidential Disaster Declaration included tornados and the June 2, 1997, flash flood event contained high straight winds which blew over trees in the Island Branch area and penny-size (0.75 inch) hail in Charleston.

EXPOSURE OF ASSETS

By virtue of their locations on either the Elk or Kanawha Rivers, all of the municipalities in Kanawha County experience flooding to some degree. Due to the presence of larger population densities near major waterways and higher valued assets, as seen in Figure 2.2.7.a (below), however, Charleston, Clendenin, Dunbar, Marmet, Pratt, and South Charleston can be said to have slightly higher vulnerability to flooding. Identification of floodplain areas within the county and the incorporated municipalities is based on Digital Flood Insurance Rate Map (DFIRM) data produced by the National Flood Insurance Program (NFIP). Geographic information system (GIS) maps developed for this plan display the location of all major water bodies in the county and delineate the 100-year floodplain boundaries. These are areas that have a one percent chance of equaling or exceeding the recorded base flood elevation during any year.

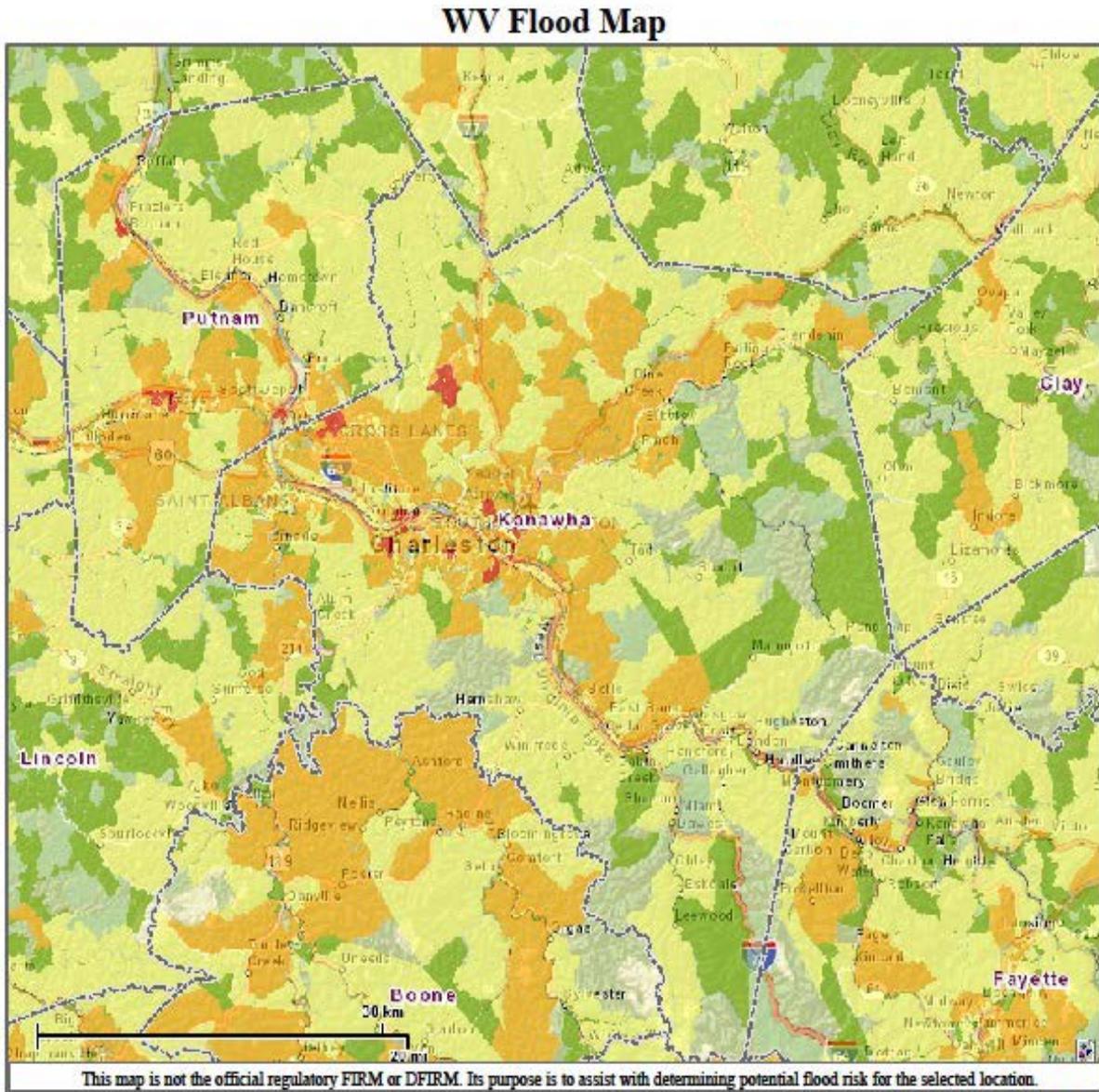


Figure 2.2.7.a

The color-shaded areas in the figure represent the potential flood risk in terms of the exposure of total assets. The following is the key to the map (in thousands of dollars).



Table 2.2.7.1 depicts expected building damage based on a HAZUS-MH run for Kanawha County based on a 100-year flooding event.

Table 2.2.7.1

Expected Building Damage by Occupancy

<i>Occupancy</i>	<i>1-10%</i>	<i>11-20%</i>	<i>21-30%</i>	<i>31-40%</i>	<i>41-50%</i>	<i>>50% (Substantially)</i>
Agriculture	0	1	1	1	0	1
Commercial	2	142	30	12	6	8
Education	0	0	0	0	0	0
Government	4	29	0	0	0	0
Industrial	0	1	2	1	2	3
Religion	1	12	0	0	0	1
Residential	0	116	1,483	1,176	4,016	2,536
TOTAL	7	301	1,516	1,190	4,024	2,549

Regarding building damage, HAZUS-MH estimates both building loss and business interruption dollar losses, organized by category of building.

Table 2.2.7.2

Building-Related Economic Loss Estimates (millions of dollars)

<i>Area</i>	<i>Residential</i>	<i>Commercial</i>	<i>Industrial</i>	<i>Others</i>	<i>Total</i>
Building Loss					
Building	1,102.33	363.14	52.70	66.50	1,584.66
Content	670.12	838.77	116.88	277.61	1,903.37
Inventory	0.00	17.88	20.43	2.69	41.00
Business Interruption					
Business Interruption	1.89	10.98	0.03	8.72	21.64
TOTAL	1,774.33	1,230.76	190.06	355.51	3,550.67

The HAZUS system also provides data regarding expected damage to critical facilities: fire stations, hospitals, police stations, and schools. Facilities under all categories could be impacted by a 100-year event. Table 2.2.7.3 lists the facilities by types and numbers impacted as well as lists the facilities that HAZUS likely referenced. (NOTE: HAZUS does not list facilities by name.)

Table 2.2.7.3

Potential Critical Facility Flooding Impacts

<i>Facility Type</i>	<i>Total</i>	<i>Sustain Moderate Damage</i>	<i>Loss of Use</i>	<i>Likely Facilities Referenced</i>
Fire Stations	28	7	7	Cabin Creek VFD, Clendenin VFD, Dunbar FD, Glasgow VFD, Jefferson VFD, Malden VFD, Tornado VFD
Hospitals	5	3	2	St. Francis Hospital, CAMC Memorial
Police Stations	18	11	11	KCSD-Elkview Detachment, Clendenin PD, UC Public Safety & Security, US Marshals-District IV, Chesapeake PD
Schools	86	24	23	Mountaineer Montessori, Andrews Heights ES, Dunbar Primary Center, Dunbar MS, Conquerors Christian School, Tyler MS, Bonham ES, Elkview MS, Elk Valley Christian School, Bridge ES, Herbert Hoover HS, Clendenin ES, Sissonville MS, Sissonville ES, Sharon Dawes ES, East Bank MS, Upper Kanawha Valley Christian School, Belle ES

Local leaders are aware of the flooding impacts to commercial and industrial interests (which are presented in the tables above generally). Several large employers are impacted by flooding in some way. For instance, portions of the University of Charleston's campus is located in the floodplain, as is a portion of Columbia Gas' property south of the Kanawha River, the Kanawha County Courthouse, county annex building, Charleston Town Center Mall, federal building, municipal auditorium, and portions of the Charleston Civic Center, . Also in Charleston, CAMC Memorial could be impacted by flooding. Outside of Charleston, the parking lot at the Dupont plant in Belle are located in the floodplain. Downstream of Charleston, portions of the Union Carbide/Dow Tank Farm are in the floodplain, as is Shamblin Stone and ZRAT in Dunbar.

Numerous public health concerns also arise from flooding. Most notably, in the immediate aftermath of significant flooding incidents, debris is generated. Said debris not only piles up, but flooding debris could also have been standing in floodwaters and may have been subject to a number of bacteria in standing floodwaters. HAZUS-MH breaks debris into three general categories: finishes (dry wall, insulation, etc.), structural (wood, brick, etc.), and foundations (concrete slab, concrete block, rebar, etc.). Based on a 100-year flood scenario, the program estimates that a total of 495,859 tons of debris would be generated (29% - Finishes, 36% - Structural).

The Kanawha-Charleston Health Department ranked flooding as the second highest hazard risk for health and health systems in Kanawha County in its 2012 risk assessment. (It is significant to note that dam failure was the highest ranked, the principle impact of which would be flooding.) In flooding hazards, the public health role would be to monitor drinking water; ensure no chemical spills at plants and, if so, initiate clean-up; and set-up cooling/heating stations depending on temperature.

UTILITIES AND INFRASTRUCTURE

Flooding could result in damage to utilities and infrastructure throughout Kanawha County and the municipalities therein. (Again, these figures are based on the 100-year flooding scenario in HAZUS-MH.)

Table 2.2.7.4

Estimated Water/Wastewater System Damage

<i>System</i>	<i>Facilities Damaged</i>	<i>Avg. % Damaged</i>	<i>Estimated Total Loss</i>	<i>Non-Functional Facilities</i>
Potable Water	4	40	54,878,000	4
Wastewater	24	37.21	\$612,680,000	23

HAZUS-MH allows for a comparison between utility system dollar exposure and the estimated direct economic losses.

Table 2.2.7.5

Utility System Exposure vs. Estimated Loss

<i>System</i>	<i>Exposure</i>	<i>Estimated Direct Loss</i>	<i>Percentage</i>
Potable Water	137,196,000	54,878,000	40.00
Wastewater	3,841,488,000	612,680,000	15.95
Oil Systems	206,000	41,000	19.90
Natural Gas	15,718,000	1,784,000	11.35
Electric Power	453,200,000	0	0.00
Communication	1,854,000	0	0.00
TOTAL	4,449,662,000	669,384,000	15.04

Impacts to transportation systems vary and include temporary blockages due to inundation as well as physical damage. Long-term damage would be expected to be rather light, with HAZUS-MH only estimating one highway bridge being rendered a total loss.

EMERGENCY SERVICES CONSIDERATIONS

A 100-year or larger flood would comprise a significant emergency response in the Kanawha Valley. To plan for such a response, emergency management and response agencies have compiled the *Kanawha-Putnam Emergency Management Plan* and the *Kanawha County-City of Charleston Evacuation Plan*. Though both of these documents are all-hazard in nature, they do address flooding concerns. For example:

- **Emergency Management Plan:** The all-hazard plan guides the general response to emergencies throughout Kanawha County and the municipalities therein. In addition to guidelines applicable to all types of responses, the plan contains hazard-specific annexes detailing weather emergencies (including flash flooding) and dam/impoundment emergencies.
- **Evacuation Plan:** This plan includes flooding and dam failure as hazards that could necessitate an evacuation. Further, it discusses the amount of lead time that might be available should flooding be noted at certain areas (i.e., if stream gauges reach certain levels).

