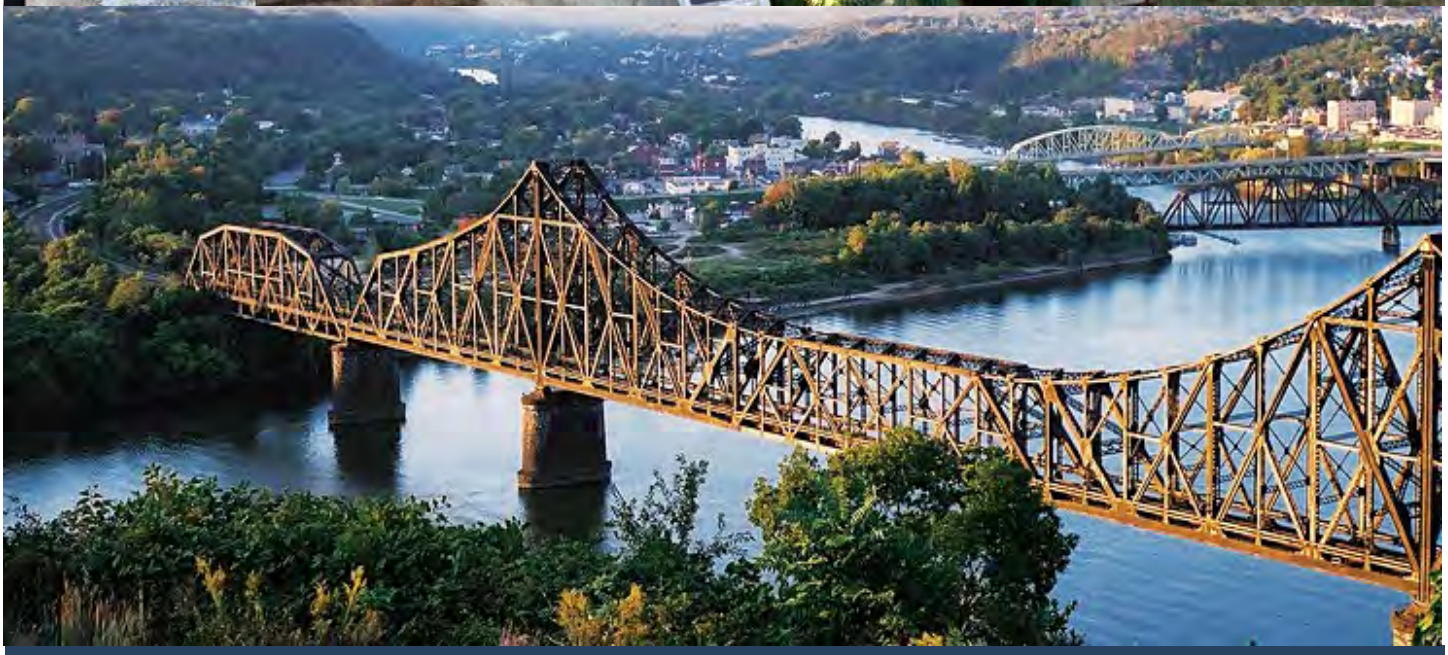
Beaver County
Hazard Mitigation Plan



June 2016

Prepared by:
Tetra Tech, Inc.
2400 Park Drive, Suite I
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EXECUTIVE SUMMARY

The 2016 update to the Beaver County Hazard Mitigation Plan (HMP) was prepared in accordance with the Disaster Mitigation Act of 2000 (DMA 2000). DMA 2000 requires states and local governments to prepare HMPs to remain eligible to receive pre-disaster mitigation grant funds made available in the wake of federally declared disasters. Additionally, DMA 2000 effectively improves the disaster planning process by increasing hazard mitigation planning requirements for hazard events, and requiring participating municipalities to document their hazard mitigation planning process and identify hazards, potential losses, and mitigation needs, goals, and strategies.

The Beaver County HMP represents the work of citizens, elected and appointed government officials, business leaders, and volunteer and nonprofit groups to protect community assets, preserve economic viability of the community, and save lives. DMA 2000 regulations require formal updates and adoptions of local plans every 5 years, reassessing risks and updating local strategies to manage and mitigate those risks. To comply, Beaver County and inclusive jurisdictions actively participated in updating the HMP. Extensive outreach efforts by Beaver County Emergency Services resulted in full participation from 45 of its municipalities. Upon completion and approval of the HMP, participating jurisdictions will continue to address and implement findings and recommendations of this HMP update. This 2016 version is the second update of the County HMP, with the original HMP developed in 2005, and the first update occurring in 2011.

Table ES-1 identifies municipal governments that actively participated in the HMP update process.

Table ES-1. Participating Jurisdictions in the 2016 Beaver County HMP Update

Jurisdictions		
Aliquippa, City of	Eastvale, Borough of	Monaca, Borough of
Ambridge, Borough of	Economy, Borough of	New Brighton, Borough of
Baden, Borough of	Fallston, Borough of	New Galilee, Borough of
Beaver Falls, City of	Frankfort Springs, Borough of	New Sewickley, Township of
Beaver, Borough of	Franklin, Township of	Patterson Heights, Borough of
Big Beaver, Borough of	Freedom, Borough of	Patterson, Township of
Bridgewater, Borough of	Greene, Township of	Potter, Township of
Brighton, Township of	Hanover, Township of	Pulaski, Township of
Center, Township of	Harmony, Township of	Rochester, Borough of
Chippewa, Township of	Hopewell, Township of	Rochester, Township of
Conway, Borough of	Independence, Township of	Shippingport, Borough of
Darlington, Borough of	Industry, Borough of	South Beaver, Township of
Darlington, Township of	Koppel, Borough of	South Heights, Borough of
Daugherty, Township of	Marion, Township of	Vanport, Township of
East Rochester, Borough of	Midland, Borough of	West Mayfield, Borough of

During the plan update process, Beaver County and its participating municipalities engaged in the following planning process steps:

1. Identified and prioritized hazards that may affect the County and its municipalities.
2. Assessed the County's and municipalities' vulnerabilities to these hazards.

3. Identified mitigation actions that can reduce those vulnerabilities.
4. Developed a strategy for implementing those actions, including identifying the agency (or agencies) responsible for each implementation.

Throughout the planning process, the general public was offered opportunity to comment on the existing HMP and provide suggestions for the updated version. Three public meetings occurred, two of which were also joint Planning Team meetings, at which residents could provide input on the HMP.

The following hazards were identified by the Planning Team as presenting the highest risk to the County and its municipalities:

- Flood, flash flood, and ice jam
- Winter storm
- Tornadoes and windstorms
- Environmental hazards (e.g., hazardous materials spills)
- Nuclear Incident
- Transportation Accidents
- Drought
- Pandemic
- Utility Interruption

This HMP also includes hazard profiles for the following hazards (listed in order of risk factor analysis ranking):

- Dam Failure
- Urban Fire and Explosions
- Radon Exposure
- Landslide
- Levee Failure
- Terrorism, Criminal Activity, or Civil Disturbance
- Earthquake

To mitigate against effects of those hazards, the Planning Team identified the following goals for hazard mitigation over the next 5 years:

1. **Goal 1:** Protect lives, property, environmental quality, and natural resources of the County.
2. **Goal 2:** Enhance consistent coordination, collaboration, and communication among stakeholders.
3. **Goal 3:** Provide a framework for active hazard mitigation planning and implementation.
4. **Goal 4:** Build political support and secure funding for mitigation efforts.
5. **Goal 5:** Increase awareness, understanding, and preparedness.

Objectives and actions to be implemented are discussed in the Mitigation Action Plan in Section 6.4.

Additionally, to monitor implementation of the HMP, the Planning Team members will meet annually to evaluate the status of plan implementation and will prepare a summary report of HMP status and any needed updates. The mitigation evaluation will address changes as new hazard events occur, as the area develops, and as more information becomes available pertaining to hazards and their impacts. The evaluation will include an assessment of whether the planning process and actions have been effective, whether development or other issues warrant changes to the HMP or its priorities, if progress toward the communities' goals is satisfactory, and whether changes are warranted. Opportunities for public feedback will occur via direct contact with the County Hazard Mitigation Planning Team Coordinator, during recurring review meetings, and during the 5-year revision process.

To request information or provide comments regarding this plan, please contact Beaver County Emergency Services:

Mailing Address:	Hazard Mitigation Planning Team c/o Beaver County Emergency Services 351 14th Street Ambridge, PA 15003
Contact Name:	Jeff Bolland or Eric Brewer, Emergency Services
E-mail Address:	jbolland@beavercountypa.gov, ebrewer@beavercountypa.gov
Telephone:	724-775-1700

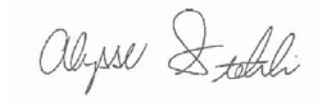
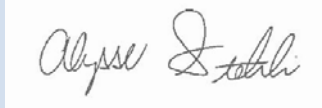
CERTIFICATION OF ANNUAL REVIEW MEETINGS

The Beaver County Hazard Mitigation Planning Team has reviewed this Hazard Mitigation Plan (HMP). See Section 7 of this document for further details regarding this certification section. The Beaver County Emergency Services HMP Coordinator hereby certifies the review.

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED?*	SIGNATURE
2013	2013	Yes	Mr. Jeffrey Bolland
2014			
2015			
2015			
2016	2016 (Various)	Yes	Mr. Jeffrey Bolland, Ms. Alysse Stehli Note: For HMP Update
2017			
2018			
2019			

* Confirm yes here annually, and describe on record of changes page.

RECORD OF CHANGES

DATE	DESCRIPTION OF CHANGE MADE, MITIGATION ACTION COMPLETED, OR PUBLIC OUTREACH PERFORMED	CHANGE MADE BY (PRINT NAME)	CHANGE MADE BY (SIGNATURE)
2013	Reviewed HMP and noted changes to plan since 2011 approval	Jeff Bolland	Mr. Jeffrey Bolland
2/3/2016	Reviewed and updated HMP to incorporate information from previous 5 years; added new hazard profiles including radon exposure; reprioritized mitigation actions based on PA-STEEL evaluation; revised mitigation action plans; completed other revisions required by the Federal Emergency Management Agency (FEMA) for plan approval.	Alysse Stehli (consultant)	
6/3/2016	FEMA notified Beaver County HMP Coordinator that the County received Approval Pending Adoption (APA) designation for its 2016 HMP update.	Alysse Stehli (consultant)	
6/6/2016	Finalized 2016 HMP update with APA designation and update to month of approval.	Alysse Stehli (consultant)	

REMINDER: ***Please attach all associated meeting agendas, sign-in sheets, handouts, and minutes.***

Section **Page**

Appendices

SECTION 1 INTRODUCTION

This section presents background information, describes the purpose, and defines the scope of the 2016 update of the Beaver County Hazard Mitigation Plan (HMP).

1.1 BACKGROUND

Across the United States, natural and human-caused disasters have led to increasing levels of deaths, injuries, property damage, and interruptions of business and government services. The time, money, and effort spent to recover from these disasters exhausts resources, diverting attention from important public programs and private agendas.

Beaver County, Pennsylvania, has experienced a significant number of statewide or County-specific gubernatorial and presidential disaster declarations since 1954. The emergency management community, citizens, elected officials, and other stakeholders in Beaver County recognize the impact of disasters on their community and concluded that proactive efforts need to be taken to reduce the impact of natural and human-caused hazards.

"Hazard mitigation" describes actions taken to prevent or reduce the long-term risks to life and property caused by a hazard event. Pre-disaster mitigation actions are taken in advance of a hazard event and are essential to breaking the typical disaster cycle of damage, reconstruction, and repeated damage. With careful selection, mitigation actions can be long-term, cost-effective means of reducing the risk of loss.

The Beaver County Hazard Mitigation Planning Team (Planning Team)—composed of Beaver County officials, municipal representatives, emergency responders, and business leaders—has updated this HMP. Through an open-bid process, Beaver County contracted Tetra Tech, Inc. (Tetra Tech), to update the County HMP from 2011.

The HMP update is the result of 8 months of collaboration between the citizens and officials of the County and representatives from Tetra Tech to develop a pre-disaster, multi-hazard mitigation plan that will guide the County toward greater disaster resistance, while respecting the character and needs of the community.

1.2 PURPOSE

The purpose of this HMP is to minimize the effects that natural, technological, and man-made hazards have on the people, property, environment, and business operations within Beaver County. This document exists to provide the background information and rationale for the mitigation actions that the Planning Team and municipal representatives have chosen to implement across the County.

The document is governed by the Disaster Mitigation Act of 2000 (DMA 2000) and its implementing regulations (Title 44 Code of Federal Regulations [CFR] §201.6, published February 26, 2002). Local jurisdictions must comply with DMA 2000 and these regulations to remain eligible for funding and technical assistance from State and federal hazard mitigation programs.

1.3 SCOPE

The implementation actions within this HMP apply to Beaver County and any municipalities within the County that adopt this HMP as their own. However, only those municipalities that have participated in the plan update process will remain eligible for State and federal hazard mitigation funding through the HMP. For the purpose of this plan, municipal participation was defined as completion and submission of a Risk Assessment Update Worksheet, Capability Assessment Survey, and Mitigation Strategy 5-Year Plan Review Worksheet and attendance by an official municipal representative at a planning or public meeting conducted as part of the planning process.

SECTION 2 COUNTY PROFILE

This section discusses Beaver County geography and environment, community facts, population and demographics, land use and development, and critical facilities.

Beaver County includes 54 municipalities. According to the 2010 Beaver County Comprehensive Plan, the County is home to 25 "urban" municipalities, 8 "suburban" municipalities, and 21 "rural" municipalities. Although included among the 54 municipalities, the Borough of Ellwood City is part of both Beaver and Lawrence Counties, and operates as a municipality of Lawrence County. Because of this, Ellwood City participates in the update to the Lawrence County Hazard Mitigation Plan (HMP). Because the Lawrence County HMP includes detailed information on risk to, vulnerability of, and mitigation priorities for Ellwood City, this jurisdiction will not be considered in the 2016 Beaver County HMP.

2.1 GEOGRAPHY AND ENVIRONMENT

Beaver County is in the southwestern part of Pennsylvania, encompassing 443.9 square miles (434.21 square miles of land and 9.69 square miles of water). The County is divided into thirds by the Ohio River and the Beaver River. The Ohio River enters Beaver County from the south and generally flows northward. The Beaver River enters the County from the north, flowing southward and emptying into the Ohio River in central Beaver County. At this confluence of the Ohio and Beaver Rivers, the Ohio River turns and generally flows westward, exiting Beaver County and entering the State of Ohio. Beaver County is surrounded by Lawrence County to the north, Butler and Allegheny Counties to the east, Allegheny and Washington Counties to the south, and Columbiana County, Ohio, and Hancock County, West Virginia, to the west.

The County is part of the Allegheny Plateau, and thus is characterized by irregular terrain. It has sharp hills and valleys, along with pockets of moderately sloped terrain (36% of the County has a slope of 25% or greater). Elevations range from 1,383 feet in New Sewickley Township (Big Knob), in the eastern part of the County, to 660 feet along the Ohio River. Beaver County is traversed by over 878 miles of rivers and streams, with major floodplains adjacent to the Ohio and Beaver Rivers, as well as Brush, Connoquenessing, Raccoon, and North Fork Little Beaver Creeks. The County also has over 8,000 acres of wetlands.

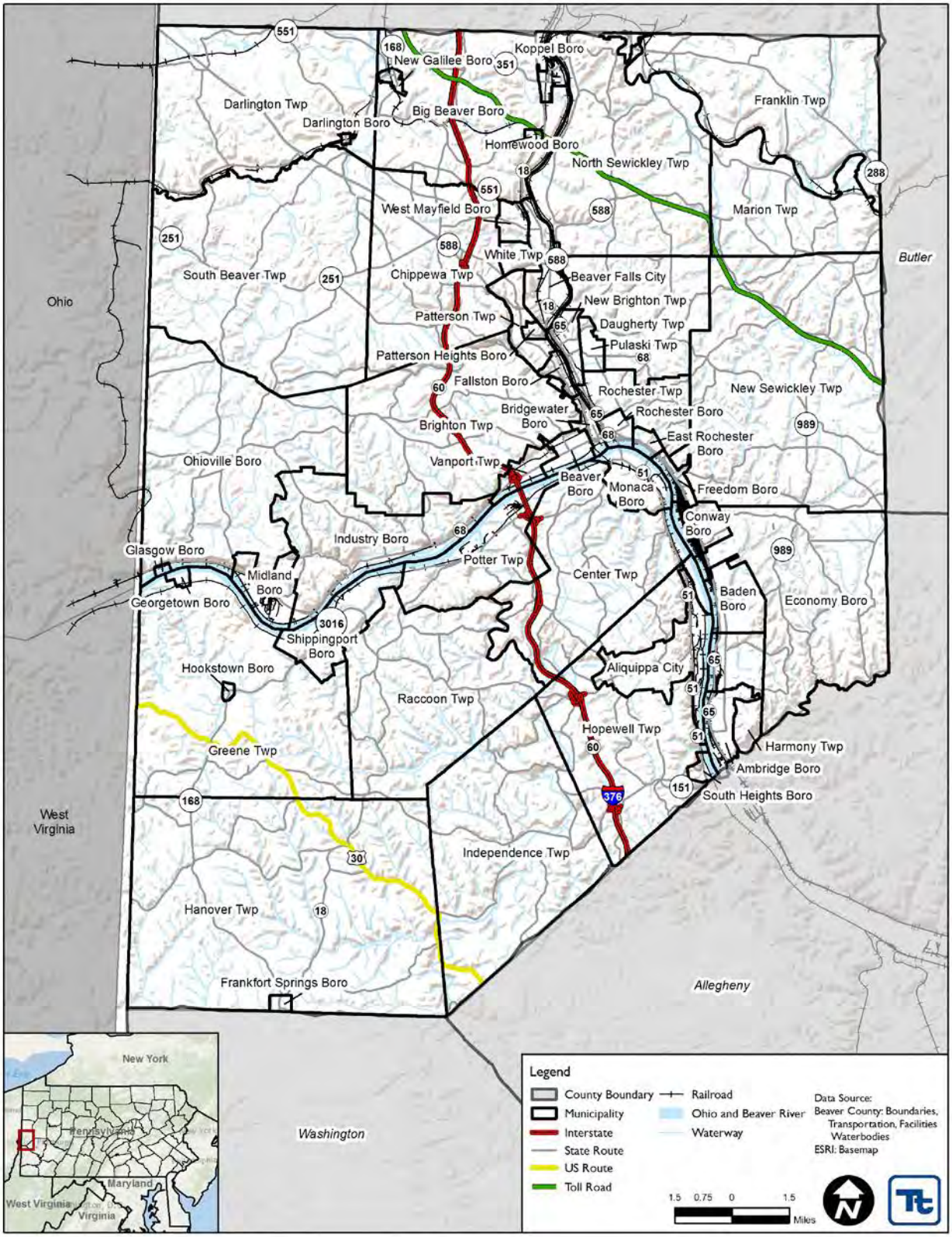
Beaver County has one state park complex, the 1,400-acre Raccoon Creek State Park, run by the Department of Conservation and Natural Resources. The County also includes four County Parks, four State game lands, the State Fish & Boat Commission-maintained Hereford Manor Lake (Franklin Township), and the Beaver County Conservation District Environmental Center (Independence Township). Other protected lands include several privately held game lands and conservation easements.

Beaver County has an extensive transportation network of roads, and the major routes include US Route (US-) 30; Pennsylvania State Routes (PA-) 18, 51, 65, 68, 151, 168, 251, 288, 551, 588, 989; and Interstates (I-) 76 and 376. Additionally, primarily along the Beaver and Ohio Rivers, rail transportation is a significant part of the Beaver County landscape. Four main railway companies operate in the County: Amtrak, Buffalo and Pittsburgh (BPRR), CSX Transportation, and Norfolk Southern. The Conway Rail Yard, a major rail hub, is operated by Norfolk Southern and situated in Conway Borough.

The Ohio River is a major part of Southwestern PA's transportation infrastructure, facilitating movement of large quantities of goods shipped via barge. The County is home to one lock and dam, Montgomery Lock and Dam, near Industry Borough.

A base map of Beaver County appears on Figure 2-1.

Figure 2-1. Beaver County Base Map



Source: Beaver County

2.2 COMMUNITY FACTS

Beaver County was created in 1800, from portions of Allegheny and Washington Counties. The County was named after the Beaver River, a translation of a Native American name for the stream. Today, Beaver County has a diverse landscape that includes both rural and urban settings, high-density residential and commercial areas, such as the City of Aliquippa and Center Township, and large tracts of open space and agricultural lands.

As noted earlier, the County includes 54 municipalities—2 cities, 22 townships, and 30 boroughs (including Ellwood City). The County seat is Beaver Borough, with a population of 4,531.

Beaver County is home to four institutions of higher learning—Geneva College, Community College of Beaver County, Pennsylvania State University (PSU) Beaver Campus, and Mountain State University. Community College of Beaver County, and PSU Beaver are within Center Township. Geneva College is within the City of Beaver Falls. Also within the County are a number of business, technical, and trade schools, including the Beaver County Career and Technology Center. There are 14 public school districts, 17 private schools, and 3 primary charter schools. The Beaver County Library System consists of 11 public libraries and a Bookmobile. Further information on these and other County critical facilities appears in Section 2.5 below.

2.3 POPULATION AND DEMOGRAPHICS

Changes in population or demographics may be used to identify higher-risk populations. Maintaining up-to-date data on demographics will allow the County to better assess magnitudes of hazards and develop more specific mitigation plans. Baseline demographic information about Beaver County is listed in Table 2-1.

Table 2-1. Demographics

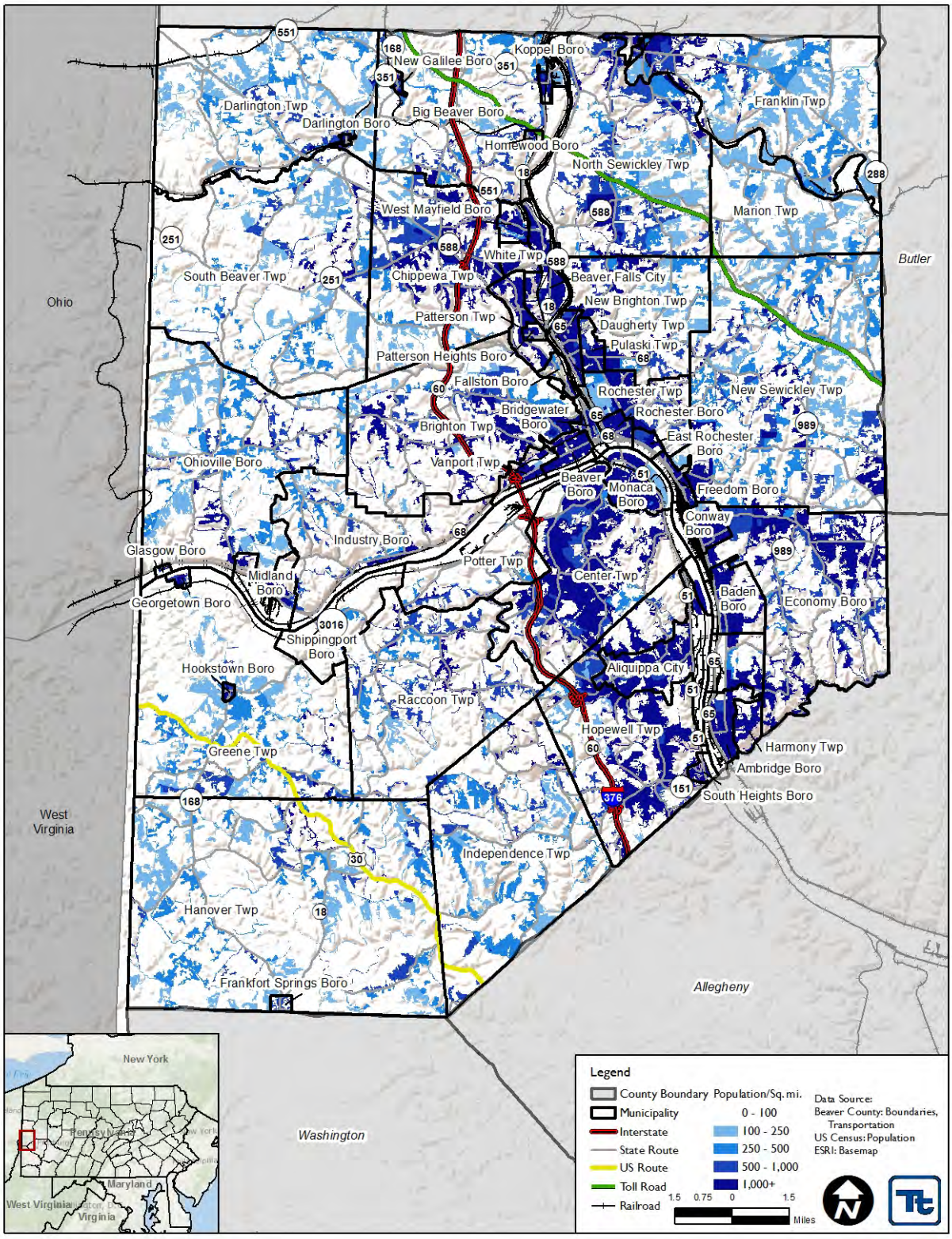
Demographics	2010 Census
Total population	170,539
Male	82,279
Female	88,260
Median age (years)	44.4
Under 5 years	8,966
18 years and over	135,661
65 years and over	31,660
Household population	167,157
Group quarters population	3,382

Source: U.S. Census Bureau 2010, General Population and Housing Characteristics, Beaver County

Beaver County ranks as the 20th most populous county in the Commonwealth of Pennsylvania. It has a relatively dense population (392.3 people per square mile [U.S. Census Bureau Quick Facts 2010]). A higher population density means that people are clustered in groups, rather than spread throughout the County. A higher population density facilitates dissemination of information, instructions, and resources to residents; however, centralization of population can also pose challenges, including (1) increased likelihood that a hazard will affect a significant number of people concurrently, (2) more rapid spread of diseases among people in close contact, and (3) quicker spread of fires among structures nearby each other.

Figure 2-2 illustrates population distribution in Beaver County based on 2010 U.S. Census data.

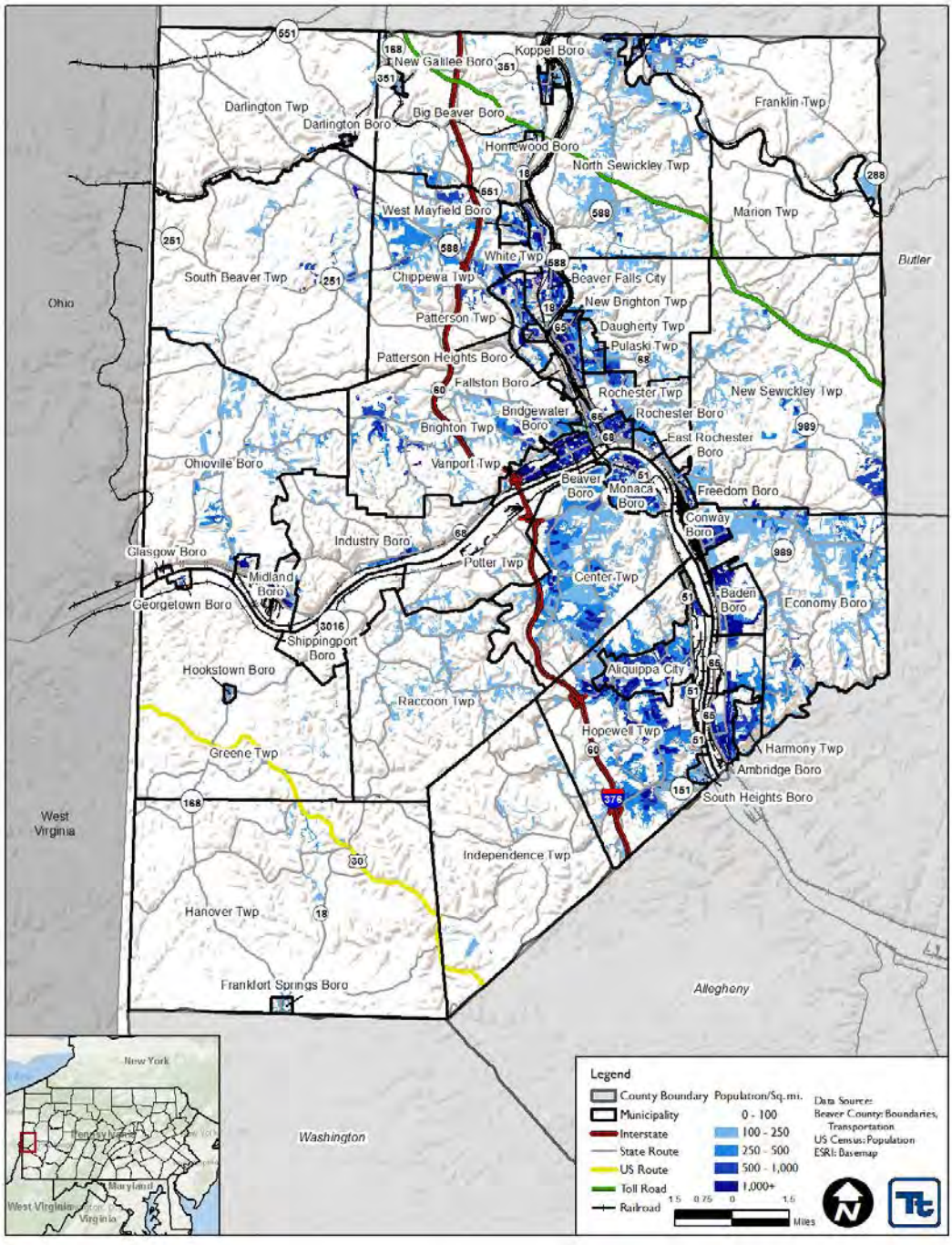
Figure 2-2. Beaver County 2010 Population Distribution



Source: U.S. Census Bureau 2010; HAZUS-MH 3.0

Approximately 18.6 percent of Beaver's population is age 65 or older. These residents may have special needs. For example, many residents in this age bracket may be unable to drive; therefore, development of special evacuation plans for them may be necessary. They may also have hearing or vision impairments that could hinder their reception of emergency instructions. Both older and younger populations are at higher risks for contracting certain diseases. Beaver County's combined under-5-years-of-age and over-65 populations constitute approximately 24 percent of its population. Figure 2-3 illustrates population distribution for residents age 65 and older.

Figure 2-3. Beaver County Population Over 65 Years



Source: U.S. Census Bureau 2010; HAZUS-MH 3.0

Almost 2 percent of Beaver's population lives in "group quarters"—communal settings that can include inmates in a prison, students in a dorm, or elderly or mentally disabled in group-care homes. Many residents living in group quarters have special needs. It is important to ensure that each group-quarter facility has its own emergency plan to account for the unique needs of its residents during a hazard event.

Table 2-2 below lists population estimates for each municipality in Beaver County and for the County as a whole. Anticipated population of the entire County by year 2040 is estimated at 151,666, a decrease of almost 30,000 people within a 30-year period. Population loss typically results in vacancies of some structures, aging infrastructure, and little new development (or subsequent infrastructure updates). It is important that Beaver County properly maintain its existing infrastructure and have plans to manage or redevelop vacant properties. Moreover, despite the County's expected overall decrease in population, populations in some individual municipalities (including Brighton Township and Center Township) are expected to increase,.

Table 2-2. Population Estimates per Municipality in Beaver County

Municipality Name	2000 Census	2010 Census	2020 Projected	2030 Projected	2040 Projected
City of Aliquippa	11,734	9,438	8,589	7,816	6,999
Ambridge Borough	7,769	7,050	6,534	5,946	5,399
Baden Borough	4,377	4,135	3,763	3,465	3,125
Beaver Borough	4,775	4,531	4,282	4,036	3,788
City of Beaver Falls	9,920	8,987	8,178	7,442	6,665
Big Beaver Borough	2,186	1,970	1,813	1,650	1,491
Bridgewater Borough	739	704	682	653	628
Brighton Township	8,024	8,227	8,620	8,904	9,250
Center Township	11,492	11,795	12,353	12,766	13,262
Chippewa Township	7,021	7,620	7,896	8,356	8,711
Conway Borough	2,290	2,176	2,051	1,932	1,809
Darlington Borough	299	254	231	210	188
Darlington Township	1,974	1,962	1,919	1,894	1,859
Daugherty Township	3,441	3,187	3,083	2,893	2,752
East Rochester Borough	623	567	516	470	420
Eastvale Borough	293	225	205	186	167
Economy Borough	9,363	8,970	8,835	8,552	8,354
Fallston Borough	307	266	232	220	197
Frankfort Springs Borough	130	130	128	127	125
Franklin Township	4,307	4,052	4,220	4,147	4,212
Freedom Borough	1,763	1,569	1,428	1,299	1,164
Georgetown Borough	182	174	164	155	145
Glasgow Borough	63	60	55	51	46
Greene Township	2,705	2,356	2,282	2,076	1,946
Hanover Township	3,529	3,690	3,793	3,929	4,046
Harmony Township	3,373	3,197	2,938	2,727	2,488
Homewood Borough	147	109	99	90	81
Hookstown Borough	152	147	135	127	117
Hopewell Township	13,254	12,593	12,298	11,794	11,410
Independence Township	2,802	2,503	2,511	2,344	2,277
Industry Borough	1,921	1,835	1,670	1,550	1,404
Koppel Borough	856	762	693	631	565

Municipality Name	2000 Census	2010 Census	2020 Projected	2030 Projected	2040 Projected
Marion Township	940	913	919	906	904
Midland Borough	3,137	2,635	2,398	2,182	1,954
Monaca Borough	6,286	5,737	5,221	4,751	4,254
New Brighton Borough	6,641	6,025	5,639	5,132	4,694
New Galilee Borough	424	379	345	314	281
New Sewickley Township	7,076	7,360	7,482	7,697	7,859
North Sewickley Township	6,120	5,488	5,184	4,717	4,344
Ohioville Borough	3,759	3,533	3,376	3,179	3,005
Patterson Township	3,197	3,029	3,027	2,931	2,888
Patterson Heights Borough	670	636	675	672	694
Potter Township	580	548	554	538	534
Pulaski Township	1,674	1,500	1,412	1,285	1,181
Raccoon Township	3,391	3,064	2,905	2,543	2,440
Rochester Borough	4,014	3,657	3,423	3,115	2,849
Rochester Township	3,129	2,802	2,594	2,361	2,142
Shippingport Borough	237	214	210	195	186
South Beaver Township	2,974	2,717	2,625	2,439	2,307
South Heights Borough	542	475	432	393	352
Vanport Township	1,451	1,321	1,202	1,094	980
West Mayfield Borough	1,187	1,239	1,190	1,199	1,174
White Township	1,434	1,394	1,269	1,192	1,087
BEAVER COUNTY (TOTAL)	**181,412**	**170,539**	**164,862**	**157,895**	**151,666**

Source: Pennsylvania Department of Environmental Protection (PADEP) 2012

Less than 1 percent of Beaver County's population is not proficient in English. While currently a low percentage, the projected growth through 2040 may indicate an increase in the number of individuals with little to no proficiency in English residing in Beaver County in the future. Subsequently, future hazard mitigation strategies should consider addressing language barriers to ensure that all residents can receive emergency instructions. Table 2-3 summarizes current information about races and ethnicities among the Beaver County population.

Table 2-3. Race and Ethnicity

Race and Ethnicity	2010 Census
One race	167,585
White	155,561
Black or African American	10,676
American Indian and Alaska Native	181
Asian	724
Pacific Islander	40
Other	403
Two or more races	2,954
Hispanic or Latino	1,998

Source: U.S. Census Bureau 2010, General Population and Housing Characteristics, Beaver County

Beaver County has 78,211 residential properties. These properties may be vulnerable to various natural hazards, particularly flooding and windstorms. Damage to residential properties is not only expensive to repair or rebuild, but devastating to the displaced residents.

Approximately 8.7 percent of the County's residential properties are vacant. Vacant buildings are particularly vulnerable to arson and criminal activity. Because vacant properties have not been maintained, many are structurally deficient and at risk of collapse.

Approximately 26.7 percent of the County's population live in rented homes. Because renters are more transient than homeowners, communicating with renters may be more difficult than communicating with homeowners. Similarly, communications with tourists would be harder during an emergency event. Communication strategies should be developed to ensure that these populations receive proper notifications.

Table 2-4 summarizes housing characteristics of residential properties in Beaver County.

Table 2-4. Housing Characteristics

Housing Characteristics	2010 Census
Total housing units	78,211
Owner-occupied housing units	52,335
Renter-occupied housing units	19,048
Vacant housing units	6,828
Average household size	2.34
Housing units with a mortgage	31,703
Housing units (owned) without a mortgage	20,632

Source: U.S. Census Bureau, General Housing Characteristics, Summary File 1 (SF 1), Beaver County

In 2014 (the most current data available), the median household income in the County was $50,242, which was lower than the Commonwealth of Pennsylvania's estimated median household income ($53,115). The County's 2014 estimated per capita income of $26,925 was also lower than the Commonwealth's 2013 estimated per capita income of $28,912. A little less than 9 percent of families' incomes in Beaver County were below poverty level, and 12.1 percent of its individuals' incomes were below poverty level. Emergency responders may have difficulty connecting with individuals within this economic bracket for several reasons, including less access to the Internet within these communities. Additionally, many low-income families and individuals may not own vehicles, and therefore could be a more vulnerable population during an evacuation. Table 2-5 summarizes economic characteristics of Beaver County's population.

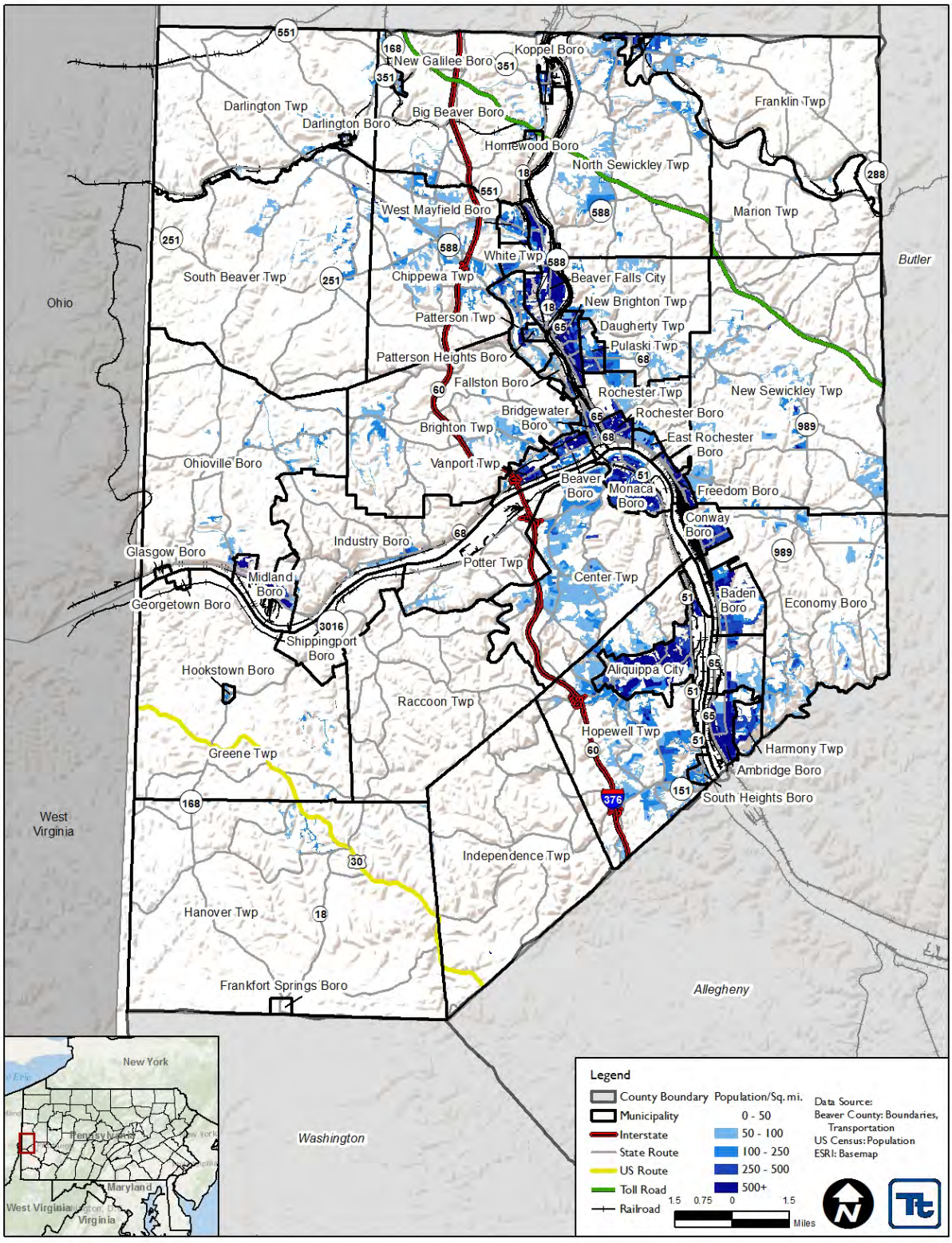
Table 2-5. Economic Characteristics

Economic Characteristics	2014 Data
Median household income in 2014	$50,242
Median family income in 2014	$64,766
Per capita income in 2014	$26,925
Families below poverty level (%)	8.8
Individuals below poverty level (%)	12.1

Source: U.S. Census Bureau 2013, Selected Economic Characteristics 2014 American Community Survey 5-Year Estimates, Beaver County and Pennsylvania

Figure 2-4 illustrates population distribution of residents with incomes below the poverty level.

Figure 2-4. Beaver County Population Below the Poverty Level



Source: U.S. Census Bureau 2010; HAZUS-MH 3.0

2.4 LAND USE AND DEVELOPMENT

Beaver County's existing land use patterns are greatly influenced and shaped by surrounding natural features such as mountain ranges, valleys, and waterways. These features have largely determined locations of transportation corridors and development activities, as well as agricultural practices. Figure 2-5 at the end of this subsection provides a visual reference for diversity of land use and land cover in the County.

A network of high-capacity transportation systems traverses Beaver County. These systems include the Pennsylvania Turnpike, I-76; I-376; US Route 30; and PA Routes 65, 68, 18, and 51. Beaver County also has a significant amount of trans-state traffic due to its proximity to Ohio and West Virginia. The County's transportation systems have greatly contributed to Beaver County's accessibility and land development patterns.

