Jefferson County, West Virginia's Flood Risk

Located at the confluence of the Potomac and Shenandoah Rivers, Jefferson County is separated into three major drainage divides by the County's rolling topography. The Shenandoah River has a drainage area of 247 square miles at the downstream county boundary. Its average channel slope within Jefferson County is approximately 4.6 feet per mile. Between these drainage divides are a network of 22 major streams that feed into the two aforementioned rivers and Opequon Creek. Opequon Creek has a drainage area of 8.0 square miles and an average channel slope of approximately 56 feet per mile. Most streams in the County flow in a northwest-southeast orientation toward the Opequon or Shenandoah. Turkey Run, one of the largest streams, has a total drainage area of 8.0 square miles and its average channel slope within Jefferson County is approximately 50 feet per mile. Evitts Run, another large stream, has a drainage area of 17.91 square miles. Its headwaters are in central Jefferson County and flows eastward to the Shenandoah River. Flowing Springs Run, an additional large stream, has a drainage area of 7.88 square miles. It heads just north of Ranson and flows eastward to the Shenandoah River. Almost all of these streams are spring fed, thus resulting in the intermingling of surface and subsurface waters. Regardless of their origin, all waters ultimately flow into the lower Potomac River and the Chesapeake Bay.

2.2 PROFILING HAZARDS

2.2.4. 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 rapid flooding of low-lying areas, rivers, and streams that is caused by intense rainfall and is often associated with thunderstorms.

INTRODUCTION

Floods are the most prevalent hazard in the United States. Each year, floods cause more property damage in the United States than any other type of natural disaster, killing an average of 150 people a year. The history of flooding within Jefferson County indicates that flooding can occur at any time of the year. However, nearly all major floods are produced by winter and spring rains falling on already-saturated, snow covered, or frozen soil. Winter and spring rains, although of lesser intensity than summer and fall rains, are usually of longer duration and result in greater peak flows in streams.

Period of Occurrence:	Primarily April through August (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 (1993 – 2012):	35
Probability of Event:	Frequent.
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.

Figure 2.4a

Several methods of research identified flooding as a hazard in Jefferson County, including reviews of Flood Insurance Rate Map (FIRM) maps, review of existing plans that have been compiled including the Jefferson County Emergency Operations Plan (EOP), reviews of newspaper

coverage, reviews of past disaster declarations, discussions with local floodplain coordinators and floodplain managers, and public input. The following Internet sites were also used to gain information on flooding.

Floods are described by their horizontal extents, the depth of the floodwaters and the probability of occurrence. Unfortunately, the probability of occurrence has historically been expressed in terms such as a "100 year flood", which the general public logically assumes means a flood that happens once in 100 years. In fact, the probability of occurrence is best interpreted as a percent chance of occurring. So, a 100 year flood is that flood level which has a 1 percent (1%) chance of occurring in any given year. The 100 year, or 1% flood, is often used for planning purposes. Smaller floods are more likely to occur, thus a 10 year flood has a 10% chance of occurring in any given year. Table 2.4a shows common flood probability terms.

Flood Recurrence Intervals	Chance of Occurrence in any Given Year
10 Year	10%
50 Year	2%
100 Year	1%
500 Year	0.2%

Table 2.4a

For the purposes of this Hazard Risk Assessment (HRA) it is assumed that Jefferson County has a moderate to high flooding risk. The risk of flooding is targeted to several different areas within the county. Identification of floodplain areas within the county and its municipalities is based on Flood Insurance Rate Map (FIRM) data produced by the National Flood Insurance Program (NFIP).

High Probability Low Impact	High Probability Moderate Impact	High Probability High Impact
Moderate Probability Low Impact	Moderate Probability Moderate Impact	Moderate Probability High Impact
Low Probability Low Impact	Low Probability Moderate Impact	Low Probability High Impact

Figure 2.4b

HAZARD IDENTIFICATION

Flooding is arguably the highest priority hazard in Jefferson County, as flooding in some form has the potential to threaten nearly the entire county. Located at the confluence of the Potomac and Shenandoah Rivers, Jefferson County is separated into three (3) major drainage divides by the county's rolling topography. The Shenandoah River has a drainage area of 105 square miles at the downstream county boundary. Its average channel slope within Jefferson County is approximately 4.6 feet per mile. The Potomac River has a drainage area of 62 square miles. Between these drainage divides are a network of 22 major streams that feed into the two (2) aforementioned rivers and Opequon Creek. Opequon Creek has a drainage area of 44 square miles, and an average channel slope of approximately 56 feet per mile. Most streams in the county flow in a northwest-southeast orientation toward the Opequon or Shenandoah. Turkey Run, one of the largest streams, has a total drainage area of 8.0 square miles and its average channel slope within Jefferson County is approximately 50 feet per mile. Evitts Run, another large stream, has a drainage area of 17.91 square miles. Its headwaters are in central Jefferson County and flows eastward to the Shenandoah River. Flowing Springs Run, an additional large stream, has a drainage area of 7.88 square miles. It heads just north of Ranson and flows eastward to the Shenandoah River. Almost all of these streams are spring fed, thus resulting in the intermingling of surface and subsurface waters. Regardless of their origin, all waters ultimately flow into the lower Potomac River and the Chesapeake Bay.