HAZUS-MH also estimates the number of households that would be expected to be displaced as a result of the 100-year event. The model estimates 13,754 households would be displaced, which includes households evacuated from within or very near to the inundated area. Of these, approximately 33,700 people could need temporary shelter. Even if current planning estimates hold true – that only approximately 10% would seek shelter in public shelters – the local emergency services network may have to shelter 3,370 impacted persons.

REPETITIVE LOSS PROPERTIES

Table 2.2.7.6 depicts the repetitive loss properties in Kanawha County and the municipalities therein. This data is necessarily general to protect the privacy of the property owners.

Table 2.2.7.6

Repetitive Loss Properties

<i>Community</i>	<i>Number</i>	<i>Type</i>	<i>No. of Losses</i>	<i>Mitigated (Y/N)</i>
Kanawha County	126	Residential	323	0 (Y), 126 (N)
	11	Non-Residential	25	0 (Y), 11 (N)
City of Charleston	20	Residential	59	13 (Y), 7 (N)
	2	Non-Residential	5	1 (Y), 1 (N)
Town of Clendenin	5	Residential	11	0 (Y), 5 (N)
	0	Non-Residential	N/A	N/A
Town of Dunbar	4	Residential	8	0 (Y), 4 (N)
	0	Non-Residential	N/A	N/A
Town of Marmet	1	Residential	2	0 (Y), 1 (N)
	0	Non-Residential	N/A	N/A
Town of Pratt	3	Residential	8	0 (Y), 3 (N)
	0	Non-Residential	N/A	N/A
City of South Charleston	4	Residential	9	0 (Y), 4 (N)
	1	Non-Residential	3	0 (Y), 1 (N)
TOTAL	163	Residential	420	13 (Y), 407 (N)
	14	Non-Residential	33	1 (Y), 32 (N)

NATIONAL FLOOD INSURANCE PROGRAM PARTICIPATION AND MANAGEMENT

All 15 local governments in Kanawha County are participants in the National Flood Insurance Program (NFIP). Table 2.2.7.1 shows the community status for each of these jurisdictions.

Community Name	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Regulation-Emergency Plan Date
Kanawha County	04/25/1975	03/18/1985	02/06/2008	03/18/1985
Belle, Town of	10/31/1975	04/15/1982	02/06/2008	04/15/1982
Cedar Grown, Town of	03/08/1974	06/01/1982	02/06/2008	06/01/1982
Charleston, City of	05/10/1974	06/15/1983	02/06/2008	06/15/1983
Chesapeake, Town of	03/15/1974	06/01/1982	02/06/2008	06/01/1982
Clendenin, Town of	06/11/1976	07/16/1984	02/06/2008	07/16/1984
Dunbar, City of	03/01/1974	06/01/1982	02/06/2008	06/01/1982
East Bank, Town of	03/22/1974	06/01/1982	02/06/2008	06/01/1982
Glasgow, Town of	03/08/1974	06/15/1982	02/06/2008	06/15/1982

Community Name	Initial FHB Identified	Initial FIRM Identified	Current Effective Map Date	Regulation- Emergency Plan Date
Handley, Town of	01/17/1975	07/05/1984	02/06/2008	07/05/1984
Marmet, Town of	04/12/1974	04/15/1982	02/06/2008	04/15/1982
Nitro, City of	03/15/1974	04/15/1982	02/06/2008	04/15/1982
Pratt, Town of	03/08/1974	05/01/1974	02/06/2008	05/01/1984
South Charleston, City of	11/01/1974	06/15/1982	02/06/2008	06/15/1982
St. Albans, City of	03/08/1974	06/15/1982	02/06/2008	06/15/1982

Table 2.2.7.7

In all instances, jurisdictions have designated an “NFIP Coordinator” (typically referred to as a “floodplain administrator” or “floodplain manager”). The NFIP Coordinator maintains the jurisdiction’s floodplain ordinance and ensures that development is compliant with that ordinance (and, consequently, the NFIP). Jurisdictional NFIP coordinators also coordinate the jurisdiction’s floodplain permitting process, determines/interprets base flood elevations, and interfaces, as necessary, with community leaders and the public. (Additional information, where provided, is detailed below.) Kanawha County’s flood map modernization project was completed when updated Digital Flood Insurance Rate Map (DFIRM) data became available in February 2008.

The floodplain manager for the City of Charleston, who works in the city’s planning department, is the primary individual responsible for enforcing the city’s floodplain ordinance (which was adopted by the Charleston City Council on December 17, 2007 and revised in January, 2011), which includes making flood zone determinations, ascertaining the base flood elevation (BFE) in numbered A zones, and issuing permits for development in a community’s floodplain. The floodplain manager role in the city also includes maintaining community floodplain management files, such as FIRM maps, floodplain permits, elevation certificates, and FEMA map revisions (LOMCs), as well as coordinating the Community Rating System (CRS) for the City of Charleston.

Charleston’s floodplain ordinance identifies the floodplain as those areas in the city which are subject to the 100-year flood, as shown on the FIRM and described in the Flood Insurance Study (FIS) prepared for the city by FEMA, February 6, 2008.

Generally, new development would not be permitted in the floodway where reasonable alternatives exist elsewhere. When no alternatives exist, floodway encroachment shall be the minimum necessary to accomplish the project. Any development and/or use of land in the floodway fringe and approximated floodplain is permitted such that all uses, activities, and/or development is undertaken in strict compliance with flood-proofing. All subdivision proposals and other proposed new developments proposed to take place either fully or partially within the approximated floodplain area (which are greater than 10 lots or two acres) shall include base flood elevation data. All new or improved structures located in the approximated floodplain shall be elevated at least three feet above the highest adjacent grade unless BFE data has been obtained from an authoritative source.

Charleston's floodplain manager also reaches out to the public on a regular basis. The manager sends annual outreach letters to repetitive loss property owners as well as real estate agents, lenders, and insurance agents. The floodplain manager is also the individual to explain floodplain development requirements to community leaders, citizens, and the general public (when requested).

Charleston has undertaken a number of flood mitigation projects. For instance, buyouts are completed as per funding availability. Additionally, the city supported efforts by Charleston Area Medical Center to construct a floodwall near its Memorial Hospital facility. As part of the city's CRS efforts, the Planning Department completed an *area analysis* which analyzed the probable causes of flooding at each of the city's repetitive loss properties.

The City of Dunbar's floodplain ordinance was passed as Ordinance 623 on November 19, 2007. Like Charleston, Dunbar utilizes the 100-year flood as shown on the FIRM and described by the FIS prepared for the city by FEMA in February, 2008. In Dunbar, the identified floodplain shall also be those areas of the city which have been identified as flood hazards by the city by use of historic or other technical data and shown on the City of Dunbar "Local Flood Hazards Map". No encroachments, including fill, new construction, substantial improvements, repair of substantial damage, or other development will be permitted unless it has been demonstrated through hydrologic and hydraulic analysis that no increase in base flood elevation will occur.

Dunbar's floodplain manager serves as the primary point of contact for the city's floodplain ordinance. As part of that role, the manager reviews proposed development less than 10 lots or two acres to ascertain the specific flood risk at the building site and assigns a "minimal, moderate, or significant" risk level. The floodplain manager may

also work with owners to determine a suitable height for floodplain development. The floodplain manager also determines community flood elevation, where appropriate. The floodplain manager's role also includes making an initial determination of boundaries should disputes of flood district boundaries arise.

Article 1733 addresses the floodplain area for the City of Nitro. The city utilizes the 100-year flood and the most current FIS prepared by FEMA to establish the floodplain area. Floodplains consist of three areas: the floodway, floodway fringe, and approximated area. In the floodplain area, any development and/or use of land may be permitted, provided that all such uses, activities and/or development is undertaken in strict compliance with flood-proofing. Hydrologic and hydraulic analyses should demonstrate that any encroachments (including fill, new construction, substantial improvements, or other development) does not result in an increase of the base flood elevation.

The Town of Pratt's floodplain ordinance was passed by the Common Council of the Town of Pratt on October 9, 1990. Pratt's ordinance also uses the 100-year flood and the relevant FIS. The ordinance identifies two specific areas within the floodplain: the floodway – those areas identified as such in the FIS and as shown on the floodway map or FIRM – and the floodway fringe, which shall be those areas for which specific 100-year flood elevations have been provided in the FIS but which lie beyond the floodway area (as shown on the floodway map or FIRM). The ordinance regulates development in floodway and floodway fringe areas and also addresses the altering or relocation of a watercourse within floodplain areas. Pratt's Permit Officer serves as the floodplain administrator, issuing permits, checking elevations, and addressing boundary disputes.

St. Albans' floodplain ordinance (#2102) was based by the city council on January 3, 2008. The city's ordinance establishes a "floodplain district – the 100-year flood as shown on the FIRM and described in the FIS prepared for the city by FEMA in February, 2008 – and regulates, restricts, and limits the construction, substantial improvement, repair of substantial damage, or the placement or relocation of any building or structure or other development in the floodplain district. The ordinance also provides for certain minimum standards for construction within the floodplain district and encourages the use of appropriate construction practices in order to prevent or minimize flood damage in the future. St. Albans' City Engineer serves as the floodplain

administrator, coordinating the permitting process and determining flood elevations, obtaining/developing additional information about the flood risk, etc.

The City of South Charleston's ordinance was also adopted on January 3, 2008. Much like St. Albans, South Charleston's City Engineer serves as the floodplain administrator, performing the same sorts of tasks. South Charleston has also used the February 2008 FIS and the 100-year flood as the base event in its ordinance.

In addition to the incorporated areas listed above, Kanawha County has many unincorporated areas. Since 2008, Kanawha County has conducted several mitigation projects in these unincorporated areas such as Big Sandy, Cabin Creek, Elk, Jefferson, Loudon, Malden, Poca, and Union Districts taking every opportunity to alleviate flooding issues. Kanawha County has cleaned out blocked streams and checked parcels of property that have a structure on it to assure all FEMA and Kanawha County Floodplain Regulations has been met.

Kanawha County has worked diligently with the Appalachian Power to put in place an agreement not to allow new service to be installed until a Certificate of Floodplain Compliance has been issued thru the Kanawha County Planning Office. This agreement allows Kanawha County to better protect the safety and welfare of the citizens in the unincorporated areas from flooding disasters.

Kanawha County Homeland Security Emergency Management makes every attempt to educate, promote public awareness on the grant programs available, and how to obtain floodplain information via the Kanawha County website and brochures. Kanawha County has also partnered with the WV GIS Technical Center, FEMA and the WV Department of Homeland Security Emergency Management to create, the West Virginia Flood Tool this is designed to provide floodplain managers, insurance agents, developers, real estate agents, local planners and citizens with an effective means by which to make informed decisions about the degree of flood risk for a specific area or property.

Kanawha County's floodplain ordinance was adopted by the county commission on November 29, 2007 and became effective on February 6, 2008. The county's ordinance utilizes the 100-year floodplain, as shown on the FIRM and described in the Flood Insurance Study (FIS) prepared for the county by FEMA, February 6, 2008. According to the county's ordinance, no encroachments, including fill, new construction, substantial improvements, repair of substantial damage, or other development shall be permitted in the floodway area unless it has been demonstrated through hydrologic and

hydraulic analysis that the proposal will not result in any increase in the BFE. The intent of the ordinance is to preserve the floodway to the greatest extent possible. New development will not be permitted where reasonable alternatives exist elsewhere; where there are no alternatives, encroachment must be kept to a minimum. All permitted uses shall be undertaken in strict compliance with flood-proofing.

2.2 PROFILE HAZARDS

2.2.8. Hazardous Material Incident

A technological hazard refers to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials.