As noted at the beginning of this section, Beaver County has designated its municipalities as urban, suburban, and rural. These classifications were based on several factors, notably population density, population growth/loss, housing unit growth/loss, and public water and sewer access. Municipalities with population density exceeding 1.5 people per acre were more likely to be categorized as urban, as were municipalities undergoing population decrease or those with public water and sewer. Suburban populations typically had population densities of less than 1.5 people per acre (greater than the rural communities), had some public utilities, and had gained population or housing units. Rural municipalities had low population density, increased housing, and limited public sewer and water. Although some small boroughs did not neatly fall into a single category, many of these were determined to have more in common with surrounding rural municipalities and were therefore classified as rural (Beaver County Comprehensive Plan 2010).

Beaver County's land use priorities and recommendations are based on each community type. Focuses of urban municipalities are on revitalization of downtowns, brownfield redevelopment, strengthening of residential neighborhoods, and preservation and promotion of historic assets and riverfronts. Suburban municipalities promote balanced growth, new residential and commercial development, and protection of natural resources. New business growth is encouraged, particularly along major transportation arteries. To address increasing impacts of development, most recommendations for suburban communities include plans to: (1) construct corridor overlays in order to limit traffic congestion, (2) cluster development, and (3) preserve open space.

In contrast, land development recommendations for rural communities focus on protection of rural and agricultural land through establishments of rural resource areas, agricultural security areas, and conservation easements. Residential development is primarily low-density, and commercial development is concentrated in small "nodes" or adjacent to previously developed areas and/or highway interchanges.

At the County level, Beaver County and its residents have expressed concern about large population decreases within the past 40 years. Land use recommendations in the County Comprehensive Plan look to manage growth and reinvest in existing communities. The Comprehensive Plan gives little support to new housing and development in rural areas, focusing instead on promoting rehabilitation of existing neighborhoods and business districts, and redeveloping brownfield sites. The Future Land Use Vision recommends concentration on the following development goals:

- Residential reinvestment in the County's River Towns
- Commercial rehabilitation/infill in the downtown business districts of Aliquippa, Ambridge, Beaver Falls, Bridgewater, Midland, Monaca, New Brighton, and Rochester
- Redevelopment of suburban shopping centers in Economy, Hopewell, Big Beaver, and Aliquippa

- Mixed use developments on H.H. Robertson site in Ambridge and riverfront properties in Rochester Borough and Bridgewater
- Mixed use developments surrounding the Beaver Valley Mall and the Expressway Transit Center in Center Township
- Industrial redevelopment on the former LTV site (stretching from Aliquippa to Monaca), the former J&L site in Midland, properties in Monaca, brownfields in Beaver Falls, and industrial properties in Koppel

Strong recent growth in suburban and rural communities also prompted the Future Land Use Vision to target the following areas for new development:

- New residential developments in New Sewickley Township and Economy Borough (surrounding Freedom-Crider Road)
- New commercial development surrounding both the Chippewa Mall and Freedom-Crider Road
- Continued expansion of Hopewell Business Park and Westgate Industrial Park (Big Beaver)

Beaver County has identified five distinct high-priority areas for development or redevelopment within the County. The County is positioning these sites for rapid development and will work with municipal, other public, nonprofit, and private-sector partners to plan and pursue funding for these projects. This promotion will encourage overall growth in the County. The five targeted sites are:

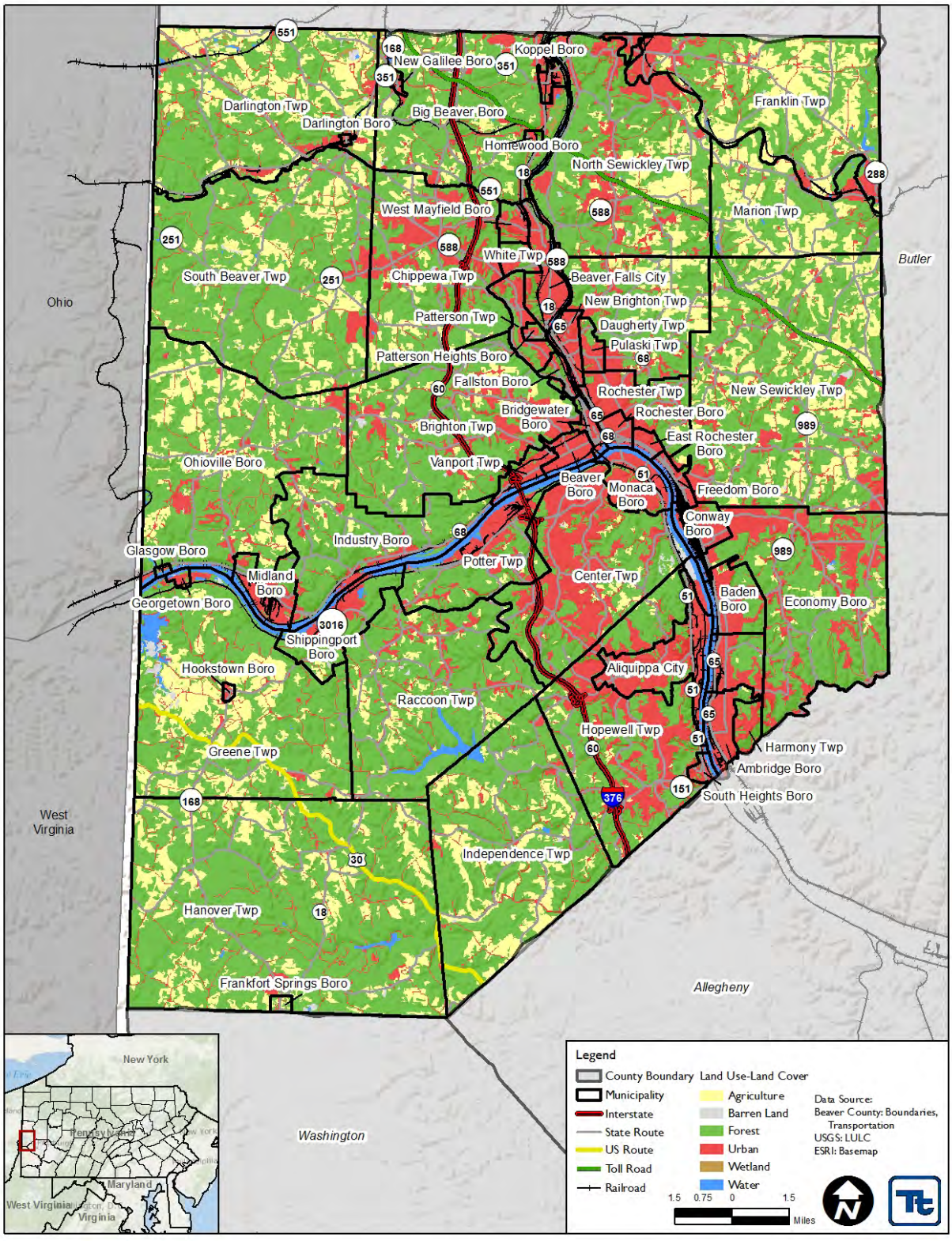
- Big Beaver (Rural) – Near the Turnpike and I-376 interchange
- Midland (Urban) – Near the former Crucible site; downtown business district, and nearby residential areas
- Rochester (Urban) – Near the Rochester TOD and Main Street districts, as well as the riverfront
- Former LTV Steel sites (Urban) – Aliquippa, Hopewell, Center, and Monaca riverfronts
- Center and Potter (Suburban) – Near I-376 and Route 18 interchange at Beaver Valley Mall (Beaver County Comprehensive Plan 2010)

Although the County has identified these growth areas in its Comprehensive Plan, it is still expanding/updating its Geographic Information System (GIS), and does not have a development layer available for mapping purposes. Hazardous regions with mapping layers—the Federal Emergency Management Agency (FEMA) flood hazard zone, environmental hazard areas, and steep slopes—cannot be contrasted yet against planned growth areas to identify potential overlays. Once the development layer is available for mapping, County GIS can analyze whether any identified growth areas are within the 1% annual chance floodplain, within the 0.5 mile buffer zone for Superfund Amendments and Reauthorization Act (SARA) Title III facilities (range identified by County), or near a slope with 25% or greater steepness. At that point, the County will ensure that the planning and development process considers any possible vulnerabilities to hazards. Until then, the County Planning Department will use best available data to avoid any potential hazard overlay. Ultimately, the County intends to (1) discourage development within vulnerable areas, areas with high population density, and the Special Flood Hazard Area (SFHA); and (2) encourage higher regulatory standards at the local level.

Land use regulations are more frequent at the municipal level than the County level. For example, Beaver County has neither a County zoning ordinance nor a subdivision and land development ordinance. Many municipal zoning, subdivision, and land development ordinances are available at http://elibrary.pacounties.org/pages/Beaver.aspx.

Beaver County's economic history is dominated by manufacturing that resulted from the County's proximity to natural resources, rivers, and transportation (railroads)—situating it well for large industrial and steel companies. The County was significantly affected by collapse of the steel industry in the 1980s, but Beaver County has steadily recovered by developing a more diversified economy within the last 35 years. Now the County includes a smaller, more specialized manufacturing sector (producing specialty metals, chemicals, and alloys), and promotes service businesses and healthcare industries. The County has been extensively involved in cleaning and redeveloping the large number of brownfield and abandoned industrial sites remaining after collapse of the steel industry (Beaver County Comprehensive Plan 2010).

Figure 2.5. Beaver County Land Use and Land Cover



Source: USGS National Land Cover Dataset

2.5 CRITICAL FACILITIES

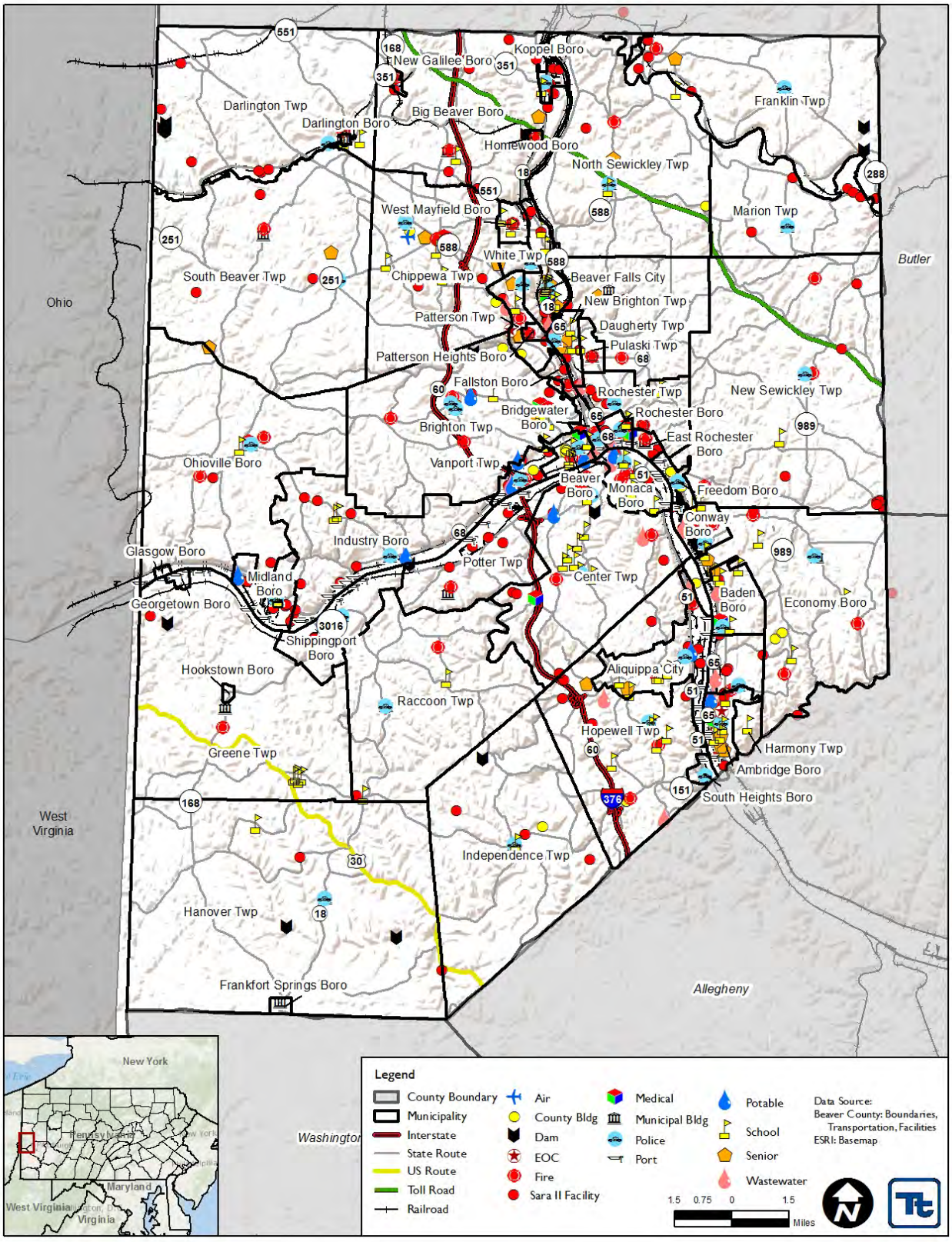
This section describes critical facilities in Beaver County, including essential facilities, transportation systems, lifeline utility systems, and high-potential loss facilities. Transportation systems include roadways, bridges, tunnels, airways, and waterways. Lifeline utility systems include potable water, wastewater, oil, natural gas, electric power facilities, and emergency communication systems.

A comprehensive inventory of critical facilities in the County was developed from various sources including input from representatives of the Steering Committee, Beaver County, participating municipal departments, and utility companies, as well as data from Hazards of the United States (HAZUS)-Multi-Hazard (MH). The inventory of critical facilities presented in this section represents the current state of the effort at the time of publication of this HMP, and was used for the risk assessment presented in Section 4. Figure 2-6 identifies critical facilities and their locations within Beaver County.

Critical facilities are those facilities considered critical to the health and welfare of the population, and that are especially important following a hazard. As defined for this HMP, critical facilities include essential facilities, transportation systems, lifeline utility systems, and high-potential loss facilities.

Essential facilities are a subset of critical facilities that include those facilities important to ensure full recovery following the occurrence of a hazard event. For the County risk assessment, this category was defined to include police, fire, Emergency Medical Services (EMS), schools, shelters, senior accommodations, and medical facilities.

Figure 2-6. Critical Facilities in Beaver County



Source: Beaver County

2.5.1 Essential Facilities

This section provides information on emergency facilities, hospital and medical facilities, shelters, schools, and senior care and living facilities.

Emergency Facilities

For the purposes of this Plan, emergency facilities include police, fire, and emergency operation centers (EOC). Table 2-6 lists types of emergency facilities in each municipality and whether they have access to backup power. The designation of "N/A" indicates that a municipality does not have that type of emergency facility within its jurisdiction.

Table 2-6. Backup Power Access for Emergency Facilities in Beaver County

Municipality	EOC	Fire	Police
City of Aliquippa	Yes	Yes	No
Ambridge Borough	Yes	Yes	Yes
Baden Borough	-	-	-
Beaver Borough	Yes	Yes	Yes
City of Beaver Falls	Yes	Yes	Yes
Big Beaver Borough	Yes	Yes	N/A
Bridgewater Borough	Yes	Yes	No
Brighton Township	Yes	Yes	Yes
Center Township	-	-	-
Chippewa Township	Yes	No	Yes
Conway Borough	-	-	-
Darlington Borough	-	-	-
Darlington Township	-	-	N/A
Daugherty Township	No	No	No
East Rochester Borough	No	N/A	N/A
Eastvale Borough	-	-	-
Economy Borough	-	-	-
Fallston Borough	With Patterson	Yes	N/A
Frankfort Springs Borough	-	-	-
Franklin Township	No	No	No
Freedom Borough	-	-	-
Georgetown Borough	-	-	-
Glasgow Borough	-	-	-
Greene Township	-	-	-
Hanover Township	-	-	N/A
Harmony Township	-	-	-
Homewood Borough	-	-	N/A
Hookstown Borough	Yes	No	N/A
Hopewell Township	-	-	-
Independence Township	-	-	-
Industry Borough	Yes	Yes	Yes

Municipality	EOC	Fire	Police
Koppel Borough	-	-	-
Marion Township	-	N/A	-
Midland Borough	-	-	-
Monaca Borough	No	Yes	Yes
New Brighton Borough	Yes	Yes	Yes
New Galilee Borough	-	-	N/A
New Sewickley Township	Yes	Yes	Yes
North Sewickley Township	-	-	-
Ohioville Borough	-	-	-
Patterson Township	Yes	-	-
Patterson Heights Borough	-	-	N/A
Potter Township	Yes	Yes	N/A
Pulaski Township	No	No	N/A
Raccoon Township	-	-	-
Rochester Borough	Yes	Yes	Yes
Rochester Township	-	-	-
Shippingport Borough	Yes	Yes	Yes
South Beaver Township	No	Yes	Yes
South Heights Borough	No	No	No
Vanport Township	-	-	N/A
West Mayfield Borough	-	-	N/A
White Township	-	-	N/A
Beaver County	Yes	N/A	N/A

Sources: Beaver County 2015, Beaver County 2016

Notes:

Some municipalities may have multiple fire stations (i.e., fire substations). These are indicated on the map of critical facilities; however, they are not designated in the table above.

N/A Municipality does not have an EOC, police station, or fire department (depending on column indicated)
No Municipality does not have backup power for this location
Yes Municipality does have backup power for this location
- Municipality did not provide a response

Hospital and Medical Centers

Table 2-7 below provides an inventory of hospitals and major medical facilities in Beaver County. As noted in the table, Heritage Valley – Beaver, the County's only hospital, does have redundant power and 361 beds available for patient care.

Table 2-7. Hospitals and Medical Centers in Beaver County

Name	Address	Municipality	# Beds	Building. Type	Backup Power
Heritage Valley – Beaver	1000 Dutch Ridge Road	Brighton Twp	361	Hospital	Yes
Heritage Valley Convenient Care Monaca	3942 Brodhead Rd	Center Twp	-	Medical Center	N/A
Heritage Valley Family Medicine – Beaver Falls	1125 7Th Ave	Beaver Falls City	-	Medical Center	N/A
Sharon Road Beaver (Laboratory Draw)	605 Sharon Road	Bridgewater Boro	-	Medical Center	N/A
Heritage Valley Women's Health Center	200 Pleasant Dr	Center Twp	-	Medical Center	N/A
Heritage Valley Lab Draw Site Baden	220 Ohio River Blvd	Baden Boro	-	Medical Center	N/A
Ambridge Blood Draw Site	1155 Merchant St	Ambridge Boro	-	Medical Center	N/A
Heritage Valley Beaver Cancer Center	1000 Dutch Ridge Road	Brighton Twp	-	Medical Center	N/A
The Heart And Vascular Center	605 Sharon Rd	Bridgewater Boro	-	Medical Center	N/A
Heritage Valley Rehab	1030 Beaver Hollow Rd	Brighton Twp	-	Medical Center	N/A
Staunton Clinic	176 Virginia Ave	Rochester Boro	-	Medical Center	N/A
Staunton Clinic	176 Virginia Ave	Rochester Boro	-	Medical Center	N/A
Heritage Valley Chippewa	2580 Constitution Blvd	Chippewa Twp	-	Medical Center	N/A

Source: Beaver County 2015

Note: - Data not available

Shelters

Table 2-8 provides an inventory of shelters in Beaver County. Shelters in Beaver County are maintained by the American Red Cross (ARC), which coordinates with Beaver County Emergency Services during an activation.

Table 2-8. Shelters in Beaver County

Name	Address	Municipality	Building. Type	Backup Power
Hopewell Junior High School	2354 Brodhead Rd	City of Aliquippa	School	-
Hopewell Senior High School	1215 Longvue Ave	City of Aliquippa	School	-
Hopewell Elementary School	3000 Kane Rd	City of Aliquippa	School	-
Hopewell Independence Elementary School	103 School Rd	City of Aliquippa	School	-
Margaret Ross Elementary School, Hopewell	1955 Maratta Rd	City of Aliquippa	School	-
Raccoon Elementary School, Hopewell	3949 Patterson Rd	City of Aliquippa	School	-
Anthony Wayne Elementary School, Ambridge	1101 Highland Ave	Ambridge Borough	School	-
Ambridge Senior High School	909 Duss Ave	Ambridge Borough	School	-
Highland Elementary School, Ambridge	1052 Highland Ave	Ambridge Borough	School	-
Ambridge State Street Elementary School	600 Harmony Rd	Baden Borough	School	-
Big Beaver Middle School	1601 8th Ave	City of Beaver Falls	School	-
Big Beaver Senior High School	1703 8th Ave	City of Beaver Falls	School	-
Highland Middle School, Black Hawk	402 Shenango Rd	City of Beaver Falls	School	-

Patterson Elementary School	701 Darlington Rd	City of Beaver Falls	School	-
Blackhawk Intermediate School	635 Shenango Rd	City of Beaver Falls	School	-
Blackhawk High School	500 Blackhawk Rd	City of Beaver Falls	School	-
Northwestern Primary School	256 Elmwood Blvd	Darlington	School	-
Freedom Middle School	1701 8th Ave	Freedom Borough	School	-
Freedom High School	1190 Bulldog Dr	Freedom Borough	School	-
Southside High School	4949 State Rt 151	Hookstown Borough	School	-
Southside Elementary School	4949 State Rt 151	Hookstown Borough	School	-
Rochester Area School District	540 Rena St	Rochester	School	-
Grace Evangelical Lutheran Church	393 Adams Street	Rochester	Church	-

Source: Beaver County 2016

Notes:

B Borough
- Data not available
T Township

Schools and Institutions of Higher Education

Table 2-9 lists schools and institutions of higher education in Beaver County.

Table 2-9. Schools in Beaver County

Name	Address	Municipality	Building. Type
Aliquippa Middle School – Admin&Maint Off	100 Harding Avenue, Aliquippa, PA 15001	Aliquippa City	School
Aliquippa Junior/Senior High School	100 Harding Avenue, Aliquippa, PA 15001	Aliquippa City	School
Aliquippa Elementary School	800 21st Street, Aliquippa, PA 15001-2790	Aliquippa City	School
Aliquippa Baptist Temple Academy	No Address	Aliquippa City	School
Saint Titus	Franklin Avenue Aliquippa, PA 15001	Aliquippa City	School
Hope Christian Academy	434 Franklin Avenue, Aliquippa, PA 15001	Aliquippa City	School
Anthony Wayne Elementary	No Address	Ambridge Boro	School
Ambridge Area Sr. High	909 Duss Avenue, Ambridge, PA 15003	Ambridge Boro	School
Ambridge Junior High	401 First Street, Freedom, PA 15042	Ambridge Boro	School
Good Samaritan	No Address	Ambridge Boro	School
Quigley Catholic High School	200 Quigley Avenue, Baden, PA 15005	Baden Borough	School
State Street Elementary	600 Harmony Road Baden, PA 15005	Baden Boro	School
Mount Gallitizin Academy	No Address	Baden Boro	School
Penn State Extension	1000 3rd St	Baden Boro	School
Beaver Middle/Senior High School	Gypsy Glen & Tuscarawas Rd, Beaver, PA 15009	Beaver Boro	School
College Square Elementary	375 College Avenue Beaver, PA 15009	Beaver Boro	School
Beaver Valley Montessori	No Address	Beaver Boro	School
Saints Peter And Paul	370 East End Avenue, Beaver, PA 15009	Beaver Boro	School
Administrative Center	No Address	Beaver Falls City	School
Big Beaver Falls Middle School	1601 8th Avenue Beaver Falls, PA 15010	Beaver Falls City	School

Big Beaver Falls Area High School	1701 8th Avenue Beaver Falls, PA 15010	Beaver Falls City	School
Central Elementary	805 15th Street Beaver Falls, PA 15010	Beaver Falls City	School
South Elementary	No Address	Beaver Falls City	School
Physical Plant Corcoran Building	No Address	Beaver Falls City	School
Divine Mercy Academy – 216	No Address	Beaver Falls City	School
Saint Philomena – 217	No Address	Beaver Falls City	School
Geneva College	3200 College Ave	Beaver Falls City	School
St. Monica Catholic Academy	609 10th Street, Beaver Falls, PA 15010	Beaver Falls City	
Big Beaver Elementary	588 Friendship Road Darlington, PA 16115	Big Beaver Boro	School
New Horizon	128 Friendship Circle Beaver, PA 15009	Brighton Twp	School
Agapeland Children Garden	No Address	Brighton Twp	School
Dutch Ridge Elementary	2220 Dutch Ridge Road Beaver, PA 15009	Brighton Twp	School
Center Grange Primary Center	225 Center Grange Road Aliquippa, PA 15001	Center Twp	School
Beaver County Area Vo Tech	No Address	Center Twp	School
Todd Lane Elementary	113 Todd Lane Monaca, PA 15061	Center Twp	School
Center Area Junior/Senior Hs & Admin	No Address	Center Twp	School
Saint Francis Cabrini – 221	No Address	Center Twp	School
Beaver County Career and Technology Center	145 Poplar Avenue, Monaca, PA 15061	Center Twp	School
Beaver Valley Intermediate Unit	147 Poplar Drive, Monaca, PA 15061	Center Twp	School
Community College Of Beaver County	1 Campus Drive, Monaca, PA 15061	Center Twp	College
Penn State Beaver Campus	100 University Drive, Monaca, PA 15061	Center Twp	College
Blackhawk Intermediate School	635 Shenango Road Beaver Falls, PA 15010	Chippewa Twp	School
Blackhawk High School	500 Blackhawk Road Beaver Falls, PA 15010	Chippewa Twp	School
Highland Middle School	402 Shenango Road Beaver Falls, PA 15010	Chippewa Twp	School
Conway Elementary	801 First Avenue, Conway, PA 15027	Conway Boro	School
Greersburg Academy	710 Market Street	Darlington Boro	School
Northwestern Elementary	256 Elmwood Boulevard Darlington, PA 16115	Darlington Twp	School
Ambridge Area Jr. High	No Address	Economy Boro	School
Economy Elementary	1000 First Street, Freedom, PA 15042	Economy Boro	School
Ridge Road Elementary	No Address	Economy Boro	School
Freedom Middle School	1701 8th Avenue, Freedom PA 15042	Freedom Boro	School
South Side Area Middle & High School	4949 State Route 151, Hookstown, PA 15050	Greene Twp	School
South Side Area Maintenance Building	No Address	Greene Twp	School
South Side Admin. Building	No Address	Greene Twp	School
South Side Elementary	4949 State Route 151 Hookstown, PA 15050	Greene Twp	School
Pleasant Hills Wesleyan Academy	466 Pleasant Hill Road, Hookstown, PA 15050	Hanover Twp	School
Highland Elementary	1101 Highland Avenue, Ambridge, PA 15003	Harmony Twp	School
Hopewell Sr. High	1215 Longvue Avenue, Aliquippa, PA 15001	Hopewell Twp	School
Hopewell Jr. High	2354 Brodhead Road, Aliquippa, PA 15001	Hopewell Twp	School
Hopewell Elementary	3000 Kane Road, Aliquippa, PA 15001	Hopewell Twp	School

Margaret Ross Elementary	1955 Maratta Road, Aliquippa, PA 15001	Hopewell Twp	School
Our Lady Of Fatima	3005 Fatima Drive, Aliquippa, PA 15001	Hopewell Twp	School
Independence Elementary School	103 School Street, Aliquippa, PA 15001	Independence Twp	School
Western Beaver Jr. Sr. High School	216 Eagle Road, Industry, PA 15052	Industry Boro	School
Ray W. Snyder Elementary	No Address	Industry Boro	School
Koppel Elementary	No Address	Koppel Boro	School
Midland Elementary-Middle School	173 7th Street, Midland, PA 15059	Midland Boro	School
Lincoln Center For The Performing Arts	1 Lincoln Park, Midland PA 15059	Midland Boro	School
Lincoln Park Performing Arts Center	1 Lincoln Park, Midland PA 15059	Midland Boro	School
Henry Mancini Arts Academy	1 Lincoln Park, Midland PA 15059	Midland Boro	School
Central Valley High School	160 Baker Road Extension Monaca, PA 15061	Monaca Boro	School
Central Valley Middle School	1500 Allen Avenue, Monaca, PA 15061	Monaca Boro	School
C. J. Mangin Elementary	No Address	Monaca Boro	School
Fifth Ward Elementary School	No Address	Monaca Boro	School
Saint John The Baptist (Monaca) – 219	No Address	Monaca Boro	School
New Brighton Area Middle School	901 Penn Avenue, New Brighton, PA 15066	New Brighton Boro	School
Beaver County Christian High School	510 37th Street, Beaver Falls, PA 15010	New Brighton Boro	School
Big Knob Elementary	205 Fezell Road, Freedom PA, 15042	New Sewickley Twp	School
Freedom Senior High School	1190 Bulldog Drive, Freedom, PA 15042	New Sewickley Twp	School
Riverside Primary Center	302 Country Club Drive, Ellwood City, PA 16117	North Sewickley Twp	School
Riverside Middle & High Schools & Admin	300/302 Country Club Drive, Ellwood City, PA 16117	North Sewickley Twp	School
Fairview Elementary	343 Ridgemont Drive, Midland, PA 15059	Ohioville Boro	School
Patterson Elementary	701 Darlington Road Beaver Falls, PA 15010	Patterson Twp	School
New Brighton High School	3202 43rd Street, New Brighton, PA 15066	Pulaski Twp	School
New Brighton Elementary	3200 4rd Street, New Brighton, PA 15066	Pulaski Twp	
Racoon Elementary	No Address	Raccoon Twp	School
Bethel Christian School	4549 Route 151, Aliquippa, PA 15001	Raccoon Twp	School
Rochester Area School	No Address	Rochester Boro	School
Sylvania Hills Christian	567 Pittsburgh Road, Rochester, PA 15074	Rochester Twp	School
Rochester Middle/High School (6-12)	540 Reno Street, Rochester, PA 15074	Rochester	School
Rochester Elementary School	540 Reno Street, Rochester, PA 15074	Rochester	School
West Mayfield Christian	No Address	West Mayfield Boro	School
Beaver County Christian West Park Elementary	West Park 3601 Short Street, Beaver Falls, PA 15010	West Mayfield Boro	School

Source: Beaver County

Senior Care and Senior Living Facilities

Table 2-10 lists the senior facilities in Beaver County.

Table 2-10. Senior Facilities in Beaver County

Name	Address	Municipality	Building. Type
Hunter's Personal Care	1916 Main St	Aliquippa City	Senior Care
Life Beaver County	100 Superior Ave	Aliquippa City	Senior Care
Elderberry Court Life Enrichment Center	1399 Merchant St	Ambridge Boro	Senior Care
Maplewood Personal Care Home	461 Maplewood Ave	Ambridge Boro	Senior Care
Supportive Services Inc	698 Melrose Ave	Ambridge Boro	Senior Care
Valley Care Adult Day Services	245 Maplewood Ave	Ambridge Boro	Senior Care
Villa St Joseph Of Baden	1030 W State St	Baden Boro	Senior Care
P R V Manor	1626 7Th Ave Ste 1	Beaver Falls City	Senior Care
Providence Care Center	900 3Rd Ave	Beaver Falls City	Senior Care
Katera's Kove Home	599 Norwood Dr	Big Beaver Boro	Senior Care
Friendship Ridge	246 Friendship Cir	Brighton Twp	Senior Care
Trinity Oaks Care Center	160 Chapel Rd	Brighton Twp	Senior Care
Comfort Keepers	275 Braden School Rd	Chippewa Twp	Senior Care
Elmcroft Of Chippewa	104 Pappan Business Dr	Chippewa Twp	Senior Care
Life Steps	104 Ridge Ln	Chippewa Twp	Senior Care
Mcguire Memorial	152 Stuber Rd	Daugherty Twp	Senior Care
Concordia Visiting Nurses	1525 Beaver Rd	Economy Boro	Senior Care
Trinity Oaks Care Center	117 Shadyrest Dr	Franklin Twp	Senior Care
Beaver Elder Care And Rehabilitation Center	616 Golf Course Rd	Hopewell Twp	Senior Care
Christian House Home Health	906 3Rd Ave	New Brighton Boro	Senior Care
E B Mcnitt Apartments	805 Allegheny St	New Brighton Boro	Senior Care
Blair Personal Care Home	1031 Mercer Rd	North Sewickley Twp	Senior Care
Cambridge Village Inc	1600 Darlington Rd	Patterson Twp	Senior Care
Five Star Quality Care	71 Darlington Rd	Patterson Twp	Senior Care
Franciscan Manor	71 Darlington Rd	Patterson Twp	Senior Care
Rochester Manor	174 Virginia Ave	Rochester Boro	Senior Care
Beaver Valley Nursing & Rehabilitation Center	257 Georgetown Rd	South Beaver Twp	Senior Care
Elmcroft	498 Lisbon Rd	South Beaver Twp	Senior Care
Lakeview Personal Care	498 Lisbon Rd	South Beaver Twp	Senior Care

Source: Beaver County

2.5.2 Transportation Systems

This section presents available inventory data regarding roadways, airports, railways, and other public transportation systems in Beaver County.

Highway, Roadways, and Associated Systems

Beaver County is home to several major roadways, notably I-376, the Pennsylvania Turnpike I-76, US-PA SR-65, PA SR-68, PA SR-18, PA SR-51, and US-30. Overall, the County has almost 1,690 miles of roadway. Of the total roadway miles in Beaver County, 40.7 are interstate highways, 66.9 are principal arterials, 150.7 are minor arterials, 168.0 are major collectors, 66.8 are minor collectors, and 1,196.6 are local roads (Pennsylvania Department of Transportation [PennDOT] Pennsylvania Highway Statistics 2013). Beaver County's bridge infrastructure consists of 334 bridges on State roads and 60 on local roads. The County Department of Public Works is responsible for maintaining and repairing the County's road and bridge infrastructure.

Airports

Airports can fall into two categories: public airports and private airports. Public airports include large commercial airports for major airplane carriers that are open to the public. Private airports are often used for small charter flights and private jets and airplanes. Military airports and restricted land zones are also identified as private airports. Beaver County is home to 12 airports, of which 10 are private and 2 are public. These are listed in Table 2-11 (PennDOT 2015, tollfreeairline 2015).

Table 2-11. Public and Private Airports in Beaver County

Airport Name	Municipality	Facility Usage
Beaver Seaplane Base	Beaver (B)	Private
MCBC Heliport	Beaver (B)	Private
Beaver County Airport	Chippewa (T)	Public
McCoy Airport	Clinton	Private
Zelienople Municipal Airport	Franklin (T)	Public
Kindelberger Landing Strip Airport	Freedom (B)	Private
Fino Airport	Hookstown (B)	Private
Hanny Beaver Airpark Inc. Airport	Hookstown (B)	Private
Sainovich Airport	Industry (B)	Private
Black Rock Airport	New Brighton (B)	Private
Beaver Creek Ultralight	New Galilee (B)	Private

Source: tollfreeairline.com 2015

Notes: Beaver Seaplane Base was listed online; however, the Planning Commission was unfamiliar with the site.

C City
B Borough
MCBC Medical Center of Beaver County
T Township

Regional airports of significance within the vicinity of Beaver County include the Greater Pittsburgh International Airport in Allegheny County. Allegheny County also has 32 other airports, 4 of which are public and 28 of which are private. Other neighboring counties are also home to airports. Butler County has 12 airports (3 public and 9 private), Washington County has 14 airports (3 public and 11 private), and Lawrence County has 8 airports (1 public and 7 private). Hancock County, West Virginia, has 3 airports, including 1 public and 2 private, and Columbiana County, Ohio, has 11 airports, including 2 public and 9 private (tollfreeairline.com 2015).

Railways

Five major railway operators are within Beaver County limits—Amtrak, BPRR, CSX Transportation, Norfolk Southern Corporation, and A&S Genesee Wyoming Railroad. Rail lines in the County are typically next to major waterways, such as the Ohio River, Beaver River, and Connoquenessing Creek. Norfolk Southern also operates the Conway Railyard in Conway Borough.

Public Transportation

The Beaver County Transportation Authority (BCTA) provides several transportation services to County residents. These include Americans with Disabilities Act (ADA) door-to-door, shared-ride services; Demand and Response Transit (DART); and a fixed-route service. DART is a door-to-door advanced reservation, shared-ride system designed to operate in both rural and urban parts of the County. It provides service to persons with specialized transportation needs, as well as those who do not live within 0.25 to 0.75 mile of a fixed-route bus service.

BCTA also offers incentives to residents to utilize local public transportation. These incentives include Smart Choice (a transit commuter benefits program), free fare to persons aged 65 and older, and reduced fare for children/youth and persons with disabilities. Residents eligible for the Medical Assistance Transportation Program receive reduced rates on fares (BCTA 2015).

County residents may also elect to travel by personal car, taxi, or limousine service. These private companies share their information online and in phone books for interested residents to access.

2.5.3 Lifeline Utility Systems

This section presents potable water, wastewater, and energy resource utility system data. Because of heightened security concerns, only partial local utility lifeline data—sufficient to complete the analysis—have been obtained. Utility data are included in HAZUS-MH but are not sufficient to support detailed analyses of the County.

Potable Water Supply

Public water service is available in 46 County municipalities; however, 14 of those municipalities have only limited services available. The municipalities with limited water services tend to be rural communities. In contrast, 10 of the 46 municipalities with water service have been identified as having extensive public water and sewer services (Beaver County Comprehensive Plan 2010).

Nineteen public systems provide drinking water to over 80 percent of County residents (Beaver County Comprehensive Plan 2010). Many residents also use well water (5,289 domestic wells are in Beaver County) (Pennsylvania Groundwater Information System [PaGWIS] 2015). Potable water supply resources in Beaver County are identified in Table 2-12.

Table 2-12. Potable Water Supply in Beaver County

Facility Name	Address	Municipality(ies) Served	Owner	Capacity (Service Connections)

Facility Name	Address	Municipality(ies) Served	Owner	Capacity (Service Connections)
Aliquippa Municipal Water Authority	160 Hopewell Avenue, Aliquippa PA 15001	City of Aliquippa, Hopewell Township, Potter Township, Raccoon Township	Authority	8,000+
Ambridge Water Authority	1800 Merchant Street Ext., Ambridge, PA 15003	Ambridge Borough, Economy Borough, Harmony Township, New Sewickley Township	Authority	7,286
Baden Borough Water Dept.	149 State Street, Baden, PA 15005	Baden Borough	Municipality	1,585
Beaver Borough Municipal Authority	469 Third Street, Beaver, PA 15009	Beaver Borough	Authority	1,787
Beaver Falls Municipal Authority	1425 8th Avenue, Beaver Falls, PA 15010	City of Beaver Falls, Big Beaver Borough, Chippewa Township, Daugherty Township, Darlington Township, Darlington Borough, East Rochester Borough, Fallston Borough, Freedom Borough, New Brighton Borough, New Sewickley Township, Patterson Heights Borough, Patterson Township, Pulaski Township, Rochester Borough, Rochester Township, South Beaver Township, West Mayfield Borough, White Township	Authority	17,094
Borough of Conway	Water tank is on East Ridge Avenue and Roosevelt Street, and a pump house is at the north end of 4th Avenue.	Conway Borough	Authority	980
Brighton Township Municipal Authority	1300 Brighton Road, Beaver, PA, 15009	Brighton Township	Authority	2,626
Center Township Water Authority	224 Center Grange Rd, Aliquippa, PA 15001	Center Township, South Heights Borough	Authority	4,776
Creswell Heights Joint Authority	3961 Jordan Street, South Heights, PA 15081	Hopewell Township	Authority	5,625
Glasgow Municipal Water Works	-	Glasgow Borough	Municipality	19
Industry Borough Municipal Authority	1149 Willowbrook Dr E., Industry, PA 15052	Industry Borough	Authority	689

Facility Name	Address	Municipality(ies) Served	Owner	Capacity (Service Connections)
Marion Township Water System	485 Hartzell School Road, Fombell, PA 16123	Marion Township	Municipality	94
Midland Borough Municipal Authority	946 Railroad Ave., Midland, PA 15059	Midland Borough, Shippingport Borough	Authority	1,054
Monaca Borough Water Department	928 Pennsylvania Ave, Ste 1, Monaca, PA 15061	Monaca Borough	Municipality	2,889
New Sewickley Township Municipal Authority	233 Miller Road, Rochester, PA 15074	New Sewickley Township	Authority	560
North Sewickley Municipal Water Authority	590 Mercer Road, Beaver Falls, PA 15010	North Sewickley Township	Authority	1,749
Ohioville Borough Municipal Authority	146 Fairlane Dr, Industry, PA 15052	Ohioville Borough	Authority	974
Shippingport Borough Water System	Shippingport Borough Office, PO Box 76, Shippingport, PA 15077	Shippingport Borough	Municipality	98
Vanport Township Municipal Authority	285 River Avenue, Vanport, PA 15009	Vanport Township	Authority	314
PA American	-	Franklin Township, Koppel Borough	Pennsylvania-American Water Company	N/A
Weirton	200 Municipal Plz, Weirton, WV 26062	Hanover Township	Municipality (City of Weirton, WV)	N/A

Source: Beaver County Comprehensive Plan 2010

Note:
- Data not available
T Township

Wastewater Facilities

Public sewer service is available in all but 10 of the County's municipalities (i.e., 44 municipalities have some form of public sewer service). As with public water service, 14 of these 44 municipalities have only limited sewer services available, while 10 municipalities have extensive services (Beaver County Comprehensive Plan 2010). Wastewater facilities in Beaver County are identified in Table 2-13.

Table 2-13. Wastewater Facilities in Beaver County

Facility Name	Address	Municipality(ies) Served
Aliquippa Municipal Water Authority	120 Hopewell, Aliquippa, PA 15001	City of Aliquippa
Ambridge Municipal Authority	2201 Ohio River Blvd, Ambridge, PA 15003	Ambridge Borough
Baden Borough Municipal Authority	101 Tevebaugh Hollow Rd., Baden PA 15005	Baden Borough
Beaver Borough Municipal Authority – Beaver Borough Waterworks	Water Street, Beaver, PA 15009	Beaver Borough

Facility Name	Address	Municipality(ies) Served
Beaver Falls Water Pollution Control Plant	100 6th Ave, Beaver Falls, PA 15010	City of Beaver Falls, Big Beaver Borough, Patterson Heights Borough
Bradys Run Sanitary Authority	2326 Darlington Rd., Beaver Falls, PA 15010	Chippewa Township
Brighton Township Municipal Authority	2845 Gypsy Glen Road, Beaver, PA 15009	Brighton Township
Center Township Water Authority	200 Fairview Drive, Monaca PA 15061	Center Township
Chippewa	-	Big Beaver Borough, Chippewa Township, Patterson Township, South Beaver Township
Borough of Conway	-	Conway Borough
Economy	-	Economy Borough
Franklin	-	Franklin Township
Harmony	-	Harmony Township
Hopewell Township Sewage Treatment Plant	103 Pollack Lane, Aliquippa, PA 15001	Hopewell Township
Industry Borough Municipal Authority	1149 East Willowbrook Rd., Industry PA 15052	Industry Borough
Koppel Borough	-	Koppel Borough
Midland	-	Midland Borough
Monaca Borough Wastewater Treatment Plant	407 Pennsylvania Avenue Ex., Monaca, PA 15061	Monaca Borough
New Brighton Sewage Treatment Plant	2200 Concord St., New Brighton PA 15066	Daugherty Township, New Brighton Borough, Pulaski Township, Rochester Township
North Sewickley	-	Franklin Township, North Sewickley Township
Rochester	-	East Rochester Borough, Freedom Borough, New Sewickley Township, Rochester Borough, Rochester Township
Vanport Township Municipal Authority	285 River Avenue, Vanport PA 15009	Vanport Township
White Township	-	White Township
Cranberry	-	New Sewickley Township
PA American Water	-	North Sewickley Township

Sources: Beaver County 2016, Beaver County 2010

Notes:

- Data not available

Energy Resources

Electric and gas utilities are deregulated whereby local delivery and supply are purchased separately. Two companies provide gas services to Beaver County residents: Dominion, Peoples, and Columbia Gas of Pennsylvania, Inc. Electric power is provided by Penn Power and Duquesne Light. Electric and natural gas facilities are not listed in a table per request for confidentiality as to locations.