Riverine flooding, which is usually caused by a significant amount of rainfall over a period of days and can be worsened by snowmelt conditions, is very likely to continue striking areas located along the banks of the Potomac and Shenandoah Rivers. Communities located along the banks of these rivers are in particularly low-lying areas. The towns of Bolivar, Harpers Ferry, and Shepherdstown are all examples of such areas.

Flash flooding in or near the urban areas of the county is often attributed to failing storm sewers and poor drainage systems; however, in the majority of Jefferson County it is often a result of large quantities of water rapidly running off of steep slopes and collecting in narrow river valleys. Excessive amounts of impermeable surfaces such as pavement can increase the amount and rate of water runoff. Development affects the runoff of storm water and snowmelt. When rain falls in an undeveloped area, as much as 90 percent (90%) of it will infiltrate the ground; in a highly developed area, as much as

90% of it will run off. Flash flooding is difficult to mitigate against, as many urbanized areas may not actually be in designated floodplains, and are not subject to floodplain ordinances. However, residents and business owners in these areas should be warned of the potential for flash flooding, especially if the storm water system in their community is old.

There are properties within Jefferson County that have been the site of multiple loss claims due to flooding; these properties are referred to as repetitive loss properties. There are currently 20 listed "repetitive loss" properties in Jefferson County according to representatives with the Federal Emergency Management Agency (FEMA), National Flood Insurance Program (NFIP). Table 2.4b below indicates the type of structure, the number of losses suffered, and the approximate location of the property. This information is legally privileged and confidential. Its use is protected under the privacy act of 1974, 5 U.S.C. Section 552(a). Use of this information should be restricted to Official Use Only (FOUO).

JEFFERSON COUNTY REPETITIVE LOSS DETAILS			
Type of Structure	**Number of Losses**	**Location**	**Mitigated**
Residential – Single Family	2	Shepherdstown	Yes
Residential – Single Family	2	Shepherdstown	Yes
Residential – Single Family	5	Harpers Ferry	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	3	Charles Town	No
Residential – Single Family	3	Charles Town	No
Residential – Single Family	3	Harpers Ferry	No
Residential – Single Family	3	Harpers Ferry	No
Residential – Single Family	3	Shepherdstown	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Charles Town	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Charles Town	No
Residential – Single Family	2	Shepherdstown	No
Residential – Single Family	2	Harpers Ferry	No
Residential – Single Family	2	Charles Town	No
Residential – Single Family	2	Shepherdstown	No
Residential – Single Family	2	Harpers Ferry	No

Table 2.4

The table below indicates when each of the jurisdictions in Jefferson County started participating in the National Flood Insurance Program (NFIP). Jefferson County and participating jurisdictions have adopted and implemented floodplain management requirements, including regulating all and substantially improved construction in Special Flood Hazard Areas, and will continue to enforce regulations in the future. Floodplain mapping has also been developed for participating jurisdictions; the most current floodplain mapping was completed on December 18, 2009.

Jurisdiction	Initial FHBM	Current Effective Map Date
Jefferson County	12/20/74	12/18/09
Bolivar	N/A	12/18/09
Charles Town	2/1/74	12/18/09
Harpers Ferry	2/27/76	12/18/09
Ranson	5/3/74	12/18/09
Shepherdstown	2/1/74	12/18/09

Source: FEMA's CIS database **Table 2.4c**

In 2012, Jefferson County was chosen as one (1) of seven (7) communities throughout the country to participate in a new Pilot Program, Resilient Neighbors Network. Developed by the Natural Hazards Mitigation Association (NHMA) in conjunction with Federal Insurance and Mitigation Administration (FIMA), this grassroots peer-to-peer community program is designed to help communities work together, strengthen, and expand local hazard-mitigation programs. This co-mentoring network will also offer ideas and feedback to FIMA on how they can help increase community resilience to natural hazards. FIMA has developed a "Mitigation Model" to establish mechanisms and incentives to facilitate and enable local risk reduction actions.

HISTORY OF EVENTS

According to records from the National Climatic Data Center (NCDC) Event Record database, the months when the most flooding occurs are March, with five (5) reported floods from 1950 to present, September, with four (4) reported floods and January and February both with three (3) reported floods. There have been 35 flood events in Jefferson County since 1993, 21 of which were river floods, and 14 that were considered flash flood events.

The worst hazard events experienced in Jefferson County were incidences of flooding resulting from heavy rains and snow melt. The earliest flood on record occurred in 1870 when the Shenandoah River was recorded at 12.9 feet above flood stage in the

community of Millville. The most damaging floods in Jefferson County have all occurred within the last decade.