RESEARCH

- Kanawha-Putnam Emergency Management Plan
- 2011 KPEPC Hazard Vulnerability Survey
- 2014 KPEPC Commodity Flow Study
- Interviews with local officials
- USEPA EnviroFacts database
- Local media coverage

Period of Occurrence:	At any time
Number of Events to Date (1986-2014):	3,681
Probability of Event:	131.46 hazmat events (including permitted releases) can be expected annually (based on number of occurrences over date range analyzed)
Warning Time:	None
Potential Impacts:	Potential loss of human life, economic loss, environmental damage
Cause Injury or Death:	Injury and risk of multiple deaths
Potential Facility Shutdown:	Days to weeks

HAZARD EFFECTS

For the purpose of this assessment, it is assumed that all technological emergencies are accidental and that their consequences are unintended.

The manufacture, storage, transportation, and use of hazardous materials can become a hazard if an accident occurs. Hazardous material incidents typically happen in two ways: fixed facility and transportation accidents. The major difference between the two is that it is reasonably possible to identify and prepare for a fixed facility incident because laws require those facilities to notify state and local authorities of what materials are being used and/or produced at that facility. This could give more warning time for a hazardous material incident at a facility because there are known materials with known effects. Transportation incidents are substantially more difficult for which to prepare, however, because it is difficult to determine what material(s) could be involved until the

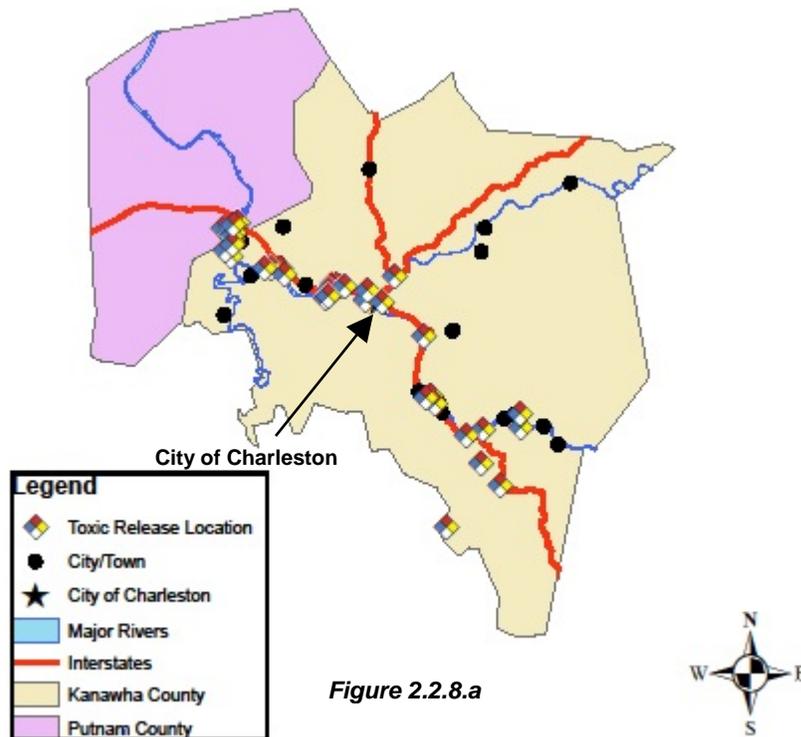
accident actually happens and these events give virtually no warning. Information is routinely compiled on the locations of facilities that store hazardous materials and transportation is dynamic with the information only listed on a manifest within the vehicle and in a report at the company that sent it. Within the *2011 KPEPC Hazard Vulnerability Survey*, this category was divided into many, more specific event categories. Table 2.2.8.1 lists those categories and what each of the rankings is out of 54.

2011 Hazardous Material Incident Categories

Event	Ranking (out of 54)
Chemical release (industrial accident)	3
Hazmat Accident	8
Transportation accident (highway)	15
Industrial accident	29
Transportation accident (railroad)	34
Radiological/nuclear	38
Transportation accident (air)	46
Transportation accident (water)	48

Table 2.2.8.1

In review of the EPA's Envirofacts, 2,807 facilities are regulated in some capacity to include water discharge permitting, and hazardous waste disposal. 2,156 are within 20 miles of Charleston and 513 are within 2.5 miles. These numbers include 52 facilities that Envirofacts places on the Putnam County side of Nitro (<http://oaspub.epa.gov/enviro>). Through interviews with local officials, 82 facilities are within the City of Charleston and 118 entities report to Kanawha County under EPA's Tier II reporting requirements. Of those listed in EPA's Envirofacts, 1,002 have water release permits, 1,162 have hazardous waste permits, and there are no radiation permits. 43 facilities have had toxic release inventory (TRI) events which include 10 facilities that are listed on the Putnam County side of Nitro. These facilities have been mapped in Figure 2.2.8.a. Figure 2.2.8.a shows the majority of the TRI events have occurred at facilities along I-64, I-77, I-79, and the Kanawha River. These same facilities are also clustered around larger population density areas to include Charleston, South Charleston, Nitro, Institute, and Marmet.



Beyond these known TRI events, the *2014 KPEPC Commodity Flow Study* shows a significant increase from 2008 to 2014 on I-77, Exit 85 in the number of hazmat carrying trucks per hour as well as a wide variety of chemicals to include Extremely Hazardous Substances (EHS). Near Institute on I-64, a significant increase in the percentage of hazmat carrying trucks was observed as well as in South Charleston. Finally, Table 2.2.8.2 lists larger cities and town in Kanawha County which have a higher chance of a hazardous material incident because of the various hazardous material using locations and transportation methods available nearby. For a more detailed look at the transportation aspect, refer to the *2014 KPEPC Commodity Flow Study*.

Higher Risk Areas In Kanawha County

Location	Interstate	Rail	Waterway	Covered Facility
Belle		X		X
Charleston	X	X	X	X
Dunbar	X	X		X
Marmet	X	X	X	X
Nitro	X	X		X
St. Albans	X	X		
South Charleston	X	X		X

Table 2.2.8.2

Hazardous material incidents by rail have recently been a concern of local leaders. In February 2015, a 109-car CSX train derailed in neighboring Fayette County, West Virginia. Approximately 20 cars caught fire; some exploded (www.reuters.com). The train was carrying Bakken crude oil. Though it was ultimately determined that none of the derailed cars entered the Kanawha River, it was initially reported that one car had. Tests were conducted for several days for traces of oil at water intakes. It is significant to note that this train had passed through Charleston on the same trip on which it had derailed.

Beyond the fixed industrial facilities and the transportation aspects associated with the materials to and from these fixed facilities, large quantities of wastewater, “coal slurry”, can be detrimental to the waterways. In January 2014, the cleaning product Crude 4-Methylcyclohexanemethanol (MCHM) leaked into the Elk River affecting 300,000 residents (<http://www.amwater.com/wvaw/About-Us/news.html>). A month later, on February 12, 2014, another 100,000 gallons of coal cleaning wastewater was released. This time it was in the Kanawha River but was not MCHM. The new chemical that appeared in this event was able to be filtered through the Kanawha Valley Water Treatment Plant, thereby not affecting the public water supply (<http://tlarremore.wordpress.com/2014/02/12/environment-pollution-in-west-virginias-kanawha-river/>). This wastewater was from cleaning coal of impurities. Other forms of wastewater are increasing because of drilling within the Marcellus-Utica Shale has increased. It is unclear what problems this wastewater could bring. While the percentage by volume is low, often less than 0.5%, the quantities of water are often extremely high; for example, a typical hydrofrac job, three million gallons of water will be used and 15,000 gallons of chemicals could be present. This wastewater can contain brines, heavy metals, radionuclides, and organics (USGS Fact Sheet 2009-3032, 2009).

2.2 PROFILE HAZARDS

2.2.9. Land Subsidence

Land subsidence refers to any failures in the ground that cause collapses in the earth's surface.

RESEARCH SOURCES

- USGS National Maps
- FEMA Disaster Declarations
- FEMA: *State and Local Mitigation Planning How-To Guide: Understanding Your Risks*, 386-2
- USDA Soil Conservation Service: *Kanawha County Soil Survey*
- 2011 KPEPC Hazard Vulnerability Survey
- NCDC Storm Events
- Internet research

Period of Occurrence:	At any time – Chance of occurrence increases following long periods of heavy rain, snowmelt, or near construction activity
Number of Events to Date (1996 to 2015):	2
Probability of Event:	10.53% chance of occurring in any single year (based on number of occurrences over date range analyzed)
Warning Time:	Weeks to months – Some instances of land subsidence can occur quickly without warning, but often in the context of other storm events.
Potential Impacts:	Economic losses such as decreased land values, agrobusiness losses, disruption of utility and transportation systems, and costs for any litigation. May cause geological movement, causing infrastructure damages ranging from minimal to severe.
Cause Injury or Death:	Injury
Potential Facility Shutdown:	Days to weeks

HAZARD EFFECTS

Land subsidence hazards include: landslides (a wide range of earth movement such as rock falls), debris flow (e.g. mudslides and avalanches), and expansive soils (which is the swelling and sinking of soil). Each of these hazards involves ground movement in or on the earth's surface. These hazards can be caused by natural processes such as the dissolving of limestone underground, earthquakes, or volcanic activity. Land subsidence hazards can also occur as a result of human actions such as the withdrawal of subsurface fluids or underground mining; unplanned commercial,

residential or industrial developments; roadway construction; etc. The 2011 *KPEPC Hazard Vulnerability Survey* ranked mining accidents at 7 out of 54 and landslides at 49 out of 54.

According to the *Kanawha County Soil Survey*, compiled by the USDA's Soil Conservation Service, the northern and southeastern portions of the county are more susceptible to subsidence. Soils in the Cross Lanes area are gilpin-upshur-vincent soils. The soil survey indicates that shrink-swell potential, the slip hazard, and permeability are among the main limitations for non-farm uses in areas with these soils. The southern portion of the county is comprised of a variety of types of soils, including gilpin-upshur-vandalia and clymer-gilpin-dekalb. In the first variety, slope, permeability, shrink-swell potential, and the slip hazard create the potential for subsidence. In the latter, slope, the slip hazard, and shrink-swell potential create potential subsidence.

Most of Kanawha County lies at the edge of the geological formation containing evaporate rock such as salt and gypsum Figure 2.2.9.a shows the presence of "evaporite rocks" in West Virginia and around the Kanawha County area (<http://geospatialresponse.files.wordpress.com/2013/03/karst-topography.gif>).