Communication Resources

Residents in Beaver County may choose to use Sprint/Embarq, AT&T, Verizon, or other phone carriers for their local telephone, data, and Internet service needs. Comcast is the predominant cable provider, although Armstrong and Beaver Falls provide local cable services to Franklin Township, Koppel Borough, New Sewickley Township, North Sewickley Township, and Patterson Township (Patterson Township is the only jurisdiction with Beaver Falls cable; all others can access Armstrong cable). In addition, satellite service is

readily available. Major radio stations licensed in the County include WGEV, WPVP (AM 1230), and WAOB-FM (FM 106.7), all of which are based in Beaver Falls.

2.5.4 High-Potential Loss Facilities

High-potential loss facilities include military installations, dams, levees, nuclear power plants, and hazardous materials (HAZMAT) facilities. No military installations were identified in the County. The County nuclear power plant, HAZMAT facilities, levee system, and dams are described below.

Nuclear Power Plant

The Beaver Valley Power Station (BVPS), in Shippingport Borough within central Beaver County, is one of five nuclear power generation stations in Pennsylvania. It maintains two pressurized water reactor units on a 453-acre site, producing 1,800 megawatts (mw) of electricity (FirstEnergy Nuclear Operating Company [FirstEnergy] 2012). Nuclear regulations require dissemination of information to those within the 10- and 50-mile Emergency Planning Zones (EPZ), because these areas are the most vulnerable should an incident occur at the facility. Approximately 94,023 residents (roughly 54 percent of the County's population), 37,723 structures, and 127 critical facilities (in 31 municipalities) are within the 10-mile plume exposure pathway EPZ (Beaver County 2010). All of the County, as well as neighboring jurisdictions, are within the 50-mile ingestion exposure pathway EPZ. Extensive regulations imposed by the nuclear industry and the Federal Government help BVPS and Beaver County ensure that appropriate safety precautions are followed and monitoring of the site occurs.

HAZMAT Facilities

Beaver County is home to over 160 identified facilities that utilize, ship, or house chemicals considered hazardous. These facilities have been identified under SARA as exceeding the quantity threshold for reporting. These facilities are required to comply with regulations set forth by the federal SARA, and comply with reporting requirements specified in the Pennsylvania Hazardous Materials Emergency Planning and Response Act (Act 165). The County monitors these reporting requirements, as necessary, to ensure facility safety.

Levee Systems

Beaver County has one levee system—the Darlington System—in Darlington Township near North Fork Little Beaver Creek. The system was created in 1960 and is owned and operated by Darlington Township (U.S. Army Corps of Engineers [USACE] 2015). The Darlington System actually consists of two levees: one is on the right bank and the other is on the left bank of North Fork Little Beaver Creek. The right bank levee is 0.1 mile long, and the left bank levee is 0.25 mile long (USACE 2015). Although Beaver County Emergency Services and Beaver County Planning monitor functionality of the levee, the Pittsburgh District of the USACE has also provided technical assistance for maintenance and repair of the levee in the past.

Dams

According to the National Inventory of Dams (NID) and the Pennsylvania Department of Environmental Protection (PADEP), Beaver County has 35 dams. A dam is included in the NID if (1) it is a "high" or "significant" hazard potential class dam, (2) it is a "low" hazard potential class dam that exceeds 25 feet in height and 15 acre-feet of storage, or (3) it is a "low" hazard potential class dam that exceeds 50 acre-feet of storage and 6 feet in height. PADEP also tracks dams that may not fall into these categories.

Table 2-14 defines the hazard potential classifications, as accepted by the NID Interagency Committee on Dam Safety. PA DEP also designates dams based on potential risk level; this classification is slightly more detailed than that of the NID and is presented in Table 2-15. Table 2-16 lists the dams in Beaver County and identifies their hazard classifications.

Table 2-14. NID Dam Hazard Potential Classifications

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, and Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

Table 2-15. Pennsylvania Dam Classification Definitions

Size Category		
Category	**Impoundment Storage (Acre-feet)**	**Dam Height**
A	Equal to or greater than 50,000	Equal to or greater than 100
B	Less than 50,000 but greater than 1,000	Less than 100 but greater than 40
C	Equal to or less than 1,000	Equal to or less than 40
Hazard Potential Category		
Category	**Population at Risk**	**Economic Loss**
1	Substantial (numerous homes or small businesses or a large business or school)	Excessive such as extensive residential, commercial, or agricultural damage, or substantial public inconvenience.
2	Few (a small number of homes or small businesses)	Appreciable such as limited residential, commercial, or agricultural damage, or moderate public inconvenience.
3	None expected (no permanent structures for human habitation or employment)	Significant damage to private or public property and short duration public inconvenience such as damage to storage facilities or loss of critical stream crossings.
4	None expected (no permanent structures for human habitation or employment)	Minimal damage to private or public property and no significant public inconvenience

Source: Commonwealth of Pennsylvania 2011

Table 2-16. Dams in Beaver County

Dam Name	Municipality	Stream	Type	PADEP Classification	NID Classification	Permittee
High Hazard Dams						
Bradys Run	Brighton Township	South Branch Brady Run	Earth	C-1	High	Beaver County Commissioners
Little Blue Run	Greene Township	Little Blue Run	Earth	A-1	High	FirstEnergy Generation, LLC
Group Camp	Hanover Township	Traverse Creek	Earth	C-2	High	DCNR
Raccoon Creek	Hanover Township	Traverse Creek	Earth	B-1	High	DCNR
J C Bacon	Independence Township	Service Creek	Earth	B-1	High	Ambridge Water Authority
Other Dams						
Clarks Run Detention Pond	Beaver Borough	Clarks Run	Earth	C-4	Low	Darlington Ready Mix Company
Eastvale	Beaver Falls City	Beaver River	Timber Crib, Concrete, Run of River	C-4	Low	Beaver Falls Municipal Authority
Patterson	Beaver Falls City	Beaver River	N/A	C-4	Low	Beaver Valley Power Company
Koppel Reservoir	Big Beaver Borough	Stockman Run	Earth	C-4	Low	Koppel Borough
Hudak	Big Beaver Borough	Wallace Run	Earth	N/A	N/A	Dave Hudak
Lakewood Development	Center Township	TR Moon Run	Earth	C-3	Significant	Ted Vana and Cathy Saunders
Industrial Wastes Sediment Pond	Darlington Township	TR East Fork Stateline Creek	Earth	C-3	Significant	Thomas McLaughlin
Industrial Wastes Inc., Pond #1	Darlington Township	TR East Fork Stateline Creek	Earth	C-4	Low	Thomas McLaughlin
Industrial Wastes Inc., Pond #2	Darlington Township	TR East Fork Stateline Creek	Earth	C-4	Low	Thomas McLaughlin
Industrial Wastes Inc., South Pond	Darlington Township	TR East Fork Stateline Creek	Earth	C-4	Low	Thomas McLaughlin

Husar	Economy Borough	TR N Fork Big Sewickley Creek	Earth	C-4	Low	James and Nikki Husar
Country Club	Franklin Township	Connoquenessing Creek	Other	C-4	Low	Connoquenessing Dam Association
Upper Hereford Manor	Franklin Township	Doe Run	Earth	N/A	N/A	PA Fish and Boat Commission
Little Blue Saddle	Greene Township	TR Mill Creek	Earth	B-3	Significant	FirstEnergy Generation Corporation
Barnes	Hanover Township	TR Little Traverse Creek	Earth	C-4	Low	Rick Sharbonno
Hughes Lake	Hanover Township	Laurence Run	Earth	C-4	Low	Danny Binkoski
Hughes Lake	Hanover Township	Laurence Run	Earth	C-4	Low	Gary Rodgers
Upper Southside Sport	Hanover Township	TR Traverse Creek	Earth	C-3	Significant	Southside Sportsmen's Club
Homewood	Homewood Borough	TR Clarks Run	Earth	C-3	Significant	Alfred E Desanzo
Koppel Reservoir	Koppel Borough	Stockman Run	Earth	C-4	Low	Koppel Borough
Sweikowski	Marion Township	TR Connoquenessing Creek	Earth	C-4	Low	Richard and Anna Sweikowski
Patterson Dam	New Brighton Borough	Beaver River	Timber Crib	C-4	Low	Beaver Valley Power Company
Connoquenessing Country Club	North Sewickley Township	TR Connoquenessing Creek	Timber Crib, Concrete, Run of River	C-4	Low	Connoquenessing Country Club
Townsend	Patterson Township	Beaver River	N/A	C-4	Low	Beaver Falls Municipal Authority
Townsend Dam	Patterson Township	Beaver River	N/A	C-4	Low	Beaver Falls Municipal Authority
Montgomery Lock and Dam	Potter Township	Ohio River	Gravity	N/A	N/A	USACE
North Low Dissolved Solids IMP	Shippingport Borough	Watershed Ohio River	Earth	C-3	Significant	FirstEnergy Generation, LLC

South Low Dissolved Solids IMP	Shippingport Borough	Watershed Ohio River	Earth	C-3	Significant	FirstEnergy Generation, LLC
West Low Dissolved Solids IMP	Shippingport Borough	Watershed Ohio River	Earth	C-3	Significant	FirstEnergy Generation, LLC
Wischerman	South Beaver Township	UNT North Fork Little Beaver	Earth	C-4	Low	Dan Wischerman

Source: PADEP 2015

Notes:

DCNR Pennsylvania Department of Conservation and Natural Resources
N/A Not Available
PADEP Pennsylvania Department of Environmental Protection
USACE U.S. Army Corps of Engineers

2.5.5 Other Critical Facilities

Table 2-17 lists other critical facilities identified by the County.

Table 2-17. Other Facilities in Beaver County

Name	Municipality	Building. Type
36-1-01 Magistrate Office	Ambridge Boro	County Building
County Courthouse	Beaver Boro	County Building
Courthouse Annex	Beaver Boro	County Building
Parking Garage	Beaver Boro	County Building
36-1-02 Magistrate Office – Ambridge Boro	Beaver Falls City	County Building
Beaver County Community Housing Dev Org Inc	Beaver Falls City	County Building
Humans Services	Beaver Falls City	County Building
36-2-02 Magistrates Office	Brighton Twp	County Building
Brady's Run Park	Brighton Twp	County Building
Brady's Run Park	Brighton Twp	County Building
Red Cross Building	Brighton Twp	County Building
36-3-03 Magistrate Office – Center Twp	Center Twp	County Building
36-3-02 Magistrate Office	Chippewa Twp	County Building
Beaver County Airport	Chippewa Twp	County Building
Brady's Run Park Part B. C. Lodge 4 Seasons Shelter (all buildings on S.R. 51)	Chippewa Twp	County Building
Economy Park	Economy Boro	County Building
Economy Park & Villages	Economy Boro	County Building
36-2-01 Magistrate Office – Freedom	Freedom Boro	County Building
36-2-01 Magistrate Office - Freedom Boro	Freedom Boro	County Building
Vicary House	Freedom Boro	County Building
36-3-04 Magistrate Office	Hopewell Twp	County Building
Beaver County Jail	Hopewell Twp	County Building
Beaver County Conservation District	Independence Twp	County Building
36-3-01 Magistrate Office	New Brighton Boro	County Building
Brush Creek Park	North Sewickley Twp	County Building
Department Of Public Works	Patterson Twp	County Building
Housing Authority Of Beaver County	Vanport Twp	County Building
Aliquippa City	Aliquippa City	Municipal Building
Ambridge Boro	Ambridge Boro	Municipal Building
Baden Boro	Baden Boro	Municipal Building
Beaver Boro	Beaver Boro	Municipal Building
Beaver Falls City	Beaver Falls City	Municipal Building
Big Beaver Boro	Big Beaver Boro	Municipal Building
Bridgewater Boro	Bridgewater Boro	Municipal Building
Brighton Twp	Brighton Twp	Municipal Building
Center Twp	Center Twp	Municipal Building
Chippewa Twp	Chippewa Twp	Municipal Building
Conway Boro	Conway Boro	Municipal Building
Darlington Boro	Darlington Boro	Municipal Building
Darilington Twp	Darlington Twp	Municipal Building
Daugherty Twp	Daugherty Twp	Municipal Building
East Rochester	East Rochester Boro	Municipal Building
Economy Boro	Economy Boro	Municipal Building
Fallston Boro	Fallston Boro	Municipal Building
Frankfort Springs Boro	Frankfort Springs Boro	Municipal Building

Franklin Twp	Franklin Twp	Municipal Building
Freedom Boro	Freedom Boro	Municipal Building
Greene Twp	Greene Twp	Municipal Building
Hanover Twp	Hanover Twp	Municipal Building
Harmony Twp	Harmony Twp	Municipal Building
Hopewell Twp	Hopewell Twp	Municipal Building
Independence Twp	Independence Twp	Municipal Building
Industry Boro	Industry Boro	Municipal Building
Koppel Boro	Koppel Boro	Municipal Building
Marion Twp	Marion Twp	Municipal Building
Midland Boro	Midland Boro	Municipal Building
Monaca Boro	Monaca Boro	Municipal Building
New Brighton Boro	New Brighton Boro	Municipal Building
New Sewickley Twp	New Sewickley Twp	Municipal Building
North Sewickley Twp	North Sewickley Twp	Municipal Building
Ohioville Boro	Ohioville Boro	Municipal Building
Patterson Heights	Patterson Heights Boro	Municipal Building
Patterson Twp	Patterson Twp	Municipal Building
Potter Twp	Potter Twp	Municipal Building
Pulaski Twp	Pulaski Twp	Municipal Building
Raccoon Twp	Raccoon Twp	Municipal Building
Rochester Boro	Rochester Boro	Municipal Building
Rochester Twp	Rochester Twp	Municipal Building
Shippingport Boro	Shippingport Boro	Municipal Building
South Beaver Twp	South Beaver Twp	Municipal Building
South Heights Boro	South Heights Boro	Municipal Building
Vanport Twp	Vanport Twp	Municipal Building
West Mayfield Boro	West Mayfield Boro	Municipal Building
White Twp	White Twp	Municipal Building

Source: Beaver County 2015

SECTION 3 PLANNING PROCESS

A successful planning process builds partnerships and brings together members representing government agencies, the public, and other stakeholders to reach consensus on ways the community will prepare for and respond to those hazards most likely to occur. Applying a comprehensive and transparent process adds validity to the Hazard Mitigation Plan (HMP). Participants involved in the HMP planning process gained better understanding of problems and issues, and helped devise solutions and actions for the community—resulting in a revised set of common community values and widespread support for directing financial, technical, and human resources to agreed-upon actions.

The planning process was an integral part of updating the Beaver County HMP. This section describes the planning process used to update the HMP, with participation from 45 of the County's municipalities. This section also describes the hazard mitigation Planning Team, meetings and documentation, public and stakeholder participation, multi-jurisdictional planning, and existing planning mechanisms implemented during the HMP update process. Additional details about the process of updating each section of this HMP appear at the beginnings of those sections.

3.1 UPDATE PROCESS AND PARTICIPATION SUMMARY

In accordance with Disaster Mitigation Act of 2000 (DMA 2000) requirements, this plan documents the following topics:

- Planning process
- Hazard identification
- Risk assessment
- Mitigation strategy: goals, actions, and projects
- Formal adoption by the participating jurisdictions
- Pennsylvania Emergency Management Agency (PEMA) and Federal Emergency Management Agency (FEMA) approval

The PEMA All-Hazard Mitigation Planning Standard Operating Guide lays out the standard planning process in Pennsylvania to create and update HMPs (including this HMP), and is cited in Appendix A, under Authorities and References. Hazard vulnerabilities and the risk assessment are described in Section 4 (Risk Assessment), and the mitigation strategy is described in Section 6 (Mitigation Strategy) of this HMP.

Public participation and planning meetings served as the main forums for gathering information to update the HMP. The Planning Team and Tetra Tech, Inc. (Tetra Tech) were afforded access to information in relevant and approved plans, policies, and procedures for Beaver County. Opportunities for public participation included attending public meetings, completing written surveys, and reviewing and commenting on the existing Plan and other documents. To develop all sections of the HMP, meetings, surveys, e-mail correspondence, and teleconferences were used to solicit input from County, municipal, and other stakeholders, including members of the general public; most information received for this update came from the County, its municipalities, and the Beaver County Conservation District. Through this planning process, the County established a comprehensive approach to reduce effects of hazards on the County and its municipalities.

3.2 THE HAZARD MITIGATION PLANNING TEAM

The County's Planning Team consisted of the following members:

Table 3-1. Beaver County Planning Team

Name	Department / Agency	Name	Department / Agency
Jeffrey Bolland	County Emergency Services, New Brighton Borough	Mark Forrest	Freedom Borough
Wesley Hill	County Emergency Services, Rochester Borough	Jerry Torrance	Georgetown Borough, Greene Township, Hookstown Borough
Eric Brewer	County Emergency Services, New Sewickley Township	Sharon L. Vinci	Hanover Township
James McCarthy	Geographic Information Services (GIS), County Emergency Services	Janet Miklos	Harmony Township
Frank Mancini	Beaver County Planning Commission	John Bates	Hopewell Township
Bill Evans	Beaver County Planning Commission	Mark New	Independence Township
Frank Vescio	Beaver County Planning Commission	Debra Shaffer	Independence Township
Dan Distler	Beaver County Conservation District	Chuck Ward	Industry Borough
Mike Demcak	City of Aliquippa	Andy Randza	Koppel Borough, North Sewickley Township
David Foringer	City of Aliquippa	Marilyn Zona	Marion Township
Joe Kauer	Ambridge Borough	Amber Mineard	Midland Borough
Timothy Firich	Baden Borough	Jeff McKay	Monaca Borough
Dan Martone	Beaver Borough	Jeff Bolland	New Brighton Borough
Derek Lang	City of Beaver Falls	Don Cripe	New Galilee Borough
Jesse Lazzaro	Big Beaver Borough, Midland Borough, Center Township (at meetings), and Lennon, Smith, Souleret Engineering, Inc. (LSSE)	Walter C. Beighey, Jr., Eric Brewer	New Sewickley Township
Charles D. Bates	Bridgewater Borough	Bill Starn	Patterson Heights Borough
Dennis Bevington	Bridgewater Borough	Susan Pokego	Patterson Heights Borough
Charles Bates	Bridgewater Borough	WR Livingston	Patterson Township
Bryan K. Dehart	Brighton Township	Linda McCoy	Potter Township
Rachel DelTondo	Center Township	Jim Bishop	Potter Township
Kevin Whipple	Chippewa Township	Doug Margetic	Pulaski Township
Diane McKay	Conway Borough	Wesley Hill	Rochester Borough
M. Bevois Walton	Darlington Borough	Charles Etta	Rochester Borough

Jeffrey Frye	Darlington Township	Norm Ely	Rochester Township
Travis M. Cavanaugh	Daugherty Township	Laura Korcan	Shippingport Borough
Jim Cable	East Rochester Borough	Pat Lampe	Shippingport Borough
William Heaton	West Mayfield Borough	Ashley Carr	South Beaver Township
Randy Kunkle	Economy Borough	Roberta Jones	South Heights Borough
Lisa Peacock	Fallston Borough	Maureen Bostwick	Vanport Township
Dale Bonner	Frankfort Springs Borough	Ray Evans, Jr.	White Township
Shannon Schlosser	Franklin Township		

Mr. Jeffrey Bolland of Beaver County Emergency Services served as chair of the Planning Team. He was supported by Mr. Eric Brewer, Deputy Director of Beaver County Emergency Services.

The Planning Team acknowledged that important steps in developing a comprehensive HMP were identifying hazards that specifically affect Beaver County, and assessing their likelihood of occurrence, along with potential damage to the people, property, and environment of the County. The Planning Team chose to focus on an all-hazards approach rather than to narrow the focus to natural disasters only.

3.3 MEETINGS AND DOCUMENTATION

Table 3-2 lists meetings held by the County Planning Team as part of the process of updating the Beaver County HMP.

Table 3-2. Public and Planning Meetings

Date	Description of Meeting
July 17, 2015	Kickoff meeting with PEMA representatives, including administrative and grant requirements overview
July 28, 2015	Kickoff meeting with County Office of Emergency Services, including five-year plan review
September 9, 2015	First kickoff meeting with Planning Team members, including five-year plan review and plan update process
September 10, 2015	Second kickoff meeting with Planning Team members, including five-year plan review and plan update process
September 29, 2015	Municipal Emergency Management Coordinator Quarterly Training; included review of hazard mitigation planning and plan update process
December 16, 2015	Planning Team meeting to review capabilities assessment results, hazard profiles, and risk assessment results
January 5, 2016	Mitigation Solutions Workshop to identify potential mitigation goals, objectives, and actions
January 5, 2016	Public meeting to review capabilities assessment results and updated risk assessment
January 27, 2016	Mitigation Strategy Review Planning Team and public meeting to review mitigation goals, objectives, actions, and current plan status with municipal representatives, stakeholders, and residents.
Various, October 2015 through February 2016	Direct outreach to municipalities by phone and in person to explain HMP update process, worksheet and participation requirements, and mitigation project selection.
February 5, 2016	Approve draft HMP for public review

March 8, 2016	Public and Planning Team meeting to review the draft
To be determined – upon receipt of APA designation	HMP adoption by County Commissioners

Notes:
APA Approval Pending Adoption
HMP Hazard Mitigation Plan
PEMA Pennsylvania Emergency Management Agency

Beaver County's contractor, Tetra Tech, followed up each meeting with meeting notes that documented all discussion, decisions, and unmet needs identified during the meetings. The meeting minutes were shared among the Planning Team and attendees of the meeting. Documentation from all meetings is in Appendix C. County residents were informed of public meetings through various sources, including newspaper public notices and announcements on the County HMP website (http://www.beavercountyhmp.com/). Throughout the course of the project, Beaver County received over 150 hits on the project website; specifically, the Welcome page received 157 hits, and the Draft Documents for Review page received 242 hits. Although the HMP meetings were publicly advertised, no County residents who did not represent a municipality or other stakeholder agency attended HMP meetings or provided feedback for development of the Plan. Any subsequent supporting documentation provided by County residents will be included in Appendix E (Public and Stakeholder Documentation).

The Planning Team partnered with Tetra Tech to aid in the update of the HMP. Tetra Tech assisted the County in drafting planning documents, preparing meeting materials, and facilitating meetings. The Planning Team reviewed any documentation produced by Tetra Tech, provided validation, and acted as an advocate for the HMP update.

3.4 PUBLIC AND STAKEHOLDER PARTICIPATION

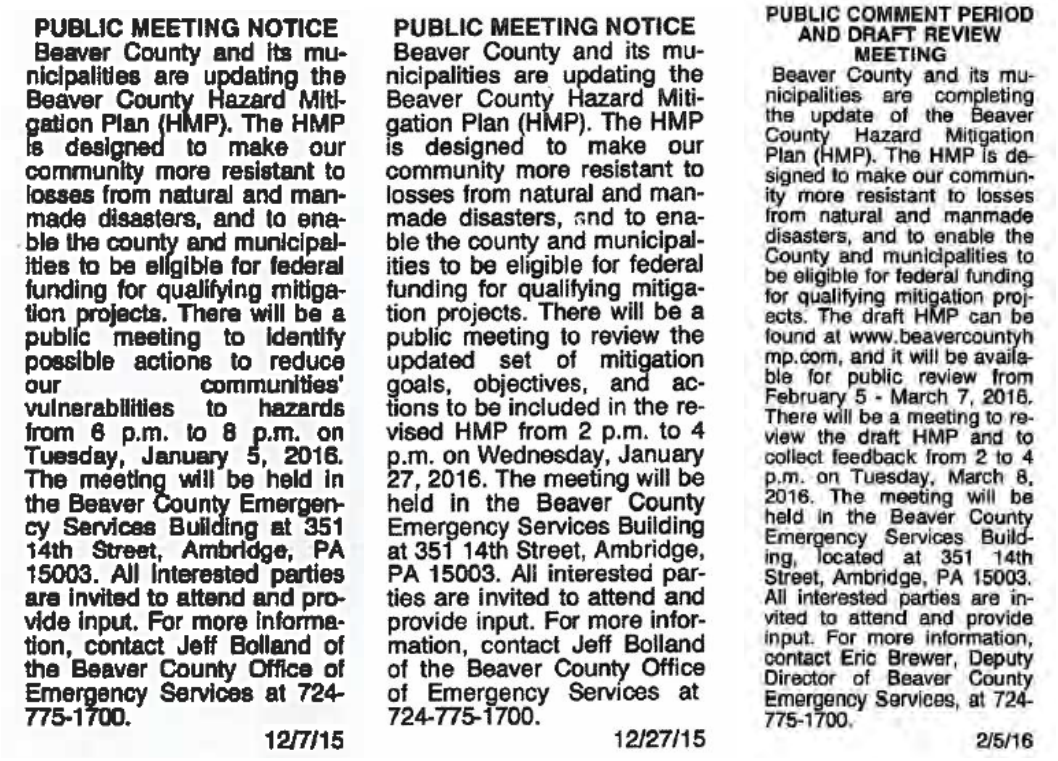
To maximize effectiveness of the HMP, the Planning Team fostered continual public and stakeholder engagement. Input was encouraged and collected through a variety of methods. Three worksheets/surveys—the Hazard/Risk Identification Survey, Capabilities Assessment Survey, and Mitigation Strategy 5-Year Plan Review Worksheet (Mitigation Review Worksheet)—were sent to each municipality in Beaver County. Of the 53 municipalities surveyed in Beaver County, 4 returned a worksheet/survey so that their input could be reviewed and incorporated into the updated HMP.

The following entities with vested interest in development of the updated HMP were given the opportunity to participate in the planning process by attending a Planning Team or public meeting, or by offering comments on the project website: local, state, and federal agencies; neighboring jurisdictions (i.e., Lawrence, Butler, Allegheny, and Washington Counties in Pennsylvania; Columbiana County in Ohio; and Hancock County in West Virginia); local businesses; community leaders; educators; and other relevant private and nonprofit groups. Invitations to participate in meetings were sent to adjacent counties, major industries, and other relevant stakeholders identified by the County; however, only Beaver County Conservation District sent a representative to meetings. Appendix E includes copies of invitation letters and lists of individuals to whom invitations were sent. Meeting invitations were also sent to all municipalities. Additionally, direct outreach by phone or one-on-one meetings was conducted with municipalities who were unable to attend other meetings or who had questions about worksheets, participation requirements, the planning process, or mitigation project selection. Of the 53 municipalities in Beaver County, 51 had representatives attending at least one meeting.

Through public notices published in the local newspaper, the above groups and the general public were invited to review the County HMP and to send comments to the Beaver County Emergency Services or to Tetra Tech. In addition, general public meetings were held during the planning process as listed in Table 3-1 in Section 3.3, "Meetings and Documentation." Preceding each of these meetings was a public notice inviting the general public to review and comment on the HMP, as well as to attend the meeting. Copies of the public notices are in Appendix E. Copies of public notices for public meetings and opening of the public comment period are

shown on Figure 3-1. These notices were published on December 7, 2015, December 27, 2015, and February 5, 2016, respectively.

Figure 3-1. Public Notices



PUBLIC MEETING NOTICE

Beaver County and its municipalities are updating the Beaver County Hazard Mitigation Plan (HMP). The HMP is designed to make our community more resistant to losses from natural and manmade disasters, and to enable the county and municipalities to be eligible for federal funding for qualifying mitigation projects. There will be a public meeting to identify possible actions to reduce our communities' vulnerabilities to hazards from 6 p.m. to 8 p.m. on Tuesday, January 5, 2016. The meeting will be held in the Beaver County Emergency Services Building at 351 14th Street, Ambridge, PA 15003. All interested parties are invited to attend and provide input. For more information, contact Jeff Bolland of the Beaver County Office of Emergency Services at 724-775-1700.

12/7/15

PUBLIC MEETING NOTICE

Beaver County and its municipalities are updating the Beaver County Hazard Mitigation Plan (HMP). The HMP is designed to make our community more resistant to losses from natural and manmade disasters, and to enable the county and municipalities to be eligible for federal funding for qualifying mitigation projects. There will be a public meeting to review the updated set of mitigation goals, objectives, and actions to be included in the revised HMP from 2 p.m. to 4 p.m. on Wednesday, January 27, 2016. The meeting will be held in the Beaver County Emergency Services Building at 351 14th Street, Ambridge, PA 15003. All interested parties are invited to attend and provide input. For more information, contact Jeff Bolland of the Beaver County Office of Emergency Services at 724-775-1700.

12/27/15

PUBLIC COMMENT PERIOD AND DRAFT REVIEW MEETING

Beaver County and its municipalities are completing the update of the Beaver County Hazard Mitigation Plan (HMP). The HMP is designed to make our community more resistant to losses from natural and manmade disasters, and to enable the County and municipalities to be eligible for federal funding for qualifying mitigation projects. The draft HMP can be found at www.beavercountyhmp.com, and it will be available for public review from February 5 - March 7, 2016. There will be a meeting to review the draft HMP and to collect feedback from 2 to 4 p.m. on Tuesday, March 8, 2016. The meeting will be held in the Beaver County Emergency Services Building, located at 351 14th Street, Ambridge, PA 15003. All interested parties are invited to attend and provide input. For more information, contact Eric Brewer, Deputy Director of Beaver County Emergency Services, at 724-775-1700.

2/5/16

Section 3.5, entitled "Multi-jurisdictional Planning," includes Table 3-2, showing overall municipal participation in the planning process.

As illustrated, the Planning Team felt that jurisdictional and stakeholder participation was critical to the process. The Planning Team met regularly to review the status of the HMP, the HMP itself, and strategies to involve the public. Because this particular HMP was an update, the Planning Team felt that it was critical to allow adequate time for stakeholders to review each section individually. The Planning Team also individually contacted various municipalities to elicit feedback on the various sections of the HMP.

3.5 MULTI-JURISDICTIONAL PLANNING

Beaver County took a multi-jurisdictional approach to preparing its HMP, so that the HMP would apply to the County and all participating municipalities. The County was able to provide resources (e.g., funding, data, geographic information system [GIS], etc.) to which the municipalities may not have had access. However, the County depended on municipal buy-in because the municipalities have the legal authority to enforce compliance with land use planning and development directives. The County, together with Tetra Tech, undertook an intensive effort to involve all 53 municipalities in the update process, although only 45 municipalities participated in meeting attendance and information sharing.

Each municipality was given the opportunity to participate in this process. Municipal officials and representatives were invited to attend Planning Team and public meetings, were sent a copy of the existing HMP for comment, and were asked to review and prioritize the mitigation actions. Municipal participation

culminated in formal adoption of the HMP; copies of municipal adoption resolutions are in Appendix F. Table 3-3 indicates how each municipality participated in the planning process.

Table 3-3. Planning Participation

Municipality	Risk Assessment Survey Received	Capabilities Assessment Survey Received	Mitigation Review Worksheet Received	Attended Meeting(s)	Adopted 2016 Plan	2016 Plan Adoption Date
Beaver County	X	X	X	X		
Aliquippa, City of	X	X	X	X		
Ambridge, Borough of	X	X	X	X		
Baden, Borough of	X	X	X	X		
Beaver Falls, City of	X	X	X	X		
Beaver, Borough of	X	X	X	X		
Big Beaver, Borough of	X	X	X	X		
Bridgewater, Borough of	X	X	X	X		
Brighton, Township of	X	X	X	X		
Center, Township of	X	X	X	X		
Chippewa, Township of	X	X	X	X		
Conway, Borough of	X	X	X	X		
Darlington, Borough of	X	X	X	X		
Darlington, Township of	X	X	X	X		
Daugherty, Township of	X	X	X	X		
East Rochester, Borough of	X	X	X	X		
Eastvale, Borough of	X	X	X	X		
Economy, Borough of	X	X	X	X		
Fallston, Borough of	X	X	X	X		
Frankfort Springs, Borough of	X	X	X	X		
Franklin, Township of	X	X	X	X		
Freedom, Borough of	X	X	X	X		
Georgetown, Borough of	-	-	-	X		
Glasgow, Borough of	-	-	-	-		
Greene, Township of	X	X	X	X		
Hanover, Township of	X	X	X	X		
Harmony, Township of	X	X	X	X		
Homewood, Borough of	-	-	-	-		
Hookstown, Borough of	-	-	-	X		
Hopewell, Township of	X	X	X	X		
Independence, Township of	X	X	X	X		
Industry, Borough of	X	X	X	X		

Municipality	Risk Assessment Survey Received	Capabilities Assessment Survey Received	Mitigation Review Worksheet Received	Attended Meeting(s)	Adopted 2016 Plan	2016 Plan Adoption Date
Koppel, Borough of	X	X	X	X		
Marion, Township of	X	X	X	X		
Midland, Borough of	X	X	X	X		
Monaca, Borough of	X	X	X	X		
New Brighton, Borough of	X	X	X	X		
New Galilee, Borough of	X	X	X	X		
New Sewickley, Township of	X	X	X	X		
North Sewickley, Township of	-	-	-	X		
Ohioville, Borough of	-	-	-	X		
Patterson Heights, Borough of	X	X	X	X		
Patterson, Township of	X	X	X	X		
Potter, Township of	X	X	X	X		
Pulaski, Township of	X	X	X	X		
Raccoon, Township of	-	-	-	X		
Rochester, Borough of	X	X	X	X		
Rochester, Township of	X	X	X	X		
Shippingport, Borough of	X	X	X	X		
South Beaver, Township of	X	X	X	X		
South Heights, Borough of	X	X	X	X		
Vanport, Township of	X	X	X	X		
West Mayfield, Borough of	X	X	X	X		
White, Township of	-	-	-	X		

3.6 EXISTING PLANNING MECHANISMS

The planning process also allowed for review and incorporation, if appropriate, of existing plans, studies, reports, and other information that would aid in mitigation of hazards across the County. Sections 5 and 7 of this HMP provide additional information regarding integration of existing and future County and municipal processes with hazard mitigation, specifically as these concern administrative, budgetary, and regulatory processes and plans; funding sources; and partnerships. Beaver County will apply existing plans and programs to implement decided-upon hazard mitigation actions. Based on capability assessments of the participating municipalities, the County will continue to plan and implement programs to reduce effects of hazards on people, places, and the environment. This updated HMP builds upon momentum developed through previous related planning efforts and mitigation programs, and recommends implementing actions, where possible.

4.1 Methodology and Tools

This section describes the methodology and tools used to support the risk assessment process.

4.1.1 Methodology

The risk assessment process used for this Hazard Mitigation Plan (HMP) update is consistent with the process and steps presented in the Federal Emergency Management Agency (FEMA) 386-2, State and Local Mitigation Planning How-to-Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses (FEMA 2001). This process identifies and profiles the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities, and the economy) at risk in the community. A risk assessment provides the foundation for the community's decision makers to evaluate mitigation measures that can help reduce the impacts of a hazard when one occurs (mitigation measures are described in Section 6). The risk assessment process consists of the following steps:

Step 1: The first step of the risk assessment process is to identify the hazards of concern. FEMA's current regulations only require an evaluation of natural hazards. Natural hazards are natural events that threaten lives, property, and other assets. Natural hazards often can be predicted to reoccur the same geographical locations because they are related to weather patterns or physical characteristics of an area.

Step 2: The next step of the risk assessment is to prepare a profile for each hazard of concern. These profiles assist communities in evaluating and comparing the hazards that can impact their area. Each type of hazard has unique characteristics that vary from event to event. That is, the impacts associated with a specific hazard can vary depending on the magnitude and location of each event (a hazard event is a specific, uninterrupted occurrence of a particular type of hazard). Further, the probability of occurrence of a hazard in a given location impacts the priority assigned to that hazard. Finally, each hazard will impact different communities in different ways based on geography, local development, population distribution, age of buildings, and mitigation measures already implemented.

Steps 3 and 4: To understand risk, a community must evaluate its assets (Step 3) and determine which assets are exposed or vulnerable to the identified hazards of concern (Step 4). Hazard profile information—combined with data regarding population, demographics, general building stock, and critical facilities at risk—prepares the community to develop risk scenarios and estimate potential damages and losses for each hazard. Critical facilities in Beaver County are presented in Section 2.6 of this HMP.

4.1.2 Tools

To address Disaster Mitigation Act of 2000 (DMA 2000) requirements and better understand potential vulnerability and losses associated with hazards of concern, Beaver County used standardized tools combined with local, state, and federal data and expertise to conduct the risk assessment. Tools used by the County to support the risk assessment are described in the sections below.

Hazards U.S. – Multi-Hazard (HAZUS-MH)

In 1997, FEMA developed a standardized model for estimating losses caused by earthquakes known as Hazards U.S. (HAZUS). HAZUS was developed in response to the need for more effective national-, state-, and community-level planning and the need to identify areas that face the highest risk and potential for loss. HAZUS was expanded into a multi-hazard methodology (HAZUS-MH) with new models for estimating potential losses from wind (hurricanes) and flood (riverine and coastal) hazards. HAZUS-MH is a geographic information system (GIS)-based software tool that applies engineering and scientific risk calculations that have

been developed by hazard and information technology experts to provide defensible damage and loss estimates. These methodologies are accepted by FEMA and provide a consistent framework for assessing risk across a variety of hazards. The GIS framework also supports the evaluation of hazards and assessment of inventory and loss estimates for these hazards.

HAZUS-MH uses GIS technology to produce detailed maps and analytical reports that estimate a community's direct physical damage to building stock, critical facilities, transportation systems, and utilities. To generate this information, HAZUS-MH uses default HAZUS-MH-provided data for inventory, vulnerability, and hazards. These default data can be supplemented with local data to provide a more refined analysis. Damage reports can include induced damage (such as inundation, fire, and threats posed by hazardous materials and debris) and direct economic and social losses (such as casualties, shelter requirements, and economic impact) depending on the hazard and available local data. HAZUS-MH's open data architecture can be used to manage community GIS data in a central location. The use of this software also promotes consistency of current and future data output, and standardization of data collection and storage. The guidance "Using HAZUS-MH for Risk Assessment: How-to Guide" (FEMA 433) was relied upon to support the application of HAZUS-MH for this risk assessment and plan (FEMA 2015). More information on HAZUS-MH is available at http://www.fema.gov/plan/prevent/hazus/index.shtm.

In general, probabilistic analyses were performed to develop estimates of long-term average losses (annualized losses) for the earthquake and tornado/windstorm hazards, as well as an expected or estimated distribution of losses (mean return period losses) for the earthquake; flood, flash flood, and ice jam; and tornado and windstorm hazards. The probabilistic hazard analyses generate estimates of damage and loss for specified return periods. For annualized losses, HAZUS-MH 3.0 calculates the maximum potential annual dollar loss resulting from various return periods averaged on a per-year basis. The analysis consists of the summation of all HAZUS-supplied return periods (e.g., 10, 50, 100, 200, 500) multiplied by the return period probability (as a weighted calculation). In summary, the estimated cost of a hazard (earthquake, flood, and tornado and windstorm hazards) each year is calculated.

The following custom methodologies in HAZUS-MH 3.0 (HAZUS-MH) were used to assess potential exposure and losses associated with hazards of concern for Beaver County:

- Inventory: The default demographic data in HAZUS-MH 3.0, based on the 2010 U.S. Census, were used for the potential loss analysis (such as for sheltering and injuries) for each hazard model.

  The default building inventory in HAZUS-MH 3.0 was used for Beaver County. The occupancy classes available in HAZUS-MH 3.0 were condensed into categories (residential, commercial, industrial, agricultural, religious, government, and educational) to facilitate the analysis and the presentation of results. Residential loss estimates address both multi-family and single-family dwellings. Building replacement cost values are based upon 2014 RS Means Company, Inc. (RS Means) valuations. The County provided a building footprint layer that covers approximately 2/3 of the County; the buildings for the remaining 1/3 were determined using the parcel and tax data provided by the County. Both layers were merged and used to calculate the exposure for each hazard.

  An updated critical facility inventory was also developed and incorporated into HAZUS-MH, replacing the default essential facility (police, fire, schools, etc.), transportation, and utility inventories for the earthquake, flood, and tornado/windstorm hazard models. This comprehensive inventory was developed by gathering input from numerous sources including Beaver County GIS, participating municipalities, and the Planning Committee.

The "user-defined facilities" category includes all assets that Beaver County plan participants deemed critical to include in the inventory and that do not fit within a pre-defined HAZUS-MH facility category. These facilities include County buildings, senior care facilities, and municipality-owned buildings.

HAZUS-MH 3.0 incorporates two types of census block-based data, homogenous and dasymetric. Homogenous census blocks display the full extent of each block, while the dasymetric census blocks have had homogenous undeveloped areas (bodies of area, forests, etc.) removed. The dasymetric blocks were developed to provide more accurate loss estimates by excluding uninhabited and undeveloped areas of a census block.

- Earthquake: A probabilistic assessment was conducted for Beaver County for the 100-, 500- and 2,500-year mean return periods (MRP) through a Level 2 analysis in HAZUS-MH 3.0 to analyze the earthquake hazard and provide a range of loss estimates for Beaver County. The probabilistic method uses information from historic earthquakes and inferred faults, locations, and magnitudes and computes the probable ground-shaking levels that may be experienced during a recurrence period by Census tract.

  As noted in the HAZUS-MH Earthquake User Manual, "*Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. These factors can result in a range of uncertainly in loss estimates produced by the HAZUS Earthquake Model, possibly at best a factor of two or more*" (FEMA 2015f). However, HAZUS' potential loss estimates are acceptable for the purposes of this HMP.

  Ground shaking is the primary cause of earthquake damage to manmade structures and soft soils amplify ground shaking. One contributor to the site amplification is the velocity at which the rock or soil transmits shear waves (S-waves). The National Earthquake Hazard Reduction Program (NEHRP) developed five soil classifications that impact the severity of an earthquake, ranging from A to E. Soil classified as A represents hard rock that reduces ground motions from an earthquake, and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. NEHRP soil classifications were not available for Beaver County at the time of this analysis. Soils were estimated as NEHRP soil Type D across Beaver County as a conservative approach to this risk assessment. Groundwater was set at a depth of 5 feet (default setting). Damages and losses due to liquefaction, landslide, or surface fault rupture were not included in this analysis.