- October 1962 – Flooding of the Shenandoah River at Millville resulted in estimated damages to over 40 homes and mobile homes. The river crested at 32.45 feet.
- April 22, 1992 – Both the Shenandoah and the Potomac Rivers crested above flood stage after 4.5 inches of rainfall. A car and a mobile home were destroyed by the high waters.
- March 25-28, 1993 – Flash flooding occurred after snow melted throughout the county. Several people were evacuated and approximately $5,000 in damages to public facilities was caused.
- January 19-21, 1996 – A three-day period of flooding resulting from snow melting after the Blizzard of 1996. Several roads were closed and many structures were affected or damaged by high water. This flooding resulted in approximately $593,000 in damages to public and private facilities.
- September 6, 1996 – Heavy rain and flooding was experienced as a result of Hurricane Fran. Damage was sustained by many residential structures throughout the county. Harpers Ferry was especially hard hit with the flooding of park exhibition buildings and clean-up costs of over $2.8 million. Transportation was also impacted with roadways closed and washed out as well as severe damage to some CSX tracks.
- November 7-10, 1997 – Flooding on the Potomac River, Opequon Creek, and the Shenandoah River resulted in the inundation of roadways and other minor damages.
- January 8-10, 1998 – Roadways flooded with minor damages reported. The Opequon Creek crested .75 inches above flood stage; Potomac River crested 1/2 foot under flood stage; and the Shenandoah River crested 1.8 feet over flood stage at Millville.
- January 28-29, 1998 – Flooding occurred along the Shenandoah and Potomac Rivers and the Opequon Creek banks during a Winter Storm Warning issued by the National Weather Service.
- May 26, 2002 – Basements and yards were flooded. Water collected on Route 480 near Shepherdstown. Scattered thunderstorms with large hail and very heavy downpours moved through the Eastern Panhandle between 3 and 7 PM. In Jefferson County, golfball sized hail fell in Shepherdstown near Route 480. In

Kearneysville, baseball sized hail was reported. Numerous trees were downed in the vicinity. Power was knocked out in Charles Town and Ranson. Heavy downpours flooded basement and yards. High water was also reported on Route 480 near Shepherdstown. No financial data for property damage was reported.

- January 2, 2003 – Heavy rainfall on the 1st caused minor flooding on rivers and creeks in Berkeley and Jefferson counties. In Shepherdstown, the Potomac River reached a stage of 16.57 feet. Flood stage is 15 feet. The road to a housing development was flooded and several other low lying areas along the river were inundated by water. No financial data for property damage was reported.
- February 23, 2003 – A combination of 1.5 to 3 inches of rain that fell between the evening of the 21st and the morning of the 23rd and snow melt from the massive snowstorm of 14-18 February led to widespread flooding. In Jefferson County, drivers had to be rescued when their vehicles stalled in high water on Bloomery Road. Avon Bend Road was flooded by the Shenandoah River and a motorist had to be rescued when his car became stalled in flood waters. No financial data for property damage was reported.
- May 16, 2003 – A large area of showers and thunderstorms containing heavy downpours moved through the region between the afternoon of the 15th and the morning of the 16th. The system dropped between 1.5 and 3 inches of rain across the extreme northeast portion of the Eastern Panhandle, resulting in minor flooding. In Jefferson County, Route 230 was closed by high water. Roads were also flooded in the Ranson and Millville areas. In addition, flooding was reported along Route 340 near the confluence of the Shenandoah and Potomac rivers near Harpers Ferry. No financial data for property damage was reported.
- September 18-20, 2003 – Heavy rain and flooding was experienced as a result of Hurricane Isabel. At Shepherdstown, there was moderate flooding with the river cresting at 19.83 feet at 4:30 on September 20. Flood stage is 15 feet. The Opequon Creek at Martinsburg had minor flooding. Millville on the Shenandoah River had moderate flooding reaching a crest of 17.31 feet at 8 pm on September 20. Flood stage is 13.5 feet. Harpers Ferry at the confluence of the two rivers saw minor flooding. In Jefferson County, a car drove into flood waters. The driver and child in the car were rescued. Total property and crop damage for the Eastern Panhandle was $1,070,000.