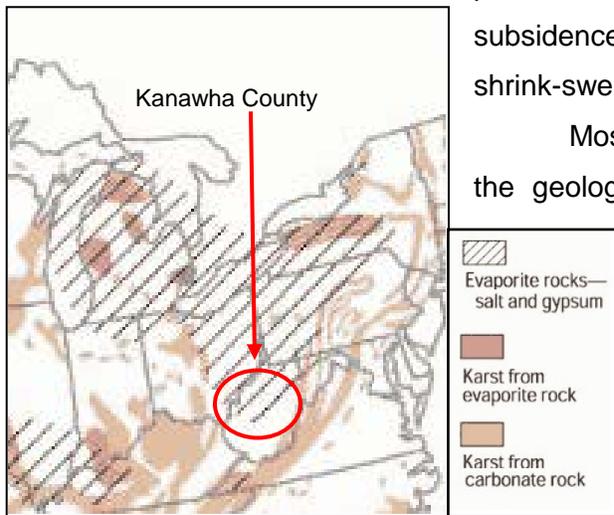


Figure 2.2.9.a

This area is prone to cave formations and sink holes, an abrupt depression in the ground surface usually when the ground cover is less than 50 feet thick. Neglected underground coal mines can result in subsidence sinkholes as well as sudden

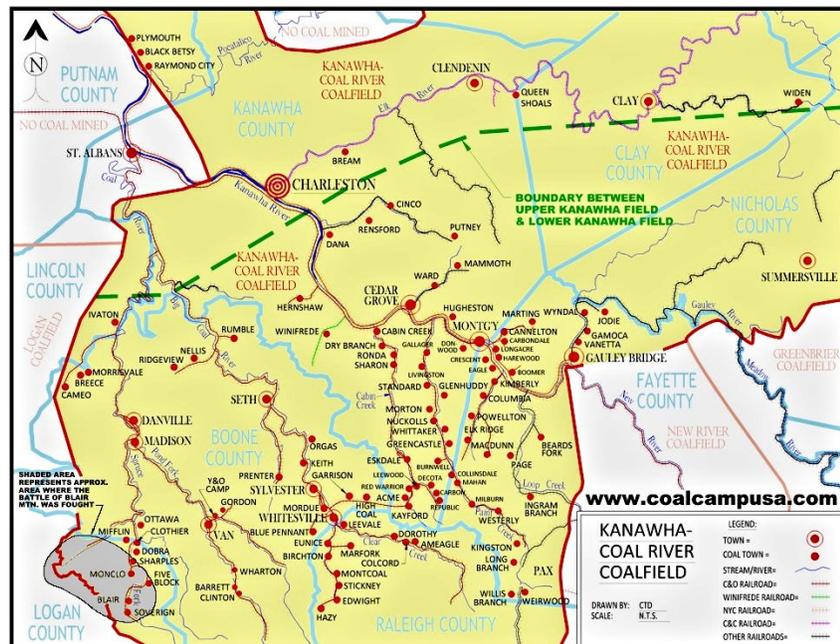


Figure 2.2.9.b

drops in the water tables due to excessive groundwater pumping (<http://people.uwec.edu/EH/Below/Matt%20Below%20-%20-%20-%20GEOG%20361-sinkhole.htm>). Figure 2.2.9.b shows Kanawha County's coalfields (<http://www.coalcampusa.com/sowv/kanawha/kanawha-coalfield-map.jpg>). A large

number of mineable coalfields exist in the southern portion of the county resulting in that area to be more susceptible to collapse and possible sinkholes. Monitoring of abandoned mines and caves can increase the warning time since observing dome formations

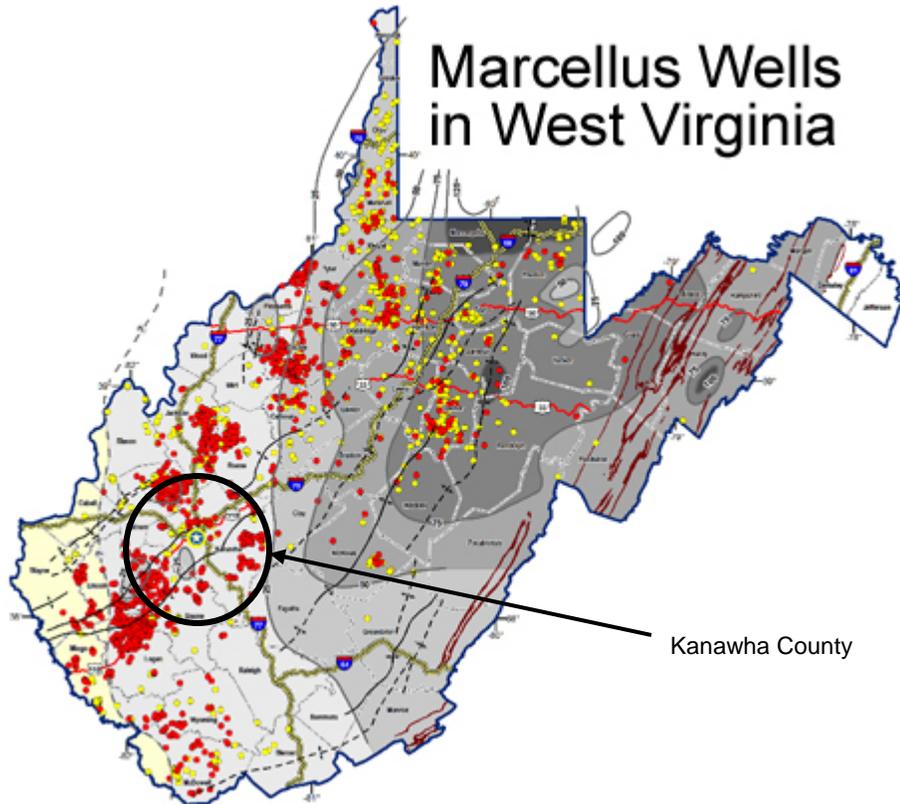


Figure 2.2.9.c

within caves can be signs of potential collapse. With the increase in groundwater pumping to extract gases within the Marcellus-Utica shale bed, there could also be an increase in sinkholes.

Figure 2.2.9.c (http://www.wvcommerce.org/App_Media/Asset/images/energy/fossilfuels/Marcellus_455.jpg) shows the areas in Kanawha County most affected by the well sites. Wells exist in all portions of the county but more in the

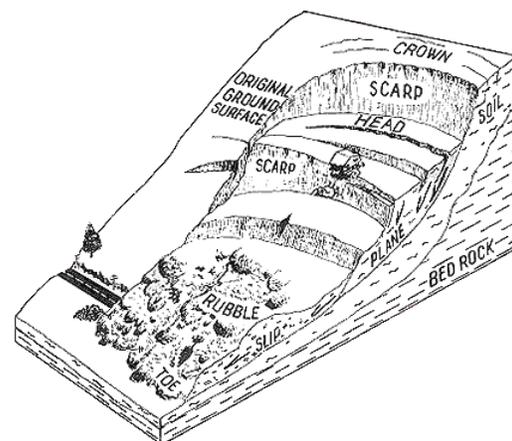


Figure 2.2.9.d

southwest and eastern portions of the county. Due to the vast differences in karst bedrock though, subsidence hazards vary substantially from one location to the next.

Contradictorily though, sink holes and other subsidence are not predicted to be extensive in the areas of West Virginia containing these formations.

In addition to sinkholes, Kanawha County can have landslides. Landslides are debris flows often as a result of weakened ground cohesion support systems. Landslides can occur because of erosion to underlying ground or loss of surface

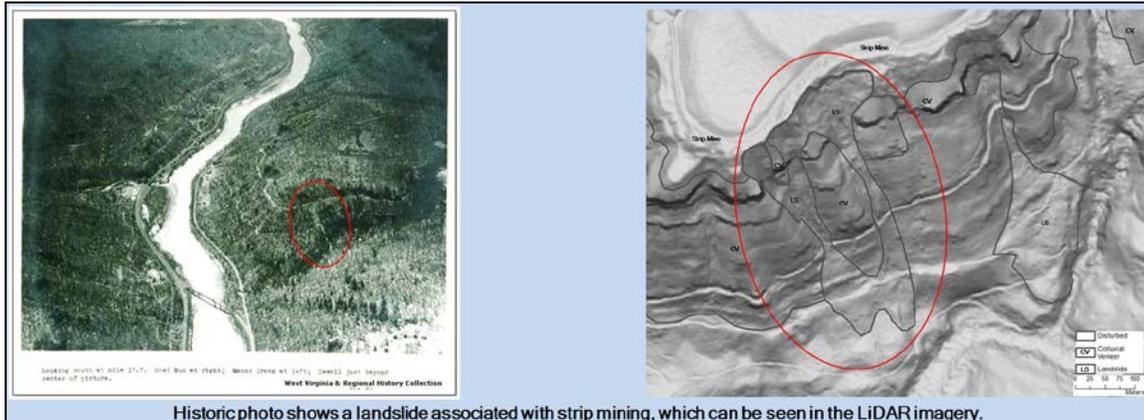


Figure 2.2.9.e

vegetation such as trees and grass. Naturally, landslides can be the result of flooding or wildfires. They can also be created by human causes such as over-deforestation, strip mining (Figure 2.2.9.e), underground mining, and construction activities. It was a combination of mining and flooding that resulted in the March 30, 2009 landslide near East Bank causing \$100,000 in property damage. Additionally, this landslide blocked WV 61 for a week (<http://www.ncdc/noaa.gov/stormevents>). In March 2015, a slip near the end of Yeager Airport's safety-overrun area became a landslide, shearing off a section of fill that tumbled across Keystone Drive, demolishing a brick home and spilling into Elk Two-Mile Creek – see photo, courtesy of the Charleston Gazette, at right (<http://www.wvgazette.com/article/20150312/GZ01/150319671>). The landslide reached one wall of the Keystone Apostolic Church. About 25 houses were asked to evacuate.



Kanawha County has also been associated with six Presidential Disaster Declarations which included landslides between 2002 and 2010 (<http://www.fema.gov/disasters/grid/state-tribal-government/45>). Regardless of what

caused a landslide, a typical landslide in West Virginia is a “slump” landslide and appears as seen in Figure 2.2.9.d. This is can occur throughout the entire county as seen in Figure 2.2.9.f which defines West Virginia as a High Risk state for landslides (http://wxbrad.com/wp-content/uploads/2014/03/nathazmap_landslide_hazard_map.186191323.jpg).

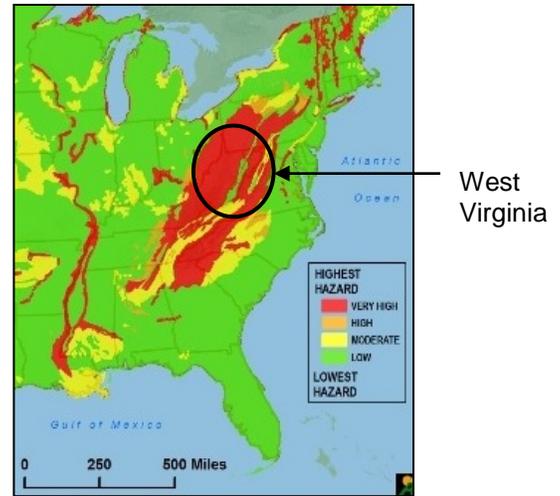


Figure 2.2.9.f

2.2 PROFILE HAZARDS

2.2.10. River Erosion

River erosion is the gradual wearing and carrying away of land or sediment by river currents, water, wind, general weather conditions, and man.

RESEARCH

- 2011 KPEPC Hazard Vulnerability Survey
- Internet research

Period of Occurrence:	Gradual
Number of Events to Date:	N/A
Probability of Event:	Likely
Warning Time:	Days to Years
Potential Impacts:	Shoreline property can be severely damaged. Development in coastal areas can be significantly hampered.
Cause Injury or Death:	None
Potential Facility Shutdown:	Minimal

HAZARD EFFECTS

River erosion occurs on the banks of a river and this occurs as stream channels move (Connecticut River Joint Commission, 1996). Erosion continues to happen even in the appearance of equilibrium which is the erosion from one spot along the river and the sedimentation at another. While this process is beneficial to the aquatic ecosystem, increased human activities increase the rate of erosion and sedimentation. With the increase of the process, aquatic habitats could be threatened; loss of agricultural soils, roads, bridges, dams, buildings can all be affected by the process.

Factors that can cause river erosion include:

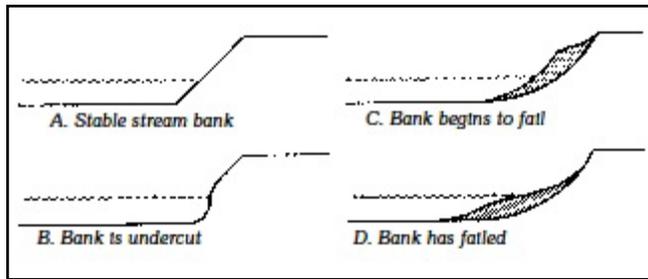


Figure 2.2.10.a

- **Hydraulic action:**

Water flow pushes into cracks and crevices applying a force and weakening the river bank. This causes the bank to

then collapse. As clays absorb water, there is an increase in groundwater pressure. This increase in pressure combined with the soil creep, slight shift in earth due to a weakened cohesion, causes the breaking of the bank. The removal of bank vegetation such as reeds, trees, grass, etc. reduces the shear strength of the soil, speeding up the creep and making the erosion more visible. As seen in Figure 2.2.10.a, waves and boat wakes can undercut a river bank particularly if the bank is non-vegetated, allowing the unsupported material to collapse into the river. This material though is not removed completely from the system, portions will continue to travel in the water and possibly enter other river systems outside of Kanawha County, but most will remain becoming trapped by man-made structures such as dams and bridges. Dams can cause an imbalance in water pressure levels resulting in greater pressure against the banks of the river. Bridges create artificial banks at pylons allowing for the collection of debris and altering the natural water flow.