- Flood, Flash Flood, and Ice Jam: The FEMA Digital Flood Insurance Rate Map (DFIRM) dated August 2015 was used to evaluate exposure for the 1- and 0.2-percent annual chance flood events, and determine potential future losses for the 1-percent annual chance event in Beaver County; this flood event is generally considered by planners and evaluated under federal programs such as the National Flood Insurance Program (NFIP). The FEMA-generated, 1-percent annual chance flood depth grid obtained from the Pennsylvania Spatial Data Clearinghouse was incorporated into HAZUS-MH to estimate potential losses for the County (Pennsylvania Spatial Data Clearinghouse 2010). According to FEMA Region III, the 2010 depth grid is based on the data used to develop the 2010 DFIRMs. HAZUS-MH 3.0 was used to develop the depth grid for all other areas of the Special Flood Hazard Areas (SFHA) using a 1/3 Arc Second elevation model from U.S. Geological Survey (USGS). The depth grid was integrated into HAZUS-MH 3.0 and the model was run to estimate potential losses at the structure level using the County's custom building inventory.

- Tornado and Windstorm: After reviewing historic data, a HAZUS-MH 3.0 probabilistic analysis was performed for the 100- and 500-year MRP events to analyze the wind hazard losses for Beaver County. The probabilistic hurricane hazard contains data on historic hurricane events and wind speeds; the model activates a database of thousands of potential storms with tracks and intensities reflecting the full spectrum of Atlantic hurricanes observed since 1886, and then identifies those storms with tracks associated with the County. It also includes surface roughness and vegetation (tree coverage) maps for the County. Surface roughness and vegetation data support the modeling of wind force across various types of land surfaces. Default demographic and building stock data from HAZUS-MH 3.0 and updated critical facility inventories were used for the analysis.

- Other Hazards: GIS tools including HAZUS-MH were used to evaluate other hazards (such as landslide, environmental hazards, etc.) as feasible. For many of the hazards evaluated in this risk assessment, historic data are not adequate to model future losses at this time. For these hazards of concern, areas and inventory susceptible to specific hazards were mapped and exposure was evaluated to help guide mitigation efforts (mitigation efforts are discussed further in Section 6). Where GIS data are not available for some hazards, a qualitative analysis was conducted using the best available data and professional judgment.

For this risk assessment, the loss estimates, exposure assessments, and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

1) Approximations and simplifications necessary to conduct such a study
2) Incomplete or dated inventory, demographic, or economic parameter data
3) The unique nature, geographic extent, and severity of each hazard
4) Mitigation measures already employed by the participating municipalities and the amount of advance notice residents have to prepare for a specific hazard event

These factors can result in a range of uncertainty in loss estimates, possibly by a factor of 2 or more. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk. Over the long term, Beaver County will collect additional data to assist in developing refined estimates of vulnerabilities to natural and non-natural hazards.

4.2 Hazard Identification

In identifying hazards that pose significant risk to Beaver County, the Planning Team reviewed additional information and historical records from a wide range of sources, and identified the following hazards for consideration and profiling from the original 2011 plan:

Natural Hazards

- Drought
- Earthquake
- Flood, Flash Flood, and Ice Jam
- Landslide
- Pandemic
- Tornado and Windstorm
- Winter Storm

Non-Natural Hazards

- Dam Failure
- Environmental Hazards
- Levee Failure
- Nuclear Incident
- Terrorism, Criminal Activity, or Civil Disturbance
- Transportation Accidents
- Urban Fire and Explosion
- Utility Interruption

As part of the plan update process, the Planning Team reviewed the hazards of concern detailed in the 2011 version of the plan as well as those identified in the State HMP. The Planning Team also considered the history of hazard events occurring in Beaver County, as well as events occurring after the completion of the 2011 version of the plan. This review of historical events included an evaluation of all emergency and disaster declarations in the Commonwealth, with a focus on those in which Beaver County was designated for federal assistance.

Further, all jurisdictions participating in the plan update process were provided a Hazard Identification/ Evaluation of Risk worksheet to help identify the hazards—natural and non-natural—that each community believed posed significant risk to Beaver County, including any that may not have been considered in either the 2011 version of the plan or the State HMP. Completed worksheets submitted by the municipalities are included in Appendix D.

Based on all available information and input from the municipalities, the Planning Team selected the following natural and non-natural hazards for consideration in this plan:

Natural Hazards

- Drought
- Earthquake
- Flood, Flash Flood, and Ice Jam
- Landslide
- Pandemic
- Radon Exposure

- Tornado and Windstorm
- Winter Storm

Non-Natural Hazards

- Dam Failure
- Environmental Hazards
- Levee Failure
- Nuclear Incident
- Terrorism, Criminal Activity, or Civil Disturbance
- Transportation Accidents
- Urban Fire and Explosion
- Utility Interruption

These hazards have been profiled individually in Section 4.3 of this plan.

4.3.1 Dam Failure

This section provides a profile and vulnerability assessment of the dam failure hazard for Beaver County. A dam is an artificial barrier that has the ability to store water, wastewater, or liquid-borne materials for many reasons (flood control, human water supply, irrigation, livestock water supply, energy generation, containment of mine tailings, recreation, or pollution control). Many dams fulfill a combination of these stated functions (Association of State Dam Safety Officials 2013). Dams are an important resource in the United States.

Manmade dams can be classified according to the type of construction material used, the methods used in construction, the slope or cross-section of the dam, the way the dam resists the forces of the water pressure behind it, the means used for controlling seepage, and, occasionally, the purpose of the dam. The materials used for construction of dams include earth, rock, tailings from mining or milling, concrete, masonry, steel, timber, miscellaneous materials (plastic or rubber), and any combination of these materials (Association of State Dam Safety Officials 2013).

More than one-third of the dams in the United States are 50 or more years old. Approximately 14,000 of those dams pose a significant hazard to life and property if failure occurs. About 2,000 unsafe dams are located throughout the United States, in almost every state.

Dams typically fail when spillway capacity is inadequate and excess flow overtops the dam, or when internal erosion (piping) through the dam or foundation occurs. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-filled waters that rush downstream, damaging or destroying anything in its path (Federal Emergency Management Agency [FEMA] 2005).

Dam failures can result from one or a combination of several the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam
- Deliberate acts of sabotage
- Structural failure of materials used in dam construction
- Movement or failure of the foundation supporting the dam
- Settling and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep (FEMA 2015f)

Regulatory Oversight for Dams

The potential for catastrophic flooding caused by dam failures led to the enactment of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program (NDSP) has been used for 30 years to protect Americans from dam failure. The NDSP is a partnership between the states, federal agencies, and other stakeholders that encourages individual and community responsibility for dam safety. Under FEMA's leadership, state assistance funds have allowed all participating states to improve their programs through increased inspections, emergency action planning, and the purchase of needed equipment. FEMA has also expanded existing training programs and initiated new ones. Grant assistance from FEMA provides support for improvement of dam safety programs that regulate most of the dams in the United States (FEMA 2015).

Pennsylvania Department of Environmental Protection

The Pennsylvania Department of Environmental Protection (PADEP) holds responsibility for dam safety in Pennsylvania. Hazard Potential Category 1 dams are those "where its failure could result in significant loss of

life, excessive economic losses, and significant public inconvenience" (PADEP 2009). Hazard Potential Category 2 dams are those "where its failure could result in the loss of a few lives, appreciable property damage, and short-duration public inconvenience" (PADEP 2009). Owners of dams classified as Hazard Categories 1 or 2 ("high-hazard" dams) are required to create an Emergency Action Plan (EAP) that describes the dam, the inundation area if the dam were to catastrophically fail, and procedures for responding to the dam failure (such as notification to the vulnerable population). Beaver County uploads all copies of EAPs received (as well as school, jail, and other plans) to the reporting center Previstar. This system ensures only authorized personnel have access to important information.

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers (USACE) is responsible for safety inspections of some federal and nonfederal dams in the United States that meet the size and storage limitations specified in the National Dam Safety Act. USACE has inventoried dams and has surveyed each state's and federal agency's capabilities, practices, and regulations regarding design, construction, operation, and maintenance of the dams. USACE has also developed guidelines for inspection and evaluation of dam safety (USACE 2011). The USACE National Inventory of Dams (NID) provides the most recent inspection dates for 24 of the Beaver County dams, listed in Table 4.3.1-1.

Table 4.3.1-1. Beaver County Dam Inspection Dates

Beaver County Dam	Inspection Date
Bradys Run	April 4, 2012
Group Camp	April 24, 2012
Homewood	April 26, 2011
Hudak	May 12, 2011
Industrial Wastes Sediment Pond	June 13, 2012
Industrial Wastes, Inc. Pond #1	June 13, 2012
Industrial Wastes, Inc. Pond #2	June 13, 2012
Industrial Wastes, Inc. South Pond	June 13, 2012
J C Bacon	June 27, 2012
Lakewood Development	August 2, 2012
Little Blue Run	July 11, 2012
Little Blue Saddle	July 11, 2012
Lower Hereford Manor	April 4, 2012
Montgomery Locks and Dam	June 12, 2009
North Low Dissolved Solids IMP	November 16, 2011
Patterson	August 22, 2012
Patterson Dam	June 13, 2006
Raccoon Creek	April 24, 2012
South Low Dissolved Solids IMP	November 16, 2011
Townsend	August 22, 2012
Townsend Dam	June 13, 2006
Upper Hereford Manor	April 4, 2012
Upper Southside Sport	April 23, 2012
West High Dissolved Solids IMP	November 16, 2011

Source: USACE 2015

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) has the largest dam safety program in the United States. FERC cooperates with a large number of federal and state agencies to ensure and promote dam safety and,

more recently, homeland security. A total of 3,036 dams are part of regulated hydroelectric projects and are included in the FERC program; two-thirds of these are more than 50 years old. Concern about safety and integrity grows as dams age, making oversight and regular inspection especially important (FERC 2005). FERC staff inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license (FERC 2005)

Every 5 years, an independent consulting engineer, approved by FERC, must inspect and evaluate projects with dams higher than 32.8 feet (10 meters) or with a total storage capacity of more than 2,000 acre-feet (FERC 2005).

FERC monitors and evaluates seismic research in geographic areas where concerns about seismic activity exist. This information is applied in investigating and performing structural analyses of hydroelectric projects in these areas. FERC staff also evaluates the effects of potential and actual large floods on the safety of dams. FERC staff visits dams and licensed projects during and after floods, assesses the extent of damage, and directs any studies or remedial measures the licensee must undertake. FERC's *Engineering Guidelines for the Evaluation of Hydropower Projects* guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies (FERC 2005).

FERC requires licensees to prepare EAPs and conducts training sessions on developing and testing these plans. The plans outline an early warning system in the event of an actual or potential sudden release of water from a dam failure. The plans include operational procedures that may be implemented during regulatory measures, such as reducing reservoir levels and downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that all applicable parties are informed of the proper procedures in emergencies (FERC 2005).

4.3.1.1 Location and Extent

A total of 35 dams are located throughout Beaver County, shown on Figure 4.3.1-1. The vast majority of these dams pose little risk; however, there are five "high-hazard" dams that require EAPs. Three of these high-hazard dams have either impoundment storage of greater than 1,000 acre feet or a dam height of over 40 feet. Table 4.3.1-2 lists dam classification definitions. Table 4.3.1-3 provides a complete list of dams in Beaver County; dams with the "high-hazard" classification are listed first.

In addition to the dams within Beaver County, the County has also noted concern with Kinzua Dam located in Warren County, which has an A-1 classification. Although this dam is located outside the County, several riverside communities in Beaver County lie within the limit of the spillway design flood with dam failure. A warning and evacuation plan is in place for the dam should an emergency occur.

Table 4.3.1-2. Dam Classification Definitions

Size Category		
Category	**Impoundment Storage (Acre feet)**	**Dam Height (Feet)**
A	Equal to or greater than 50,000	Equal to or greater than 100
B	Less than 50,000 but greater than 1,000	Less than 100 but greater than 40
C	Equal to or less than 1,000	Equal to or less than 40
Hazard Potential Category		
Category	**Population at Risk**	**Economic Loss**
1	Substantial (Numerous homes or small businesses or a large business or school)	Excessive such as extensive residential, commercial, or agricultural damage, or substantial public inconvenience.
2	Few (A small number of homes or small businesses)	Appreciable such as limited residential, commercial, or agricultural damage, or moderate public inconvenience.
3	None expected (no permanent structures for human habitation or employment)	Significant damage to private or public property and short-duration public inconvenience such as damage to storage facilities or loss of critical stream crossings.
4	None expected (no permanent structures for human habitation or employment)	Minimal damage to private or public property and no significant public inconvenience

Source: Commonwealth of Pennsylvania 2011

Table 4.3.1-3. Dams in Beaver County

Dam Name	Municipality	Stream	Type	PADEP Classification	NID Classification	Permittee
High Hazard Dams						
Group Camp	Hanover Township	Traverse Creek	Earth	C-2	High	DCNR
Raccoon Creek	Hanover Township	Traverse Creek	Earth	B-1	High	DCNR
Bradys Run	Brighton Township	South Branch Brady Run	Earth	C-1	High	Beaver County Commissioners
J C Bacon	Independence Township	Service Creek	Earth	B-1	High	Ambridge Water Authority
Little Blue Run	Greene Township	Little Blue Run	Earth	A-1	High	FirstEnergy Generation, LLC
Other Dams						
Eastvale	Beaver Falls City	Beaver River	Timber Crib, Concrete, Run of River	C-4	Low	Beaver Falls Municipal Authority
Barnes	Hanover Township	TR Little Traverse Creek	Earth	C-4	Low	Rick Sharbonno
Koppel Reservoir	Big Beaver Borough	Stockman Run	Earth	C-4	Low	Koppel Borough
Koppel Reservoir	Koppel Borough	Stockman Run	Earth	C-4	Low	Koppel Borough
Homewood	Homewood Borough	TR Clarks Run	Earth	C-3	Significant	Alfred E Desanzo
Country Club	Franklin Township	Connoquenessing Creek	Other	C-4	Low	Connoquenessing Dam Association
Lakewood Development	Center Township	TR Moon Run	Earth	C-3	Significant	Ted Vana and Cathy Saunders
Sweikowski	Marion Township	TR Connoquenessing Creek	Earth	C-4	Low	Richard and Anna Sweikowski
Clarks Run Detention Pond	Beaver Borough	Clarks Run	Earth	C-4	Low	Darlington Ready Mix Company
Industrial Wastes Sediment Pond	Darlington Township	TR East Fork Stateline Creek	Earth	C-3	Significant	Thomas McLaughlin
Industrial Wastes Inc., Pond #1	Darlington Township	TR East Fork Stateline Creek	Earth	C-4	Low	Thomas McLaughlin
Industrial Wastes Inc., Pond #2	Darlington Township	TR East Fork Stateline Creek	Earth	C-4	Low	Thomas McLaughlin
Industrial Wastes Inc., South Pond	Darlington Township	TR East Fork Stateline Creek	Earth	C-4	Low	Thomas McLaughlin

Dam Name	Municipality	Stream	Type	PADEP Classification	NID Classification	Permittee
Husar	Economy Borough	TR N Fork Big Sewickley Creek	Earth	C-4	Low	James and Nikki Husar
North Low Dissolved Solids IMP	Shippingport Borough	Watershed Ohio River	Earth	C-3	Significant	FirstEnergy Generation, LLC
South Low Dissolved Solids IMP	Shippingport Borough	Watershed Ohio River	Earth	C-3	Significant	FirstEnergy Generation, LLC
West Low Dissolved Solids IMP	Shippingport Borough	Watershed Ohio River	Earth	C-3	Significant	FirstEnergy Generation, LLC
Hughes Lake	Hanover Township	Laurence Run	Earth	C-4	Low	Danny Binkoski
Hughes Lake	Hanover Township	Laurence Run	Earth	C-4	Low	Gary Rodgers
Wischerman	South Beaver Township	UNT North Fork Little Beaver	Earth	C-4	Low	Dan Wischerman
Upper Southside Sport	Hanover Township	TR Traverse Creek	Earth	C-3	Significant	Southside Sportsmen's Club
Little Blue Saddle	Greene Township	TR Mill Creek	Earth	B-3	Significant	FirstEnergy Generation Corporation
Connoquenessing Country Club	North Sewickley Township	TR Connoquenessing Creek	Timber Crib, Concrete, Run of River	C-4	Low	Connoquenessing Country Club
Patterson	Beaver Falls City	Beaver River	N/A	C-4	Low	Beaver Valley Power Company
Patterson Dam	New Brighton Borough	Beaver River	Timber Crib	C-4	Low	Beaver Valley Power Company
Townsend	Patterson Township	Beaver River	N/A	C-4	Low	Beaver Falls Municipal Authority
Townsend Dam	Patterson Township	Beaver River	N/A	C-4	Low	Beaver Falls Municipal Authority
Hudak	Big Beaver Borough	Wallace Run	Earth	N/A	N/A	Dave Hudak
Upper Hereford Manor	Franklin Township	Doe Run	Earth	N/A	N/A	PA Fish and Boat Commission
Montgomery Lock and Dam	Potter Township	Ohio River	Gravity	N/A	N/A	USACE

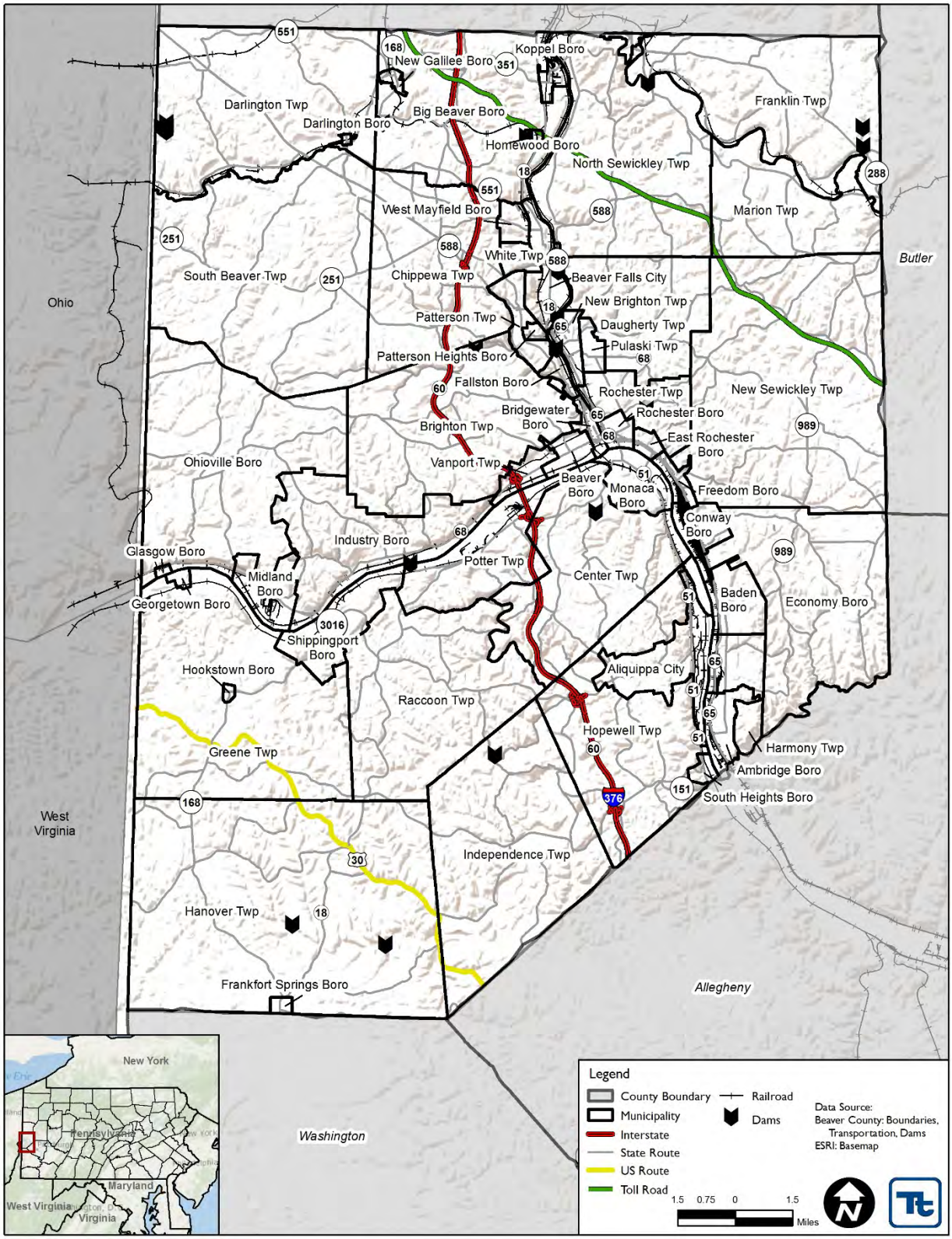
Source: PADEP 2013; PADEP 2015

Notes:

DCNR Pennsylvania Department of Conservation and Natural Resources
IMP Impoundment

N/A	Not Applicable
NID	National Inventory of Dams
PADEP	Pennsylvania Department of Environmental Protection
TR	Tributary
UNT	Unnamed Tributary
USACE	U.S. Army Corps of Engineers

Figure 4.3.1-1. Dams in Beaver County



Source: Beaver County 2015

4.3.1.2 Range of Magnitude

The extent or magnitude of a dam failure event can be measured in terms of the classification of the dam. FEMA has three classification levels of dams: low, significant, and high. The classification levels build on each other. The hazard potential classification system should be used with the understanding that the failure of any dam or water-retaining structure could represent a danger to downstream life and property (FEMA 2004). Each of FEMA's dam classification levels is described below:

- Low hazard potential dams are those where failure or misoperation would result in no probable loss of human life and low economic or environmental losses. Losses are principally limited to the owner's property.
- Significant hazard potential dams are those where failure or misoperation would result in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas.
- High hazard potential dams are those where failure or misoperation will probably cause loss of human life.

USACE developed the classification system shown in Table 4.3.1-4 for the hazard potential of dam failures. The USACE hazard rating system is based only on the potential consequences of a dam failure; it does not take into account the probability of failures.

Table 4.3.1-4. U.S. Army Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss-of-life potential is based on inundation mapping of the area downstream of the project. Analysis of loss-of-life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Lifeline losses include indirect threats to life caused by the interruption of lifeline services from project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Property losses include damage to project facilities and downstream property and indirect impact from loss of project services, such as impact from loss of a dam and navigation pool, or impact from loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: USACE 2011

The worst-case scenario dam failure would be the sudden catastrophic failure of the Little Blue Run dam, which presents both a substantial risk to local residents and has a large impoundment storage (equal or greater than 50,000 acre feet). Also of concern would be the potential failure of Bradys Run, J C Bacon, or Raccoon Creek dams. While these dams have a smaller impoundment storage than Little Blue Run dam, they still would impact a substantial number of nearby residents. The most likely dam failure would be the failure of a small earthen dam along a minor stream, and would not threaten any lives or property.

4.3.1.3 Past Occurrence

There have been no recorded dam failures in Beaver County (Beaver County 2010). According to the Pennsylvania Emergency Management Agency (PEMA), minor dam failures occur annually, but the impact of these events is minimal. Only one Beaver County Dam, the Upper Hereford Manor Upper/Lower Dam, has been designated as "unsafe," in the past (Beaver County Hazards Vulnerability Assessment 2010). Due to this designation, the dam was deliberately breached in 2012 to prevent any potential incidents.

4.3.1.4 Future Occurrence

The likelihood of a dam failure in Beaver County is difficult to predict. Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, and excessive rainfall and snowmelt. However, the risk of such an event increases for each dam as the dam's age increases or frequency of maintenance decreases.

"Residual risk" is associated with dams, which is the risk that remains after safeguards have been implemented. The residual risk for dams is associated with events beyond those that the facility was designed to withstand. However, the probability of any type of dam failure is low in today's dam safety regulatory and oversight environment.

Based on the Risk Factor Methodology Probability Criteria, dam failures are considered *unlikely,* provided that regular maintenance and inspections of the dams in Beaver County are performed. Section 4.4 of the Plan further defines this criterion.

4.3.1.5 Vulnerability Assessment

The dam failure hazard is of significance to Beaver County because there are 35 dams across Beaver County, including five Category 1 and 2 (i.e., high-risk) dams. The direct and indirect losses associated with dam failures include injury and loss of life, damage to structures and infrastructure, agricultural losses, utility failure (power outages), and stress on community resources.

The entire population residing within a dam failure inundation zone is considered exposed and vulnerable. Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact to their family. The population over the age of 65 is also highly vulnerable because they are more likely to seek or need medical attention that may not be available because of isolation during a flood event, and they may have more difficulty evacuating.

The EAPs associated with the Beaver County high-hazard dams provide information concerning the estimated number of homes and residents vulnerable to a dam failure. The County considers the EAP for Little Blue Run dam to be the most significant, due to the potential impact of a dam failure from this dam. A failure from this dam would primarily impact the local area, although the EAP estimates it could impact a much wider region depending on the scope of the failure. The number of vulnerable structures includes 2,000 homes, 150 businesses, and 5 schools, and the number of vulnerable residents totals 6,000 (both in Pennsylvania and West Virginia). Inundation information for Montgomery Locks and Dam and other high-hazard dams was not available at the time of this update.

There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and

compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard.

All buildings and infrastructure located in the dam failure inundation zone are considered exposed and vulnerable. Property located closest to the dam inundation zone has the greatest potential to experience the largest, most destructive surge of water. All transportation infrastructures within the dam failure inundation zone are vulnerable to damage. Damage to these infrastructures could cut off evacuation routes, limit emergency access, and create isolation issues. Utilities such as overhead power, cable, and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation zones.

4.3.2 Drought

This section provides a profile and vulnerability assessment of the drought hazard in Beaver County. Drought is a period characterized by long durations of below normal precipitation. Drought conditions occur in virtually all climatic zones, yet characteristics of drought vary significantly from one region to another, relative to normal precipitation within respective regions. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life. Drought is a temporary irregularity in typical weather patterns and differs from aridity, which reflects low rainfall within a specific region and is a permanent feature of the climate of that area.

Drought can be defined or grouped in four categories:

- Meteorological drought is a measure of departure of precipitation from normal, defined solely by reference to relative degree of dryness. Because of climatic differences, dryness considered a drought at one location of the country may not be considered drought at another location.
- Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and other parameters. Agricultural drought occurs when not enough water is available for a particular crop to grow at a particular time. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.
- Hydrological drought is associated with below normal surface or subsurface water supply resulting from periods of precipitation shortfalls (including snowfall). Hydrological drought is related to effects of precipitation shortfalls on stream flows and water levels in reservoirs, lakes, and groundwater.
- Socioeconomic drought is associated with supply and demand of an economic good, with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned types of drought because its occurrence depends on supply and demand to identify or classify droughts. Supplies of many economic goods such as water, silage, food grains, fish, and hydroelectric power depend on weather. Socioeconomic drought occurs when demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply (National Drought Mitigation Center ([NDMC] 1985).

Drought can affect many sectors of an economy and can reach beyond an area undergoing physical drought. Because water is essential for producing goods and providing services, drought can reduce crop yield, increase fire hazard, lower water levels, and damage wildlife and fish habitat. Further consequences of these impacts include reductions in crop yields, rangeland, and forest productivity that may lower incomes of farmers and agribusinesses; increased prices of food and timber; increased unemployment; reduction in tax revenues as expenditures decline; increased crime, foreclosures, and migration; and exhausted disaster relief funds. The many impacts of drought can be categorized as economic, environmental, or social.

Scientists at this time do not know how to predict drought more than 1 month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and accumulated influence of weather systems on the global scale (NDMC Date Unknown).

4.3.2.1 Location and Extent

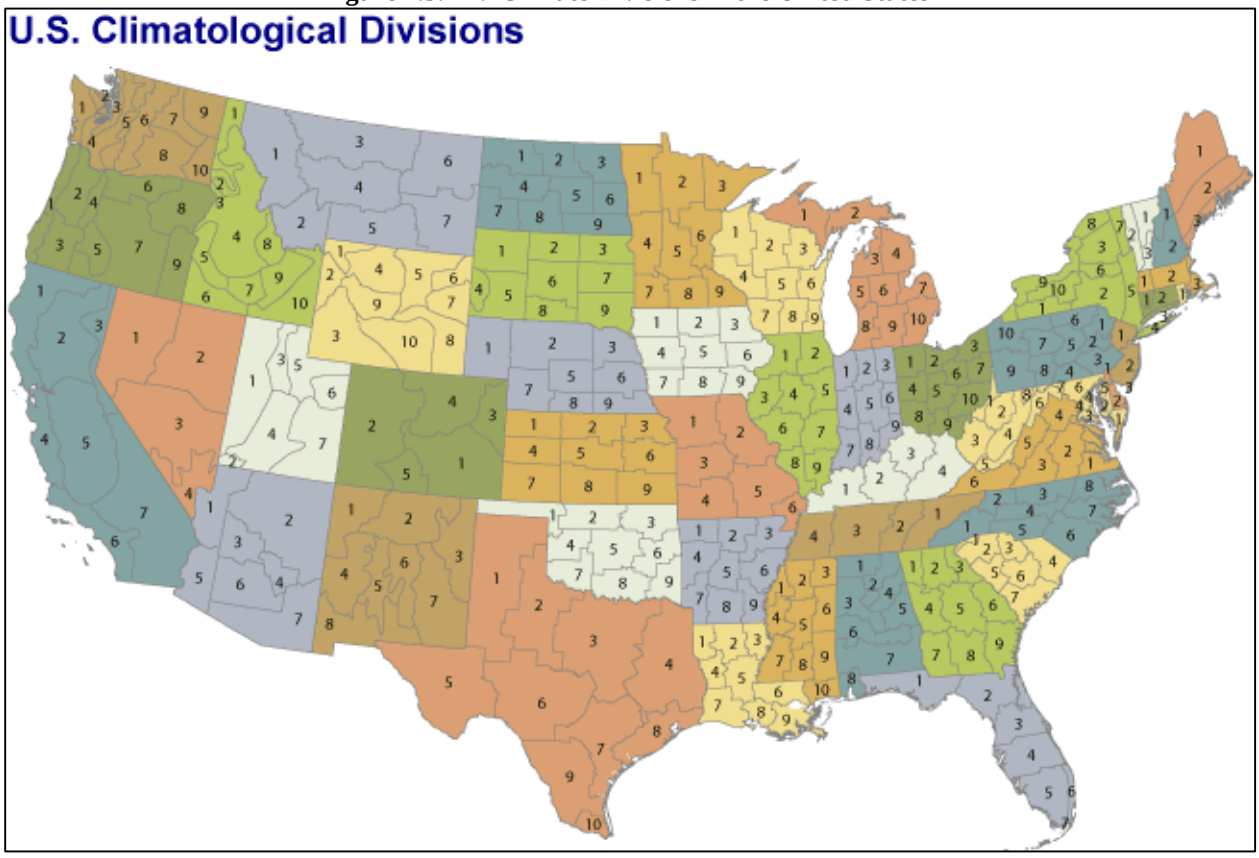
Droughts are regional in scope and may affect the entirety of Beaver County rather than only individual municipalities within the County. Droughts may also concurrently affect counties near Beaver County, or even

the entire State. Generally, areas along waterways will indicate drought conditions later than areas away from waterways.

Climate divisions are regions within a state that are climatically homogenous. The National Oceanic and Atmospheric Administration (NOAA) has divided the United States into 359 climate divisions. The boundaries of these divisions typically coincide with county boundaries, except in the western United States where they are based largely on drainage basins (Climate Prediction Center [CPC] 2005).

According to NOAA, Pennsylvania includes 10 climate divisions: Pocono Mountains, East Central Mountains, Southeastern Piedmont, Lower Susquehanna, Middle Susquehanna, Upper Susquehanna, Central Mountains, South Central Mountains, Southwest Plateau, and Northwest Plateau Climate Division (National Climatic Data Center [NCDC] 2015). Figure 4.3.2-1 shows the climate divisions throughout the United States, and Figure 4.3.2-2 shows the climate divisions of Pennsylvania. Beaver County is within the Southwest Plateau climate division.

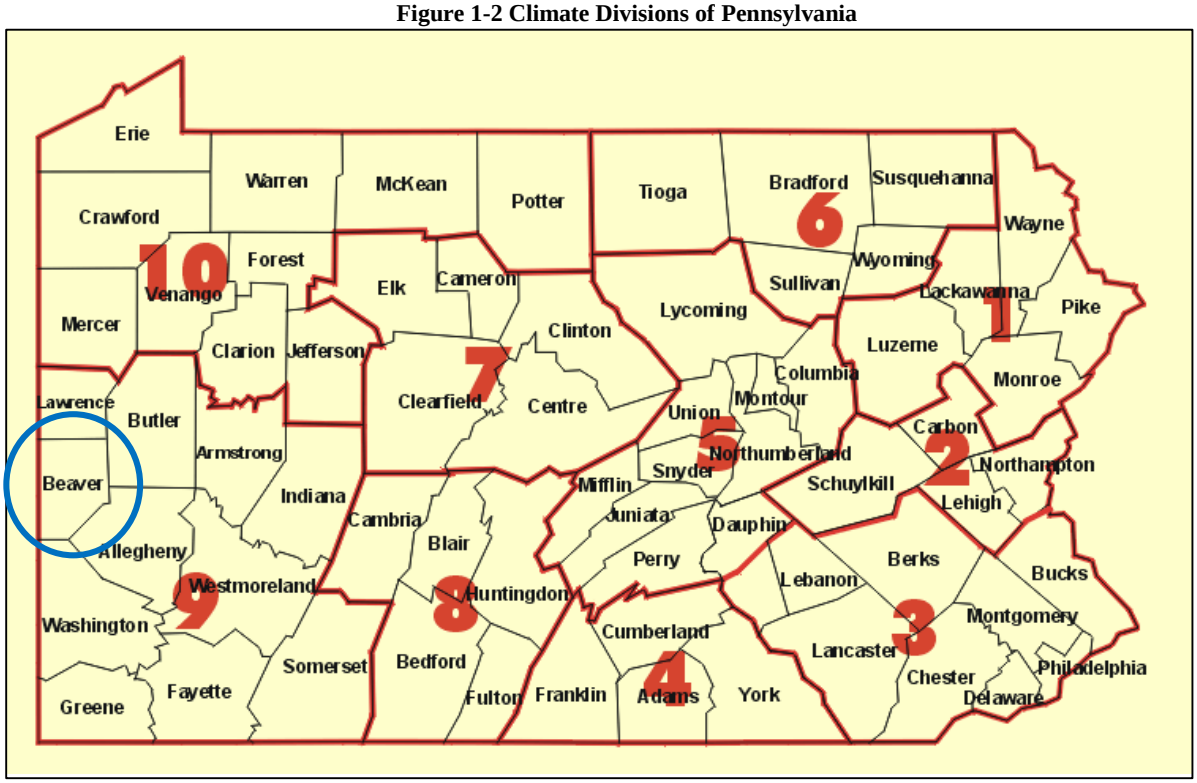
Figure 4.3.2-1. Climate Divisions in the United States



Source: NCDC 2012

Notes: Climate division names vary from state to state. The climate divisions for Pennsylvania are:
1 = Pocono Mountains; 2 = East Central Mountains; 3 = Southeastern Piedmont; 4 = Lower Susquehanna; 5 = Middle Susquehanna; 6 = Upper Susquehanna; 7 = Central Mountains; 8 = South Central Mountains; 9 = Southwest Plateau; 10 = Northwest Plateau

Figure 1-2 Climate Divisions of Pennsylvania



Source: CPC 2005

Notes: Highlight added.

The climate divisions for Pennsylvania are:

1 = Pocono Mountains; 2 = East Central Mountains; 3 = Southeastern Piedmont; 4 = Lower Susquehanna; 5 = Middle Susquehanna; 6 = Upper Susquehanna; 7 = Central Mountains; 8 = South Central Mountains; 9 = Southwest Plateau; 10 = Northwest Plateau

Particularly at locations where citizens rely on wells for drinking water, water supplies are vulnerable to effects of drought and thus can impact the severity of a drought. Residents depending on well water can more easily handle short-term droughts without major inconveniences than can populations that rely on surface water. However, longer-term droughts inhibit groundwater aquifers from recharging and can thus extend the problems of well owners for an indeterminate amount of time—Beaver County residents who depend on private domestic wells have this greater "hidden vulnerability" to droughts.

Table 4.3.2-1 lists the number of reported domestic wells within each municipality of Beaver County. The well data were obtained from the Pennsylvania Groundwater Information System (PaGWIS). PaGWIS is maintained by Pennsylvania Department of Conservation and Natural Resources (DCNR) and relies on voluntary submissions of well record data by well drillers; as a result, it is not a complete database of all domestic wells in the County. It is, however, the most complete dataset of domestic wells available.

Table 1-1. Domestic Wells in Beaver County

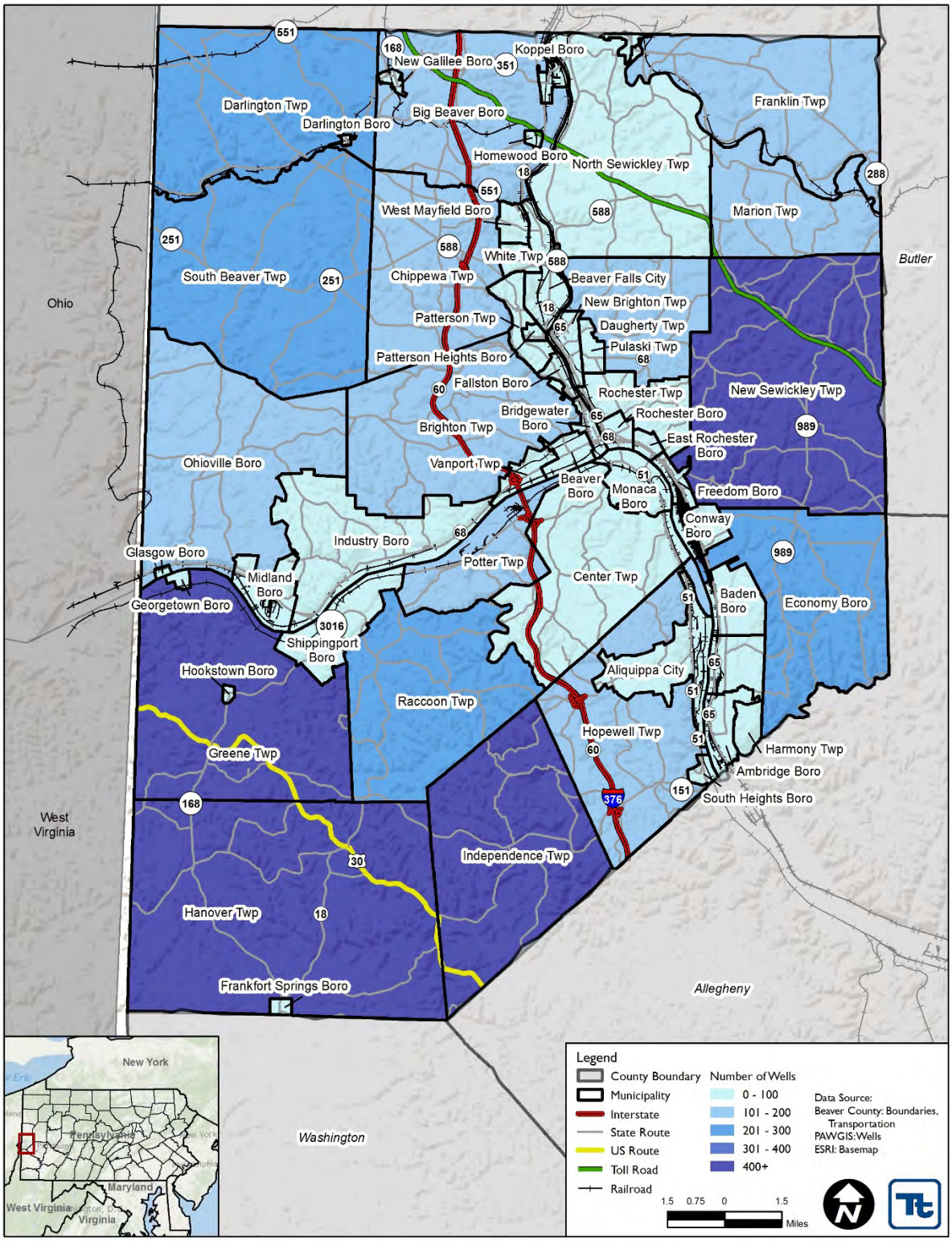
Municipality	Number of Reported Domestic Wells
Aliquippa, City of	86
Ambridge, Borough of	37
Baden, Borough of	34
Beaver Falls, City of	25
Beaver, Borough of	71
Big Beaver, Borough of	120
Bridgewater, Borough of	3
Brighton, Township of	117
Center, Township of	53
Chippewa, Township of	108
Coneway, Borough of	90
Darlington, Borough of	4
Darlington, Township of	270
Daugherty, Township of	122
East Rochester, Borough of	16
Eastvale, Borough of	0
Economy, Borough of	295
Fallston, Borough of	8
Frankfort Springs, Borough of	7
Franklin, Township of	183
Freedom, Borough of	16
Georgetown, Borough of	19
Glasgow, Borough of	4
Greene, Township of	459
Hanover, Township of	489
Harmony, Township of	26
Homewood, Borough of	1
Hookstown, Borough of	19
Hopewell, Township of	131
Independence, Township of	470
Industry, Borough of	48
Koppel, Borough of	14
Marion, Township of	119
Midland, Borough of	34
Monaca, Borough of	40
New Brighton, Borough of	15
New Galilee, Borough of	14
New Sewickley, Township of	721
North Sewickley, Township of	63
Ohioville, Borough of	123
Patterson Heights, Borough of	0

Municipality	Number of Reported Domestic Wells
Patterson, Township of	6
Potter, Township of	109
Pulaski, Township of	1
Raccoon, Township of	246
Rochester, Borough of	35
Rochester, Township of	78
Shippingport, Borough of	57
South Beaver, Township of	247
South Heights, Borough of	19
Vanport, Township of	6
West Mayfield, Borough of	10
White, Township of	1
BEAVER COUNTY	**5,289**

Source: PAGWIS 2015

Figure 4.3.2-3 shows well counts by municipality within Beaver County.