- September 28, 2004: A few secondary roads flooded. The remnants of Hurricane Jeanne brought widespread flooding to Eastern West Virginia on the 28th. The flooding lasted from mid morning at some sites through late evening. Many secondary and primary roads, including US Routes 51 and 11, were under water. No financial data for property damage was reported.
- November 29, 2005 – Vehicles were flooded out in water across the county. A large low pressure system moved from the Ohio Valley into the Middle Appalachians on November 29. Southerly winds brought moisture into the region. Prolonged heavy rainfall occurred in the Eastern West Virginia Panhandle. This heavy rainfall lead to flooding in some areas. On the evening of the 29th, some thunderstorms produced flash flooding in Jefferson and Berkeley counties. A few severe thunderstorms also occurred. Total property damage reported was $150,000.
- June 26, 2006 – High water caused a vehicle accident on Highway 230 near Covenant Baptist Church. Spruce Street flooded. Water went into the Bolivar-Harpers Ferry Public Library. Basement flooding in homes in Bolivar. Scattered areas of flash flooding began late on June 27 and continued into June 28. Numerous road closures and several water rescues were reported across the Eastern Panhandle of West Virginia. Total property damage reported was $25,000.
- March 2, 2007 – On Saturday, March 3rd, two people became stranded in the flood waters when they drove past the "Road Closed" and "High Water" signs on River Road. The occupants were able to get out of their car and wade through the 2 feet of water to get to shore. When a law enforcement officer arrived at the scene to help retrieve the vehicle, he drove an SUV through the water and was able to cross successfully. However, the engine was blown. Another woman was stranded later in the day in the flooded roadway at the Rattlesnake Run end of River Road. The South Branch of the Potomac River at Shepherdstown crested at 15 feet after midnight on March 2nd. Total property damage reported was $15,000.
- April 16, 2007 – Newspapers reported flooding along River Road near the Pack Horse Farm subdivision in Shepherdstown, WV.
- March 13, 2010 – The 2 to 4 inches of rain combined with nearly saturated antecedent conditions to produce flooding over eastern West Virginia. Several

Roads across Jefferson County were closed due to high water, including John Rissler Road, Bloomery Road, and River Road.

- April 16, 2011 – With ground already saturated from several rounds of significant rainfall in the past week, flooding and flash flooding resulted. Rainfall amounts over the eastern West Virginia panhandle exceeded three (3) inches in spots. A mudslide and flooded basements were reported near the top of the mountain near the Virginia border. Chestnut Hill Road was closed due to water cascading down the road toward Highway 340.
- October 30, 2012 – Predicted flooding on Opequon Creek caused evacuations of residents in both Jefferson and Berkeley Counties. The river crested at 13.5 feet.

HAZARD IMPACT

Flooding continues to be a frequent and damaging natural disaster as a result of the Potomac and Shenandoah Rivers, and their many tributaries. Flooding is the most costly natural hazard in Jefferson County, and has resulted in approximately $21 million in property damage over the past 61 years.

Flooding impacts to the community include injuries to citizens and public safety officials, damage to property, lost revenue and economic damages, and increased demand on public safety and infrastructure related services. Response activities include unanticipated overtime for Emergency Operations Center (EOC) activations, evacuations, sheltering of displaced people, rerouting traffic destined for impassible roads, bridge and road damage repairs, and rescue or medical missions related to motorists and isolated families. Private property damages to homes and vehicles as well as land erosion, river channel changes, agricultural damages and livestock losses resulting in significant rural economic impacts to local residents.

The table below summarizes the asset inventory for addressable structures in the floodplain across Jefferson County.

	Charles Town	Ranson	Harpers Ferry	Shepherdstown	Unincorporated County	Total
Addressable Structures	19	88	4	126	443	680

Table 2.4d

Source: Jefferson County GIS/Addressing Office & 2009 FEMA 100-Year Floodplain data

Based on this analysis, of the incorporated areas Shepherdstown has the greatest number of addressable structures within the floodplain in Jefferson County. An estimated 126 addressable structures in the Corporation of Shepherdstown fall within the identified flood hazard areas. Shepherdstown has a mix of both residential and commercial structures at risk from flooding as well as other buildings such as properties belonging to the town and Shepherd University.

The second highest amount of addressable structures within a municipality located in the floodplain occurs in Ranson, where 88 structures are at risk from flooding.

Charles Town has the third highest amount of structures in the floodplain at 19. These structures are primarily located along Evitts Run, a creek that crosses through the southwestern portion of the town, and the majority is in the area surrounding the Evitts Run Park. Charles Town is also the only municipality within Jefferson County to have a critical facility located within the floodplain, the Charles Town Waste Water Treatment Plant.

Based on the existing FIRM maps and the Jefferson County GIS/Addressing Office database only four (4) structures within Harpers Ferry are located within the 100-year floodplain all of which are located in the Harpers Ferry National Historical Park. Interviews with town representatives indicate that Harpers Ferry has experienced some of the worst flooding within Jefferson County and many structures have received damages in the past. The inaccuracy of the FIRM maps used to delineate the floodplain in this area may account for the lower than expected structure count. GIS maps from the National Park Service that contain more updated studies of the location of floodplains in Harpers Ferry were also reviewed, however, this information did not lend any insight to the flood problem outside of the park boundaries.