- **Abrasion:** The use of rocks, pebbles, sand, debris, ice, etc. to rub against areas and dislodge river bank. Wind and water are the two largest culprits of abrasion. Wind could pick up dust, sand, dirt, and like a power washer, blast an area causing rock particles to rub away. As seen in the severe storm section (2.2.11), Kanawha County is susceptible to strong winds above 50 mph.
- **Attrition:** The smoothing of rocks by water currents making rocks smaller and more easily transferrable.
- **Corrosion:** Rainwater mixes with chemicals as it falls from the sky creating a slightly acidic solution that dissolves rock creating Karst which Kanawha County is greatly filled with.

Other factors that can affect river erosion are any changes to land use that causes water to reach the stream quicker and with more force. Some examples are the following:

- Removal of wetlands increases the chances of flooding and then a greater amount of attrition occurring.
- Large scale deforestation and removal of surface plant cover.
- Construction of impervious surfaces such as paved parking areas and shopping centers can keep water from be absorbed by the soil thereby creating more water to flow to the rivers, flooding the rivers and increasing the erosion of the rivers. This can occur even if the development occurs far upstream.
- Upstream channelization (i.e., removing the natural curving flow of a river to create a straighter path [http://en.wikipedia.org/wiki/River_engineering]) or bank stabilization projects can prevent a river from using its natural floodplain, increasing the amount of erosion.
- During the standard hydraulic erosion process, water enters cracks and crevices. As it freezes, water expands, deteriorating the shear strength. Once the ice thaws again, larger areas can be affected. Chunks of ice can also cause abrasions increasing erosions.

River erosion is constantly occurring, so constant vigilance is necessary. If constant vigilance does not occur, structures could possibly collapse resulting in economic and demographic losses. Ports could become blocked or unsafe and unusable, parking lots could deteriorate and collapse into a nearby river, or people could become injured as a tree falls into the river. In each instance proper vigilance would have given a warning time possibly significant enough to mitigate the problem before it happens.

2.2 PROFILE HAZARDS

2.2.11. Severe Storms (hail/thunderstorms/lightning/windstorms/heavy rain)

Severe storms come in many forms to include hail, a form of precipitation which occurs when freezing water forms in layers around an icy core. Thunderstorms are considered severe when that storm produces a tornado, winds of at least 58 mph (50 knots), and/or hail at least 3/4" in diameter. Lightning is the electrical discharge of energy between clouds and the earth. Heavy rain is unusually large amount of rain which does not cause a flash flood or flood, but causes damage.

RESEARCH

- NCDC Event Records
- 2011 KPEPC Hazard Vulnerability Survey

HAZARD EFFECTS - HAIL

When hail occurs, it can cause damage by battering crops, structures, automobiles, and transportation systems. When hailstorms are large, especially when combined with high winds, damage can be somewhat extensive. Hailstorms are more common

Period of Occurrence:	At any time
Number of Events to Date (1950-2014):	78 Hailstorms 161 Thunderstorms 8 Lightning 33 Heavy Rain
Probability of Event:	Hailstorms: 1.22 expected annually Thunderstorms: 2.52 expected annually Lightning: 12.5% chance of occurring in any single year Heavy Rain: 51.56% of occurring in any single year (based on number of occurrences over date range analyzed)
Warning Time:	Minutes to hours
Potential Impacts:	Large hail can minimally damage property (facilities) as well as crops
Cause Injury or Death:	Injury
Potential Facility Shutdown:	Minimal

in elevated areas, such as the mountains, than tropical areas since locations such as mountains are closer to the bottom of thunderstorms. In mountainous areas, the falling hail has less time to melt before touching the ground. Kanawha County is susceptible to hailstorms due to it's proximity to the mountainous portions of West Virginia.

The 2011 *KPEPC Hazard Vulnerability Survey* did not rank the risk for hailstorms. According to the National Climatic Data Center (NCDC), Kanawha County experiences hailstorm relatively frequently. Most hailstorms are not severe and Kanawha County has experienced 76 hailstorms that caused approximately \$15.213 Million from

1950 to 2013. These reported storms contained hail ranging from 0.75 inches (penny) to 2.50 (hen egg) inches in diameter as seen in Table 2.2.11.1. There have been no deaths or injuries from hailstorms but on both June 2, 1998 (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5659182>) and August 30, 2006 (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5525722>) in Charleston there were \$6 Million in property damage on each occasion. During the 1998 event, large hail bombarded the Kanawha City section of Charleston causing vehicles to

Approximate Hail Size	
Appearance	Approximate size (inches)
Pea	0.25-0.50
Penny	0.75
Nickel	0.88
Quarter	1.00
Half Dollar	1.25
Walnut/Ping Pong Ball	1.50
Golf Ball	1.75
Hen Egg	2.00
Tennis Ball	2.50
Baseball	2.75
Tea Cup	3.00
Grapefruit	4.00
Softball	4.50

Table 2.2.11.1

be dented, roofs collapse, windows broken, and large trees uprooted. One business owner in Kanawha City said, “I never saw anything like this before. I never thought I’d go through this in West Virginia.”

These types of damages are typical from hailstorms in addition to damaged HVAC systems, destroyed landscaping, etc. Hail rarely does enough damage to close a business or keep employees from reporting to work though.

HAZARD EFFECTS – THUNDERSTORMS/LIGHTNING

The wind gusts associated with thunderstorms (ranked 14 out of

54 in the 2011 *KPEPC Hazard Vulnerability Survey*) pose a threat to life and/or property. Severe thunderstorms also have the potential of producing a tornado (see 2.2.13) with little or no advanced tornado warning. These storms may contain frequent cloud-to-ground lightning and heavy rain (both have not been ranked by the 2011 *KPEPC Hazard Vulnerability Survey*) which can lead to localized flooding (see 2.2.7). Generally, a weak thunderstorm which produces a wind gust of the required strength would be defined as “severe” whereas a very violent thunderstorm with continuous lightning and very heavy rain (but without the required wind gusts, hail, or tornado/funnel cloud) would not. For the

purposes of this plan, though, these violent thunderstorms are also considered severe because they are more frequent and cause a significant amount of damage annually throughout the county.

According to NCDC data, Kanawha County has had 7 recorded lightning events and 130 severe thunderstorms with high winds since 1950. The lightning strikes have

resulted in 1 death, 4 injuries, and \$113,500 in property damage. At the other extreme, thunderstorms have produced 3 deaths, 67 injuries and approximately \$8.9 Million in property damage in Kanawha County. It should be noted that of the 67 injuries because of thunderstorms, 58 of these occurred in one event on April 9, 1991. It would become known as the “The West Virginia Derecho of 1991”

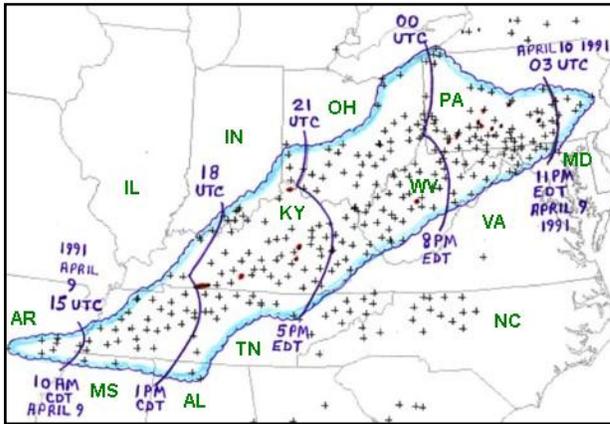


Figure 2.2.11.a

(<http://www.spc.noaa.gov/misc/AbtDerechos/casepages/apr91991page.htm>). Figure 2.2.11.a shows the path the 1991 derecho took spanning from Arkansas (AR) to Pennsylvania (PA) and Maryland (MD). Winds exceeded 80 to 100 mph at points in straight wind gusts destroying or damaging many buildings and mobile homes. It was described by one National Weather Service Charleston forecaster as a “big black mass.” The one death within the Charleston area was from someone being trapped inside a mobile home that overturned and rolled down an embankment. The 58 injuries were mostly from flying debris and falling trees. Storms, however, are common throughout the spring and summer months (although a thunderstorm can occur in any season) that cause downed trees and power lines. Residents and businesses are likely to incur more damage as a result of these “smaller” storms as individual houses and vehicles are damaged by fallen limbs and businesses are forced to close due to a lack of electricity.

2.2 PROFILE HAZARDS

2.2.12. Terrorism

Any activity that involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources and is a violation of the criminal laws of the United States or of any state or other subdivision of the United States; and, appears to be intended to intimidate or coerce a civilian population, or to influence the policy of a government by intimidation or coercion, or to affect the conduct of a government by mass destruction, assassination, or kidnapping.

RESEARCH

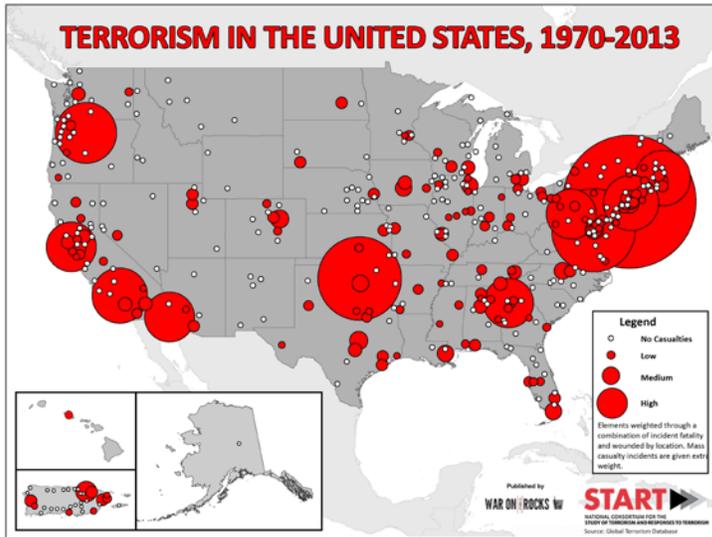
- Federal Emergency Management Agency Website
- 2011 KPEPC Hazard Vulnerability Survey
- National Infrastructure Plan
- National Consortium for the Study of Terrorism and the Responses to Terrorism (START)
- Internet research

Period of Occurrence:	At any time
Number of Events to Date (2001-2014):	0
Probability of Event:	Infrequent
Warning Time:	Minimal – Depends on the presence of a threat
Potential Impacts:	Potential loss of human life, economic loss, environmental damage, disruption of lifeline facilities
Cause Injury or Death:	Injury and risk of multiple deaths
Potential Facility Shutdown:	Days to weeks or more

HAZARD EFFECTS

Terrorism itself has been defined by many different organizations slightly differently. Within the FEMA Course *Hazards, Disasters and U.S. Emergency Management: An Introduction* by Dr. B. Wayne Blanchard, CEM, ten slightly different definitions appear in the appendix of selected terms. For the purposes of this profile the Department of Homeland Security’s definition will be used:

Premeditated threat or act of violence against noncombatant persons, property, and environmental or economic targets to induce fear, intimidate, coerce, or affect a government, the civilian population, or any segment thereof, in furtherance of political, social, ideological, or religious objectives. (National Infrastructure Protection Plan, 2009)



Acts of terrorism include but are not limited to assassinations, kidnappings, hijackings, bomb scares and bombings, cyber-attacks (computer-based) and the use of chemical, biological, nuclear and radiological weapons. They can be further defined by either “international terrorism”, where agents operate or seek asylum outside the territorial boundaries

of the United States, or “domestic terrorism” which occurs primarily within the territorial jurisdiction of the United States by agents from within the United States. “International terrorism”, while a moderate hazard in Kanawha County, is less likely than “domestic terrorism”. Domestic terrorism can involve disgruntled employees (in the case of large industrial plants), angry parents (at schools), upset citizens (at government facilities), etc. Domestic terrorists may often only intend to harm a single individual or a small group of individuals, but the threat of their actions can be highly disruptive. As seen in Figure 2.2.12.a, the terrorism “Hot Spots” are to the east of central and southern West Virginia.