Figure 1-3. Beaver County Domestic Well Counts by Municipality



Source: PAGWIS 2015

In addition to domestic wells in the County, residents may also receive their water from municipal water providers. In fact, according to the County Comprehensive Plan, the majority of residents receive drinking water from public suppliers. Specifically, the County's 19 public systems provide drinking water to over 140,000 people, or over 80% of County residents. Public water systems in the County procure their water from one of three sources: groundwater (wells), surface water (rivers or other bodies of water), or purchase from other authorities/systems. Areas in the County served by public water systems correspond with development. More intensely developed areas, including Center Township, Economy Borough, Hopewell Township, Brighton Township, Chippewa Township, and North Sewickley Township, have water service. In contrast, the northeastern, northwestern, and southwestern areas typically do not have public water access. These areas include Darlington Township, South Beaver Township, Ohioville Borough, Greene Township, Hanover Township, Independence Township, Raccoon Township, New Sewickley Township, Marion Township, and Franklin Township (Beaver County Comprehensive Plan 2010). In addition to the public water services in the County, approximately 80 additional, smaller water systems are primary providers of water to private owners, developments, mobile home parks, etc.

Each local water supply provider has sufficient capacity to meet customer demands, as indicated in Section 2.5.3.1. Table 4.3.2-2 below provides additional information on potable water supply in Beaver County.

Table 4.3.2-2. Potable Water Supply in Beaver County

Facility Name	Population Served	Water Sources
Aliquippa Municipal Water Authority	15,550	Primary (Ground)
Ambridge Water Authority	17,832	Primary (Surface)
Baden Borough Water Dept	4,377	Consecutive (Purchased Surface)
Beaver Borough Municipal Authority	4,775	Primary (Ground)
Beaver Falls Municipal Authority	41,147	Primary (Surface)
Borough of Conway	2,290	Consecutive (Purchased Surface)
Brighton Township Municipal Authority	6,708	Consecutive (Purchased Ground)
Center Township Water Authority	13,000	Primary (Surface)
Creswell Heights Joint Authority	13,130	Primary (Ground)
Glasgow Municipal Water Works	40	Primary (Ground)
Industry Borough Municipal Authority	1,860	Primary (Ground)
Marion Township Water System	220	Consecutive (Purchased Surface)
Midland Borough Municipal Authority	3,194	Primary (Surface)
Monaca Borough Water Department	6,500	Primary (Ground)
New Sewickley Township Municipal Authority	1,549	Consecutive (Purchased Surface)
North Sewickley Municipal Water Authority	4,619	Consecutive (Purchased Surface)
Ohioville Borough Municipal Authority	2,630	Consecutive (Purchased Surface)
Shippingport Borough Water System	218	Consecutive (Purchased Surface)
Vanport Township Municipal Authority	1,450	Primary (Ground)

Source: Beaver County Comprehensive Plan 2010

Notes: Primary water systems include groundwater or surface water sources, while consecutive systems purchase water from another authority/system.

4.3.2.2 Range of Magnitude

Effects of droughts vary depending on their severity, timing, duration, and location. Some droughts may exert their greatest impact on agriculture, while others may have stronger effects on water supply or recreational activities. Droughts can adversely affect the following significantly:

- Public water supplies for human consumption
- Rural water supplies for livestock consumption and agricultural operations
- Water quality
- Natural soil water or irrigation water for agriculture
- Water for forests and for fighting forest fires
- Water for navigation and recreation.

Pennsylvania Department of Environmental Protection (PADEP) and Pennsylvania Emergency Management Agency (PEMA) manage water supply droughts in Pennsylvania according to the following four conditions of drought defined in the Commonwealth of Pennsylvania 2013 Standard Hazard Mitigation Plan (PA HMP):

- Drought Watch: A period to alert government agencies, public water suppliers, water users, and the public regarding potential for future drought-related problems. The focus is on increased monitoring, awareness, and preparation for response in the event that conditions worsen. A request for voluntary water conservation is issued. The objective of voluntary water conservation measures during a drought watch is to reduce water use by 5 percent within the affected areas. Because of varying conditions, individual water suppliers or municipalities may ask for more stringent conservation actions.
- Drought Warning: This is a drought stage involving a coordinated response to imminent drought conditions and potential water supply shortages through concerted voluntary conservation measures to avoid or reduce shortages, relieve stressed sources, develop new sources, and, if possible, forestall need to impose mandatory water use restrictions. The objective of voluntary water conservation measures during a drought warning is to reduce overall water use by 10 to 15 percent within the affected areas. Because of varying conditions, individual water suppliers or municipalities may ask for more stringent conservation actions.
- Drought Emergency: During this drought stage, water management entities marshal all available resources to respond to actual emergency conditions, avoid depletion of water sources, ensure at least minimum water supplies to protect public health and safety, support essential and high-priority water uses, and avoid unnecessary economic dislocations. If deemed necessary and if ordered by the Governor during this stage, imposition of mandatory restrictions on nonessential water usage could occur as provided for in 4 *Pa. Code* Chapter 119. Objectives of water use restrictions (mandatory or voluntary) and other conservation measures during a drought emergency are to reduce consumptive water use within the affected areas by 15 percent, and to reduce total use to the extent necessary to preserve public water system supplies, avoid or mitigate local or area shortages, and ensure equitable sharing of limited supplies.
- Local Water Rationing: This fourth condition of drought is not defined as a drought stage. Local municipalities may, with the approval of the Pennsylvania Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply within designated water supply service areas. These individual water rationing plans, authorized through provisions of 4 *Pa. Code* Chapter 120, require specific limits on individual water consumption to achieve significant reductions in use. Under both mandatory restrictions imposed by the Commonwealth and local water rationing practices, procedures are specified for granting variances in consideration of individual hardships and economic dislocations (PEMA 2013).

Pennsylvania uses five parameters to assess drought conditions: precipitation deficits, stream flows, reservoir storage levels, groundwater levels, and a measure of soil moisture. These are described in detail below.

- Precipitation Deficits: As rainfall provides the basis for both groundwater and surface water resources, precipitation deficits are the earliest indicators of a potential drought. The National Weather Service (NWS) records "normal" monthly precipitation data for each county in Pennsylvania. These figures are generated from long-term monthly and decennial averages of precipitation, and are updated at the end of each decade based on the most recent 30 years. Monthly totals less than normal values represent precipitation deficits, which are then converted to percentages of the normal values. Table 4.3.2-3 lists the drought conditions (defined in the PA HMP and noted above) that are indicated by various precipitation deficit percentages (PEMA 2013).

Table 2-3. Precipitation Deficit Drought Indicators for Pennsylvania

Duration of Deficit Accumulation (months)	Drought Watch (deficit as percent of normal precipitation)	Drought Warning (deficit as percent of normal precipitation)	Drought Emergency (deficit as percent of normal precipitation)
3	25	35	45
4	20	30	40
5	20	30	40
6	20	30	40
7	18.5	28.5	38.5
8	17.5	27.5	37.5
9	16.5	26.5	36.5
10	15	25	35
11	15	25	35
12	15	25	35

Source: PEMA 2010

Table 4.3.2-4 lists normal monthly and annual precipitation from 1981 to 2010 at the two NOAA weather stations in Beaver County. These data from the NOAA weather stations are available through the National Climatic Data Center (NCDC), which compiles monthly and annual normal total precipitation (inches) data retrieved from both National Weather Service Cooperative Network (NWSCOOP) and Principal Observation (First-Order) locations throughout the United States.

Table 2-4. Normal Monthly and Annual Precipitation (total in inches) from 1981 to 2010 at NOAA Weather Stations in Beaver County

Station Name	January	February	March	April	May	June	July	August	September	October	November	December	ANNUAL
Beaver Falls 1 NE, PA US	2.50	2.07	2.64	3.24	4.02	4.04	3.72	3.22	3.21	2.59	3.16	2.85	37.26
Montgomery Lock and Dam, PA US	2.58	2.20	2.86	3.22	3.83	3.75	4.28	3.15	3.66	2.36	3.08	2.81	37.78

Source: NCDC 2015

- Stream Flows: Stream flows, which typically lag up to 2 months behind precipitation normals in signaling a drought, offer the second earliest indication of drought conditions. PADEP uses 73 U.S. Geological Survey (USGS)-maintained stream gauges throughout the State as its drought monitoring network, computing 30-day average stream flow values for each stream gauge based on the entire period of record for each gauge. For example, the Tonoloway Creek gauge near Needmore has data records as far back as October 1965 from which the long-term, 30-day average, or normal, flows are now determined. Drought status is determined from stream flows based on exceedances rather than percentages. The various stages of drought watch, warning, and emergency conditions are indicated, respectively, by 75-, 90-, and 95-percent exceedances of 30-day average flows (PEMA 2013). Detailed descriptions of these data collection methods appear in the PA HMP.
- Reservoir Storage Levels: Water level storage in several large public water supply reservoirs is another indicator that PADEP uses for drought monitoring. Depending on total quantity of storage and length of the refill period for the various reservoirs, PADEP uses varying percentages of storage drawdown to indicate the three drought stages for each reservoir (PEMA 2013).
- Groundwater Levels: Groundwater levels can be an indicator of a developing drought, although low readings may lag up to 3 months behind drought-indicative precipitation readings. This lag occurs because storage of nearly 80 trillion gallons of groundwater throughout the Commonwealth disguises precipitation deficits before significant lack of groundwater recharge becomes noticeable (PEMA 2013).

  USGS also maintains groundwater monitoring wells in each county throughout the Commonwealth. Groundwater measurements taken from these wells at exceedances of 75, 90, and 95 percent are used to indicate drought watch, warning, and emergency statuses, respectively. Within the USGS well network, the 30-day average depth-to-groundwater readings are analyzed in relation to long-term, 30-day averages based on the period of record for each county well (PEMA 2013).
- Soil Moisture: NOAA's Palmer Drought Severity Index (PDSI) provides soil moisture information for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather. The tool is frequently used to indicate availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and forest fire potential. Although notably ineffective for monitoring short-term drought, the PDSI is effective for determining long-term droughts, and as such is most frequently used to delineate disaster areas (CPC 2005).

Table 4.3.2-5 lists PDSI classifications. The PDSI uses 0 to reflect normal status, and negative numbers indicate droughts. For example, 0 is no drought, -2 is moderate drought, and -4 is extreme drought. Positive numbers signify excess precipitation (NDMC 2013).

Table 2-5. Palmer Drought Severity Index (PDSI) Classifications

Severity Category	PDSI Value	Drought Status
Extremely wet	4.0 or more	None
Very wet	3.0 to 3.99	None
Moderately wet	2.0 to 2.99	None
Slightly wet	1.0 to 1.99	None
Incipient wet spell	0.5 to 0.99	None
Near normal	0.49 to -0.49	None
Incipient dry spell	-0.5 to -0.99	None
Mild drought	-1.0 to -1.99	None
Moderate drought	-2.0 to -2.99	Watch
Severe drought	-3.0 to -3.99	Warning
Extreme drought	-4.0 or less	Emergency

Source: NDMC 2013; PEMA 2013

Availability and management of water supply are discussed in the 2009 Pennsylvania State Water Plan, a joint effort by the Statewide Water Resources Committee and PADEP. In 2009, the PADEP Secretary approved an updated State Water Plan to guide management of the State's water resources over a 15-year planning horizon. As a functional planning tool for all Pennsylvania municipalities, counties, and regional planning partnerships, the State Water Plan profiles drought and resource constraints, and encourages implementation of new technology and application of policies to facilitate reduced water uses and resource demands at critical peak times. The Plan provides inventories of water availability, as well as an assessment of current and future water use demands and trends. It also offers strategies for improving management of water resources and waterway corridors that aim to reduce damages from extreme drought and flooding conditions (PADEP 2009).

4.3.2.3 Past Occurrence

Historical information has been drawn from many sources to recount previous occurrences and losses associated with drought events throughout Pennsylvania and Beaver County. Because so many sources were reviewed for the purpose of developing this plan, loss and impact information pertaining to many events could vary depending on the source. Therefore, accuracy of cited monetary values is based only on the available information identified during research for this plan.

According to NOAA's NCDC storm events database, Beaver County underwent two drought events between January 1, 1950, and August 31, 2015—August 1999 and September 1999. No statewide crop or property losses were reported because of the droughts; statewide losses would have included damages in other counties.

Since November 1980, the Commonwealth has undergone 12 drought events that resulted in a Governor's proclamation or a Federal Emergency Management Agency (FEMA)-declared disaster or emergency. Beaver County was included in two of these events (both of which were Governor's proclamations, not FEMA-declared disasters), and full details are available in PEMA's Pennsylvania Disaster History list (PEMA 2015). In addition to these events, PADEP indicated that Beaver County has undergone 25 drought-watch declarations, 11 drought-warning declarations, and 1 drought-emergency declaration between November 1980 and July 2015 (PADEP 2015).

According to FEMA, between 1954 and 2015, Pennsylvania underwent one drought-related disaster (DR) or emergency (EM) classified as one or a combination of the following disaster types: drought or water shortage. Because these disaster types generally cover a wide region of the Commonwealth, this single disaster impacted many counties. However, not all counties were included in the disaster declaration. FEMA, PEMA, and other sources indicate that Beaver County has not been declared a disaster area as a result of a drought-related event (FEMA 2015).

Based on all sources researched, drought events between 1988 and 2015 that have affected Beaver County are identified in Table 4.3.2-6. But not all sources have been identified or researched, and therefore Table 4.3.2-6 may not include all events that have occurred throughout the County.

Table 4.3.2-6. Drought Events in Beaver County between 1988 and 2015

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts / PDSI Value	Source(s)
July 7, 1988 – August 24, 1988	Drought Watch	N/A	N/A	Not listed	PADEP
August 24, 1998 – December 12, 1988	Drought Warning	N/A	N/A	Not listed	PADEP
March 3, 1989 – May 15, 1989	Drought Watch	N/A	N/A	Not listed	PADEP
June 18, 1991 – July 24, 1991	Drought Watch	N/A	N/A	Not listed	PADEP
July 24, 1991 – August 16, 1991	Drought Watch	N/A	N/A	Not listed	PADEP
August 16, 1991 – September 13, 1991	Drought Warning	N/A	N/A	Not listed	PADEP
September 13, 1991 – October 21, 1991	Drought Warning	N/A	N/A	Not listed	PADEP
October 21, 1991 – January 16, 1992	Drought Warning	N/A	N/A	Not listed	PADEP
January 17, 1992 – April 20, 1992	Drought Warning	N/A	N/A	Not listed	PADEP
April 20, 1992 – June 23, 1992	Drought Warning	N/A	N/A	Not listed	PADEP
June 23, 1992 – September 11, 1992	Drought Warning	N/A	N/A	Not listed	PADEP
September 1, 1995 – September 20, 1995	Drought Watch	N/A	N/A	Not listed	PADEP
September 20, 1995 – November 8, 1995	Drought Watch	N/A	N/A	Not listed	PADEP
November 8, 1995 – December 18, 1995	Drought Watch	N/A	N/A	Not listed	PADEP
December 3, 1998 – December 8, 1998	Drought Watch	N/A	N/A	Not listed	PADEP
December 8, 1998 – December 14, 1998	Drought Watch	N/A	N/A	Not listed	PADEP

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts / PDSI Value	Source(s)
December 14, 1998 – December 16, 1998	Drought Watch	N/A	N/A	Not listed	PADEP
December 16, 1998 – January 15, 1999	Drought Watch	N/A	N/A	Not listed	PADEP
January 15, 1999 – March 15, 1999	Drought Watch	N/A	N/A	Not listed	PADEP
March 15, 1999 – June 10, 1999	Drought Watch	N/A	N/A	Not listed	PADEP
June 10, 1999 – June 18, 1999	Drought Watch	N/A	N/A	Not listed	PADEP
June 18, 1999 – July 20, 1999	Drought Warning	N/A	N/A	Not listed	PADEP
July 20, 1999 – September 30, 1999	Drought Emergency	N/A	N/A	Not listed	PADEP
July 1999	Drought	N/A	Yes	Governor Tom Ridge – Governor's Proclamation, Individual Assistance, Hazard Mitigation Grant Program – Amended to include all 67 counties for an agricultural disaster	PEMA
August 1999	Drought	N/A	N/A	The dry conditions that actually began in July 1998 continued through August. On August 2, USDA declared four counties (Beaver, Fayette, Greene, and Washington Counties) agricultural disaster areas. Average basin rainfall across Western Pennsylvania for the month of August averaged anywhere between 0.50 and 2.50 inches below normal. Most reservoirs were running between 5 and 10 feet below their normal summer pool, but a few were as much as 25 to 30 feet below normal. The Palmer Drought Index showed the area to be borderline between a moderate and severe drought. In general, the area has undergone a 15% to 25% precipitation deficit over the past year, with a 60-day deficit (from 1 June through 31 July) of around 50%. Reports from farmers across Western Pennsylvania	NCDC

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts / PDSI Value	Source(s)
				indicate crop losses ranging between 25% and 100% depending on the crop and location. Area dairy farmers estimated a 15% reduction in milk production due to a combination of heat and drought.	
September 1999	Drought	N/A	N/A	Although rainfall across Western Pennsylvania for September again averaged between 1.5 and 2.0 inches below normal, the state-imposed drought emergency for the area, in effect since July 20, was downgraded to a drought warning on September 30. However, the Palmer Drought Severity Index shows the entire Western Pennsylvania area continuing under a moderate to severe drought. Statewide, latest estimates show farmers have lost at least $700 million from the drought, with up to 50% of the year's crops destroyed.	NCDC
September 30, 1999 – December 16, 1999	Drought Warning	N/A	N/A	Not listed	PADEP
December 16, 1999 – February 25, 2000	Drought Warning	N/A	N/A	Not listed	PADEP
February 25, 2000 – May 5, 2000	Drought Watch	N/A	N/A	Not listed	PADEP
September 5, 2002 – November 7, 2002	Drought Watch	N/A	N/A	Not listed	PADEP
November 7, 2002 – December 19, 2002	Drought Watch	N/A	N/A	Not listed	PADEP
December 19, 2002 – January 8, 2003	Drought Watch	N/A	N/A	Not listed	PADEP
January 8, 2003 – June 18, 2003	Drought Watch	N/A	N/A	Not listed	PADEP
April 11, 2006 – June 30, 2005	Drought Watch	N/A	N/A	Not listed	PADEP
April 2007	Drought and	N/A	Yes	SBA Economic Injury	PEMA

Dates of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts / PDSI Value	Source(s)
	Extreme Heat				
August 6, 2007 – September 5, 2007	Drought Watch	N/A	N/A	Not listed	PADEP
November 7, 2008 – January 26, 2009	Drought Watch	N/A	N/A	Not listed	PADEP
September 16, 2010 – November 10, 2010	Drought Warning	N/A	N/A	Not listed	PADEP
November 10, 2010 – December 17, 2010	Drought Watch	N/A	N/A	Not listed	PADEP
August 5, 2011 – September 2, 2011	Drought Watch	N/A	N/A	Not listed	PADEP
July 19, 2012 – August 31, 2012	Drought Watch	N/A	N/A	Not listed	PADEP

Sources: NRCC 2015, PEMA 2014, NCDC 2014, PADEP 2015

Notes:

FEMA Federal Emergency Management Agency
N/A Not applicable
NCDC National Climatic Data Center
NRCC Northeast Regional Climate Center
PADEP Pennsylvania Department of Environmental Protection
PDSI Palmer Drought Severity Index
PEMA Pennsylvania Emergency Management Agency
USDA U.S. Department of Agriculture

Table 4.3.2-7 lists crop loss insurance payments on claims from Beaver County caused by drought events since 1948.

Table 3-7. Crop Loss Insurance Claims Due to Drought, 1948 to 2014

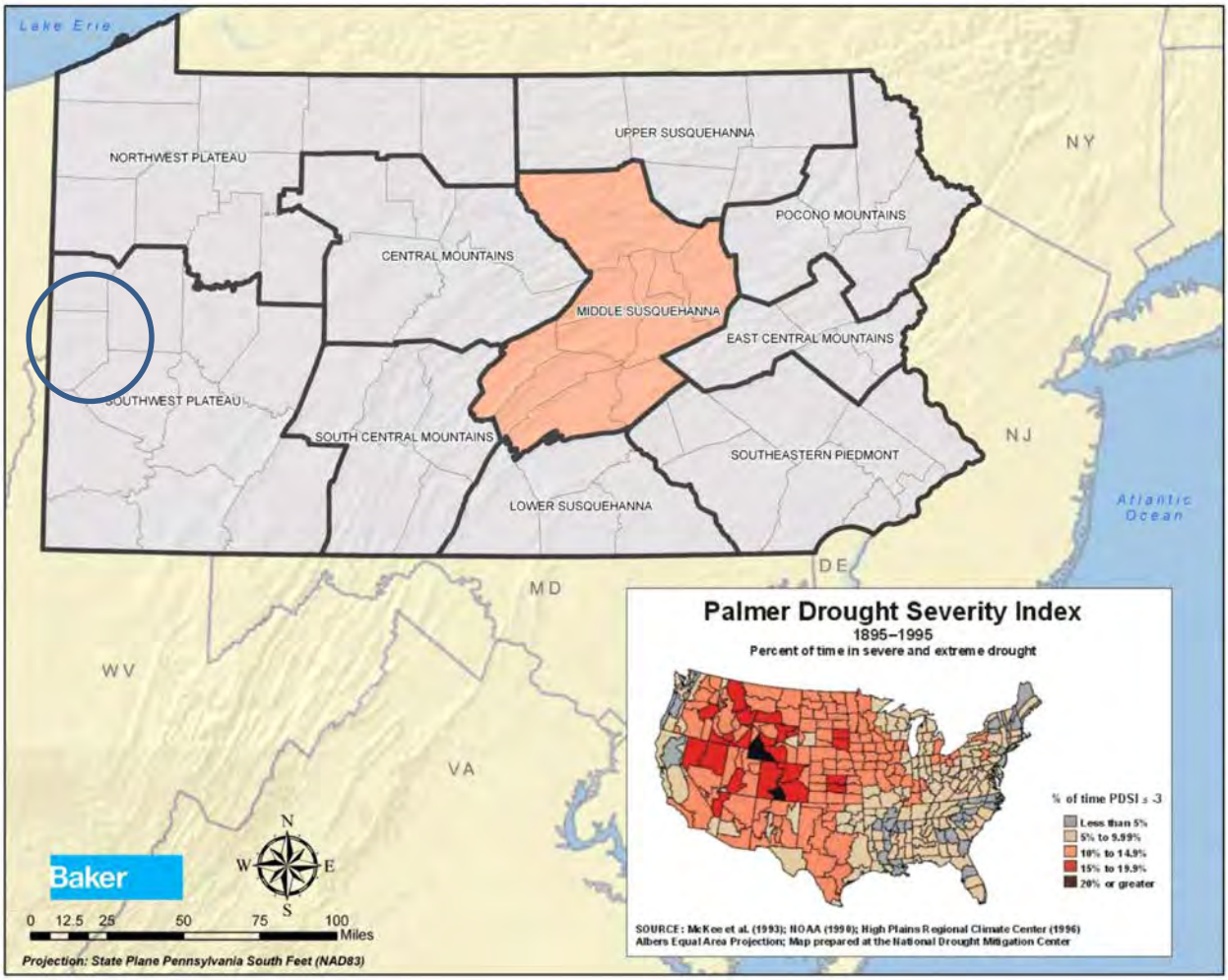
Crop Year	Total Claims	Crop Year	Total Claims
1948-1988	$0	2002	$110,872
1989	$11,063	2003	$0
1990	$0	2004	$0
1991	$28,431	2005	$60,200
1992	$1,916	2006	$0
1993	$23,573	2007	$8,359
1994	$1,610	2008	$106,574
1995	$776	2009	$924
1996	$0	2010	$124,780
1997	$34,328	2011	$27,590
1998	$4,087	2012	$67,714
1999	$17,508	2013	$0
2000	$0	2014	$0
2001	$34,630		

Source: USDA 2015

4.3.2.4 Future Occurrence

Frequency of droughts is difficult to forecast. Based on national annual data from 1895 to 1995, Beaver County underwent severe or extreme drought conditions less than 5 percent of the time (illustrated on Figure 4.3.2-4). Based on national annual data from 1895 to July 2013, the Southwest Plateau (climate division 9), in which Beaver County is located, had its lowest PDSI when it reached -6.85 (August 1930 through July 2931). This climate division has been in severe or extreme drought during approximately 7.3 percent of the 119 years on record (Northeast Regional Climate Center [NRCC] 2013). Future occurrences of drought events are considered *likely*, as defined by the Risk Factor Methodology probability criteria (described in Section 4.4).

Figure 4-4. Palmer Drought Severity Index for Pennsylvania (1895 to 1995)



Source: PEMA 2013 (highlight added)

4.3.2.5 Vulnerability Assessment

To understand risk, a community must evaluate assets exposed and vulnerable within the identified hazard area. For the drought hazard, all of Beaver County has been identified as the hazard area. Therefore, all assets (population, structures, critical facilities, and lifelines) described in the County Profile (Section 2) are vulnerable to a drought. This section evaluates and estimates potential impacts of the drought hazard on Beaver County in the following subsections:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts on (1) life, health, and safety; (2) general building stock; (3) critical facilities; (4) economy; and (5) future growth and development
- Effects of climate change on vulnerability
- Further data collections that will assist in understanding this hazard over time.

Overview of Vulnerability

Beaver County is vulnerable to drought. Assets at particular risk include any open land or structures along the wildland/urban interface (WUI) that could become vulnerable to the wildfire hazard caused by extended periods of low rain and high heat, usually associated with drought. In addition, water supply resources could be impacted by extended periods of low rain. Finally, vulnerable populations could be particularly susceptible to the drought hazard and cascading impacts because of age, health conditions, and limited ability to mobilize to shelter, cooling, and medical resources.

Data and Methodology

At the time this Plan was updated, insufficient data were available to model long-term potential impacts of a drought on Beaver County. Over time, additional data will be collected to allow better analysis of this hazard. Preliminary assessments based on available data are provided below.

Impact on Life, Health, and Safety

Drought conditions can cause a shortage of water available for human consumption and can reduce local firefighting capabilities. Social impacts of a drought include mental and physical stress, public safety threats (increased threat from forest/grass fires), health threats, conflicts among water users, reduced quality of life, and inequities in distribution of impacts and disaster relief. The infirm, young, and elderly are particularly susceptible to drought and extreme temperatures, sometimes associated with drought conditions, due to their age, health conditions, and limited ability to mobilize to shelters, cooling, and medical resources. Impacts on the economy and environment may have social implications as well (New York State Disaster Preparedness Commission [NYSDPC] 2011). For the purposes of this Plan, the entire population of the County is considered vulnerable to drought events.

Impact on General Building Stock and Critical Facilities

A drought is not expected to directly affect any structures, and all are expected to be operational during a drought event. However, droughts contribute to conditions conducive to wildfires. Risk to life and property is greatest in regions where forested areas adjoin urbanized areas (high-density residential, commercial, and industrial), also known as the WUI. Therefore, all assets in and adjacent to the WUI zone—including population, structures, critical facilities, lifelines, and businesses—are considered vulnerable to wildfire.

Impact on the Economy

A prolonged drought can exert serious direct and indirect economic impacts on a community or across the County. A summary of impacts on the economy is presented in Table 4.3.2-8.

Table 5-8. Impacts on the Economy

Losses to Agricultural Producers	Losses to Livestock Producers	Losses of Timber Production
Annual and perennial crop losses	Reduced productivity of rangeland	Wildland fires
Damage to crop quality	Reduced milk production	Tree disease
Income loss for farmers due to reduced crop yields	Forced reduction of foundation stock	Insect infestation
Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.)	High cost/unavailability of water for livestock	Impaired productivity of forest land
Insect infestation	Cost of new or supplemental water resource development (wells, dams, pipelines)	Direct loss of trees, especially young ones
Plant disease	High cost/unavailability of feed for livestock	**Losses to Transportation Industry**
Wildlife damage to crops	Increased feed transportation costs	Loss from impaired navigability of streams, rivers, and canals
Increased irrigation costs	High livestock mortality rates	**Decline in food production/disrupted food supply**
Cost of new or supplemental water resource development (wells, dams, pipelines)	Disruption of reproduction cycles (delayed breeding, more miscarriages)	Increase in food prices
Losses of Fishery Production	Decreased stock weights	Increased importation of food (higher costs)
Damage to fish habitat	Increased predation	**Losses to Water Suppliers**
Loss of fish and other aquatic organisms due to decreased flows	Grass fires	Revenue shortfalls and/or windfall profits
Losses to Recreation and Tourism Industry	**Energy-related Effects**	Cost of water transport or transfer
Loss to manufacturers and sellers of recreational equipment	Increased energy demand and reduced supply because of drought-related power curtailments	Cost of new or supplemental water resource development
Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.	Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power	

Source: NYSDPC 2011

Note: Dark blue cell boxes indicate a new category of economic loss; all losses immediately underneath that category pertain to that loss type.

Loss estimates are based on lost agricultural revenues statewide. Table 5- below enumerates the County's farmland acreage exposure to the drought hazard, as well as the annual market value of all agricultural products sold, as documented in the 2012 USDA Census of Agriculture. If the County would lose its agricultural yield due to drought, total losses could amount to almost $11,000. Table 4.3.2-10 details potential losses associated with County livestock by providing livestock totals for the County and their associated market value. Livestock, poultry, and associated products have a potential loss value of over $10,000 (USDA 2012).

Table 5-9. Estimated County Losses Relating to Agricultural Production

Impacted Farmland Acreage	Market Value Of All Agricultural Products
55,795	$10,879,000

Source: USDA 2012

Table 5-10. Estimated County Losses Relating to Agricultural Production

Livestock and Poultry	Inventory	Market Value Of All Livestock, Poultry, and Their Products
Cattle and Calves	7,374	**$10,035,000**
Hogs and Pigs	N/A	
Sheep and Lambs	1,097	
Layers	2,175	
Total	**10,646**	

Source: USDA 2012

Note: Market value of livestock and poultry is provided only by total value and not available by category.

Impact on the Environment

As summarized in the PA HMP, environmental impacts of drought include:

- Hydrologic effects – lower water levels in reservoirs, lakes, and ponds; reduced streamflow; loss of wetlands; estuarine impacts; groundwater depletion and land subsidence; effects on water quality such as increases in salt concentration and water temperature
- Damage to animal species – lack of feed and drinking water; disease; loss of biodiversity; migration or concentration; and reduction and degradation of fish and wildlife habitat
- Damage to plant communities – loss of biodiversity; loss of trees from urban landscapes and wooded conservation areas
- Increased number and severity of fires
- Reduced soil quality
- Air quality effects – dust and pollutants
- Loss of quality in landscape through loss in plants and plant diversity
- Increase in nitrate levels, which can negatively affect health of pregnant women and children (PEMA 2013).

Future Growth and Development

Areas targeted for potential future growth and development within the next 5 to 10 years have been identified across the County (further discussed in Section 2.4 of this HMP). Exposure of any new development and new residents to the drought hazard is anticipated.

Effect of Climate Change on Vulnerability

Climate is defined not just as average temperature and precipitation but also by type, frequency, and intensity of weather events. Both globally and at the local level, climate change can alter prevalence and severity of weather extremes such as droughts. While predicting changes in drought events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating effects of future climate change on human health, society, and the environment (U.S. Environmental Protection Agency [EPA] 2014).

PADEP was directed by the Climate Change Act (Act 70 of 2008) to initiate a study of potential impacts of global climate change on the Commonwealth. The June 2009 Pennsylvania Climate Impact Assessment and October 2013 Pennsylvania Climate Impact Assessment Updates's main findings indicate that Pennsylvania is very likely to undergo increased temperatures in the 21st century. Increases in temperature will likely lead to increased evapotranspiration, and thus an increase in soil-moisture-related droughts throughout late spring and early fall. Pennsylvania's precipitation climate is projected to become more extreme in the future, with longer dry periods and greater intensity of precipitation (although the number of severe storms may in fact decrease). Most models project an increase in the maximum number of consecutive dry days in a year, a drought indicator (Shortle et al. 2009, 2013).

Future improvements in modeling smaller-scale climatic processes can be expected and will lead to improved understanding of how the changing climate will alter temperature, precipitation, storm frequency, and intensity in Pennsylvania. Understanding this information can help provide better indications of future drought events (Shortle et al. 2009).

4.3.3 Earthquake

An earthquake is sudden movement of the Earth's surface caused by release of stress accumulated within or along the edge of the Earth's tectonic plates, a volcanic eruption, or a manmade explosion (Shedlock and Pakiser 1997). Most earthquakes occur at the boundaries where the Earth's tectonic plates meet (faults); less than 10 percent of earthquakes occur within plate interiors. As plates continue to move and plate boundaries change geologically over time, weakened boundary regions become part of the interiors of the plates. These zones of weakness within the continents can cause earthquakes, which are a response to stresses that originate at the edges of the plate or in the deeper crust (Shedlock and Pakiser 1997).

According to the U.S. Geological Survey (USGS) Earthquake Hazards Program, an earthquake hazard is any disruption associated with an earthquake that may affect residents' normal activities. This category includes surface faulting, ground motion (shaking), landslides, liquefaction, tectonic deformation, tsunamis, and seiches. Each of these terms is defined below:

- Surface faulting: Displacement that reaches the Earth's surface during a slip along a fault. Commonly occurs with shallow earthquakes—those with an epicenter of less than 20 kilometers (km).
- Ground motion (shaking): Movement of the earth's surface from earthquakes or explosions. Ground motion or shaking is produced by waves generated by a sudden slip on a fault or sudden pressure at the explosive source, and that travel through the Earth and along its surface.
- Landslide: Movement of surface material down a slope.
- Liquefaction: A process by which water-saturated sediment temporarily loses strength and acts as a fluid, like the wet sand near the water at the beach. Earthquake shaking can cause this effect.
- Tectonic Deformation: Change in the original shape of a material caused by stress and strain.
- Tsunami: A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major sub-marine slides, or exploding volcanic islands.
- Seiche: Sloshing of a closed body of water, such as a lake or bay, from earthquake shaking (USGS 2012).

Ground shaking is the primary cause of earthquake damage to man-made structures. Damage can be increased when soft soils amplify ground shaking. Soils influence damage in different ways. Soft soils can amplify the motion of earthquake waves, producing greater ground shaking and increasing stresses on built structures on the land surface. Loose, wet, sandy soils also can cause damage when they lose strength and flow as a fluid when shaken, causing foundations and underground structures to shift and break (Stanford 2003).

The National Earthquake Hazard Reduction Program (NEHRP) developed five soil classifications (A to E) distinguished by soil shear-wave velocity that alters severity of an earthquake; each classification is listed in Table 4.3.3-1. Class A soils—hard rock—reduce ground motion from an earthquake, and Class E soils—soft soils—amplify and magnify ground shaking, and increase building damage and losses.

Table 4.3.3-1. NEHRP Soil Classifications

Soil Classification	Description
A	Hard rock
B	Rock
C	Very dense soil and soft rock
D	Stiff soils
E	Soft soils

Source: Federal Emergency Management Agency (FEMA) 2013

The following sections discuss location and extent, range of magnitude, previous occurrence, future occurrence, and vulnerability assessment associated with the earthquake hazard in Beaver County.

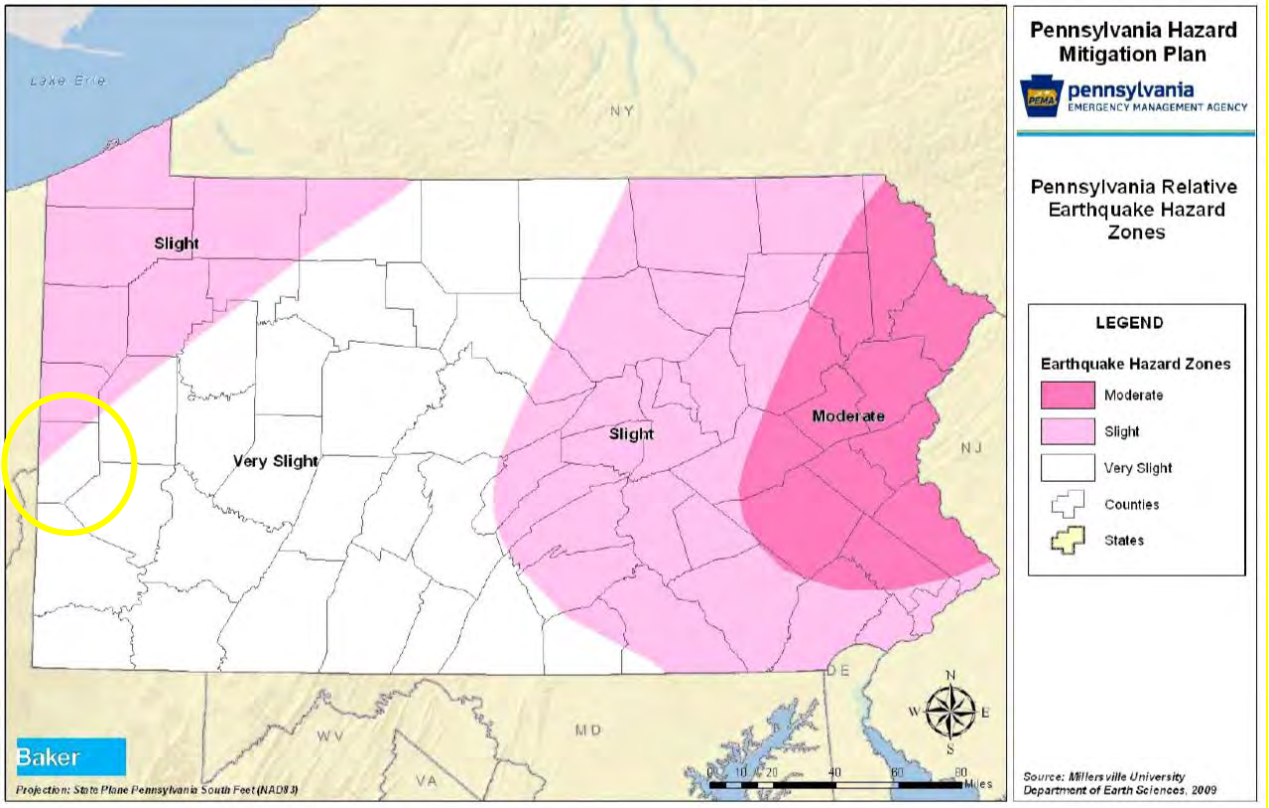
4.3.3.1 Location and Extent

Focal depth and geographic position of the epicenter of an earthquake commonly determine its location. Focal depth of an earthquake is the depth from the Earth's surface to the region where an earthquake's energy originates (the focus or hypocenter). The epicenter of an earthquake is the point on the Earth's surface directly above the hypocenter. Earthquakes usually occur without warning, and their effects can be felt in areas at great distances from the epicenter.

According to the Pennsylvania Bureau of Topographic and Geologic Survey, events that occur in the Commonwealth involve very small impact areas (less than 100 km in diameter). The most seismically active region in the Commonwealth is in southeastern Pennsylvania in the area of Lancaster County (Pennsylvania Emergency Management Agency [PEMA] 2013). Areas of Pennsylvania, including Beaver County, may be subject to the effects of earthquakes with epicenters outside the Commonwealth.

Pennsylvania has three earthquake hazard area zones: very slight, slight, and moderate (shown on Figure 4.3.3-1) (PEMA 2013). The northern half of Beaver County is within the "slight zone," while the southern half of the county is considered within the "very slight zone." Minor earthquake damage is expected in these zones.

Figure 4.3.3-1. Pennsylvania Earthquake Hazard Zones

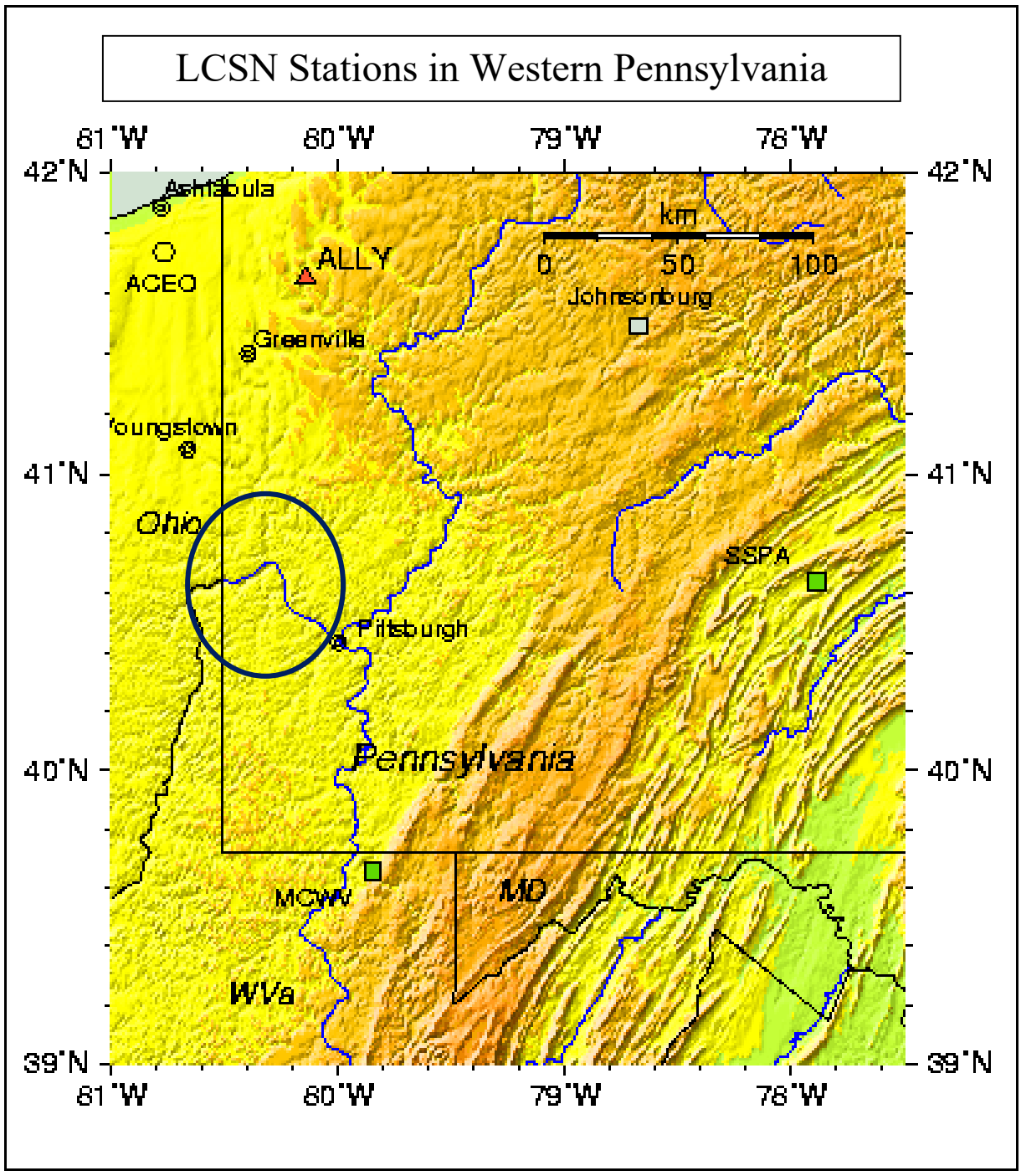


Source: PEMA 2013

Note: Beaver County is within the yellow oval on the map.