According to information collected by the National Park Service, the lower town of Harpers Ferry has reached or surpassed the flood stage of 18.5 feet over 36 times. The highest river crest on record for the Harpers Ferry area was 36.5 feet on March 19, 1936. Based on the procedures detailed in the Emergency Response Plan for Harpers Ferry National Historical Park a variety of park and town facilities are at risk when the river crests above flood stage:

- 16-18 feet – Pedestrian Bridge over Potomac River.
- 18.5-20 feet – Shenandoah Street and Harpers Ferry/Bolivar Public Service District.
- 20-27 feet – Lower town.

Interviews with local government officials in Harpers Ferry provided further insight to the flooding problem experienced by the town. Based on previous flood events when waters rise above 23 feet in Harpers Ferry, the first two (2) buildings on Potomac Street outside of the National Park property are inundated with water. If the floodwaters rise to 25 feet the remaining properties on Potomac Street are flooded including six (6) commercial establishments and one (1) residential property.

Infrastructure layers were also intersected with FEMA 100-Year floodplain data across the county to determine the location and amounts of vulnerable roadways, railroads, and utilities. The table below summarizes the findings of this portion of the analysis. These results indicate that approximately 65 miles of infrastructure are located in flood hazard areas.

Facility Type	Number of Miles
Roads	46.81
Utilities	2.25
Railroads	15.53
Total	**64.59**

Table 2.4e
Source: Jefferson County GIS/Addressing Office

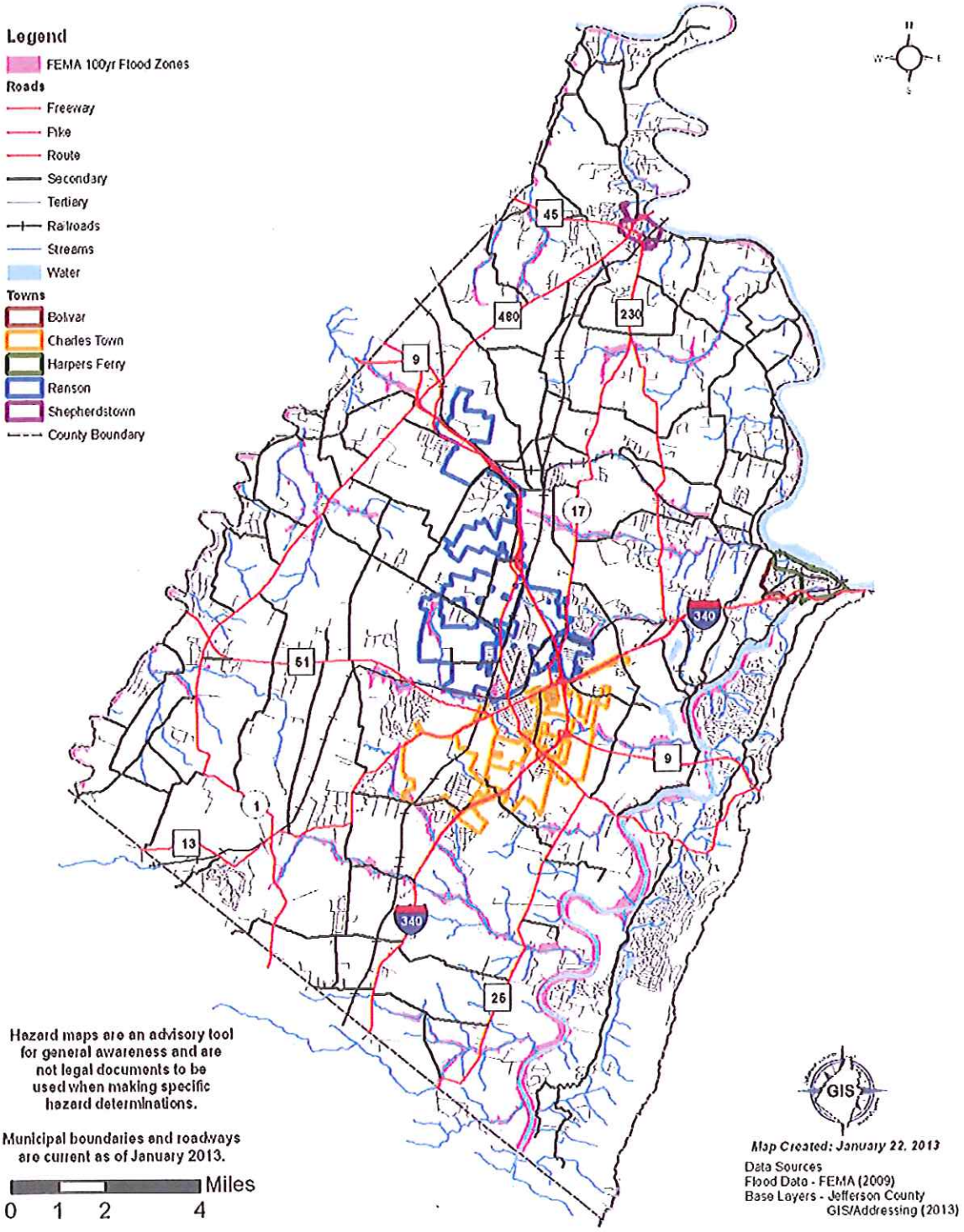
PAST MITIGATION EFFORTS

Past mitigation efforts to reduce the effects of flooding throughout Jefferson County include the following:

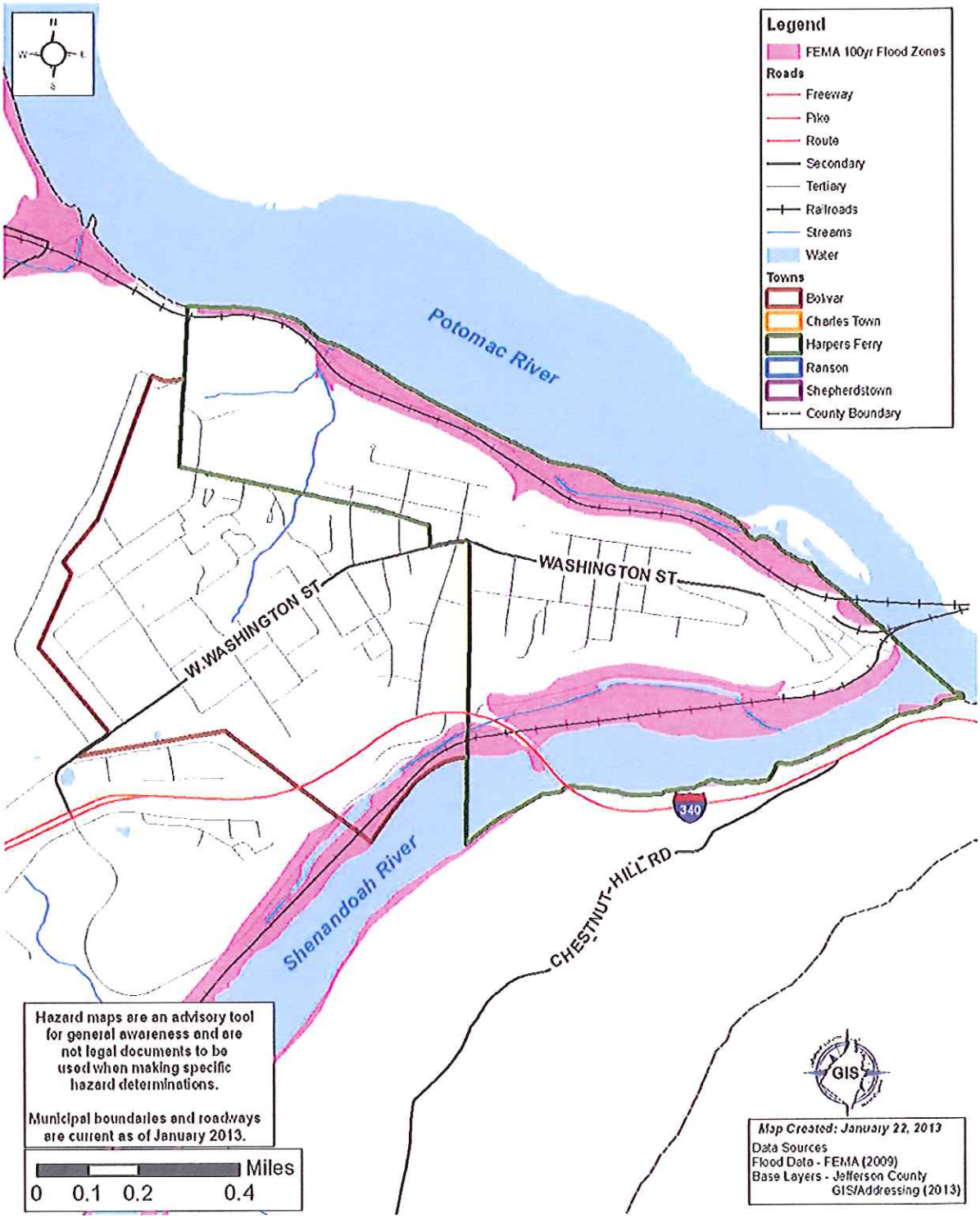
- The distribution of public awareness materials concerning flood hazard risks, updating the county's website, and use of social media (i.e., facebook, twitter, etc.) to provide hazard related information that is easily accessible.
- The yearly distribution of letters to all property owners in or near a floodplain in the county regarding potential flood hazards as required for participation in the Community Rating System (CRS). Jefferson County is now a Class eight (8) in the CRS, resulting in a 10% reduction of flood insurance premiums for policies in the unincorporated areas of Jefferson County.
- Holding local courses on the National Flood Insurance Program (NFIP) for realtors, bankers, and insurers.
- Working with the municipalities to update all floodplain ordinances adopted prior to 1987, all have been updated.