Because of the location though, this area can be a development ground for events in these other areas. The 2011 *KPEPC Hazard Vulnerability Survey* expands the topic of terrorism into many different subtopics. Table 2.2.12.1 lists how the KPEPC ranked terrorism associated events out of 54 possible events.

2011 KPEPC Hazard Vulnerability Survey	
Event	Ranking out of 54
Biological Attack	5
Cyber Attack	6
Chemical Warfare	9
Radiological (dirty bomb)	13
IED	17
Explosion	20
Hostage Taking	21
Suspicious Parcels	27
Radiological/nuclear	38
Electromagnetic Pulse Attack	41

Table 2.2.12.1

“Biological attacks are often deliberate releases of germs or other biological substances that can make [an individual] sick” (<http://www.ready.gov/biological-threats>). Biological attacks are usually in the form of bacteria, viruses, and toxins which are then dispersed usually in one of four ways:

1. Aerosols,
2. Animals,
3. Food and water contamination, and
4. Person-to-person.

For an aerosol to work, the agent must be able to be dispersed into the air usually in a fine mist. While it could travel for miles on the wind currents, aerosols are most effective within a closed area to allow for a maximum concentration. The use of animals as an intermediary is possible, disguising the true perpetrator since so many diseases are passed from vermin to humans, pets, and livestock alike. Contamination of food and water spreads quickly, mostly within a small area such as the 1984 attacks in Dalles, Oregon by the Rajneeshees releasing salmonella to gain political power is possible (<http://www.examiner.com/article/25-years-ago-bioterrorism-at-the-salad-bar>). Person-to-person is a very common method. Just as a person can pass the common

cold, smallpox, the plague, and Lassa viruses can be passed. These events might appear as a biological incident (2.2.1) but have occurred purposefully.

Cyber-attacks are the deliberate access and alteration of information or control systems. A cyber-attack could be an organized cybercrime, state-sponsored hackers, or cyber espionage. Often these attacks are focused on government facilities but businesses can also be vulnerable if the business has high level corporate rivals, involvement with government entities, or are considered a higher profile company for the area. Nationally, there have been many reports of retailers having customer credit card information stolen, but other information such as company trade secrets (i.e., chemical formulas, transportation routes, and internal communications), employee information, and possibly security systems can all be targets within a cyber-attack. Outside of government facilities and businesses, the infrastructure of a community can be at risk. Dams, transmission lines, communication systems, trains, subways, airplanes, and traffic signals can all be the target of manipulation or virus attack. In some cases, an attack on a less guarded system is the target, but malicious software is implemented to allow for easier access at a later time or to infect a more critical system. In 2012, Vivek Shah was arrested in attempts to extort millions of dollars from major figures in West Virginia (<http://www.homelandsecurityedu.org/west-virginia/charleston/>).

Chemical warfare is the use of chemicals to cause toxic effects on people, animals, and plants. Often, these are combined with conventional explosives for dispersion but difficulties often occur without expertise because chemicals can be destroyed while trying to disperse using this method. It is most often mistaken as a hazardous material incident (2.2.8) so responses are often similar, but these releases were purposefully made thereby directed to cause detrimental fiscal and demographic effects. The release is often placed in a certain location because of wind directions or confined areas such as buildings or railcars. These events occur quickly but can often cause long durations to recover depending on the chemical used.

Improvised Explosive Devices (IEDs) and explosions are the use of conventional explosives to damage property, harm life, or disperse other types of agents. IEDs are often simply constructed but can have devastating effects such as a bucket of cut nails or scrap metal with black powder or ammonium nitrate solutions while explosives can be commercially constructed such as sticks of dynamite or blocks of C-4. Both are extremely portable and can be delivered with little or no notice causing widespread panic and fear. Because of the versatility, ease, and low financial cost, explosives and IEDs

are the most common type of weapon used in terrorism. Threats to use these types of weapons have occurred in Kanawha County and the City of Charleston. For example, in 2005, 60-70 letters were sent from Huntington, WV to the Charleston area stating that WV, specifically Charleston, is one of the top five states to be hit by future terror attacks (<http://www.firehouse.com/forums/t71943>) or the October 28, 2014 arrest of a man in Charleston making statements about ISIS (Islamic State of Iraq and Syria) and the possibility of a building coming down to Kanawha County Metro dispatchers (<http://www.wboy.com/story/27147391>).

Hostage taking is often used to influence or as a secondary effect to some other agenda. Hostage taking can be a single person such a financially endowed person's child, busloads of people to influence the actions of arrest attempting officers, innocent patrons at an establishment or influential government officials. In each instance, fear is used to control. The threat or actual use of force is implemented to influence outcomes in favor of the perpetrator. With Charleston being the capital of West Virginia, many influential people reside in or near the city thereby flowing into Kanawha County as well where many residences for these influential people could be.

Suspicious packages could be the delivery method for any of the other types of agents. A biological incident could result like in the anthrax filled letters of 2001. A chemical release could occur upon opening the package. Explosives are commonly sent great distances through the mail system or left on doorsteps looking inconspicuous. A suspicious package could even contain radiological or nuclear sources which would saturate an unsuspecting individual upon opening the package and contaminating the area debilitating responses. With all of the commerce and package transfers that occur at businesses, residences, and government facilities, the possibility for a suspicious package being used can be high.

Radiological/nuclear incidents both involve the dispersal of radiation. A radiological incident could simply be the deliberate release of alpha, beta, or gamma radiation to cause ill effects on unshielded people, animals, or plants. Often radiological attacks are combined with conventional explosives creating radiological dispersion devices (RDDs) or "dirty bombs" allowing for a wider contaminated area and more difficult to clean up. Nuclear devices use radiation, but also contain extremely powerful explosive characteristics. Nuclear devices are highly guarded, but more countries are obtaining nuclear capabilities and less scrupulous individuals are willing to sell such devices within the black market communities.

Electromagnetic Pulse (EMP) attacks are often associated with nuclear devices. They are disruptive forces dampening and countering electromagnetic currents and signals. As technology grows though, EMPs can be created to disrupt communication, navigational equipment, power stations, or data storage.

Kanawha County and Charleston has a higher risk for terror attacks than most other parts of West Virginia outside the eastern panhandle because of its designation as the state capital. Other high-risk targets for acts of terrorism include military and civilian government facilities (i.e., U.S. Attorney's office for the Southern District, Protective Security Advisor for the Charleston District, and Citizen's Corps Council), federal and state law enforcement facilities (i.e., FBI, ATF, DEA, State Police, and the WV Intelligence Fusion Center [WVIFC]), international airports, large cities, and high-profile landmarks. Terrorists might also target large public gatherings (i.e. Charleston Civic Center, festivals, and parades), water and food supplies, utilities, medical centers, and corporate centers.

Kanawha County contains multiple facilities that could serve as terrorist targets. Areas in the central part of the county, including the municipalities of Charleston, Dunbar, Marmet, Nitro, and South Charleston, are ranked more vulnerable to terrorism – both international and domestic – than other areas of the county.

2.2 PROFILE HAZARDS

2.2.13. Tornado

Wind storms are destructive wind events that occur with or without the presence of other storm events, such as tornados or severe thunderstorms.

A tornado is a violently rotating column of air extending from a thunderstorm to the ground.

RESEARCH

- NCDC Event Records
- National Weather Service
- FEMA *State and Local Mitigation Planning How-To Guide: Understanding Your Risks*, 386-2
- 2011 KPEPC Hazard Vulnerability Survey
- Internet research
- Tornado history project

Period of Occurrence:	At any time – Primarily during March through August
Number of Events to Date (1950–2014):	1 Funnel Cloud 6 Tornadoes
Probability of Event:	10.94% chance of tornado/funnel cloud occurring in any single year (based on number of occurrences over date range analyzed)
Warning Time:	Minutes to hours
Potential Impacts:	Utility damage and outages, infrastructure damage (transportation and communication systems), structural damage, and damaged or destroyed critical facilities. Impacts human life, health, and public safety.
Cause Injury or Death:	Injury and risk of multiple deaths
Potential Facility Shutdown:	Days to weeks or more

HAZARD EFFECTS

The *2011 KPEPC Hazard Vulnerability Survey* ranks tornadoes at 33 out of 54. The most violent tornadoes though are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long. They often bring other weather conditions as well including thunderstorms, hail, and lightning (see 2.2.11 for more details. Tornadoes are among the most unpredictable of weather phenomena. Tornadoes can occur in any state in the U.S. but are more frequent in the Midwest and Southeast as seen in Figure 2.2.13.a (http://apps.startribune.com/blogs/user_images/NOAAatordist20012010.jpg).

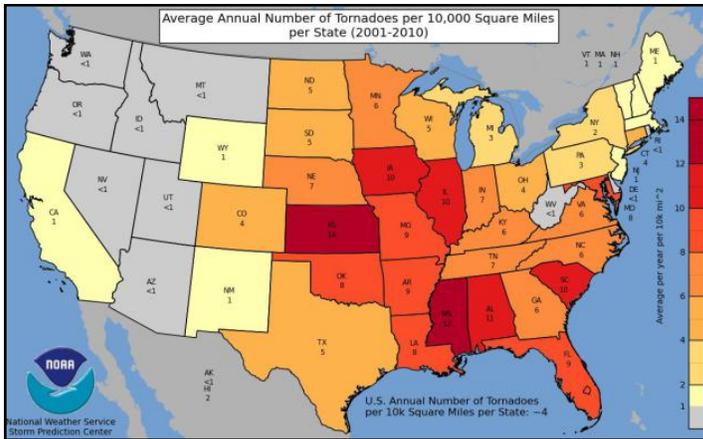


Figure 2.2.13.a

The nature of tornadoes is that they strike at random. While it is known that some areas of the country experience tornadoes more than others, predicting exactly what parts of Kanawha County have a greater chance of being struck by a tornado is difficult. The best predictor of future

tornadoes is the occurrence of previous tornadoes. According to NCDC records, there have been seven tornadoes recorded in Kanawha County between 1950 and 2013. Four of these tornadoes were classified as Fujita scale (F)1, two as F0, and one as Enhanced Fujita scale (EF)0. The Enhanced Fujita scale was developed by engineers and became implemented in 2007. Table 2.2.13.1 shows the comparative F and EF Three Second Gust speeds (mph).

Fujita Scale (F)		Enhanced Fujita Scale (EF)	
F Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	45-78	0	65-85
1	79-117	1	86-110
2	118-161	2	111-135
3	162-209	3	136-165
4	210-261	4	166-200
5	262-317	5	Over 200

Table 2.2.13.1

For planning purposes, it is less important to map the tornado risk than it is to identify it. This is because it is so difficult to predict the path of future tornadoes. At the same time it is interesting to note that tornadoes seem to be attracted to waterways as seen in Figure 2.2.13.b (http://www.tornadohistoryproject.com/tornado/West_Virginia/Kanawha/map).