The Lamont-Doherty Cooperative Seismographic Network (LCSN) monitors earthquakes that occur primarily in the northeastern United States. Goals of the project are to compile a complete earthquake catalog for this region, assess earthquake hazards, and study causes of earthquakes in the region. LCSN operates 40 seismographic stations in the following seven states: Connecticut, Delaware, Maryland, New Jersey, New York, Pennsylvania, and Vermont. Figure 4.3.3-2 shows locations of seismographic stations in western Pennsylvania. The network is composed of broadband and short-period seismographic stations (LCSN 2012).

Figure 4.3.3-2. Lamont-Doherty Seismic Stations Locations in Western Pennsylvania



Source: LCSN 2006

Note: Beaver County is within the oval on the map.

In addition to the Lamont-Doherty Seismic Stations, USGS operates a global network of seismic stations to monitor seismic activity. While no seismic stations are within Beaver County, nearby stations are in State College, Pennsylvania, and Morgantown, West Virginia. Figure 4.3.3-3 shows their locations.

Figure 4.3.3-3. USGS Seismic Stations

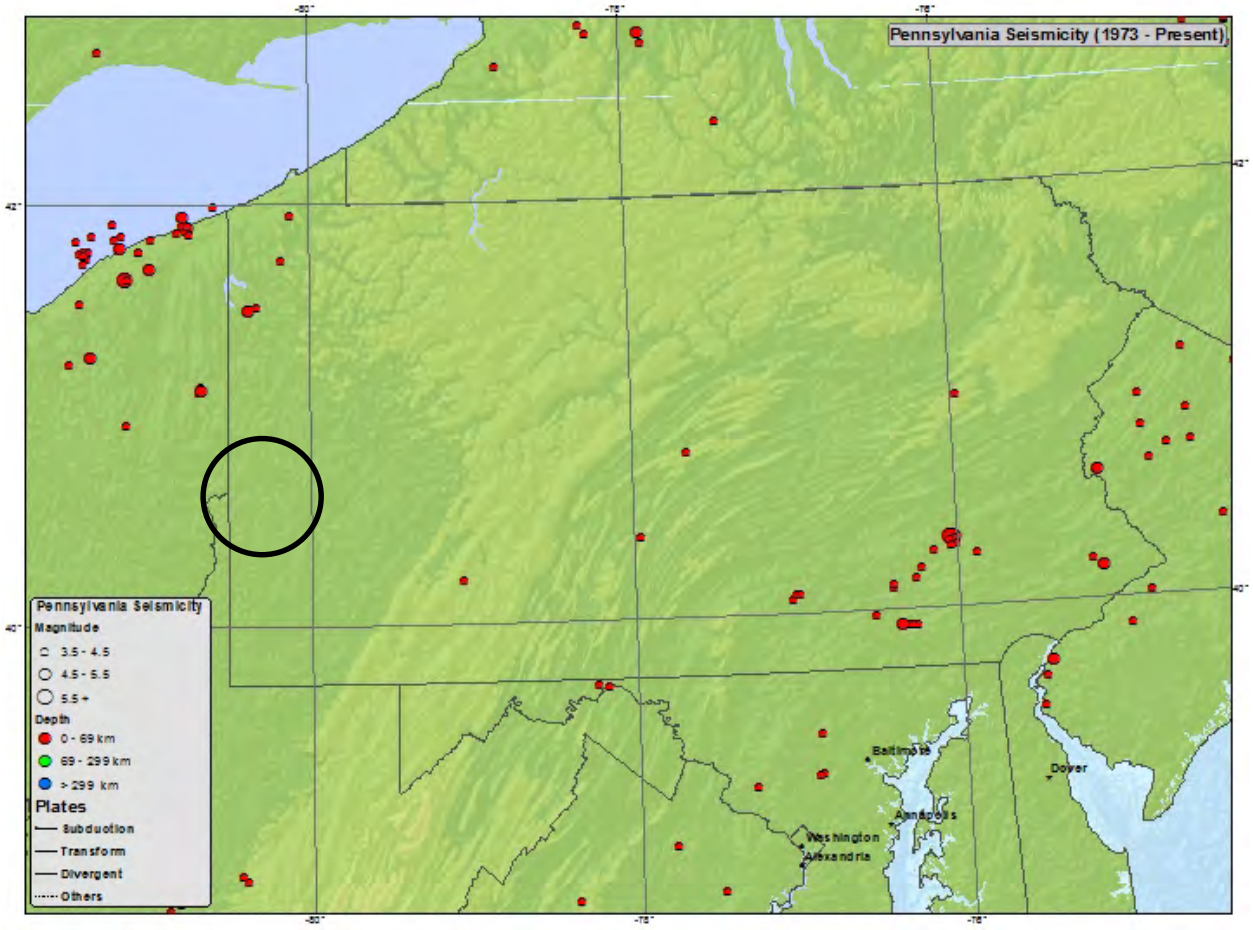
Source: USGS 2015

Note: Seismic station locations are indicated by green triangles, and Beaver County is within the black oval.

USGS provides the website *Did You Feel It?* (http://earthquake.usgs.gov/earthquakes/dyfi/) for citizens to report earthquake experiences and to share information regarding the earthquake and its effects. The website is intended to gather citizens' experiences during an earthquake and incorporate the information into detailed maps for illustrating shaking intensity and damage assessments (USGS 2015).

Earthquakes above a magnitude 5.0 can cause damage near their epicenters, and larger-magnitude earthquakes can cause damage over larger, wider areas. Earthquakes in Pennsylvania appear to be centered in the southeastern portion and northwestern corner of the Commonwealth. Figure 4.3.3-4 illustrates earthquake activity in Pennsylvania from 1973 to 2012, with Beaver County circled in black. A discussion of previous occurrences of earthquakes in Beaver County appears in the Previous Occurrence section (Section 4.3.3.3) of this profile.

Figure 4.3.3-4. Earthquake Epicenters in Pennsylvania, 1973 – 2012



Source: USGS 2015

Note: The black circle indicates the approximate location of Beaver County.

4.3.3.2 Range of Magnitude

Seismic waves are vibrations from earthquakes that travel through the Earth and are recorded on instruments called seismographs. The magnitude or extent of an earthquake is a given value of the earthquake size, or amplitude of the seismic waves, as measured by a seismograph. The Richter magnitude scale (Richter scale) was developed in 1932 as a mathematical device to compare sizes of earthquakes. The Richter scale is the most widely known scale that measures magnitude of earthquakes. It has no upper limit and is not used to express damage. An earthquake in a densely populated area that results in many deaths and considerable damage may have the same magnitude and shock in a remote area that did not undergo any damage. Table 4.3.3-2 lists Richter scale magnitudes and corresponding earthquake effects associated with each magnitude. The worst-case earthquake in Beaver County would likely result in trees swaying, objects falling off walls, walls cracking, and plaster falling.

Table 4.3.3-1. Richter Scale Magnitudes

Richter Magnitude	Earthquake Effects
2.5 or less	Usually not felt, but can be recorded by seismograph
2.5 to 5.4	Often felt, but causes only minor damage
5.5 to 6.0	Slight damage to buildings and other structures
6.1 to 6.9	May cause a lot of damage in very populated areas
7.0 to 7.9	Major earthquake; serious damage
8.0 or greater	Great earthquake; can destroy communities near the epicenter

Source: PEMA 2013

The intensity of an earthquake is based on observed effects of ground shaking on people, buildings, and natural features, and varies with location. The Modified Mercalli Intensity (MMI) scale expresses the intensity of an earthquake and is a subjective measure that describes the strength of a shock felt at a particular location. The MMI scale expresses intensity of an earthquake's effects in a given locality according to a scale from I to XII. Descriptions of MMI scales appear in Table 4.3.3-3. Earthquakes that occur in Pennsylvania originate deep within the Earth's crust, and not on an active fault. No injury or severe damage from earthquake events has been reported in Beaver County.

Table 4.3.3-2. Modified Mercalli Intensity Scale with Associated Impacts

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

Source: PEMA 2013

Seismic hazards are often expressed in terms of Peak Ground Acceleration (PGA) and Spectral Acceleration (SA). USGS defines PGA and SA as the following: "PGA is what is experienced by a particle on the ground. Spectral Acceleration (SA) is approximately what is experienced by a building, as modeled by a particle mass on a massless vertical rod having the same natural period of vibration as the building" (USGS 2012). Both PGA and SA can be measured in *g* (the acceleration caused by gravity) or expressed as a percent acceleration force of gravity (percent g). For example, at 100 percent g PGA (equivalent to 1.0 g) during an earthquake (an extremely strong ground motion), objects accelerate sideways at the same rate as when they drop from a ceiling. At 10 percent g PGA, ground acceleration is 10 percent that of gravity (New Jersey Office of

Emergency Management [NJOEM] 2011). PGA and SA hazard maps provide insight into location-specific vulnerabilities (New York State Disaster Preparedness Commission [NYSDPC] 2011).

PGA is a common earthquake measurement that indicates three factors: (1) geographic area affected, (2) probability of an earthquake at each level of severity, and (3) strength of ground movement (severity) expressed in percent g. In other words, PGA expresses the severity of an earthquake and is a measure of how hard the earth shakes (or accelerates) in a given geographic area (NYSDPC 2011). Damage levels from an earthquake vary with intensity of ground shaking and with seismic capacity of structures, as noted in Table 4.4.3-4.

Table 4.3.3-3. Damage Levels Experienced in Earthquakes

Ground Motion Percentage	Explanation of Damages
1-2% g	Motions are widely felt by people; hanging plants and lamps swing strongly, but damage levels, if any, are usually very low.
Below 10% g	Usually causes only slight damage, except in unusually vulnerable facilities.
10-20% g	May cause minor-to-moderate damage in well-designed buildings, with higher levels of damage in poorly designed buildings. At this level of ground shaking, only unusually poor buildings would be subject to potential collapse.
20-50% g	May cause significant damage in some modern buildings and very high levels of damage (including collapse) in poorly designed buildings.
≥50% g	May causes higher levels of damage in many buildings, even those designed to resist seismic forces.

Source: NJOEM 2011

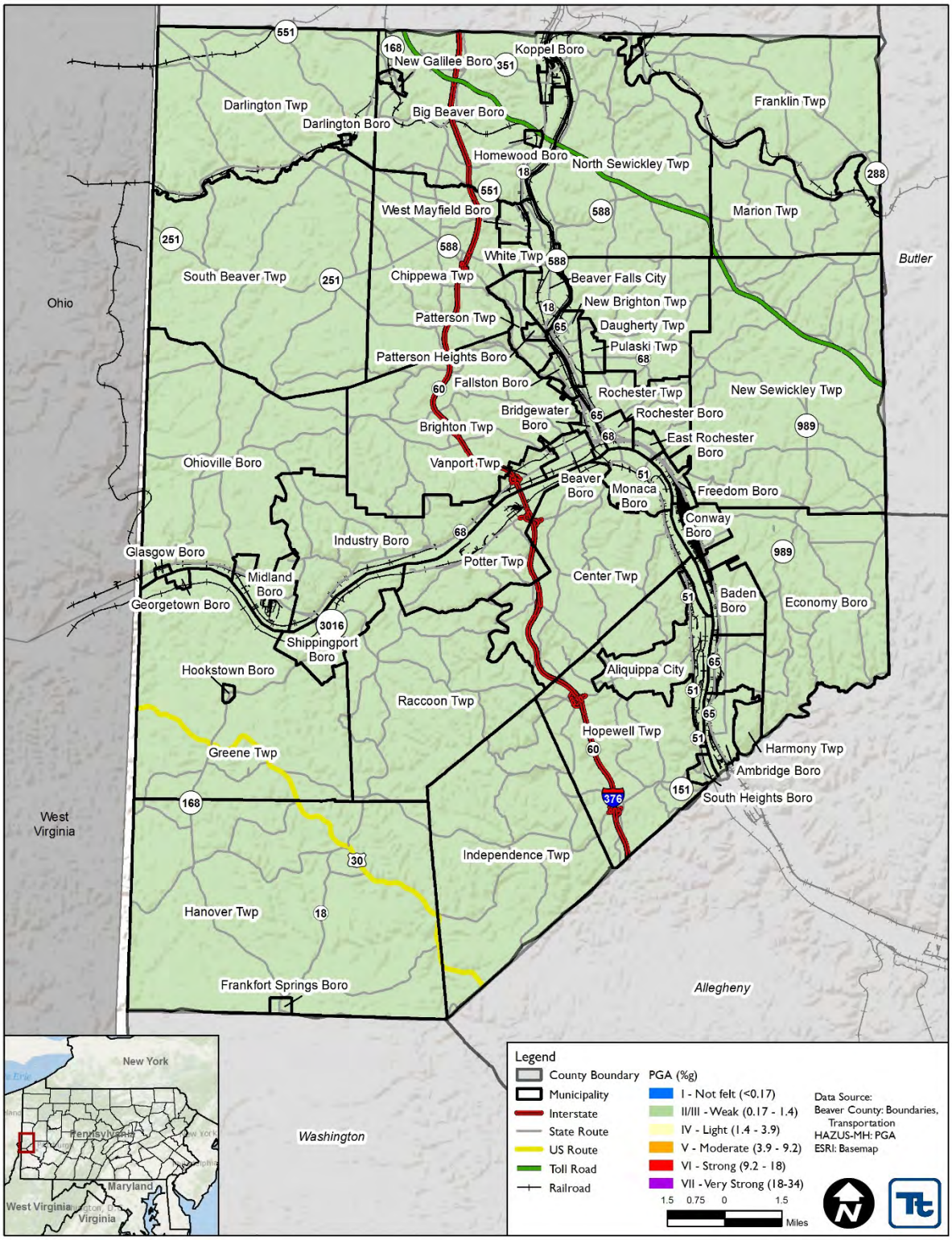
Note: % g Peak Ground Acceleration

National maps of earthquake shaking hazards have been produced since 1948. These maps provide information essential for creating and updating seismic design requirements for building codes, insurance rate structures, earthquake loss studies, retrofit priorities, and land use planning applied in the United States. Scientists frequently revise these maps to reflect new information and knowledge. Buildings, bridges, highways, and utilities built to meet modern seismic design requirements are typically able to withstand earthquakes better, with less damage and disruption. After thoroughly reviewing the studies, professional organizations of engineers update seismic-risk maps and seismic design requirements specified in building codes (Brown and others 2001).

To analyze the earthquake hazard in Beaver County, a probabilistic assessment was conducted for the 100-, 500- and 2,500-year mean return periods (MRP) in Hazards U.S. – Multi-Hazard (HAZUS-MH) 3.0. A HAZUS analysis evaluates statistical likelihood that a specific event will occur and the consequences of that event. A 100-year MRP event is an earthquake with a 1-percent chance that the mapped ground motion levels (PGA) will be exceeded in any given year. A 500-year MRP event is an earthquake with a 0.2-percent chance that the mapped ground motion levels (PGA) will be exceeded in any given year. A 2,500-year MRP event (the worst-case scenario) is an earthquake with 0.04-percent chance that the mapped PGA will be exceeded in any given year.

Figures 4.3.3-5 through 4.3.3-7 illustrate the geographic distribution of PGA (percent *g*) across Beaver County for each event. Potential losses estimated by HAZUS-MH for the MRP and the associated PGA are discussed in the Vulnerability Assessment section (Section 4.3.3.5) of this profile.

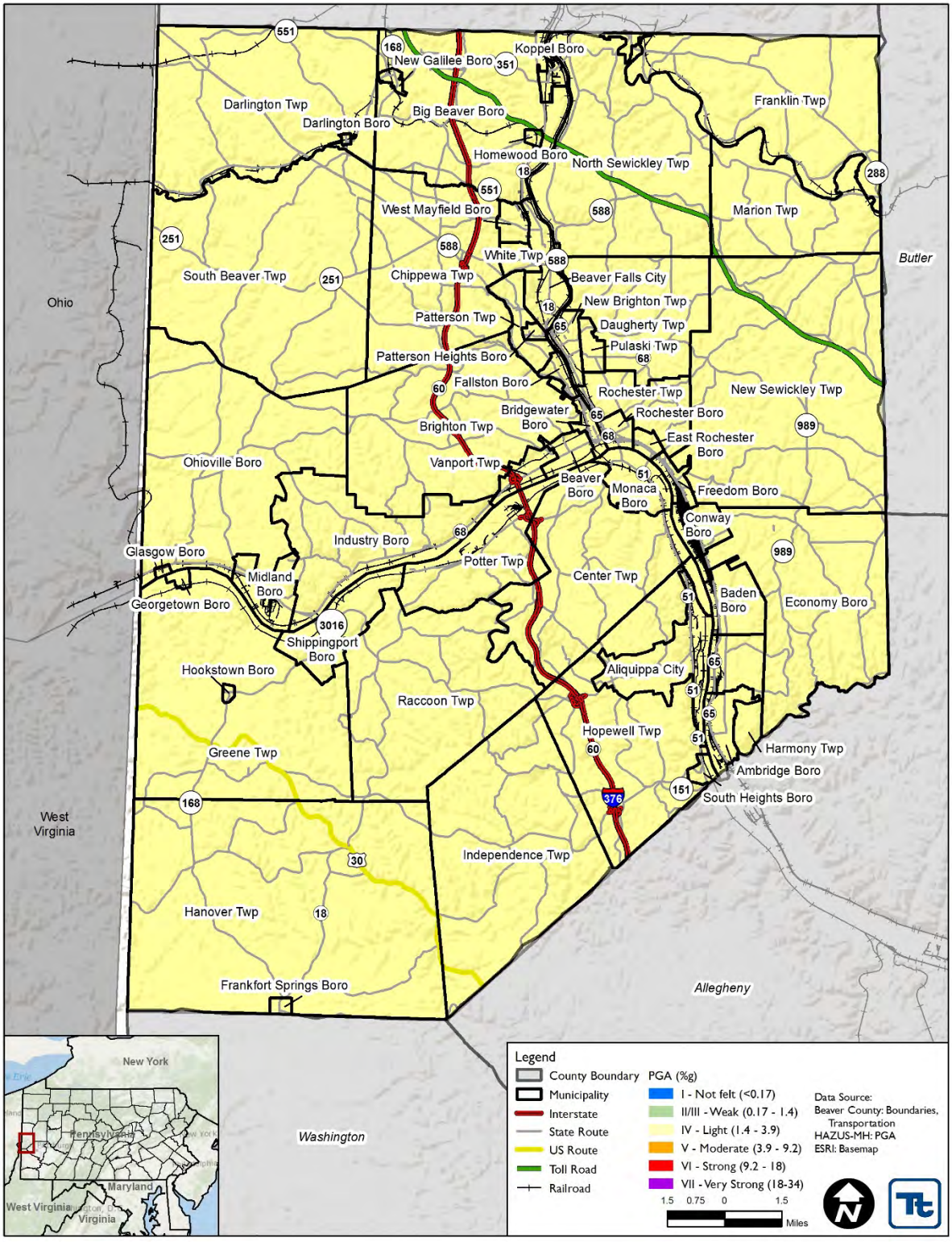
Figure 4.3.3-5. Peak Ground Acceleration Modified Mercalli Scale in Beaver County for a 100-Year MRP Earthquake Event



Source: HAZUS-MH 3.0

Note: The peak ground acceleration for the 100-year MRP is 0.88-0.90%*g*.

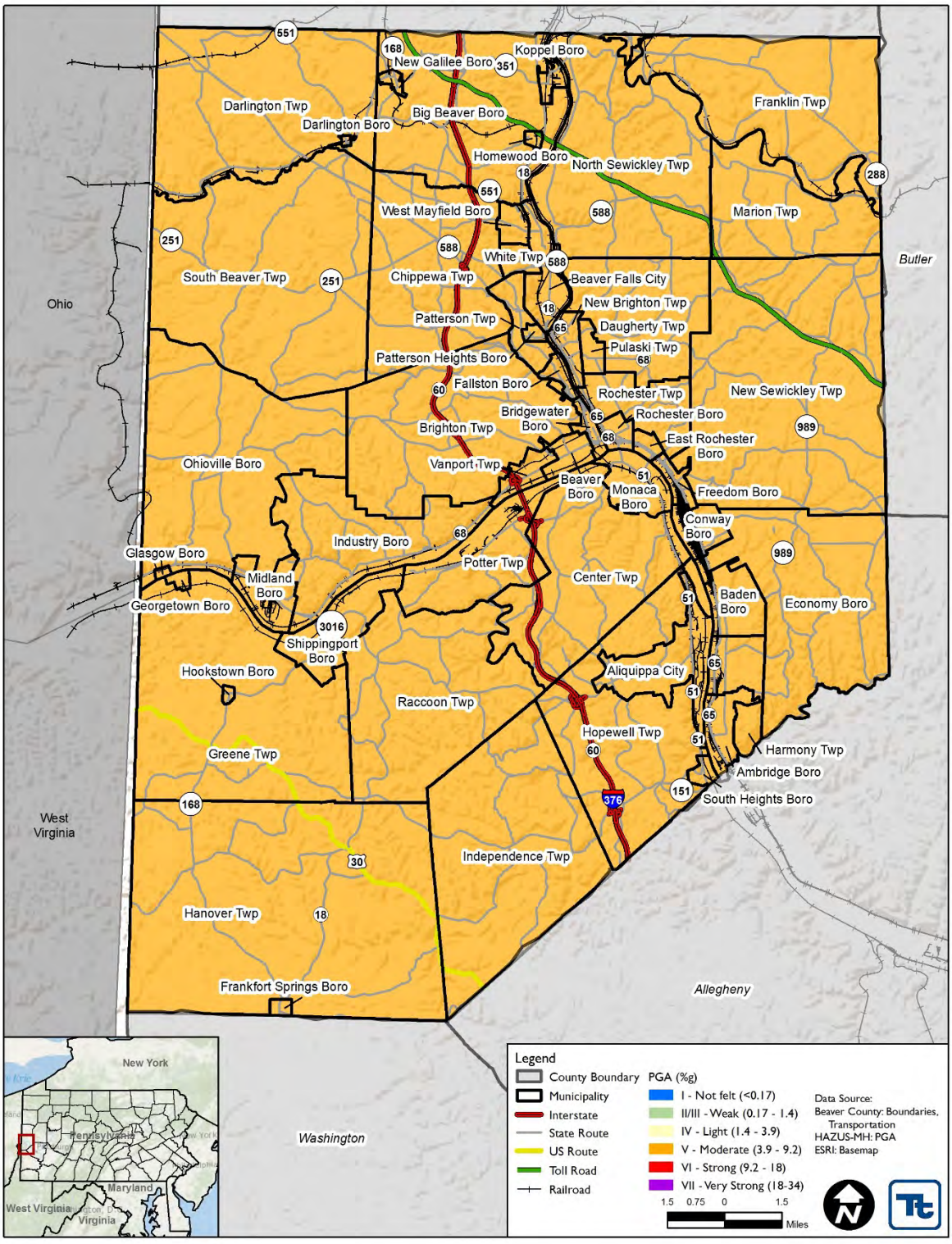
Figure 4.3.3-6. Peak Ground Acceleration Modified Mercalli Scale in Beaver County for a 500-Year MRP Earthquake Event



Source: HAZUS-MH 3.0

Note: The peak ground acceleration for the 500-year MRP is 2.33-2.42%*g*.

Figure 4.3.3-7. Peak Ground Acceleration Modified Mercalli Scale in Beaver County for a 2,500-Year MRP Earthquake Event



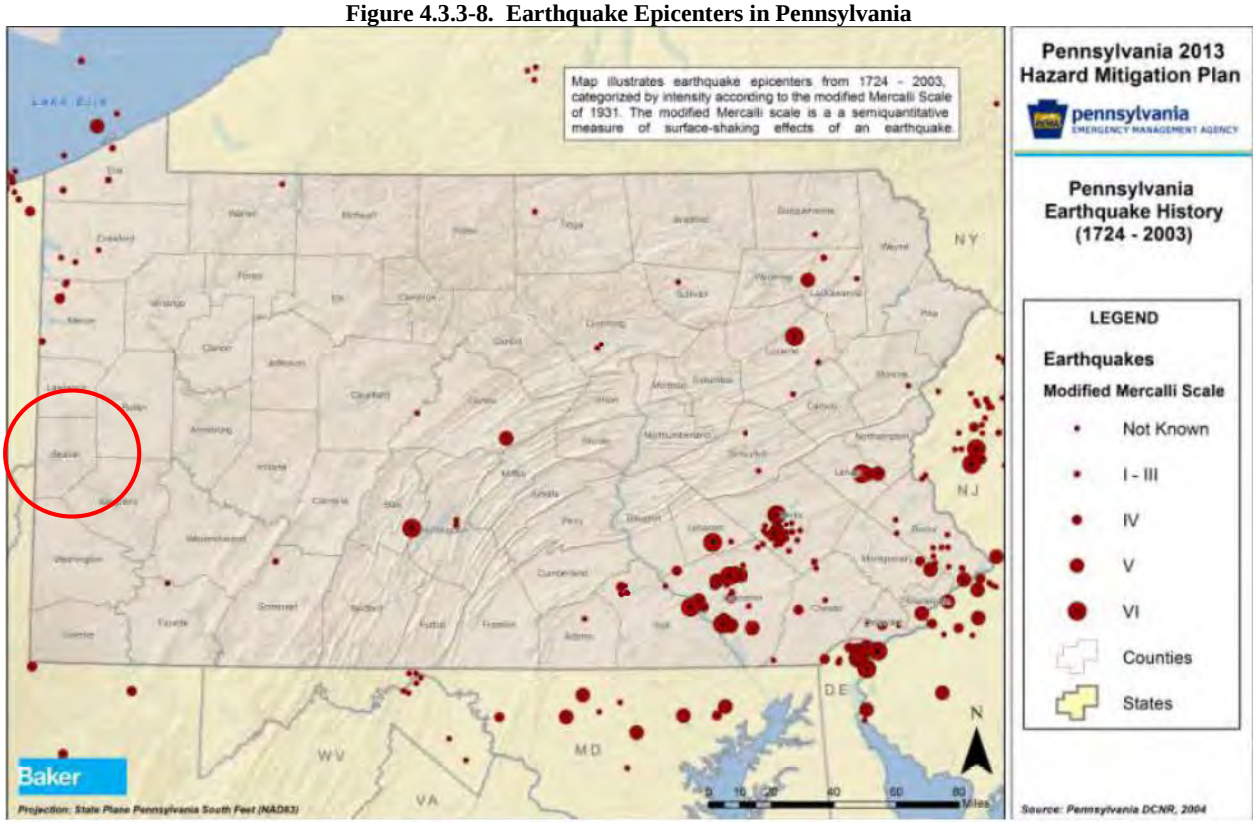
Source: HAZUS-MH 3.0

Note: The peak ground acceleration for the 2,500-year MRP is 5.75-6.23%*g*.

4.3.3.3 Past Occurrence

The historical record of earthquakes goes back approximately 200 years. In Pennsylvania, about 48 earthquakes have caused light damage since the Colonial period. Nearly half of these events had out-of-state epicenters (PEMA 2013, USGS 2014). Figure 4.3.3-8 is a map of earthquake epicenters in Pennsylvania from 1724 to 2003, updated with events from 2003 to January 2014. No damages were reported in Beaver County.

Figure 4.3.3-8. Earthquake Epicenters in Pennsylvania



Source: PEMA 2013

Note: Beaver County is within the red circle.

The Pennsylvania Department of Conservation and Natural Resources (PA DCNR) indicated that no earthquake epicenters had been recorded in Beaver County between 1724 and August 31, 2015. Recorded epicenters closest to Beaver County were a 3.3 magnitude earthquake on October 8, 1965, along the border of Fayette and Westmoreland Counties, and a 4.2 magnitude earthquake on October 29, 1927, in Mahoning County, Ohio (two events) (PA DCNR 2015). PEMA's Pennsylvania Disaster History list includes no significant earthquake events in Pennsylvania, and no Federal Emergency Management Agency (FEMA) major disaster (DR) / emergency declarations have occurred for significant earthquake events in Pennsylvania. Moreover, no records of the USGS "Did You Feel It" events with epicenters in Pennsylvania indicate impacts on residents in Beaver County by a Pennsylvania earthquake. Beaver County records, however, do note possible earthquakes in 2010 and 2011 (Knowledge Center 2015). If these events were genuine earthquakes, they must have been fairly minor geologic events because they were not recorded elsewhere.

Earthquakes with epicenters outside of Pennsylvania can affect Beaver County. Historically, large earthquakes in eastern North America have occurred in three regions: (1) Mississippi Valley near the Town of New Madrid, Missouri; (2) St. Lawrence Valley region of Quebec, Canada; and (3) Charleston, South Carolina. In

February 1925, one of the region's largest earthquakes on record occurred (magnitude near 7.0) with its epicenter in a region of Quebec. If a similar-magnitude earthquake would occur in the western part of the Quebec region, some moderate damage might be expected in one or more counties of Pennsylvania's northern tier. An earthquake with an estimated magnitude of about 7.5 occurred on August 31, 1886, in Charleston, South Carolina. The earthquake was felt in most of Pennsylvania. Since then, an earthquake with a magnitude of 5.8 occurred in Louisa County, Virginia; it was felt throughout Pennsylvania, causing evacuations, minor damage, and emergency infrastructure inspections (PEMA 2013).

Other earthquakes have occurred in east coast areas, including eastern Massachusetts, southeastern New York, and northern New Jersey. Moderate earthquakes occurred in southeastern New York and northern New Jersey, and were felt in eastern Pennsylvania. If an earthquake of magnitude 6.0 or greater would occur in that area, damage would likely result in easternmost counties of Pennsylvania, but not in Beaver County.

4.3.3.4 Future Occurrence

An earthquake's severity can be expressed by considering the rate in change of motion of the earth's surface during a seismic event as a percent of the normal rate of acceleration caused by gravity (g), which is called the Peak Horizontal Ground Acceleration (PHGA). In general, ground acceleration must exceed 15 percent of g for significant damage to occur, although soil conditions at local sites are extremely important in considering how much damage will occur as a consequence of a given amount of ground acceleration. According to PEMA, the highest seismic hazard in the State is in southeastern Pennsylvania, where PHGA values range from 10 to 14 percent and there is a 90-percent probability that maximum horizontal acceleration in rock of 10 percent g will not be exceeded within a 50-year period (PEMA 2010).

Based on available historical data, future occurrences of earthquake events can be considered *unlikely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4 of this plan).

4.3.3.5 Vulnerability Assessment

To understand risk, a community must evaluate which assets are exposed or vulnerable in the identified hazard area. The entire County has been identified as exposed to the earthquake hazard. Therefore, all assets in Beaver County (population, structures, critical facilities, and lifelines) described in the County Profile (Section 2), are vulnerable. The following section provides an evaluation and estimation of the potential impact of the earthquake hazard on Beaver County, including the following:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on: (1) life, safety, and health of residents; (2) general building stock; (3) critical facilities; (4) economy; (5) environment; and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding of this hazard over time.

Overview of Vulnerability

Earthquakes usually occur without warning and can be felt in areas at great distance from their point of origin. Extent of damage depends on density of population, as well as building and infrastructure construction in the area shaken by the quake. Some areas may be more vulnerable than others based on soil type, age of buildings, and building codes in place. Compounding potential for damage is that, historically, Building Officials Code Administration (BOCA) in the northeastern United States was developed to address local concerns including heavy snow loads and wind; seismic requirements for design criteria are not as stringent compared to the West Coast's reliance on the more seismically-focused Uniform Building Code. Thus, a

smaller earthquake in the northeastern United States can cause more structural damage than it would in the western part of the United States.

The entire population and general building stock inventory of the County are at risk for damage or loss from impacts of an earthquake. Potential losses associated with earth shaking were calculated for Beaver County for the 100-, 500-, and 2,500-year MRP events. A summary of the data used and methodology applied for this assessment appears below, followed by impacts on population, existing structures, critical facilities, and the economy within Beaver County.

Data and Methodology

A probabilistic assessment was conducted for the 100-, 500-, and 2,500-year MRP in HAZUS-MH 3.0 to analyze the earthquake hazard and provide a range of loss estimates for Beaver County. The probabilistic method uses historical earthquake information from historical earthquakes and inferred faults, locations, and magnitudes, and computes probable ground-shaking levels that may be experienced during a recurrence period by Census tract. According to the New York City Area Consortium for Earthquake Loss Mitigation (NYCEM), probabilistic estimates are best for urban planning, land use, zoning, and seismic building code regulations (NYCEM 2003). The default assumption is a magnitude-7.0 earthquake for all return periods.

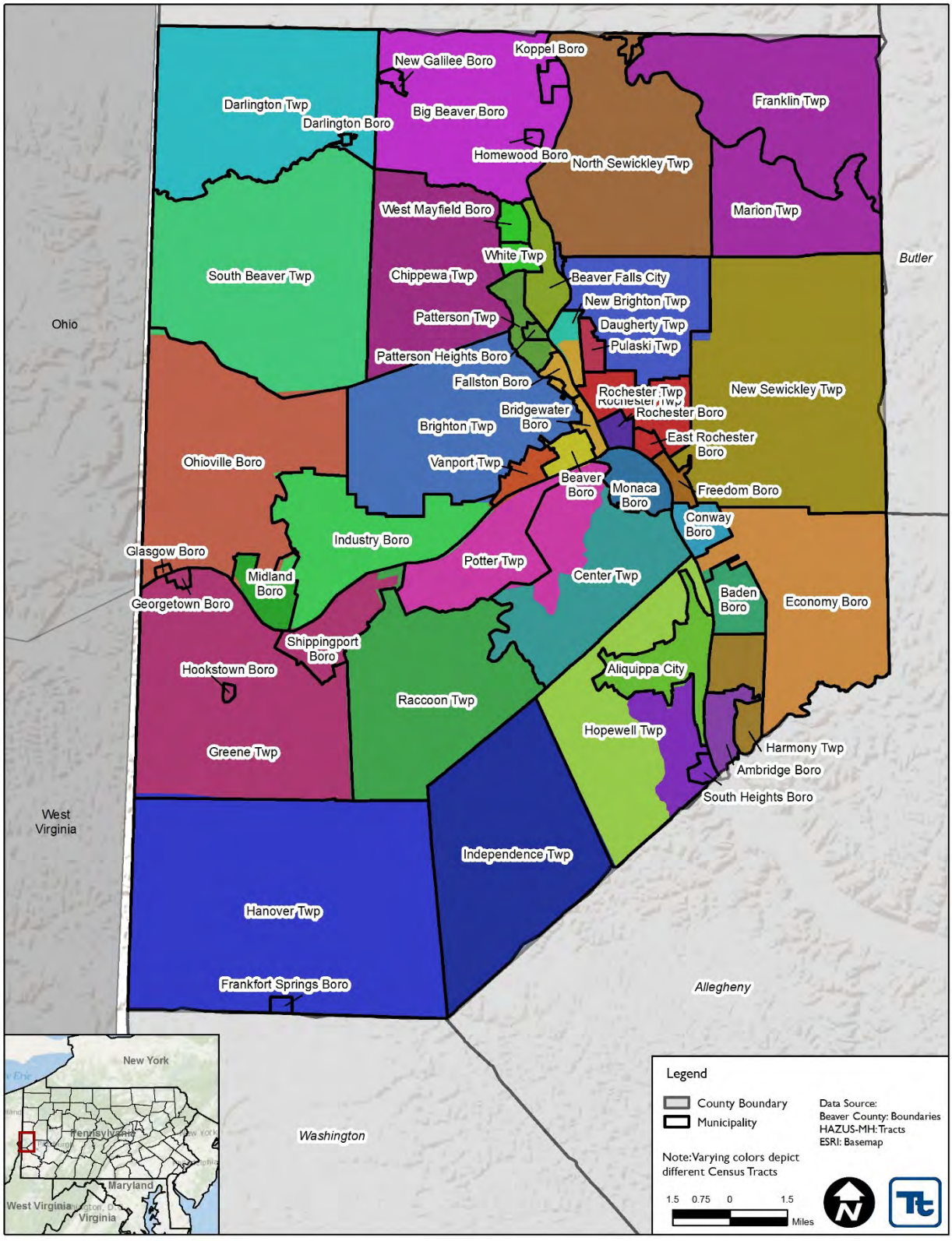
In addition to the probabilistic scenarios cited, an annualized loss run was conducted in HAZUS 3.0 to estimate annualized general building stock dollar losses within Beaver County. The annualized loss methodology combines estimated losses associated with ground shaking for each return period, which are based on values from the USGS seismic probabilistic curves. Annualized losses are useful for mitigation planning because they provide a baseline that can be used to compare (1) the risk of one hazard across multiple jurisdictions, and (2) the degree of risk of all hazards for each participating jurisdiction.

As noted in the HAZUS-MH Earthquake User Manual, "Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning earthquakes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics, and economic parameters add to the uncertainty. These factors can result in a range of uncertainty in loss estimates produced by the HAZUS Earthquake Model, possibly at best a factor of 2 or more." However, HAZUS potential loss estimates are acceptable for the purposes of this Hazard Mitigation Plan (HMP).

The occupancy classes available in HAZUS-MH 3.0 were condensed into the following categories to facilitate the analysis and presentation of results: residential, commercial, industrial, agricultural, religious, government, and educational. Residential loss estimates address both multi-family and single-family dwellings. Impacts on critical facilities and utilities were also evaluated.

HAZUS-MH 3.0 generates results at the Census-tract level. Boundaries of the Census tracts are not always coincident with municipal boundaries in Beaver County. Results in subsequent tables are presented for the Census tracts, with the associated municipalities listed for each tract. Figure 4.3.3-9 below shows spatial relationships between Census tracts and municipal boundaries.

Figure 4.3.3-9. HAZUS-MH Census Tracts in Beaver County



Source: HAZUS-MH 3.0

Impact on Life, Health, and Safety

Overall, the entire population of Beaver County is exposed to the earthquake hazard event. According to the 2010 U.S. Census, Beaver County had a population of 170,539 people. The impact of earthquakes on life, health, and safety depends on the severity of the event. Risks to public safety and loss of life from an earthquake in Beaver County are minimal, with higher risk occurring in buildings as a result of damage to the structure, or people walking below building ornamentation and chimneys that may be shaken loose and fall as a result of the quake.

Populations considered most vulnerable are located in the built environment, particularly near unreinforced masonry construction. In addition, the vulnerable population includes the elderly (persons over the age of 65) and individuals living below the Census poverty threshold. These socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard, and locations and construction quality of their housing.

Residents may be displaced or require temporary to long-term sheltering as a result of the event. The number of people requiring shelter is generally less than the number displaced, as some displaced persons use hotels or stay with family or friends after a disaster event. HAZUS-MH 3.0 does not estimate any displaced persons or population that may require short-term sheltering as a result of the 100-year event. Table 4.3.3-5 summarizes the estimated sheltering needs for Beaver County.

Table 4.3.3-5. Summary of Estimated Sheltering Needs for Beaver County

Scenario	Displaced Households	Persons Seeking Short-Term Shelter
500-Year Earthquake	4	2
2,500-Year Earthquake	33	19

Source: HAZUS-MH 3.0

Structural building damage correlates strongly to the number of injuries and casualties from an earthquake event (NYCEM 2003). Furthermore, different sectors of the community would be exposed to the hazard depending on time of day of occurrence. For example, HAZUS considers that maximum residential occupancy occurs at 2:00 a.m.; educational, commercial, and industrial sectors maximum occupancy at 2:00 p.m.; and peak commute time at 5:00 p.m. Whether affected directly or indirectly, the entire population would have to deal with consequences of earthquakes to some degree. Business interruption could prevent people from working, road closures could isolate populations, and loss of functions of utilities could affect populations that suffered no direct damage from an event. HAZUS-MH 3.0 estimates no injuries or casualties in Beaver County as a result of a 100-year MRP event. Table 4.3.3-6 summarizes estimated number of injuries, hospitalizations, and casualties as a result of the 500-year MRP event. Table 4.3.3-7 summarizes estimated number of injuries, hospitalizations, and casualties as a result of the 2500-year MRP event.

Table 4.3.3-4. Estimated Number of Injuries, Hospitalizations, and Casualties from the 500-Year MRP Earthquake Event

	Time of Day		
Level of Severity	2:00 a.m.	2:00 p.m.	5:00 p.m.
Injuries	3	2	2
Hospitalization	0	0	0
Casualties	0	0	0

Source: HAZUS-MH 3.0

Table 4.3.3-5. Estimated Number of Injuries, Hospitalizations, and Casualties from the 2,500-Year MRP Earthquake Event

Level of Severity	Time of Day		
	2:00 a.m.	2:00 p.m.	5:00 p.m.
Injuries	18	15	13
Hospitalization	2	2	2
Casualties	0	0	0

Source: HAZUS-MH 3.0

Impact on General Building Stock

After consideration of the population exposed to the earthquake hazard, an evaluation of value of general building stock exposed to and damaged by the 100-, 500- and 2,500-year MRP earthquake events occurred. In addition, annualized losses were calculated by use of HAZUS-MH 3.0. The entire study area's general building stock is considered at risk and exposed to this hazard.

The HAZUS-MH 3.0 model estimates value of exposed building stock and loss (in terms of damage to exposed stock). The County Profile section of this HMP (Section 2) presents statistics on replacement values of general building stock (structure and contents).

A probabilistic model was run to estimate annualized dollar losses within Beaver County by application of HAZUS-MH 3.0. Annualized losses are useful for mitigation planning because they provide a baseline that can be used to compare (1) risk of one hazard across multiple jurisdictions, and (2) degree of risk of all hazards within each participating jurisdiction. Notably, annualized loss does not predict losses in any particular year. Estimated earthquake annualized losses are approximately $45,000 per year (building and contents) within the County.

According to NYCEM, where earthquake risks and mitigation were evaluated in the New York, New Jersey, and Connecticut region, most damage and loss caused by an earthquake would directly or indirectly result from ground shaking (NYCEM 2003). NYCEM found a strong correlation between PGA and damage a building might undergo. The HAZUS-MH model is based on the best available earthquake science and aligns with these statements. HAZUS-MH 3.0 methodology and model were used to analyze the earthquake hazard for the general building stock within Beaver County. Figures 4.3.3-5 through 4.3.3-7 earlier in this profile illustrate the geographic distribution of PGA (*g*) across the County for the 100-, 500-, and 2,500-year MRP events.

In addition, according to NYCEM (NYCEM 2003), a building's construction determines how well it can withstand the force of an earthquake. The NYCEM report indicates that un-reinforced masonry buildings are most at risk during an earthquake because the walls are prone to collapse outward, whereas steel and wood buildings absorb more of the earthquake's energy. Additional attributes that affect a building's capability to withstand an earthquake's force include its age, number of stories, and quality of construction. HAZUS-MH considers building construction and age of buildings in its analysis. Default building ages and building types already incorporated into the inventory were used because the default general building stock was used for this HAZUS-MH analysis.