- Providing additional training to county and municipal development officials on NFIP requirements.
- Providing training to municipalities on the CRS program and encouraging them to participate.
- Collecting updated information of the number and location of all repetitive loss properties throughout the county and the municipalities.
- Developing a database of information on all repetitive loss properties including maps.
- Identifying owners of repetitive loss properties who are interested in participating in future property acquisition and relocation projects.
- Conducted buyouts or property acquisition and relocation projects in several areas, and have conducted flood elevation adjustments to several facilities.
- Working with FEMA and the West Virginia Division of Homeland Security and Emergency Management (WVDHSEM) on the Map Modernization Program to improve FIRMs.
- Working with the West Virginia Department of Highways to identify areas of frequent roadways flooding and develop mitigation strategies.
- Working with National Weather Service (NWS) to evaluate the flood stage data for Millville on the Shenandoah River and as of March, 2012 adjusted the flood stage from 13 feet to 10 feet.
- Utilizing the media from the distribution and publication of flooding information.
- A large USDA funded storm water channeling mitigation project was conducted in the West side of the City of Ranson.
- Potomac Edison, the NWS, and USGS formed a partnership to keep the river gauge on the Shenandoah River.
- Several mitigation buyout projects have been completed by Jefferson County. Property on Bloomery Road and Riverside Drive were purchased and returned to open space. A property at Dam Four was purchased and worked with DNR to create a recreational use/open space area.
- Structural elevations have been conducted on two (2) residential properties.
- Jefferson County has been designated by the NWS as a StormReady community since 2004.
- Jefferson County is part of FEMA's RiskMAP Program.