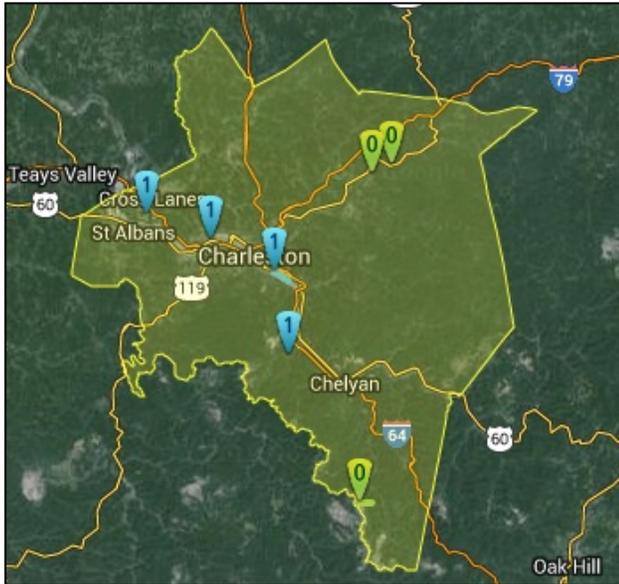


Figure 2.2.13.b

The Fujita scale and Enhanced Fujita scale provide us with an idea of the strength and extent of damages of tornadoes that can occur in Kanawha County. The Enhanced Fujita is often used to estimate the wind gust speed by comparing the type of structure against eight levels of damages. Table 2.2.13.2 lists the 28 structure types. Figure 2.2.13.c is a sample for one type of structure, one- and two-family residences, and the corresponding estimated wind speeds.

Enhanced Fujita Structure Categories

Structure Type Number	Structure Type	Structure Type Number	Structure Type
1	Small barns, farm outbuildings	15	School – 1-story elementary (interior or exterior halls)
2	One- or two-family residences	16	School – Jr. or Sr. high school
3	Single-wide mobile home	17	Low-rise (1-4 story) building
4	Double-wide mobile home	18	Mid-rise (5-20 story) building
5	Apt, condo, townhouse (3 Stories or less)	19	High-rise (over 20 story) building
6	Motel	20	Institutional building (hospital, government, university, etc.)
7	Masonry apt. or motel	21	Metal building system
8	Small retail building (fast food)	22	Service station canopy
9	Small professional (doctor office, branch bank)	23	Warehouse (tilt-up walls or heavy timber)
10	Strip mall	24	Transmission line tower
11	Large shopping mall	25	Free-standing tower
12	Large, isolated (“big box”) retail building	26	Free standing pole (light, flag, etc)
13	Automobile showroom	27	Tree-hardwood
14	Automotive service building	28	Tree-softwood

Table 2.2.13.2

2. ONE-AND TWO-FAMILY RESIDENCES (FR12)
(1000 – 5000 sq. ft.)

Typical Construction

- Asphalt shingles, tile, slate or metal roof covering
- Flat, gable, hip, mansard or mono-sloped roof or combinations thereof
- Plywood/OSB or wood plank roof deck
- Prefabricated wood trusses or wood joist and rafter construction
- Brick veneer, wood panels, stucco, EIFS, vinyl or metal siding
- Wood or metal stud walls, concrete blocks or insulating-concrete panels
- Attached single or double garage

DOD*	Damage description	EXP	LB	UB
1	Threshold of visible damage	65	53	80
2	Loss of roof covering material (<20%), gutters and/or awning; loss of vinyl or metal siding	79	63	97
3	Broken glass in doors and windows	96	79	114
4	Uplift of roof deck and loss of significant roof covering material (>20%); collapse of chimney; garage doors collapse inward; failure of porch or carport	97	81	116
5	Entire house shifts off foundation	121	103	141
6	Large sections of roof structure removed; most walls remain standing	122	104	142
7	Exterior walls collapsed	132	113	153
8	Most walls collapsed, except small interior rooms	152	127	178
9	All walls	170	142	198
10	Destruction of engineered and/or well constructed residence; slab swept clean	200	165	220

* DOD is degree of damage

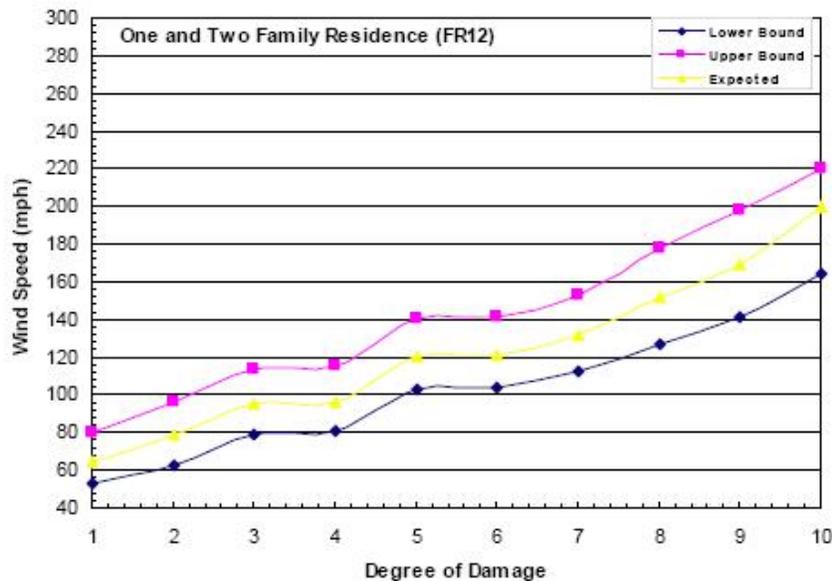


Figure 2.2.13.c

As can be seen in Figure 2.2.13.c, an expected, lower, and upper boundary for wind speed can be determined. For example, if a single family home sustained broken windows then the Degree of Damage would be considered a 3 and the wind speed would be between 79 - 114 mph with an expected 96 mph. This corresponds to an EF1 classification as seen in Table 2.2.13.1.

Historically, there has been only one tornado that caused an injury. This event was on April 18, 1969 between Cross Lanes and St. Albans. This tornado was an F1 with a damage path of 0.3 miles in length and 33 yards wide (www.ncdc.noaa.gov). The highest amount of property damage occurred from an F1 touching down in the vicinity of Charleston on June 2, 1998 causing \$100,000 in damages. Hundreds of vehicles were dented; roofs and windows damaged and large trees were uprooted (www.ncdc.noaa.gov).

Four other tornadoes have been recorded in Kanawha County in addition to these two events (www.ncdc.noaa.gov, www.tornadohistoryproject.com). Table 2.2.13.3 shows those events.

Date	Narrative	Magnitude	Injuries/ Damage	Source
6/23/1980	0.2 miles in length, 17 yards wide	F1	\$25,000 property damage	NCDC, THP
7/9/1980	1.5 miles in length, 30 yards wide; city policeman saw tornado touch down at Marmet; damage to 2 hours, 3 mobile homes, and 2 cards	F1	\$25,000 property damage	NCDC, THP
9/14/1990	0.2 miles in length, 60 yards wide; damage occurred mainly to trees, with a few awnings ripped off houses along US 119; a mobile home also sustained damage from a falling tree	F0	\$2,500 property damage	NCDC, THP
3/19/2008	0.2 miles in length, 50 yards wide; a bow echo developed as the line of showers and thunderstorms moved through Charleston; localized gust of 84 mph recorded at Yeager airport; bow echo moved northeast along Elk River Valley; tornado spun up a hillside in Youngs Bottom	EF0	\$40,000 property damage	NCDC, THP

Table 2.2.13.3

Additionally, while not a full tornado, NCDC recognized the formation of a funnel cloud in the vicinity of Charleston on May 26, 2006. While there was no strong evidence it reached the ground, some trees were felled within the hollows and gaps between hills.

2.2 PROFILE HAZARDS

2.2.14. Utility Emergencies

A utility failure occurs when an electricity, water distribution, gas, or wastewater collection system is disrupted, resulting in the unavailability of said services for an extended period of time.

RESEARCH

- 2011 KPEPC Hazard Vulnerability Survey
- Media archives
- Internet research

HAZARD EFFECTS

Four types of utility outages comprise a “utility failure” in Kanawha County: electricity, water, gas, and wastewater. An electricity failure (2011 *KPEPC Hazard Vulnerability Survey* ranked as 19 out of 54) occurs when a portion of the “power grid” is damaged or otherwise breaks the flow of electricity to certain

Period of Occurrence:	At any time
Number of Events to Date (2000-2014):	10+ (total) 1 (major)
Probability of Event:	71.43% chance of experiencing some sort of interruption in any single year 7.14% chance of experiencing a major situation in any single year (based on number of occurrences over date range analyzed)
Warning Time:	Minimal – Depends on maintenance efforts and presence of other hazard events
Potential Impacts:	Potential economic loss, disruption of lifeline facilities; extreme instances (i.e. gas explosions) could result in structural damage and/or loss of life
Cause Injury or Death:	Risk of minor injury
Potential Facility Shutdown:	0 to 10 days

areas. Many times, power lines are damaged by falling trees, severe wind, snow and ice weight, etc. (see severe storms [2.2.11] for more details). Transformers can be damaged when struck by lightning. As such, electricity failure is often an indirect, secondary hazard to such incidents as a thunderstorm, wind storm, etc. An electricity failure can be an individual hazard, however, as old lines deteriorate and fail. While electricity failure is not likely to result in widespread structural damage, it could result in contents damage (if appliances or other systems suffer from a power surge) and functional loss (if a facility must close for an extended period of time while the electricity is out). Electricity failures occurred in October 2003 as part of a winter storm and again in February 2009 as a result of widespread wind storms.

A water failure occurs when a portion of a public water distribution system fails due to a leak, treatment facility breakdown, etc. Such issues as changing geological conditions, drought, etc. may disrupt water service to these individuals. The 2011 *KPEPC Hazard Vulnerability Survey* ranks a water supply failure at 32 out of 54.

A gas failure occurs in much the same fashion as an electricity failure and results in a loss of heating/cooling (and some cooking) capabilities. Natural gas failures could result in or be the result of an explosion or fire. The 2011 *KPEPC Hazard Vulnerability Survey* does not rank gas failures.

Wastewater failures could either be the result in a disruption of the collection systems or a failure of treatment facilities. Often, wastewater failures are a secondary result of other hazards. Table 2.2.14.1 shows utility providers that could be vulnerable to utility failures as listed by the Public Service Commission of West Virginia (<http://www.psc.state.wv.us/utilities/default.htm>).

The 2011 *KPEPC Hazard Vulnerability Survey* also addressed possible communication failure. It was ranked at 22 out of 54. Communication failure could be the result of telephone connection failure, cellular phone failure, television broadcast loss, radio disruption, and internet collapse. Today's society is dependent on many of these types of systems both during normal operations and crisis situations. Any type of hazard can disrupt communications, be it loss of personnel to do the communications in a biological event, wind gusts that topple radio, television, and telephone towers, or heat damage during a drought damaging deteriorated transmission lines.

It is significant to note that utility emergencies may result from external factors (and may actually be considered a cascading impact of other emergencies). In January 2014, the cleaning product Crude 4-Methylcyclohexanemethanol (MCHM) leaked into the Elk River affecting 300,000 residents (<http://www.amwater.com/wvaw/About-Us/news.html>). A month later, on February 12, 2014, another 100,000 gallons of coal cleaning wastewater was released. This time it was in the Kanawha River but was not MCHM. The new chemical that appeared in this event was able to be filtered through the Kanawha Valley Water Treatment Plant, thereby not affecting the public water supply (<http://tlarremore.wordpress.com/2014/02/12/environment-pollution-in-west-virginias-kanawha-river/>). This wastewater was from cleaning coal of impurities. These releases resulted in numerous issues for the drinking water system.