Potential building damage was evaluated by HAZUS-MH 3.0 across the following damage categories: none, slight, moderate, extensive, and complete. Table 4.3.3-8 provides definitions of these categories of damage for a light wood-framed building; definitions for other building types are included in the HAZUS-MH technical manual documentation. General building stock damage for these damage categories by occupancy class on a countywide basis is summarized for the 500- and 2,500-year events in Table 4.3.3-9.

Table 4.3.3-8. Example of Structural Damage State Definitions for a Light Wood-Framed Building

Damage Category	Description
Slight	Small plaster or gypsum-board cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneer.
Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
Extensive	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates or slippage of structure over foundations; partial collapse of room-over-garage or other soft-story configurations.
Complete	Structure may have large permanent lateral displacement, may collapse, or be in imminent danger of collapse because of the crippled wall failure or the failure of the lateral load resisting system; some structures may slip and fall off the foundations; large foundation cracks.

Source: FEMA 2012

Table 4.3.3-9. Estimated Buildings Damaged by General Occupancy for 500-year and 2,500-year MRP Earthquake Events

	Average Damage State									
	500-Year MRP					2,500-Year MRP				
Category	None	Slight	Moderate	Extensive	Complete	None	Slight	Moderate	Extensive	Complete
Residential	67,478 (91.4%)	552 (<1%)	155 (<1%)	15 (<1%)	1 (<1%)	64,795 (87.8%)	2,463 (3.3%)	819 (1.1%)	113 (<1%)	11 (<1%)
Commercial	3,583 (4.9%)	36 (<1%)	9 (<1%)	1 (<1%)	0 (0%)	3,406 (4.6%)	160 (<1%)	56 (<1%)	7 (<1%)	0 (0%)
Industrial	1,003 (1.4%)	9 (<1%)	2 (<1%)	0 (0%)	0 (0%)	956 (1.3%)	42 (<1%)	15 (<1%)	2 (<1%)	0 (0%)
Education, Government, Religious, and Agricultural	939 (1.3%)	8 (<1%)	1 (<1%)	0 (0%)	0 (0%)	896 (1.2%)	38 (<1%)	13 (<1%)	1 (<1%)	0 (0%)

Source: HAZUS-MH 3.0

HAZUS-MH 3.0 estimates no damage to Beaver County's general building stock as a result of a 100-year MRP event. Table 4.3.3-10 summarizes estimated building value (buildings and contents) for annualized loss, 500-, and 2,500-year MRP earthquake events. Damage loss estimates include structural and non-structural damage to buildings and loss of contents. Table 4.3.3-11 summarizes estimated value (buildings and contents) damaged by 500-, and 2,500-year MRP earthquake events.

Table 4.3.3-10. Estimated Building Value (Building and Contents) Damaged by the Annualized, 500-, and 2,500-Year MRP Earthquake Events

Municipality	Total Replacement Cost Value (Building and Contents)	Estimated Total Damages*			Percent of Total Building and Contents		
		Annualized Loss	500-Year	2,500-Year	Annualized Loss	500-Year	2,500-Year
Aliquippa City	$1,752,914,000	$2,322	$259,785	$2,251,723	<1%	<1%	<1%
Ambridge Boro	$2,001,047,000	$2,565	$274,240	$2,517,116	<1%	<1%	<1%
Baden Boro	$660,129,000	<$1,000	$102,333	$873,415	<1%	<1%	<1%
Beaver Boro	$1,086,483,000	$1,501	$166,869	$1,460,662	<1%	<1%	<1%
Beaver Falls City	$2,039,706,000	$2,868	$301,603	$2,826,601	<1%	<1%	<1%
Big Beaver Boro-Homewood Boro-Koppel Boro-New Gailee Boro	$586,692,000	<$1,000	$96,541	$853,197	<1%	<1%	<1%
Bridgewater Boro-Fallston Boro-New Brighton Boro	$993,629,000	$1,270	$127,518	$1,271,467	<1%	<1%	<1%
Brighton Twp	$1,601,126,000	$2,340	$263,205	$2,251,192	<1%	<1%	<1%
Center Twp	$1,386,472,000	$1,970	$225,931	$1,876,047	<1%	<1%	<1%
Center Twp-Potter Twp	$1,044,988,000	$1,455	$160,712	$1,405,296	<1%	<1%	<1%
Chippewa Twp	$1,776,474,000	$2,494	$261,297	$2,458,689	<1%	<1%	<1%
Conway Boro	$302,730,000	<$1,000	$47,483	$399,819	<1%	<1%	<1%
Darlington Twp-Darlington Boro	$379,722,000	<$1,000	$58,861	$557,581	<1%	<1%	<1%
Daugherty Twp-Eastvale Boro	$519,915,000	<$1,000	$90,457	$741,072	<1%	<1%	<1%
Economy Boro	$1,548,629,000	$2,236	$267,081	$2,104,089	<1%	<1%	<1%
Franklin Twp-Marion Twp	$952,452,000	$1,311	$139,306	$1,291,966	<1%	<1%	<1%
Freedom Boro	$223,763,000	<$1,000	$35,300	$303,011	<1%	<1%	<1%
Green Twp-Georgetown Boro-Shippingport Boro	$416,229,000	<$1,000	$72,104	$580,696	<1%	<1%	<1%
Hanover Twp-Frankfort Springs Boro	$510,018,000	<$1,000	$91,864	$706,212	<1%	<1%	<1%
Harmony Twp	$579,980,000	<$1,000	$84,333	$740,074	<1%	<1%	<1%
Hopewell Twp	$1,765,087,000	$2,431	$277,631	$2,317,151	<1%	<1%	<1%
Hopewell Twp-South Heights Boro	$707,590,000	<$1,000	$112,415	$928,958	<1%	<1%	<1%
Independence Twp	$339,039,000	<$1,000	$61,065	$468,352	<1%	<1%	<1%
Industry Boro-Midland Boro	$308,388,000	<$1,000	$52,613	$430,745	<1%	<1%	<1%
Midland Boro	$475,952,000	<$1,000	$66,217	$618,194	<1%	<1%	<1%

Municipality	Total Replacement Cost Value (Building and Contents)	Estimated Total Damages*			Percent of Total Building and Contents		
		Annualized Loss	500-Year	2,500-Year	Annualized Loss	500-Year	2,500-Year
Monaca Boro	$1,104,111,000	$1,511	$165,381	$1,471,974	<1%	<1%	<1%
New Brighton Boro	$541,100,000	<$1,000	$86,542	$751,077	<1%	<1%	<1%
New Sewickley Twp	$1,135,707,000	$1,673	$193,385	$1,578,945	<1%	<1%	<1%
North Sewickley Twp-Ellwood City Boro	$1,027,572,000	$1,512	$168,240	$1,468,210	<1%	<1%	<1%
Ohioville Boro-Glasgow Boro	$458,109,000	<$1,000	$80,888	$672,104	<1%	<1%	<1%
Patterson Twp-Patterson Heights Boro	$616,445,000	<$1,000	$104,997	$881,307	<1%	<1%	<1%
Pulaski Twp	$204,440,000	<$1,000	$33,222	$287,381	<1%	<1%	<1%
Raccoon Twp-Shippingport Boro	$485,336,000	<$1,000	$84,081	$674,595	<1%	<1%	<1%
Rochester Boro	$699,044,000	<$1,000	$104,398	$941,714	<1%	<1%	<1%
Rochester Twp-East Rochester Boro	$608,233,000	<$1,000	$93,049	$813,383	<1%	<1%	<1%
South Beaver Twp	$564,677,000	<$1,000	$95,564	$837,827	<1%	<1%	<1%
Vanport Twp	$277,942,000	<$1,000	$38,672	$360,756	<1%	<1%	<1%
White Twp-West Mayfield Boro	$393,435,000	<$1,000	$56,763	$532,061	<1%	<1%	<1%
BEAVER COUNTY (TOTAL)	**$32,075,305,000**	**$44,964**	**$5,001,944**	**$43,504,656**	**<1%**	**<1%**	**<1%**

Source: HAZUS-MH 3.0

Notes:

- Total amount is sum of damages for all occupancy classes (residential, commercial, industrial, agricultural, educational, religious, and government).
- As stated at the beginning of the vulnerability analysis, HAZUS-MH 3.0 generates results at the Census-tract level. Boundaries of Census tracts are not always coincident with municipal boundaries in Beaver County. Results in the table are for Census tracts, with associated municipalities listed for each tract. See Figure 4.3.3-9 for a visual breakdown of Census tracts.

Table 5.4.3-6. Estimated Value (Building and Contents) Damaged by the 500- and 2,500-Year MRP Earthquake Events

Municipality	Total Improved Value (Building and Contents)	Estimated Residential Damage		Estimated Commercial Damage	
		500-Year	2,500-Year	500-Year	2,500-Year
Aliquippa City	$1,752,914,000	$188,453	$1,503,258	$51,870	$537,167
Ambridge Boro	$2,001,047,000	$127,222	$1,051,267	$113,013	$1,068,050
Baden Boro	$660,129,000	$80,671	$652,321	$12,758	$126,644
Beaver Boro	$1,086,483,000	$113,401	$922,420	$35,741	$357,905
Beaver Falls City	$2,039,706,000	$176,136	$1,506,879	$55,707	$561,633
Big Beaver Boro-Homewood Boro-Koppel Boro-New Gailee Boro	$586,692,000	$74,185	$609,392	$14,406	$148,553
Bridgewater Boro-Fallston Boro-New Brighton Boro	$993,629,000	$59,398	$508,297	$38,754	$393,263
Brighton Twp	$1,601,126,000	$217,677	$1,749,852	$36,407	$407,578
Center Twp	$1,386,472,000	$187,657	$1,462,284	$32,880	$353,838
Center Twp-Potter Twp	$1,044,988,000	$104,976	$828,809	$32,557	$322,691
Chippewa Twp	$1,776,474,000	$187,020	$1,532,206	$31,029	$322,557
Conway Boro	$302,730,000	$38,264	$306,688	$4,505	$43,459
Darlington Twp-Darlington Boro	$379,722,000	$37,834	$304,141	$10,029	$105,717
Daugherty Twp-Eastvale Boro	$519,915,000	$79,250	$623,967	$7,521	$74,268
Economy Boro	$1,548,629,000	$242,830	$1,863,826	$16,241	$157,262
Franklin Twp-Marion Twp	$952,452,000	$94,809	$755,638	$15,206	$158,306
Freedom Boro	$223,763,000	$24,697	$197,952	$3,812	$36,684
Green Twp-Georgetown Boro-Shippingport Boro	$416,229,000	$59,776	$451,033	$5,767	$55,144
Hanover Twp-Frankfort Springs Boro	$510,018,000	$78,942	$581,929	$6,197	$59,325
Harmony Twp	$579,980,000	$57,147	$441,411	$13,514	$128,782
Hopewell Twp	$1,765,087,000	$208,215	$1,588,060	$45,960	$448,419
Hopewell Twp-South Heights Boro	$707,590,000	$88,813	$691,196	$15,640	$152,197
Independence Twp	$339,039,000	$53,817	$398,112	$4,255	$40,290
Industry Boro-Midland Boro	$308,388,000	$42,729	$332,975	$7,092	$68,450
Midland Boro	$475,952,000	$46,897	$398,863	$8,381	$83,376
Monaca Boro	$1,104,111,000	$111,702	$910,807	$36,313	$365,987

Table 5.4.3-6. Estimated Value (Building and Contents) Damaged by the 500- and 2,500-Year MRP Earthquake Events

Municipality	Total Improved Value (Building and Contents)	Estimated Residential Damage		Estimated Commercial Damage	
		500-Year	2,500-Year	500-Year	2,500-Year
New Brighton Boro	$541,100,000	$68,671	$569,358	$12,026	$122,152
New Sewickley Twp	$1,135,707,000	$152,769	$1,175,891	$28,078	$272,374
North Sewickley Twp-Ellwood City Boro	$1,027,572,000	$120,011	$967,968	$36,181	$366,813
Ohioville Boro-Glasgow Boro	$458,109,000	$70,746	$564,006	$4,791	$49,642
Patterson Twp-Patterson Heights Boro	$616,445,000	$94,428	$769,892	$8,222	$83,657
Pulaski Twp	$204,440,000	$25,472	$205,855	$3,278	$32,918
Raccoon Twp-Shippingport Boro	$485,336,000	$69,990	$527,613	$7,488	$73,130
Rochester Boro	$699,044,000	$70,302	$583,083	$24,486	$251,758
Rochester Twp-East Rochester Boro	$608,233,000	$66,135	$527,082	$13,882	$136,057
South Beaver Twp	$564,677,000	$67,649	$544,949	$19,924	$204,865
Vanport Twp	$277,942,000	$25,576	$221,331	$8,019	$80,463
White Twp-West Mayfield Boro	$393,435,000	$44,558	$375,092	$4,282	$46,218
BEAVER COUNTY (TOTAL)	**$32,075,305,000**	**$3,658,824**	**$29,205,704**	**$826,208**	**$8,297,589**

Source: HAZUS-MH 3.0

Notes: As stated at the beginning of the vulnerability analysis, HAZUS-MH 3.0 generates results at the Census-tract level. Boundaries of Census tracts are not always coincident with municipal boundaries in Beaver County. Results in the table are for Census tracts, with associated municipalities listed for each tract. See Figure 4.3.3-9 for a visual breakdown of Census tracts.

An estimated $5 million in damages would occur to buildings in the County during a 500-year earthquake event. This takes into account structural damage, non-structural damage, and loss of contents, representing less than 1 percent of total replacement value for general building stock in Beaver County (total replacement value within the County would exceed $32 billion.) For the 2,500-year earthquake event, HAZUS-MH estimates more than $43 million in damages (<1 percent of the building stock). Residential and commercial buildings would undergo most damage from earthquake events. Earthquakes can cause secondary hazard events such as fires. No fires are anticipated as a result of the 100-, 500-, or 2,500-year MRP events.

Impact on Critical Facilities

After consideration of general building stock exposed to and damaged by each earthquake event, critical facilities were evaluated. All critical facilities (essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and user-defined facilities) in Beaver County are considered exposed and vulnerable to the earthquake hazard. The Critical Facilities subsection of this HMP in Section 2 (County Profile) discusses the inventory of critical facilities in Beaver County.

HAZUS-MH 3.0 estimates the probability that critical facilities may sustain damage as a result of the 100-, 500-, and 2,500-year MRP earthquake events. Additionally, HAZUS-MH estimates percent functionality of each facility days after the event. Table 4.3.3-12 (500-year MRP earthquake event) and Table 4.3.3-13 (2,500-year MRP earthquake event) list percent probabilities that critical facilities and utilities would sustain damages within the damage categories (column headings), and list percent functionalities after different numbers of days following those events (column headings). During and following a 100-Year MRP event, HAZUS-MH 3.0 estimates nearly 100% functionality of emergency facilities (police, fire, Emergency Medical Services [EMS], and medical facilities), schools, utilities, and specific facilities identified by Beaver County as critical. Therefore, impact on critical facilities by a 100-year event would not be significant.

Table 4.3.3-12. Estimated Damage to and Loss of Functionality of Critical Facilities and Utilities in Beaver County for the 500-Year MRP Earthquake Event

Name	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Critical Facilities									
Medical	98.4	1.2	<1	0	0	98	100	100	100
Police	95-98	1-4	0.3-1	<1	0	95-98	98-100	100	100
Fire	95-98	1-4	0.3-1	<1	0	95-98	98-100	100	100
EOC	98.4	1.2-1.3	<1	0	0	98	100	100	100
School	98.3-98.4	1.2-1.3	<1	0	0	98	100	100	100
Utilities									
Potable Water	99.6	<1	<1	0	0	100	100	100	100
Wastewater	99.6	<1	<1	0	0	100	100	100	100
Natural Gas	99.6	<1	<1	0	0	100	100	100	100

Source: HAZUS-MH 3.0

Notes: EOC Emergency Operations Center

Table 4.3.3-13. Estimated Damage to and Loss of Functionality of Critical Facilities and Utilities in Beaver County for the 2,500-Year MRP Earthquake Event

Name	Percent Probability of Sustaining Damage					Percent Functionality			
	None	Slight	Moderate	Extensive	Complete	Day 1	Day 7	Day 30	Day 90
Critical Facilities									
Medical	91	6	2	<1	0	91	97	100	100
Police	83-92	6-10	2-5	0.3-1	<1	83-91	93-97	99-100	99-100
Fire	83-92	6-10	2-5	0.3-1	<1	83-91	93-97	99-100	99-100
EOC	91	6	2	<1	0	91	97	100	100
School	91-92	6	2	<1	0	91	97	100	100
Utilities									
Potable Water	96	3	1	0	0	98-99	100	100	100
Wastewater	99.6	<1	<1	0	0	100	100	100	100
Natural Gas	96	3	1	0	0	98	100	100	100

Source: HAZUS-MH 3.0

Notes: EOC Emergency Operations Center

Impact on Economy

Earthquakes also impact the economy, causing loss of business function, damage to inventory, relocation costs, wage loss, and rental loss during repair or replacement of buildings. A HAZUS-MH analysis estimated total economic loss associated with each earthquake scenario, including building- and lifeline-related losses (such as transportation and utility losses) based on available inventory (facility or geographic information system [GIS] point data only). Direct building losses are estimated costs to repair or replace damages to buildings. These losses are reported in the Impact on General Building Stock section presented earlier. Lifeline-related losses include costs of direct repair to transportation and utility systems, and are reported in terms of probability of reaching or exceeding a specified level of damage caused by a given level of ground motion. Additionally, economic loss includes business interruption losses associated with inability to operate a business as a result of damage sustained during the earthquake, as well as temporary living expenses for those displaced. These losses are discussed below.

Significantly, for a 500-year event, HAZUS-MH 3.0 estimates that the County would incur approximately $2.03 million in income losses (wage, rental, relocation, and capital-related losses) in addition to structural, non-structural, and content building stock losses ($5.01 million). For a 2,500-year event, HAZUS-MH estimates that the County would incur approximately $12.3 million in income losses, and approximately $43.7 million in structural, non-structural and content building stock losses.

The HAZUS-MH analysis did not take into account damage to roadway segments. However, these features assumedly would undergo damage as a result of ground failure, and an earthquake event thus would interrupt regional transportation and distribution of materials. According to HAZUS-MH Earthquake User Manual, losses to the community resulting from damages to lifelines could be much greater than costs of repair (FEMA 2012).

Earthquake events can significantly damage road bridges, important because they often provide the only access to certain neighborhoods. Because softer soils can generally follow floodplain boundaries, bridges that cross watercourses should be considered vulnerable. A key factor in degree of vulnerability is age of a facility, which helps indicate the standards the facility was built to achieve.

HAZUS-MH Earthquake User's Manual also estimates volume of debris that may be generated as a result of an earthquake event to enable the study region to prepare and rapidly and efficiently manage debris removal and disposal. Debris estimates are divided into two categories: (1) reinforced concrete and steel that require special equipment to break up before transport, and (2) brick, wood, and other debris that can be loaded directly onto trucks with bulldozers (FEMA 2012).

No debris would be generated as a result of a 100-year earthquake event. HAZUS-MH 3.0 estimates generation of more than 5,400 tons of debris by a 500-year MRP event, and nearly 29,000 tons by a 2,500-year MRP event. Table 4.3.3-14 summaries estimated debris generated by 500- and 2,500-year MRP earthquake events.

Table 4.3.3-7. Estimated Debris Generated by 500- and 2,500-year MRP Earthquake Events

Municipality	500-Year		2,500-Year	
	Brick/Wood (tons)	Concrete/ Steel (tons)	Brick/Wood (tons)	Concrete/ Steel (tons)
Aliquippa City	255	50	1,261	340
Ambridge Boro	246	60	1,219	412
Baden Boro	101	20	502	136
Beaver Boro	142	29	710	205
Beaver Falls City	263	64	1,335	462
Big Beaver Boro-Homewood Boro-Koppel Boro-New Gailee Boro	90	17	459	121
Bridgewater Boro-Fallston Boro-New Brighton Boro	111	28	558	203
Brighton Twp	212	42	1,061	290
Center Twp	178	33	887	224
Center Twp-Potter Twp	142	31	712	215
Chippewa Twp	216	43	1,097	307
Conway Boro	51	9	252	62
Darlington Twp-Darlington Boro	55	12	285	89
Daugherty Twp-Eastvale Boro	81	15	408	101
Economy Boro	225	37	1,115	246
Franklin Twp-Marion Twp	132	31	675	222
Freedom Boro	36	7	182	48
Green Twp-Georgetown Boro-Shippingport Boro	64	12	314	80
Hanover Twp-Frankfort Springs Boro	81	14	394	94
Harmony Twp	87	18	431	125
Hopewell Twp	240	47	1,183	321
Hopewell Twp-South Heights Boro	108	20	535	136
Independence Twp	54	9	265	62
Industry Boro-Midland Boro	48	9	241	61
Midland Boro	63	13	316	92
Monaca Boro	157	32	790	228
New Brighton Boro	83	16	422	111
New Sewickley Twp	170	33	857	228
North Sewickley Twp-Ellwood City Boro	156	30	797	210
Ohioville Boro-Glasgow Boro	81	14	407	99
Patterson Twp-Patterson Heights Boro	97	16	489	114
Pulaski Twp	33	6	167	44
Raccoon Twp-Shippingport Boro	70	13	348	87
Rochester Boro	99	22	499	152

Rochester Twp-East Rochester Boro	90	18	453	126
South Beaver Twp	78	17	395	119
Vanport Twp	40	9	202	66
White Twp-West Mayfield Boro	57	11	289	75
BEAVER COUNTY (TOTAL)	**4,494**	**908**	**22,511**	**6,311**

Source: HAZUS-MH 3.0

Notes: As stated at the beginning of the vulnerability analysis, HAZUS-MH 3.0 generates results at the Census-tract level. Boundaries of Census tracts are not always coincident with municipal boundaries in Beaver County. Results in the table are for Census tracts, with associated municipalities listed for each tract. See Figure 4.3.3-9 for a visual breakdown of Census tracts

Impact on the Environment

Earthquakes can lead to numerous, widespread, and devastating environmental impacts. These impacts may include but are not limited to:

- Induced flooding or landslides
- Poor water quality
- Damage to vegetation
- Breakage in sewage or toxic material containments.

Secondary impacts can include train derailments, roadway damages, spillage of hazardous materials (HazMat), and utility interruption.

Future Growth and Development

As discussed in Section 2.4 of this HMP, areas targeted for future growth and development have been identified across the County. Human exposure and vulnerability to earthquake impacts in newly developed areas are anticipated to be similar to those current within the County. Current building codes require seismic provisions that should render new construction less vulnerable to seismic impacts than older, existing construction that may have been built to lower construction standards.

Effect of Climate Change on Vulnerability

Impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the Earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. National Aeronautics and Space Administration (NASA) and USGS scientists found that retreating glaciers in southern Alaska might be opening the way for future earthquakes (NASA 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could undergo liquefaction during seismic activity as a result of the increased saturation. Dams storing increased volumes of water as a result of changes in the hydrograph could fail during seismic events. No current models are available to estimate these impacts.

Additional Data and Next Steps

Ground shaking is the primary cause of earthquake damage to man-made structures, and soft soils amplify ground shaking. One contributor to site amplification is velocity at which rock or soil transmits shear waves (S-waves). The National Earthquake Hazards Reduction Program **(**NEHRP) developed five soil classifications defined by their shear-wave velocity that alter severity of an earthquake. These soil classifications range from

A to E, whereby A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses. When this soil information becomes available, it may be incorporated into HAZUS-MH to further refine the County's vulnerability assessment.

A HAZUS-MH earthquake analysis was conducted for Beaver County by use of the default model data. Additional data needed to further refine and enhance the County's vulnerability assessment includes identifications of unreinforced masonry critical facilities and privately-owned buildings (i.e., residences) via local knowledge and/or pictometry/orthophotos. Use of soil type data can also lead to more accurate estimates of potential losses to the County. These buildings may not withstand earthquakes of certain magnitudes, and plans to provide emergency response/recovery efforts for these properties can be established. Further mitigation actions include training of County and municipal personnel to provide post-hazard event rapid visual damage assessments, increase of County and local debris management and logistic capabilities, and revised regulations to prevent additional construction of non-reinforced masonry buildings.

4.3.4 Environmental Hazards

This section provides a profile and vulnerability assessment of the environmental hazards in Beaver County. Hazards in this profile include releases of hazardous materials (HazMat), production and distribution of Marcellus Shale oil and gas, and coal mining.

Beaver County is home to over 160 identified facilities that utilize, ship, or house chemicals considered hazardous. These facilities have been identified under the Superfund Amendment and Reauthorization Act (SARA) as exceeding the quantity threshold for reporting.

Product release into the local environment can be generated from a fixed facility or at any location along a route of travel, and may be the result of carelessness, technical failure, external incidents, or an intentional act against the facility or container. Volatility of products stored or transported, along with potential impact on a local community, may increase the risk of intentional acts against a facility or transport vehicle. Release of certain products considered HazMat can immediately and adversely impact the general population, ranging from inconvenience of evacuations to personal injury and even death. Moreover, any release can compromise the local environment through contamination of soil, groundwater, or local flora and fauna. Although explosions are often associated with environmental hazards (resulting from loss of containment of HazMat), explosions are profiled under Section 4.3.14 – Urban Fire and Explosion in this HMP update.

Marcellus Shale-related activities consist of the extraction of natural gas from the Marcellus Shale formation via horizontal drilling and a process known as "hydraulic fracturing" that pumps water, mixed with sand and potentially hazardous chemicals, into the shale formation under high pressure to fracture the shale around the well, allowing natural gas to flow freely. Upon completion of the hydraulic fracturing process, the used water, often referred to as "frac fluid," must be treated to remove chemicals and minerals (Pennsylvania Department of Environmental Protection [PADEP] 2015).

Beaver County has a number of traditional oil and gas wells, but Marcellus Shale drilling may increase the potential for environmental issues within the Commonwealth. Drilling and pipelines could affect water quality and quantity, during both hydraulic fracturing and wastewater treatment phases of the drilling process (Penn State University 2011). All oil and gas exploration and drilling in the State is regulated under all or part of the state oil and gas laws, the Clean Streams Law, the Dam Safety and Encroachments Act, the Solid Waste Management Act, the Water Resources Planning Act, and the Worker and Community Right to Know Act. PADEP is responsible for reviewing and issuing drilling permits, inspecting drilling operations, and responding to complaints about water quality problems. PADEP inspectors conduct routine and unannounced inspections of drilling sites and wells statewide (PADEP 2015).

Similarly, coal mining may increase the potential for environmental issues within the County. Three main methods of mining coal include auger, open-pit, and underground mining. Auger mining involves drilling to extract coal, whereas open-pit or strip mining involves blasting rock covering a coal deposit and then shoveling out the coal. Underground mining, the first method developed, involves driving a tunnel along a coal bed or digging a shaft down to remove coal (Edmunds 2002). Some environmental impacts from mining include increases of pollutant mineral concentrations in water supplies, breakup of forests, and retarded tree growth.

4.3.4.1 Location and Extent

The U.S. Department of Transportation (DOT) categorizes HazMat into the following nine classes based on chemical characteristics posing risk:

- Class 1: Explosives
- Class 2: Gases
- Class 3: Flammable liquids
- Class 4: Flammable solids
- Class 5: Oxidizers and organic pesticides
- Class 6: Poisons and etiologic materials
- Class 7: Radioactive materials
- Class 8: Corrosives
- Class 9: Miscellaneous.

Based on past occurrences, HazMat releases within Beaver County have been accidental and have not been considered terrorist or criminal acts. While past occurrences have not been deemed intentional, an intentional release of any of these products in large quantity would pose a threat to the local population, economy, and environment resulting in lost revenue, injuries, and deaths.

Beaver County is home to 1,689.7 miles of roadways, including 40.7 miles of interstate highway, 66.9 miles of principal arterials, 150.7 miles of minor arterials, and almost 1,200 miles of local roads. With approximately 1,700 miles of roadways linking more-populated areas with rural communities, the grid work of roadways facilitates free movement of HazMat throughout the region. The County's numerous rail lines and frequent/heavy freight transportation also increase its vulnerability to HazMat accidents.

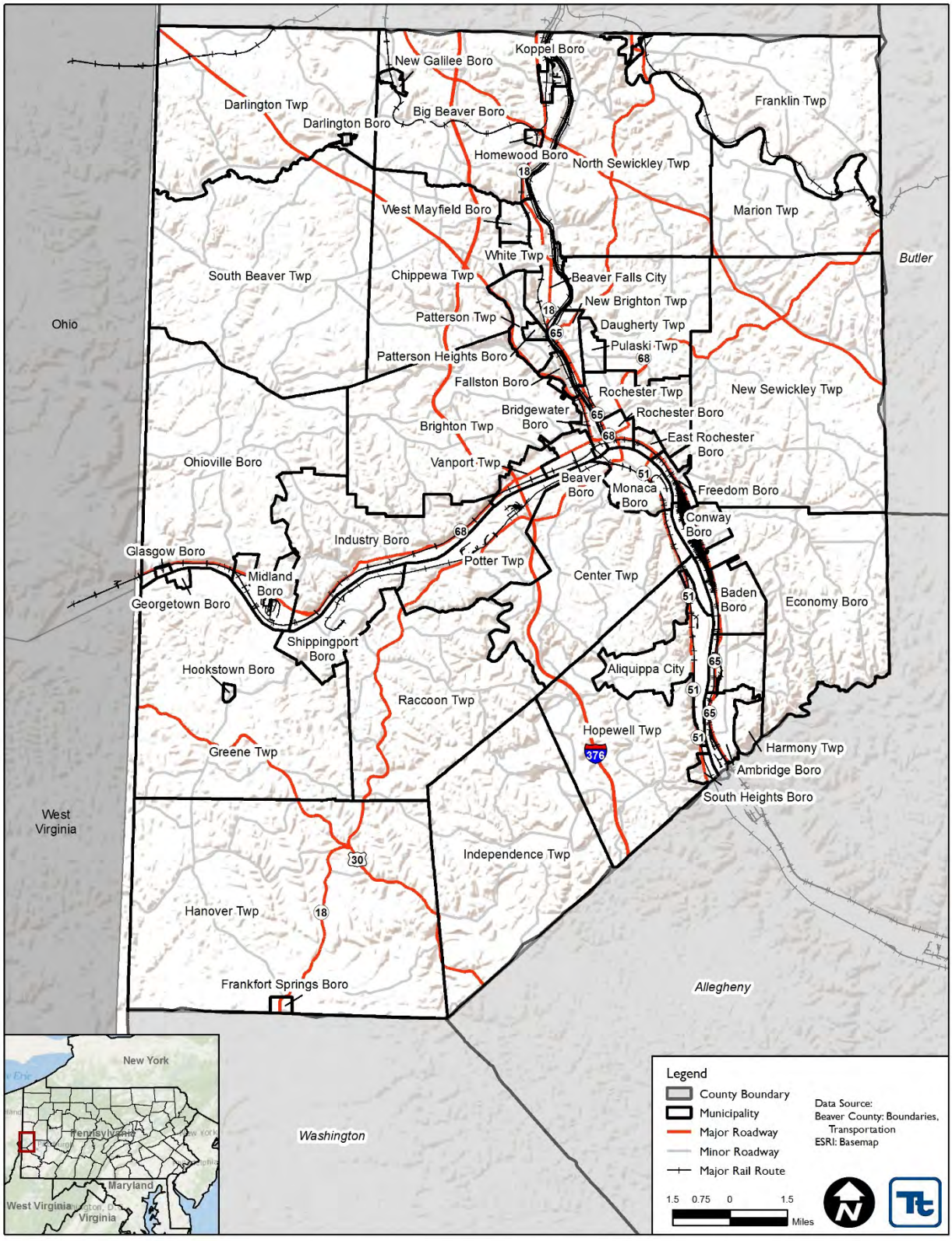
While permitted, identified hazardous substance travel routes are not maintained by the County or regional planning entities. The primary transportation corridors in Beaver County are listed as follows (and shown in red on Figure 4.3.4-1):

- Pennsylvania Turnpike (I-76)
- Interstate 376 (I-376)
- U.S. Highway 30 (US-30)
- PA State Route 65 (PA-65)
- PA State Route 68 (PA-68)
- PA State Route 18 (PA-18)
- PA State Route 51 (PA-51)
- Buffalo and Pittsburgh Railroad (BPRR) rail lines
- CSX Transportation (CSX) rail lines
- Norfolk Southern Corporation (NS) rail lines.

In addition to the major routes of transportation, each fixed facility identified within Beaver County poses a potential threat to the surrounding community.

The U.S. Environmental Protection Agency (EPA) tracks management of over 650 toxic chemicals that pose a threat to human health and the environment through the Toxic Release Inventory (TRI). Facilities in certain industries that use or house these chemicals in an amount over a certain specified level must submit annual reports on how each chemical is managed through recycling, energy recovery, treatment, and releases to the environment. A "release" of a chemical means that it is emitted to the air or water, or placed in some type of land disposal. EPA publishes all TRI data in a publicly-accessible database in *Envirofacts*. In 2014, 42 TRI facilities in Beaver County reported to EPA. Total production-related waste managed was 75.5 million pounds, and total on-site disposal, off-site disposal, and other releases consisted of 23.1 million pounds.

Figure 4.3.4-1. Major Roadways Used to Transport Hazardous Materials in Beaver County



Source: Beaver County 2015

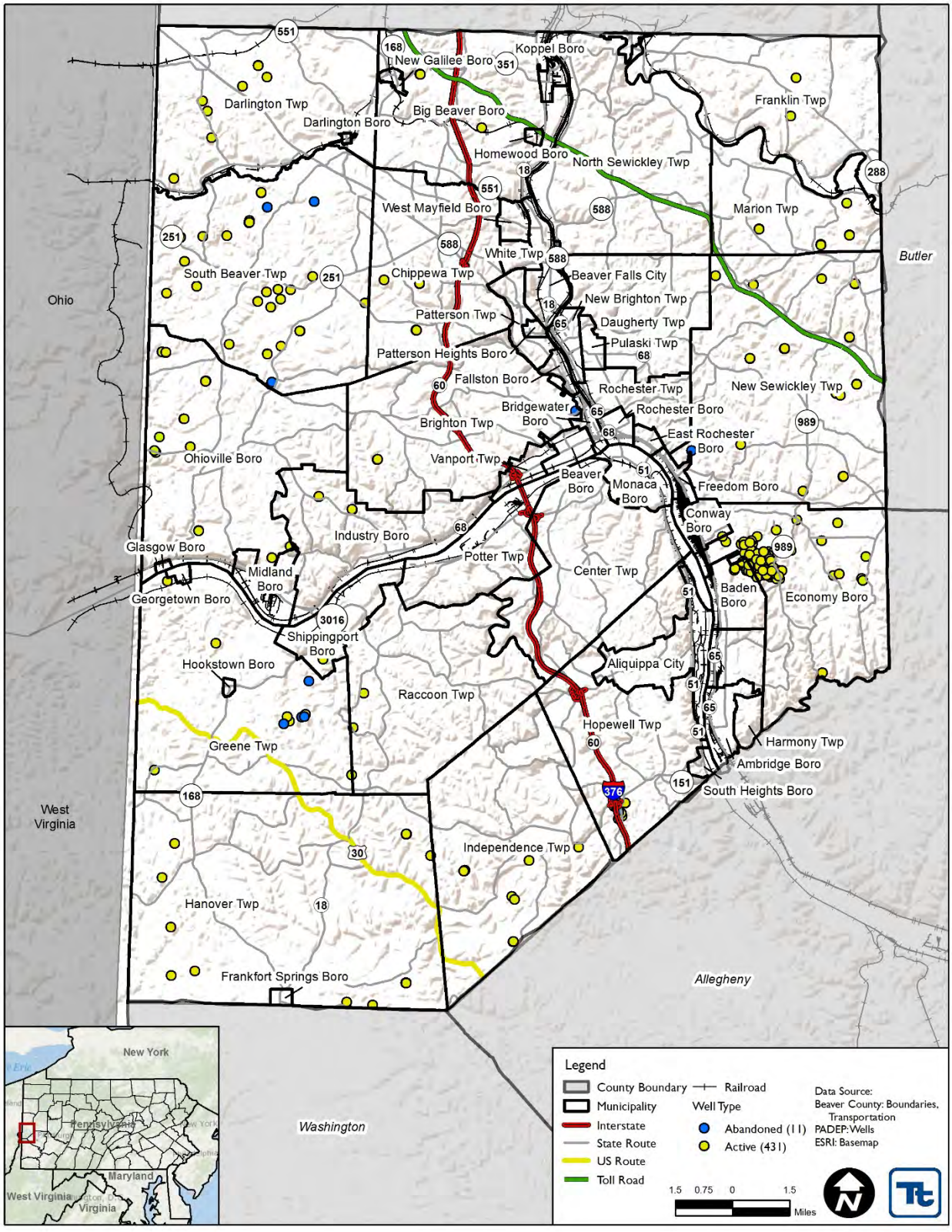
Since 2005, natural gas exploration activities in the Marcellus Shale Formation have increased significantly in the Commonwealth of Pennsylvania. According to maps produced by PADEP, in 2008, 195 Marcellus Shale wells were drilled; 2 years later, in 2010, 1,386 Marcellus Shale wells had been drilled. This number has decreased recently. Between January 2015 and August 2015, only five Marcellus Shale wells were drilled in the County (PADEP 2015). Most drilling has occurred in the northern-central and southwestern portions of the State, with highest numbers of 2015 Marcellus Shale drilling permits issued in Bradford, Susquehanna, Greene, and Washington Counties. In Washington County, bordering Beaver County to the south, the second largest number of Marcellus Shale wells (111) were drilled during 2015. The Marcellus Shale formation covers all of Beaver County. Additionally, Beaver County hosts over 100 oil and gas wells that are spatially concentrated in the area around Economy Borough. Bridgewater Borough noted that two oil companies closed their locations in the municipality, lowering the Borough's vulnerability to environmental hazards incidents.

PADEP issued 196 Marcellus Shale drilling permits (also known as unconventional well permits) in Beaver County between 2007 and September 2015—for sites in Big Beaver Borough, Brighton Township, Darlington Township, Chippewa Township, Franklin Township, Hanover Township, Greene Township, Marion Township, Industry Borough, Independence Township, New Sewickley Township, Ohioville Borough, and South Beaver Township (PADEP 2015). Additionally, Shell Corporation is considering installing a major cracker plant in Monaca Borough (Marcellus Connection 2014). While this would provide significant economic stimulus, the County is also mindful of the associated environmental hazard. Locations within the County of oil and gas wells and thus, the extent of the Marcellus Shale formation, are shown on Figure 4.3.9-2 below.

Coal mining has historically been and continues to be a major industry in Pennsylvania. Beaver County first became known for its ample supply of cannel coal in the 1830s. The County is within the Main Bituminous Field in Pennsylvania, with coal characterized as highly volatile.

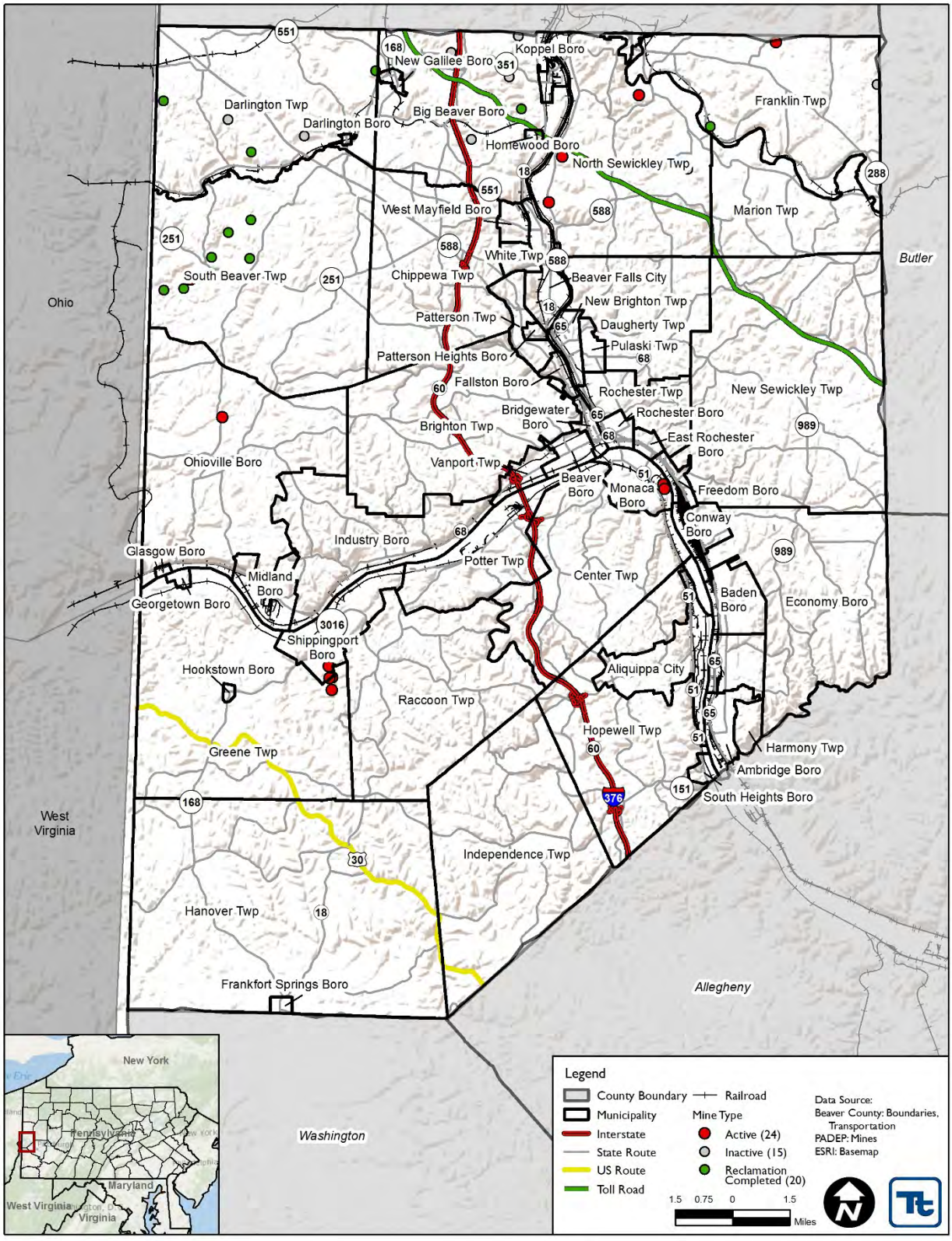
Any part of the County within the vicinity of a mine is at risk from environmental hazards resulting from coal mining activities involving underlying coal deposits. These hazards include groundwater and surface water contamination, coal slurry impoundments, and waste piles. Figure 4.3.9-3 shows locations of active and abandoned mines within Beaver County.