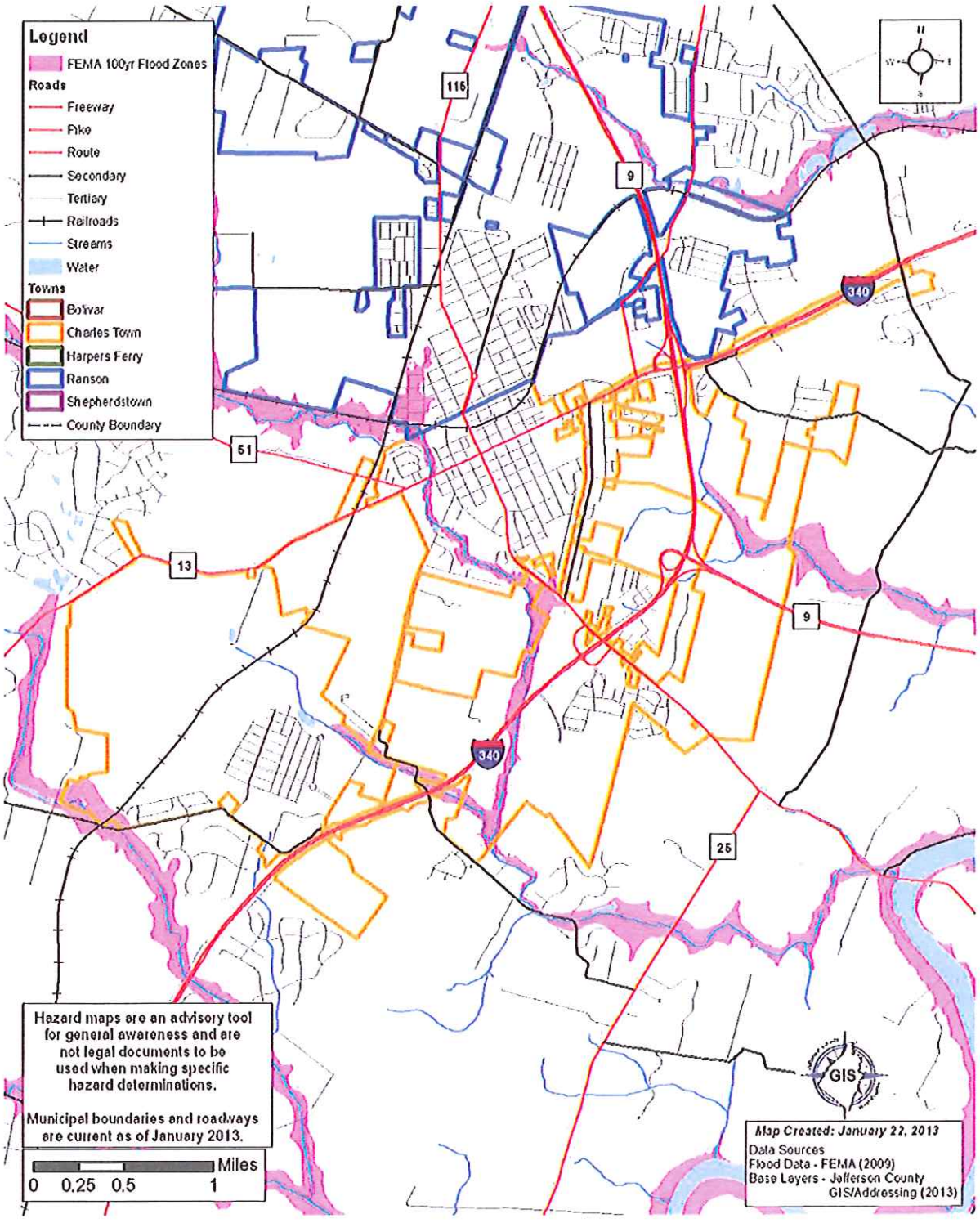
2.2 PROFILING HAZARDS: FLOODING MAP



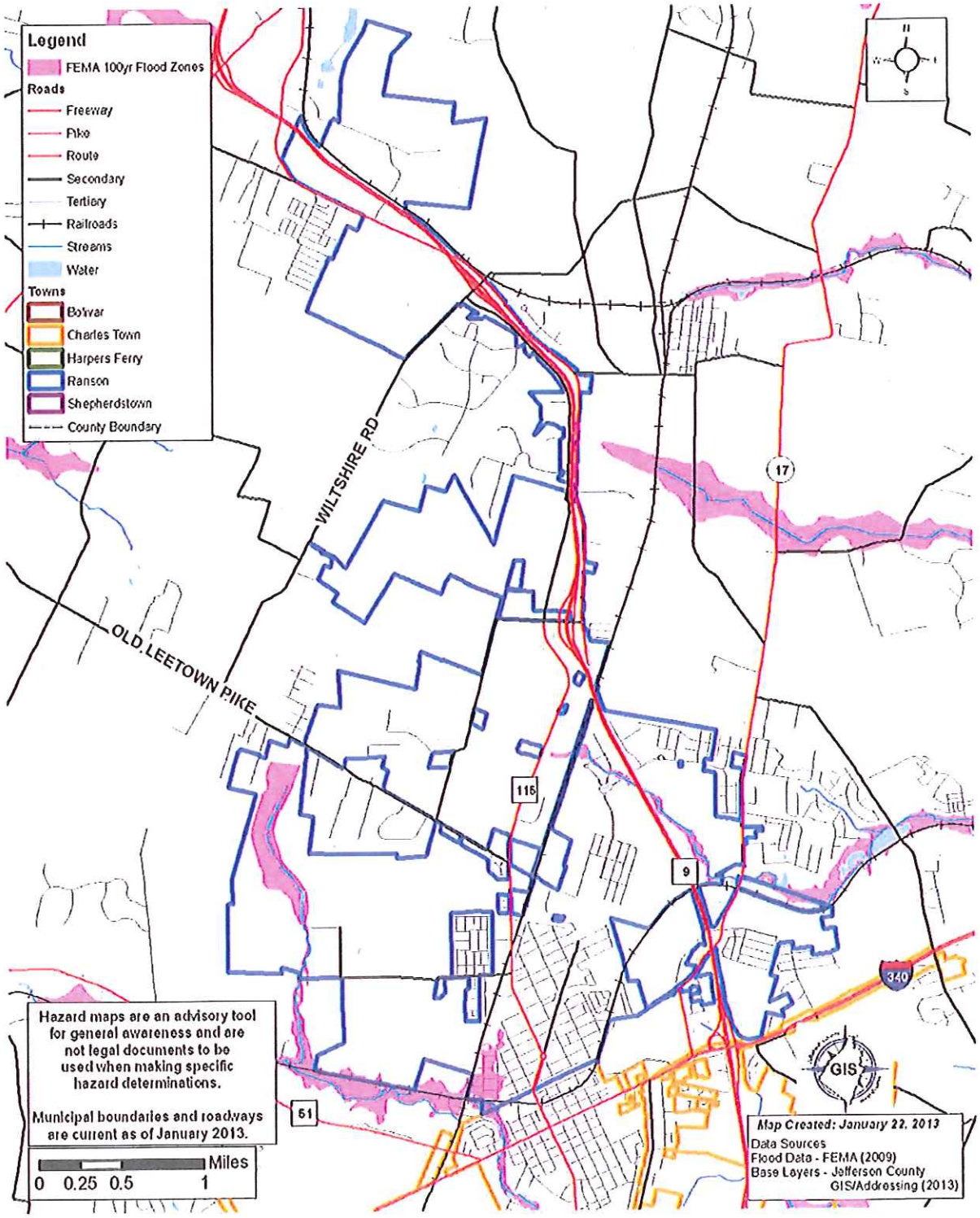
2.2 PROFILING HAZARDS: FLOODING MAP (BOLIVAR-HARPERS FERRY)



2.2 PROFILING HAZARDS: FLOODING MAP (CHARLES TOWN)



2.2 PROFILING HAZARDS: FLOODING MAP (RANSON)



2.2 PROFILING HAZARDS: FLOODING MAP (SHEPHERDSTOWN)