Public Service Commission Utilities

Company Name	Location
Electric Companies	
Appalachian Power Company	Charleston
Gas Companies	
Mountaineer Gas Company	Charleston
Southern Public Service Company	Milton
Union Oil & Gas Inc.	Charleston
Wastewater Companies	
Big Bend Sewer Association, Inc.	Charleston
Chestnut Point Property Owners Association	St. Albans
City of Charleston Sanitary Board	Charleston
Dunbar Sanitary Board	Dunbar
Elk Valley Public Service District	Elkview
Greater St. Albans Public Service District	St. Albans
Kanawha Public Service District	Cabin Creek
Malden Public Service District	Tad
Nitro Sanitary Board	Nitro
Sissonville Public Service District	Sissonville
South Charleston Sanitary Board	South Charleston
St. Albans Municipal Utility Commission	St. Albans
Town of Belle (Sanitary Board)	Belle
Town of Cedar Grove (Sewer)	Cedar Grove
Town of Chesapeake Sanitary Board	Chesapeake
Town of East Bank Sanitary Board	East Bank
Town of Glasgow (Sewer)	Glasgow
Town of Handley	Handley
Town of Marmet Sanitary Board	Marmet
Town of Pratt	Pratt
Union Public Service District	Cross Lanes
West Dunbar Public Service District	Institute
West Virginia – American Water Company	Charleston
Water Companies	
Armstrong Public Service District	Kimberly
Cedar Grove Municipal Water Department	Cedar Grove
Glasgow Municipal Water Department	Glasgow
Lincoln Public Service District	Alum Creek
St. Albans Municipal Utility Commission	St. Albans
Town of East Bank	East Bank
Town of Pratt	Pratt
West Virginia – American Water Company	Charleston

Table 2.2.14.1

2.2 PROFILE HAZARDS

2.2.15. Winter Storm

A winter storm is a type of storm in which the dominant varieties of precipitation are forms that only occur at cold temperatures such as snow or sleet, or a rainstorm where ground temperatures are cold enough to allow ice to form.

RESEARCH

- NCDC Event Records
- 2011 KPEPC Hazard Vulnerability Survey
- Internet research

HAZARD EFFECTS

Winter storms vary in size and strength and can be accompanied by strong winds that create blizzard conditions and dangerous wind chill. There are three categories of winter storms:

- **Blizzard:** A blizzard is the most dangerous of all winter storms. It combines low temperatures, heavy snowfall, and winds of at least 35 miles per hour (mph), reducing visibility to only a few yards.
- **Heavy Snowstorms:** A heavy snowstorm is one that drops four or more inches of snow in a 12-hour period.
- **Ice Storm:** An ice storm occurs when moisture falls and freezes immediately upon impact.

Period of Occurrence:	Winter
Number of Events to Date (1996-2015):	9 Winter Weather 7 Winter Storm 16 Heavy Snow 16 Cold/Wind Chill 6 Extreme Cold/Wind Chill 1 Ice Storm
Probability of Event:	2.84 events per year (based on total unique occurrences over date range analyzed)
Warning Time:	Snow – Days Ice – Minutes to hours
Potential Impacts:	Utility damage and outages, infrastructure damage (transportation and communication systems), structural damage, damaged critical facilities. Can cause severe transportation problems and make travel extremely dangerous. Power outages, which result in loss of electrical power and potentially loss of heat. Extreme cold temperatures may lead to frozen water mains and pipes, damaged car engines, and prolonged exposure to cold resulting in frostbite.
Cause Injury or Death:	Injury
Potential Facility Shutdown:	Days

The 2011 *KPEPC Hazard Vulnerability Survey* ranked ice storms as the highest risk at 11 out of 54. Heavy snow was second at 18 and blizzards were 26 out of 54. Winter storms tend to encompass the entire county whereas flooding generally occurs within predictable boundaries along the regulatory Special Flood Hazard Area (SFHA) and its main branches and tributaries. Risks associated and identified with severe winter storms include but are not limited to the following:

- Emergency medical evacuation of the sick, elderly, and infirmed to shelters.
- Power outages to those on life support systems.
- Communications interruptions and/or outages.
- Loss of the ability to heat homes.
- Interruption of the delivery of home supplies and food.

These above-described events fall within two general categories: road closures due to snow drifts and utility failures (see utility emergencies [2.2.14] for more details). Additionally, data indicates that structural damage has occurred in several instances in the past as a result of extremely heavy snowfall. Structures damaged were usually buildings such as barns, garages, carports, etc. Additionally, severe winter storms, because of the county's mountainous terrain, frequently result in dangerous driving conditions.

Kanawha County has had severe winter storms reported to NCDC. In February 2003, Kanawha County and surrounding counties experienced a winter storm with freezing rain and 1-4 inches of snow that caused approximately \$1.8 million worth of damage. Major structural damage was to a TV tower that collapsed under the buildup of ice caused by the freezing rain (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5341565>). On January 8, 1999, an ice storm affected Kanawha and the surrounding counties as rain fell on surface temperatures between 25 and 30°F resulting in approximately ½ inch of ice. While not in Kanawha County, one woman was killed as a result of this storm in nearby Cabell County (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5679051>). In February 1996, extensive cold and wind chills resulted in the need to open heating shelters because the temperatures were among the coldest in the area since 1899. In February 2015, snow, sleet, and freezing rain spread over West Virginia between 3 and 6 a.m. on the 21st (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=552824>).

Snow totals varied, with most totals in southern West Virginia being in the 10 to 17-inch range. Over 2,000 customers lost electricity in Kanawha County. In total, the storm resulted in about \$75,000 in damage. On December 18-19, 2009, a heavy wet snow associated with a storm that started as rain. Snow totals ranged from nine to 14 inches. Roads were impassable in some places, including a three-mile stretch of the West Virginia Turnpike between Chelyan and Beckley, on which 800-900 vehicles were trapped (<http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=204543>).

Finally, Kanawha County has endured 12 heavy snows since 1996. On October 29, 2012, snow levels reached three feet in areas as remnants of Hurricane Sandy clashed with a polar jetstream as seen in Figure 2.2.15.a (<http://api.ning.com/files/x3H7nLthsFR5FqyAiCj4KD-K2v1mNjbl1Ev80jzV12QiRGZ5qxbQXW2qJ04YmYNn3rSJaijJKgrFyltsigoZYIERX9CCBuL-/wxwhyImportanceOfTheJetstream385X387X96.jpg>).

This event created approximately \$1.75 million in property damages from collapsed roofs, 30 to 35 shelters being stood up, and the activation of 600 members of the West Virginia National Guard. Fears of flooding occurred, but slower temperature rise following the storm allowed for a slower melt and actually a replenishment of groundwater tables.

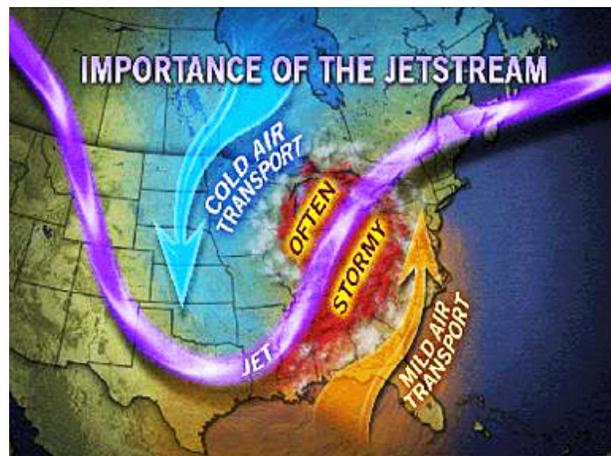


Figure 2.2.15.a

For the purposes of this assessment, the northern portions of Kanawha County are slightly more susceptible to winter storms than the southern portions. Such a determination is made based on road and other conditions during snow/ice events. In West Virginia, generally, winter storm susceptibility decreases from north to south.

APPENDIX 3: GLOSSARY

This appendix contains definitions of commonly-used terms throughout the hazard mitigation plan. These terms are considered because they are either unique to the mitigation planning process or used in a different way in a mitigation context as compared to other emergency preparedness contexts. This appendix also contains a list of the acronyms used throughout this document and their corresponding definitions.

Definition of Terms

Asset Inventory: A listing of critical facilities, historical facilities, facilities housing vulnerable populations (e.g., schools, nursing homes, hospitals), large economic assets in the community, and other, community-designated special considerations on which a risk assessment is completed.

Benefit Cost Review: A process by which a community considers both the potential benefits of mitigation projects in comparison with their costs. It is a way to determine if the costs are achievable and feasible based on the benefits that can be realistically anticipated.

Emergency Services Project: Action that protects people and property during and immediately after a disaster or hazard event.

Hazard Risk Assessment: The process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from hazards by assessing the vulnerability of people, buildings, and infrastructure to hazards.

Loss Estimate: A mathematical calculation of the potential damage – structural, contents, and functional – a facility and/or community could occur as a result of a specific hazard.

Mitigation: Activities providing a critical foundation in the effort to reduce the loss of life and property from natural and/or man-made disasters by avoiding or lessening the impact of a disaster and providing value to the public by creating safer communities. Mitigation seeks to fix the cycle of disaster damage,

reconstruction, and repeated damage. These activities or actions, in most cases, will have a long-term sustained effect.

Natural Resource Protection: Action that, in addition to minimizing hazard losses, also preserves or restores the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

Prevention: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses.

Property Protection: Actions that involve the modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area.

Public Education and Awareness Project: Action to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.

Robert T. Stafford Disaster Relief and Emergency Assistance Act: Section 322 was added as part of the Disaster Mitigation Act (DMA) of 2000 to take a new and revitalized approach to mitigation planning. This new section emphasizes the need for local entities to closely coordinate mitigation planning and implementation efforts. In succinct terms, this is the mandate requiring local communities to compile and adopt a mitigation plan as an eligibility requirement for mitigation funding.

STAPLEE Method: A technique for identifying, evaluating, and prioritizing mitigation actions based on existing local conditions. It advocates an analysis based on the following conditions: social, technical, administrative, political, legal, economic, and environmental.

Structural Project: Action that involves the construction of structures to reduce the impact of a hazard.

Definition of Acronyms

Acronym	Definition
AR	Arkansas
ARC	American Red Cross
B & O	Baltimore & Ohio Railroad
C & O	Chesapeake & Ohio Railroad
CBA	Cost-Benefit Analysis
CDBG	Community Development Block Grant
CDC	Center of Disease Control
CFR	Code of Federal Registry
CR	County Route
CRS	Community Rating System
CVB	Conference and Visitors Bureau
EF	Enhanced Fujita Scale
EHS	Extremely Hazardous Substance
EMPG	Emergency Management Performance Grant
EMS	Emergency Medical Services
ES	Elementary School
F	Fujita Scale
FD	Fire Department
FEMA	Federal Emergency Management Agency
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
HAZUS-MH	Hazard United States – Multi-Hazard
HMC	Hazard Mitigation Committee
HMEP	Hazardous Materials Emergency Preparedness
HS	High School
I	Interstate
IED	Improvised Explosive Device
JHC	JH Consulting, LLC
KCHSEM	Kanawha County Homeland Security and Emergency Management

Kg	Kilogram
KPEPC	Kanawha – Putnam Emergency Planning Committee
Kton	Kiloton
M & I	Municipal and Industrial
MD	Maryland
MM	Modified Mealli Intensity Scale
MS	Middle School
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PA	Pennsylvania
PDM	Pre-Disaster Mitigation
PDSI	Palmer Drought Severity Index
PGA	Peak Ground Acceleration
PO	Post Office
PSA	Public Service Announcement
RSEI	Risk Screening Environmental Indicators
SARS	Severe Acute Respiratory Syndrome
SERC	State Emergency Response Commission
SFHA	Special Flood Hazard Area
SR	State Route
START	Study of Terrorism and the Responses to Terrorism
TRI	Toxic Release Inventory
US	United States
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USCB	United States Census Bureau
USDA	United States Department of Agriculture
USDA	United States Department of Agriculture
USDHS	United States Department of Homeland Security
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

VFD	Volunteer Fire Department
WFAS	Wildland Fire Assessment System
WHO	World Health Organization
WVDEP	West Virginia Department of Environmental Protection
WVDHSEM	West Virginia Department of Homeland Security and Emergency Management
WVDOF	West Virginia Division of Forestry
WVSFM	West Virginia State Fire Marshall
WVU	West Virginia University