Figure 4.3.4-2. Oil and Gas Well Locations in Beaver County



Source: PADEP 2015

Figure 4.3.4-3. Coal Mining Operations in Beaver County



Source: PADEP 2015

4.3.4.2 Range of Magnitude

Environmental hazard incidents within Beaver County could range from minor petroleum spills to large, facility-based incidents that could lead to loss of life and property, and damage to the environment and the economy. Severity of an incident varies with type of material released and distances and related response times for emergency response teams. Areas within closest proximity to the releases are generally at greatest risk, yet depending on the agent, a release can travel great distances or persist over a long time (e.g., nuclear radiation), resulting in far-reaching effects on people and the environment. The Beaver County Hazardous Materials Response Team 700, founded in 1989, would respond for cleanup to most County HazMat incidents.

A HazMat release, accidental or intentional, can be exacerbated or mitigated by specific circumstances surrounding the event. Exacerbating conditions are characteristics that can enhance or magnify effects of a hazard. Mitigating conditions, on the other hand, are characteristics of the target and its physical environment that can reduce effects of a hazard. These conditions include:

- Weather conditions – affect how the hazard develops.
- Micro-meteorological effects of buildings and terrain – alter dispersion of materials.
- Shielding in the form of sheltering-in-place – protects people and property from harmful effects.
- Non-compliance with applicable codes (e.g., fire and building codes) and maintenance failures (e.g., fire protection and containment features) – can substantially increase damage to a facility and to surrounding buildings.
- Geographic location of HazMat site – if occurring within a Special Flood Hazard Area (SFHA), a materials release could cause larger-scale water contamination during a flood incident, or a flood incident could compromise production and storage of hazardous chemicals. Stormwaters and floodwaters can also move toxic chemicals swiftly across great distances.

At the lower end of the range of magnitude, a small amount of HazMat released in a remote area can trigger an evacuation of the area around the spill and a cleanup effort. However, a worst-case scenario for HazMat releases would be derailment of a train carrying HazMat in a populated area along the Beaver or Ohio River, endangering not only lives and property of individuals living and working near the release but also health of the waterway and safety of the water supply.

Concerning Marcellus Shale extraction, oil and gas well drilling can exert a variety of effects on the environment. Abandoned oil and gas wells not properly plugged can contaminate groundwater and consequently drinking water wells. Surface waters and soil are sometimes polluted by brine (a salty wastewater product of oil and gas well drilling), by oil spills at a drilling site, or by a pipeline breach. These events can spoil public drinking water supplies and significantly harm vegetation and aquatic animals.

Natural gas well fires occur when natural gas is ignited at a well site. Often, these fires erupt during drilling when a spark from machinery or equipment ignites the gas. The initial explosion and resulting flames can seriously injure or kill individuals in the immediate area. These fires are often difficult to extinguish due to the intensity of the flame and abundance of the fuel source.

During both the hydraulic fracturing and wastewater treatment phases of the process**,** Marcellus Shale drilling can affect water quality and quantity. Negligence and/or mishaps in well drilling can result in pollution of private water supplies, groundwater, and stormwater runoff by HazMat. Improper treatment of wastewater from a hydraulic fracturing process (i.e., wastewater not treated, recycled, or collected in PADEP-authorized wastewater treatment facilities) could contaminate regional water supplies, resulting in exposure of thousands of people to HazMat (PADEP 2010).

Drilling mishaps such as "blowouts" can also cause drill explosions and fires that can emit large quantities of natural gas and potentially injure/kill workers. In densely populated areas, ignition of such a natural gas leak by any of numerous external sources can cause an explosion (Efstathiou 2010). A worst-case scenario for Marcellus Shale drilling would be a blowout, as described above, resulting in loss of life and contamination of nearby waterways, livestock, and potable water supplies.

The extent of a coal mining incident can also vary greatly, depending on the event's magnitude. Primary environmental impacts of coal mining include mine-related subsidence, underground mine fire, stream contamination from mine drainage, modification of vegetation, and elevation changes. Beyond the environmental impacts are occupational hazards associated with coal mining, including loss of life from mine collapse, entrapment, gases, inundation, explosion, fire, equipment malfunction, or drowning.

The worst-case scenario for coal mining would be a mining incident that releases minerals and pollutants into the Ohio River, impacting wildlife and water quality in both Pennsylvania and Ohio along the river.

4.3.4.3 Past Occurrences

The County has undergone HazMat release accidents at facilities and along roadways. From 2004 to 2009, 49 HazMat incidents occurred in Beaver County, reported via the Pennsylvania Emergency Incident Reporting System (PEIRS). Another 112 HazMat incidents were reported to Knowledge Center between 2010 and October 2015 (with the most recent event occurring in September 2015). Most recorded events involved accidental fuel spills or gas leaks. The largest HazMat incident in Beaver County's recent history occurred on October 20, 2006, when a multi-car train derailed, involving 23 Norfolk-Southern tanker cars transporting 33,000 gallons of ethanol per railcar, spilling 759,000 gallons of product. This incident logged 82 continuous hours, close to 1,000 man hours, and involved multiple agencies from within and outside the County. More recently, in March 2011, an underground diesel fuel pipeline ruptured in Shippingport, causing fuel to shoot approximately 20 feet into the air and necessitating several days of mitigation efforts (Riely 2011).

The County has also undergone several explosions related to HazMat and environmental hazards facilities. These events are described in Section 4.3.14, under the Urban Fire and Explosions profile.

According to the Pipeline and Hazardous Materials Safety Administration (PHMSA), since 2010, 631 pipeline incidents have occurred in the United States, and 18 have occurred in Pennsylvania. None of these events occurred in Beaver County, and the event closest to the County, in July 2015 in Allegheny County, was classified as non-significant. PHMSA also tracks HazMat releases, noting that Pennsylvania has undergone 8,162 since 2006. At least 25 of these incidents occurred in Beaver County. Table 4.3.4-1 lists HazMat incidents in Beaver County from 2004 to 2015. Notably, not all events that occurred in Beaver County are included because of the large volume of documentation and the possibility that not all sources have been identified or researched. Loss and impact information could vary depending on the source. Therefore, accuracy of monetary figures discussed is based only on the available information identified during research for this HMP Update.

Table 4.3.4-1. Past Occurrences of Hazardous Material Incidents (2004-2015)

Date	Type	Location
1/2/2004	Decomposed Body	New Sewickley Township
1/2/2004	HAZMAT Response	Rochester Township
2/3/2004	White Powder	Rochester Township
4/6/2004	Chemical Spill	Rochester Township
5/2/2004	Motor Vehicle Accident	Independence Township

5/19/2004	Mercury Valve Break	Chippewa Township
8/6/2004	Unknown Liquid Spill	Aliquippa City
9/4/2004	Craft Loose on River	Rochester Borough
9/18/2004	Flooding	Potter Township
9/19/2004	Rescue Stand By	Rochester Borough
9/19/2004	Leaking Tank Car	Conway Borough
10/8/2004	Tanker Rollover	Greene Township
11/8/2004	Diesel Spill	Monaca Borough
2/27/2005	Fuel Spill	Ohio River (Industry Borough)
3/4/2005	Body Recovery	Industry Borough
3/26/2005	Meth Lab Cleanup	Big Beaver Borough
4/1/2005	Cleanup/Containment	Hanover Township
4/11/2005	Body Recovery	Conway Borough
5/17/2005	White Powder	Brighton Township
6/11/2005	Roadway Condition	Aliquippa City
7/3/2005	Boat Fire	Rochester Borough
9/5/2005	Diesel Saddle Tank Leak	Aliquippa City
9/16/2005	Fuel Spill	Conway Borough
12/18/2005	Spill	Potter Township
2/24/2006	Highway Accident – Corrosive Liquid	Ellwood City
3/31/2006	Ethyl Alcohol	Conway Borough
4/13/2006	Bridge Collapse	Economy Borough
5/9/2006	Hydrogen Peroxide Leak	Midland
8/7/2006	Chlorine Leak	Aliquippa City
8/19/2006	Water Rescue	Bridgewater
8/21/2006	Fish Kill Investigation	New Sewickley
9/15/2006	White Powder	Beaver Borough
9/15/2006	Highway Accident – Combustible Liquid	Monaca
10/17/2006	Search Detail	Industry Borough
10/20/2006	Ethanol	New Brighton
11/10/2006	Highway Accident	Beaver Falls
1/11/2007	Fuel Oil Spill	Brighton Township
4/30/2007	Bomb Threat	Economy Borough
5/07/2007	Fuel Leak	Aliquippa City
5/23/2007	Unknown	Shippingport
5/27/2007	Fuel Leak	Chippewa
6/7/2007	UN#1760	Rochester Borough
7/10/2007	Highway Accident – Hazardous Waste Liquid	Ellwood City
8/3/2007	Highway Accident – Methyl Ethyl Ketone	Zelienople
9/27/2007	Highway Accident – Sulfuric Acid	Monaca
12/30/2007	Body Recovery	Darlington Township
4/11/2008	Unknown Substance	Potter Township
4/18/2008	Chemical Reaction	Aliquippa City

4/30/2008	Chemical	Marion Township
8/20/2008	Highway Accident	Greene – Isopropanol
10/13/2008	Motor Vehicle Accident	Chippewa Township
12/22/2008	Motor Vehicle Accident	Turnpike
1/28/2009	Motor Vehicle Accident	Franklin Township
3/28/2009	Motor Vehicle Accident	New Sewickley
6/3/2009	Highway Accident – Environmentally Hazardous Liquids	Monaca
6/17/2009	Highway Accident – Environmentally Hazardous Liquids	Monaca
10/6/2009	Air Accident – Dry Ice	Aliquippa
12/21/2009	Motor Vehicle Accident	Fallston Borough
7/18/2010	Highway Accident – Environmentally Hazardous Liquids	Monaca
7/30/2010	Rail Accident – Butadienes	Aliquippa
2/16/2011	Highway Accident – Ammonia Solution	Ellwood City
5/31/2011	Rail Accident – Ammonia Solution	Monaca
7/25/2011	Rail Accident – Ammonia Solution	Monaca
1/18/2012	Highway Accident – Ethanolamine	Shippingport
5/3/2013	Highway Accident – Diesel Fuel	Hopewell Township
6/28/2013	Highway Accident – Nitric Acid Other than Red Fuming	Zelienople
11/22/2013	Highway Accident – Lithium Battery	Ellwood City
12/5/2013	Air Accident – Vanadium Pentoxide Nonfused Form	Zelienople
3/25/2014	Highway Accident – Cartridges for Weapons/Small Arms	Zelienople
3/26/2014	Highway Accident – Cartridges for Weapons/Small Arms	Zelienople
8/27/2014	Rail Accident	Aliquippa
9/22/2014	Highway Accident – Corrosive Liquid	Ellwood City
10/4/2014	Highway Accident – Gasoline	Monaca

Sources: PEIRS 2010, PHMSA 2015

Note: Unless otherwise noted, specific details are not available (e.g., type of HazMat involved in a motor vehicle or highway accident).

Reporting requirements from the State changed in 2007, allowing State agencies to categorize incidents as something other than "Hazardous Materials." For instance, a vehicle collision resulting in a spill of petroleum products (e.g., gasoline, motor oil) may be reported as a vehicle accident instead of a HazMat release. In the case of an explosion, the explosive event may not be the primary incident. Rather, the incident may be based on events that led up to an explosion.

Beaver County also tracks releases of chemicals into air, water, and land disposal units. This information is then published by EPA. In 2013, Beaver County disposed of a total of 23.1 million pounds of toxic chemicals, with disposal of 2.1 million pounds on site (1.1 million pounds into air, 1 million pounds into water, and none into land), and 20.9 million pounds off site. The top five TRI chemicals released into air included zinc compounds (44%), hydrochloric acid (1995 and after "acid aerosols" only) (33%), hydrogen fluoride (5%), ammonia (5%), and sulfuric acid (1994 and after "acid aerosols" only) (3%). The top five TRI chemicals

released water included nitrate compounds (98%), manganese compounds (1%), ammonia (1%), barium compounds (0%), and zinc compounds (0%).

Much lower historical rates of incidents in Beaver County have related to its Marcellus Shale and coal mining environmental concerns. Beaver County has no prior history of environmental hazards or deaths caused by production and/or distribution of natural gas extracted from Marcellus Shale. Moreover, while environmental incidents including water contamination and fire tracing to oil and gas well drilling have occurred throughout Pennsylvania history, no record indicates occurrences of these in Beaver County. Nonetheless, Marcellus Shale drilling has caused some environmentally hazardous situations in Pennsylvania. For instance, a well "blowout" in Clearfield County in 2010 released natural gas and hazardous drilling chemicals into the air for over 16 hours, contaminating a nearby spring and injuring seven people (Ove 2010).

Drinking water contamination stemming from hydraulic fracturing is a serious concern, emphasized by Marcellus Shale drilling opponents, although studies have supported advocates and opponents of the technique. Current assessment is that groundwater contamination from drilling occurs much less frequently than originally feared. Data from various regulatory agencies responsible for enforcement of gas well drilling regulations indicate that more than 95% of complaints received from homeowners suspecting problems from nearby gas well drilling actually traced to pre-existing problems or other nearby land use activities. A study by Penn State University in 2007 found that about 3 percent of private water wells in areas undergoing extensive drilling exceeded drinking water standards for concentrations of total dissolved solids, barium, or chloride (three of the most likely water pollutants from gas well drilling) (Penn State University 2010). While these studies indicate that contamination is not a frequent occurrence, it can still occur and lead to public health concerns. Both PADEP and EPA conduct ongoing tests of water quality in and around Marcellus Shale operations. Results of this research should be continually monitored. Because of potential impacts of Marcellus Shale incidents, South Beaver Township is considering an ordinance to prevent potential HazMat incidents related to Marcellus Shale.

Mining operations and regulations continue to improve, so while incidents still occur, these are increasingly rare. Table 4.3.4-2 indicates coal mining incidents reported to PEIRS from 2002-2009. No coal mining incidents were reported to Knowledge Center between 2010 and October 2015.

Table 4.3.4-2. Past Occurrences of Coal Mine Incidents (2002-2015)

Date	Type	Location
10/31/2002	Abandoned mine fire; no injuries reported	Big Beaver Township
5/23/2003	Miner injured while working in a mine	Greene Township

Sources: PEIRS 2002-2009, Knowledge Center 2015

4.3.4.4 Future Occurrence

Because of the wide scope of definition of environmental hazards, ranging from a small spill to a large release of a highly volatile or toxic HazMat, incidents can and will happen at any time. Additionally, the County is home to over 160 SARA facilities. Although these facilities follow applicable safety and health regulations and best practices, proximities of the facilities to population centers is a concern for the County.

HazMat is also transported along I-76, I-376, US-30, PA-65, PA-68, PA-18, and PA-51, and by rail. Transportation of HazMat on highways involves tanker trucks or trailers; not surprisingly, trucks are responsible for the greatest number of highway HazMat incidents. At several points, these transportation routes cross streams within the watersheds that are part of the County's domestic water supply. Beaver County is approximately a half hour away, by road, from Pittsburgh, Pennsylvania. The County's relative proximity to a more urban area could eventually lead to an increase in transportation of HazMat via road, rail, and air.

While HazMat release incidents in Beaver County have occurred in the past, they are generally considered difficult to predict. Smaller incidents, such as fuel spills, will affect the County many times each year, most likely during refilling of home heating oil tanks, and may not be reported. Although the County does not anticipate severe releases on any regular basis, possibility of this should not be discounted. Based on Risk Factor Methodology Probability Criteria, the likelihood of future HazMat occurrences within Beaver County remains at *highly likely*.

4.3.4.5 Vulnerability Assessment

To understand risk, a community must evaluate the assets exposed or vulnerable within the identified hazard area. To assess effects of and risk from environmental hazards, locations of SARA Title III facilities and major roadways are examined. The following sections evaluate and estimate potential impacts in Beaver County, presenting specifically:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impact on (1) life, health, and safety; (2) general building stock, critical facilities, and the economy; and (3) future growth and development.
- Impact on the environment.

Overview of Vulnerability

Facilities that produce, use, or ship HazMat within the Commonwealth of Pennsylvania are required to comply with regulations set forth within the federal SARA and the Emergency Planning and Community Right to Know Act (EPCRA), and the Commonwealth of Pennsylvania reporting requirements under the Hazardous Materials Emergency Planning and Response Act (Act 165). The County has over 160 SARA Title III facilities.

As stated above, the major roadways in the County include two interstates (I-70 and I-376), one U.S. Highway (US-30), and four State Highways (PA-65, PA-68, PA-18, and PA-51). Additionally, the County has four major rail providers (not counting passenger service): BPRR rail lines, CSX rail lines, and NS rail lines. Accidents on these roadways or rail lines could result in HazMat spills that could contaminate and impact surrounding populations and environment.

Data and Methodology

To determine potential impact on the County, a 0.25-mile buffer was placed around the identified major roadways, as well as a 0.5-mile radius around each SARA Type III facility to define the hazard area. Populations and features of the built environment within this area may be directly or indirectly affected by an environmental hazard. The hazard area was overlaid upon the 2010 U.S. Census population data in Geographic Information System (GIS) (U.S. Census 2010). Census blocks are not consistent with these boundaries; blocks with their centroids within the hazard area were determined to be affected.

The vulnerability radius for each hazard facility was set at 0.5 mile.

Impact on Life, Health, and Safety

Environmental hazards most significantly impact the residential population in Beaver County. The majority of incidents reported in the County were related to (1) petroleum spills, which may be the result of motor vehicle incidents; and (2) other chemical releases and spills. Table 4.3.4-3 lists estimated Beaver County populations vulnerable to environmental hazard areas.

Table 4.3.4-3. Estimated Beaver County Populations Vulnerable to Environmental Hazard Areas

Municipality	Total Population	Population within ¼ mile of major roadways	% Population	Population within vulnerability radii of SARA Facility	% Population
City of Aliquippa	9,438	1,011	10.7%	3,390	35.9%
Ambridge Borough	7,050	2,577	36.6%	6,806	96.5%
Baden Borough	4,135	1,018	24.6%	1,953	47.2%
Beaver Borough	4,531	3,198	70.6%	3,410	75.3%
City of Beaver Falls	8,987	6,141	68.3%	7,395	82.3%
Big Beaver Borough	1,970	466	23.7%	706	35.8%
Bridgewater Borough	704	614	87.2%	614	87.2%
Brighton Township	8,227	326	4.0%	2,100	25.5%
Center Township	11,795	1,802	15.3%	2,666	22.6%
Chippewa Township	7,620	1,670	21.9%	2,723	35.7%
Conway Borough	2,176	718	33.0%	885	40.7%
Darlington Borough	254	0	0.0%	0	0%
Darlington Township	1,962	174	8.9%	74	3.8%
Daugherty Township	3,187	313	9.8%	822	25.8%
East Rochester Borough	567	506	89.2%	567	100%
Eastvale Borough	225	12	5.3%	225	100%
Economy Borough	8,970	115	1.3%	745	8.3%
Fallston Borough	266	246	92.5%	266	100%
Frankfort Springs Borough	130	130	100.0%	0	0%
Franklin Township	4,052	349	8.6%	1,171	28.9%
Freedom Borough	1,569	1,477	94.1%	434	27.7%
Georgetown Borough	174	0	0.0%	0	0%
Glasgow Borough	60	60	100.0%	0	0%
Greene Township	2,356	247	10.5%	39	1.7%
Hanover Township	3,690	383	10.4%	204	5.5%
Harmony Township	3,197	36	1.1%	1,402	43.9%
Homewood Borough	109	63	57.8%	0	0%
Hookstown Borough	147	0	0.0%	0	0%
Hopewell Township	12,593	495	3.9%	603	4.8%
Independence Township	2,503	94	3.8%	190	7.6%
Industry Borough	1,835	768	41.9%	516	28.1%
Koppel Borough	762	449	58.9%	762	100%
Marion Township	913	102	11.2%	361	39.5%
Midland Borough	2,635	1,887	71.6%	1,568	59.5%
Monaca Borough	5,737	2,007	35.0%	4,015	70.0%

Municipality	Total Population	Population within ¼ mile of major roadways	% Population	Population within vulnerability radii of SARA Facility	% Population
New Brighton Borough	6,025	4,684	77.7%	5,227	86.8%
New Galilee Borough	379	0	0.0%	373	98.4%
New Sewickley Township	7,360	945	12.8%	444	6.0%
North Sewickley Township	5,488	997	18.2%	706	12.9%
Ohioville Borough	3,533	17	0.5%	211	6.0%
Patterson Township	3,029	668	22.1%	1,508	49.8%
Patterson Heights Borough	636	0	0.0%	407	64.0%
Potter Township	548	344	62.8%	35	6.4%
Pulaski Township	1,500	0	0.0%	892	59.5%
Raccoon Township	3,064	582	19.0%	108	3.5%
Rochester Borough	3,657	3,267	89.3%	3,657	100%
Rochester Township	2,802	1,242	44.3%	1,489	53.1%
Shippingport Borough	214	0	0.0%	198	92.5%
South Beaver Township	2,717	220	8.1%	300	11.0%
South Heights Borough	475	275	57.9%	188	39.6%
Vanport Township	1,321	1,216	92.1%	1,321	100%
West Mayfield Borough	1,239	0	0.0%	640	51.7%
White Township	1,394	0	0.0%	130	9.3%
BEAVER COUNTY (TOTAL)	**170,539**	**44,283**	**26.0%**	**64,625**	**37.9%**

Source: U.S. Census 2010; Beaver County 2015

Notes:

% Percent
SARA Superfund Amendments and Reauthorization Act

Impact on General Building Stock, Critical Facilities, and Economy

While buildings and critical facilities may be present within the hazard area, estimating direct damage to these structures and facilities would be difficult. However, damages to the surrounding environment can result in indirect impacts, such as temporary loss of function due to hazard response or damage in the area.

Economic losses from environmental hazards and explosion incidents range from non-recordable to those exceeding millions of dollars. Impacts on the local economy from a single incident are almost impossible to measure because of complexities of predicting losses of work, revenue, and future business.

Impact on the Environment

As discussed above, environmental hazards and explosion incidents can profoundly affect the surrounding environment. Contamination of soil, and surface water and groundwater supplies, can result in many direct impacts on surrounding populations and ecosystems. Local flora and fauna within hazard areas are also at risk.

Future Growth and Development

As discussed in Section 2.4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be impacted by environmental hazards if within identified hazard areas. The County intends to discourage development within vulnerable areas and SFHAs, or to encourage higher regulatory standards on the local level.

4.3.5 Flood, Flash Flood, Ice Jam

This section provides a profile and vulnerability assessment of the flood hazard in Beaver County. Floods are one of the most common natural hazards in the United States and are the most prevalent type of natural disaster occurring in Pennsylvania. Over 94 percent of the State's municipalities have been designated as flood-prone areas. Both seasonal and flash floods have been causes of millions of dollars in annual property damages, loss of lives, and disruption of economic activities (Pennsylvania Emergency Management Agency [PEMA] 2013).

The Federal Emergency Management Agency's (FEMA) definition of flooding is "a general and temporary condition of partial or complete inundation of 2 or more acres of normally dry land area or of two or more properties from the overflow of inland or tidal waters or the rapid accumulation of runoff of surface waters from any source" (FloodSmart.gov 2015).

Most floods fall into three categories: riverine, coastal, and shallow (FEMA 2015). Other types of floods may include ice-jam floods, flash floods, stormwater floods, alluvial fan floods, dam failure floods, and floods associated with local drainage or high groundwater (as indicated in the previous flood definition). For the purpose of this Plan and as deemed appropriate by the Planning Team, riverine, flash, ice-jam, and stormwater flooding are the main flood types of concern for Beaver County. These types of floods are further discussed below.

Riverine Floods

Riverine floods are the most common flood type and occur along a channel. Channels are defined features on the ground that carry water through and out of a watershed. They may be called rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas. These floods usually occur after heavy rains, heavy thunderstorms, or snowmelt, and can be slow or fast-rising, and generally develop over a period of hours to days (FEMA 2015, Illinois Association for Floodplain and Stormwater Management 2006).

Flash Floods

According to the National Weather Service (NWS), flash floods are a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within 6 hours of the causative event (e.g., intense rainfall, dam failure, or ice jam) (NWS 2015).

Flash floods can occur very quickly and with very little warning. This type of flood can be deadly because it produces rapid rises in water levels and has devastating flow velocities. Urban areas are more susceptible to flash floods because a high percentage of the surface area is impervious (Pennsylvania Emergency Management Agency [PEMA] 2013). Time elapsed before flash flooding occurs may vary in different parts of the country. Ongoing flooding can intensify to flash flooding where intense rainfall results in a rapid surge of rising flood waters (NWS 2015). A flash flood can have a dangerous wall of roaring water that carries rocks, mud, and other debris, and can sweep away most things in its path. Flash floods usually result from intense storms dropping large amounts of rain within a brief period with little or no warning, and can reach their peak within only a few minutes. They normally occur in the summer during the thunderstorm season. The most severe flooding conditions usually occur when direct rainfall is augmented by snowmelt. If the soil is saturated or frozen, stream flow may increase because of inability of the soil to absorb additional precipitation (FEMA 2008).

Ice-Jam Floods

An ice jam is an accumulation of ice that acts as a natural dam and restricts flow of a body of water. Ice jams occur when warm temperatures and heavy rains cause rapid snow melt. The melting snow, combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layers into large chunks, which float downstream and often pile up near narrow passages and obstructions (bridges and dams). Ice jams may build up to a thickness great enough to raise the water level and cause flooding (Northeast States Emergency Consortium [NESEC] Date Unknown, U.S. Army Corps of Engineers [USACE] 2002).

Ice jams are of two different types: freeze-up and breakup. Freeze-up jams occur in the early to mid-winter when floating ice may slow or stop due to a change in water slope as it reaches an obstruction to movement. Breakup jams occur during periods of thaw, generally in late winter and early spring. The ice cover breakup is usually associated with a rapid increase in runoff and corresponding river discharge caused by a heavy rainfall, snowmelt, or warmer temperatures (USACE 2002).

Dam Failure Floods

A dam is an artificial barrier that can impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water (FEMA 2010). Dams are man-made structures built across a stream or river that impound water and reduce flow downstream (FEMA 2003). They are built for purposes of power production, agriculture, water supply, recreation, and flood protection. Dam failure is any malfunction or abnormality outside of the design that adversely affects a dam's primary function of impounding water (FEMA 2011). Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed capacity of the dam (inadequate spillway capacity)
- Prolonged periods of rainfall and flooding
- Deliberate acts of sabotage (terrorism)
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate or negligent operation, maintenance, and upkeep
- Failure of upstream dams on the same waterway
- Earthquake (liquefaction/landslides) (FEMA 2010).

Flooding can occur when a dam fails or breaks, producing effects similar to flash floods. Areas most susceptible to effects of floods are low-lying areas near water or downstream from a dam (FEMA 2011).

Flooding caused by dam failure is addressed in Section 4.3.1 of this Plan.

4.3.5.1 Location and Extent

Flooding in Pennsylvania is typically associated with abnormally high and intense rainfall amounts. It can also be caused by sudden snowmelt, landslides, or dam failures. In Pennsylvania, flooding usually occurs in the summer; however, flooding has occurred during the winter months as well.

Floodplains are found in lowland areas adjacent to rivers, streams, creeks, lakes, or other bodies of water that become inundated during a flood. The size of a floodplain depends on the recurrence interval of a given flood. A 1-percent annual chance floodplain is smaller than the floodplain associated with a flood that has a

0.2-percent annual chance of occurring (PEMA 2013). Floodplain maps of each Beaver County jurisdiction are available at the end of this profile. These maps show locations of both the 1-percent chance annual floodplain and the 0.2-percent chance annual floodplain.

Flooding is the most significant natural hazard in Beaver County. Watercourses prone to flooding include Beaver River, Little Beaver Creek, Blockhouse Run, Big Sewickley Creek, Brush Creek, Connoquenessing Creek, Ohio River, and Raccoon Creek. Fifty of Beaver County's 53 municipalities have identified flood hazard areas; those that do not include Frankfort Springs, Georgetown, and Homewood Boroughs (further discussed later in this profile). Several flood-prone municipalities in the County have identified the following vulnerable roadways:

- Ambridge Borough: Route 65, 4th Street, and the intersection of 19th street and Duss Avenue
- Harmony Township: Duss Avenue, Legionville Road, 8th Street Extension, and Valley Road
- South Beaver Township: Swamp Poodle Bridge Site, Township Recreation Park, and McClain Road area.

Additionally, New Sewickley Township identified flooding problems for upstream development in Cranberry Township from Brush Creek. South Heights Borough also identified an increase in road closures from flood events.

Table 4.3.5-1 lists total land areas within the 1-percent and 0.2-percent annual chance flood zones calculated via a spatial analysis referencing the 2015 Digital Flood Insurance Rate Map (DFIRM).

Table 4.3.5-1. Total Land Areas in the 1-Percent and 0.2-Percent Annual Chance Flood Zones (Acres)

Municipality	NFIP-Participating Community	Total Area (acres)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
			Area (acres)	% of Total	Area (acres)	% of Total
City of Aliquippa	Yes	2,879	291	10.1%	348	12.1%
Ambridge Borough	Yes	1,133	216	19.1%	299	26.4%
Baden Borough	Yes	1,545	143	9.2%	163	10.6%
Beaver Borough	Yes	676	136	20.1%	137	20.2%
City of Beaver Falls	Yes	11,576	665	5.7%	682	5.9%
Big Beaver Borough	Yes	1,466	272	18.5%	315	21.5%
Bridgewater Borough	Yes	467	160	34.3%	205	43.9%
Brighton Township	Yes	12,322	275	2.2%	276	2.2%
Center Township	Yes	9,980	678	6.8%	695	7.0%
Chippewa Township	Yes	10,124	137	1.4%	142	1.4%
Conway Borough	Yes	967	179	18.5%	302	31.2%
Darlington Borough	Yes	53	3	4.8%	3	4.8%
Darlington Township	Yes	14,099	1,351	9.6%	1,351	9.6%
Daugherty Township	Yes	6,262	79	1.3%	91	1.5%
East Rochester Borough	Yes	286	69	24.3%	82	28.7%
Eastvale Borough	Yes	87	41	46.4%	41	46.9%

Table 4.3.5-1. Total Land Areas in the 1-Percent and 0.2-Percent Annual Chance Flood Zones (Acres)

Municipality	NFIP-Participating Community	Total Area (acres)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
			Area (acres)	% of Total	Area (acres)	% of Total
Economy Borough	Yes	11,550	226	2.0%	323	2.8%
Fallston Borough	Yes	337	71	21.1%	82	24.2%
Frankfort Springs Borough	Yes	154	0	0.0%	0	0.0%
Franklin Township	Yes	11,574	1,199	10.4%	1,338	11.6%
Freedom Borough	Yes	475	126	26.5%	207	43.6%
Georgetown Borough[1]	No	154	54	35.4%	54	35.4%
Glasgow Borough	Yes	67	52	78.1%	54	80.9%
Greene Township	Yes	17,150	664	3.9%	668	3.9%
Hanover Township	Yes	28,728	594	2.1%	594	2.1%
Harmony Township	Yes	1,963	184	9.4%	195	9.9%
Homewood Borough	Yes	111	5	4.8%	5	4.8%
Hookstown Borough	Yes	80	5	6.5%	5	6.5%
Hopewell Township	Yes	11,045	541	4.9%	554	5.0%
Independence Township	Yes	14,814	1,357	9.2%	1,360	9.2%
Industry Borough	Yes	6,889	787	11.4%	807	11.7%
Koppel Borough	Yes	349	49	14.0%	49	14.0%
Marion Township	Yes	6,636	637	9.6%	648	9.8%
Midland Borough	Yes	1,477	188	12.8%	189	12.8%
Monaca Borough	Yes	1,511	284	18.8%	299	19.8%
New Brighton Borough	Yes	723	128	17.7%	139	19.2%
New Galilee Borough	Yes	168	21	12.3%	21	12.3%
New Sewickley Township	Yes	21,032	532	2.5%	532	2.5%
North Sewickley Township	Yes	13,526	694	5.1%	721	5.3%
Ohioville Borough	Yes	15,009	463	3.1%	463	3.1%
Patterson Township	Yes	152	6	3.7%	6	3.7%
Patterson Heights Borough	Yes	1,071	32	3.0%	32	3.0%
Potter Township	Yes	4,439	688	15.5%	696	15.7%
Pulaski Township	Yes	465	12	2.6%	14	3.0%
Raccoon Township	Yes	12,155	532	4.4%	532	4.4%
Rochester Borough	Yes	450	108	24.1%	117	26.0%
Rochester Township	Yes	2,526	102	4.0%	115	4.6%
Shippingport Borough	Yes	2,507	462	18.4%	463	18.5%
South Beaver Township	Yes	19,035	619	3.3%	619	3.3%
South Heights Borough	Yes	269	60	22.2%	60	22.2%
Vanport Township	Yes	699	202	28.9%	227	32.4%

Table 4.3.5-1. Total Land Areas in the 1-Percent and 0.2-Percent Annual Chance Flood Zones (Acres)

Municipality	NFIP-Participating Community	Total Area (acres)	1% Flood Event Hazard Area		0.2% Flood Event Hazard Area	
			Area (acres)	% of Total	Area (acres)	% of Total
West Mayfield Borough	Yes	500	16	3.2%	18	3.5%
White Township	Yes	459	<1	<1%	<1	<1%
BEAVER COUNTY (TOTAL)	N/A	**284,379**	**16,396**	**5.8%**	**17,336**	**6.1%**

Source: FEMA 2015

Note: Areas listed include areas of inland waterways
[1] = Georgetown Borough is currently suspended from the NFIP.

In accordance with the 1978 Pennsylvania Stormwater Management Act (Act 167), counties are required to prepare stormwater management plans on a watershed-by-watershed basis that provide for improved management of stormwater impacts associated with development of land. In 2010, Beaver County developed and implemented Phase I of the Act 167 County Wide Plan Stormwater Management Plan. This phase of the Plan includes the Scope of Study—Establishing procedures for use in preparing the Plan. These procedures are determined by an overall survey of:

- Specific watershed characteristics and hydrologic conditions
- Stormwater-related problems and significant obstructions
- Alternative measures for control
- Goals, objectives, solution strategies, and estimated costs for Phase 2 of the Plan.

Beaver County has not yet developed Phase II of its Act 167 Stormwater Management Plan.

Table 4.3.5-2 lists Pennsylvania Department of Environmental Protection (PADEP)-designated Act 167 watersheds in Beaver County.

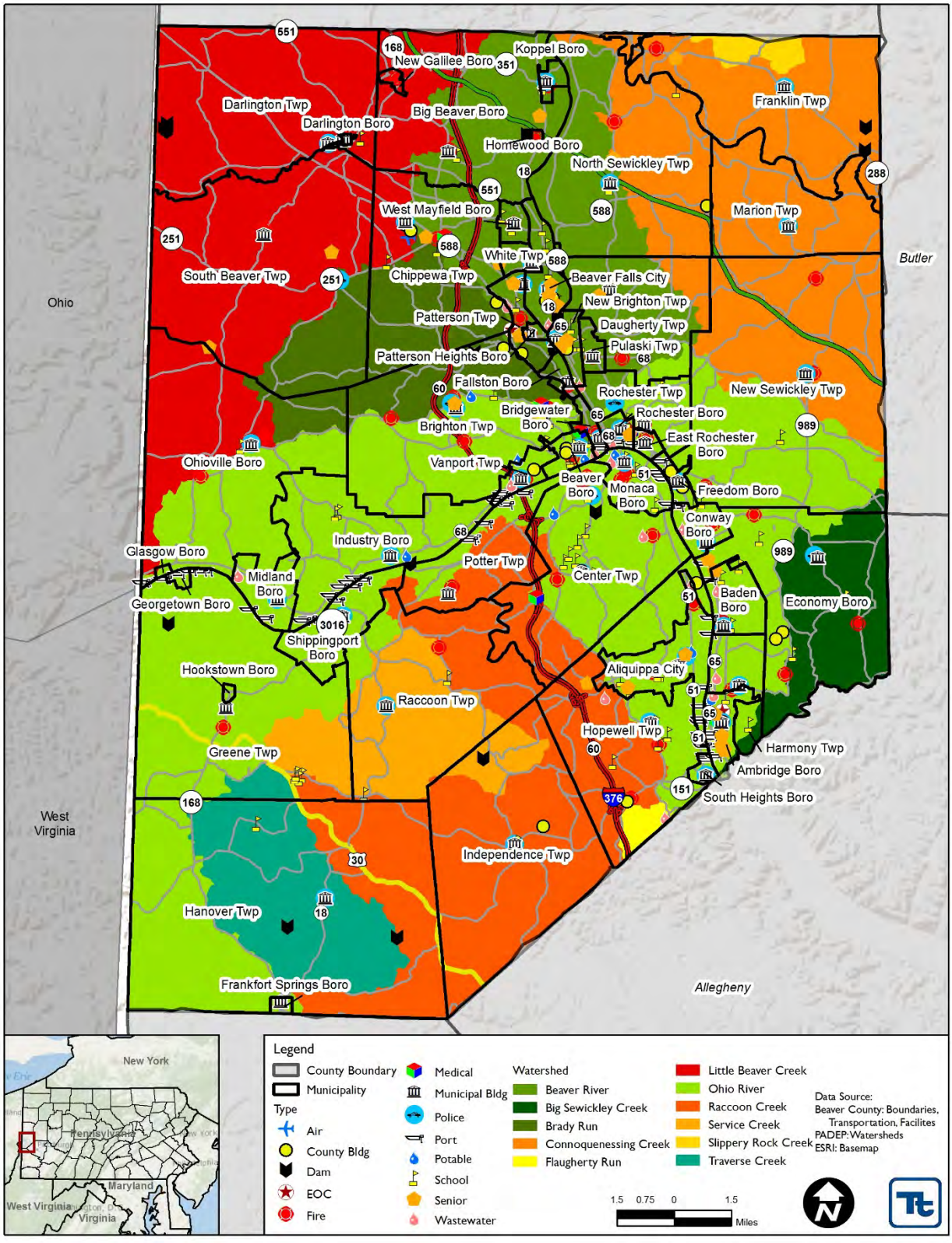
Table 4.3.5-2. PADEP-Designated Watersheds Identified in Act 167 County Stormwater Management Plan

Beaver County Watersheds	
Beaver River	Ohio River
Big Sewickley Creek	Raccoon Creek
Brady Run	Service Creek
Connoquenessing Creek	Slippery Rock Creek
Flaugherty Run	Traverse Creek
Little Beaver Creek	

Source: Beaver County Act 167 Plan, 2010

Figure 4.3.5-1 shows PADEP-designated watersheds with critical facilities in Beaver County.

Figure 4.3.5-1. PADEP-Designated Watersheds with Critical Facilities



Source: PADEP, Beaver County

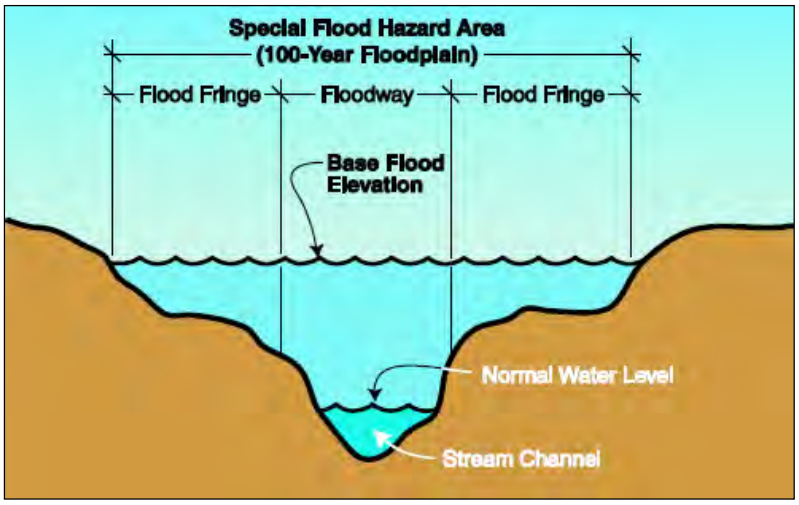
FEMA Regulatory Flood Zones

According to FEMA, flood hazard areas are defined as areas on a map shown to be inundated by a flood of a given magnitude. These areas are determined by use of statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Flood hazard areas are delineated on FEMA's Flood Insurance Rate Maps (FIRM), which are official maps of a community on which the Federal Insurance and Mitigation Administration has delineated both Special Flood Hazard Areas (SFHA) and the risk premium zones applicable to the community. These maps identify SFHAs, location of a specific property in relation to the SFHA, the base flood elevation (BFE) (1-percent annual chance) at a specific site, the magnitude of a flood hazard within a specific area, undeveloped coastal barriers where flood insurance is not available, and regulatory floodways and floodplain boundaries (1-percent and 0.2-percent annual chance floodplain boundaries) (FEMA 2003, 2005, 2008). Beaver County's FIRMs can be accessed online via the FEMA Flood Map Service Center (https://msc.fema.gov/portal).

The land area covered by floodwaters of the base flood is the SFHA on a FIRM. It is the area where the National Flood Insurance Program's (NFIP) floodplain management regulations must be enforced, and the area where mandatory purchase of flood insurance applies. This regulatory boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities because many communities have maps showing the extent of the base flood and likely depths that will occur.

The 1-percent annual chance flood is referred to as the base flood. As defined by NFIP, the BFE on a FIRM is the elevation of a base flood event, or a flood which has a 1-percent chance of occurring in any given year. The BFE describes the exact elevation of the water that will result from a given discharge level, which is one of the most important factors used in estimating potential damage within a given area. A structure within a 1-percent annual chance floodplain has a 26-percent chance of undergoing flood damage during the term of a 30-year mortgage. The 1-percent annual chance flood is a regulatory standard used by federal agencies and most states to administer floodplain management programs. The 1-percent annual chance flood is used by NFIP as the basis for insurance requirements nationwide. FIRMs also depict 0.2-percent annual chance flood designations (FEMA 2003). Figure 4.3.5-2 depicts the SFHA, the base flood elevation, the flood fringe, and the floodway areas of a floodplain for the 1-percent annual chance flood.

Figure 4.3.5-2. Floodplain Illustration



Source: PEMA 2013

The SFHA serves as the primary regulatory boundary used by FEMA and Pennsylvania. Digitized Flood Insurance Rate Maps (DFIRM), FIRMs, and other flood hazard information can be referenced to identify the expected spatial extent of flooding from a 1-percent annual chance event and 0.2-percent annual chance event.

At the time this Plan was written, the August 2015 DFIRMs were considered the best available, and were used for the risk analysis. Figure 4.3.5-3 illustrates NFIP flood zones in Beaver County. Maps of each municipality's flood zones are shown at the end of this profile.

While the FIRMs provide a creditable source to document extent and location of the flood hazard, accuracy of data reflected on these maps has limitations. Notably, FIRMs are based on existing hydrological conditions at the time of map preparation. FIRMs are not set up to account for possible changes in hydrology over time.

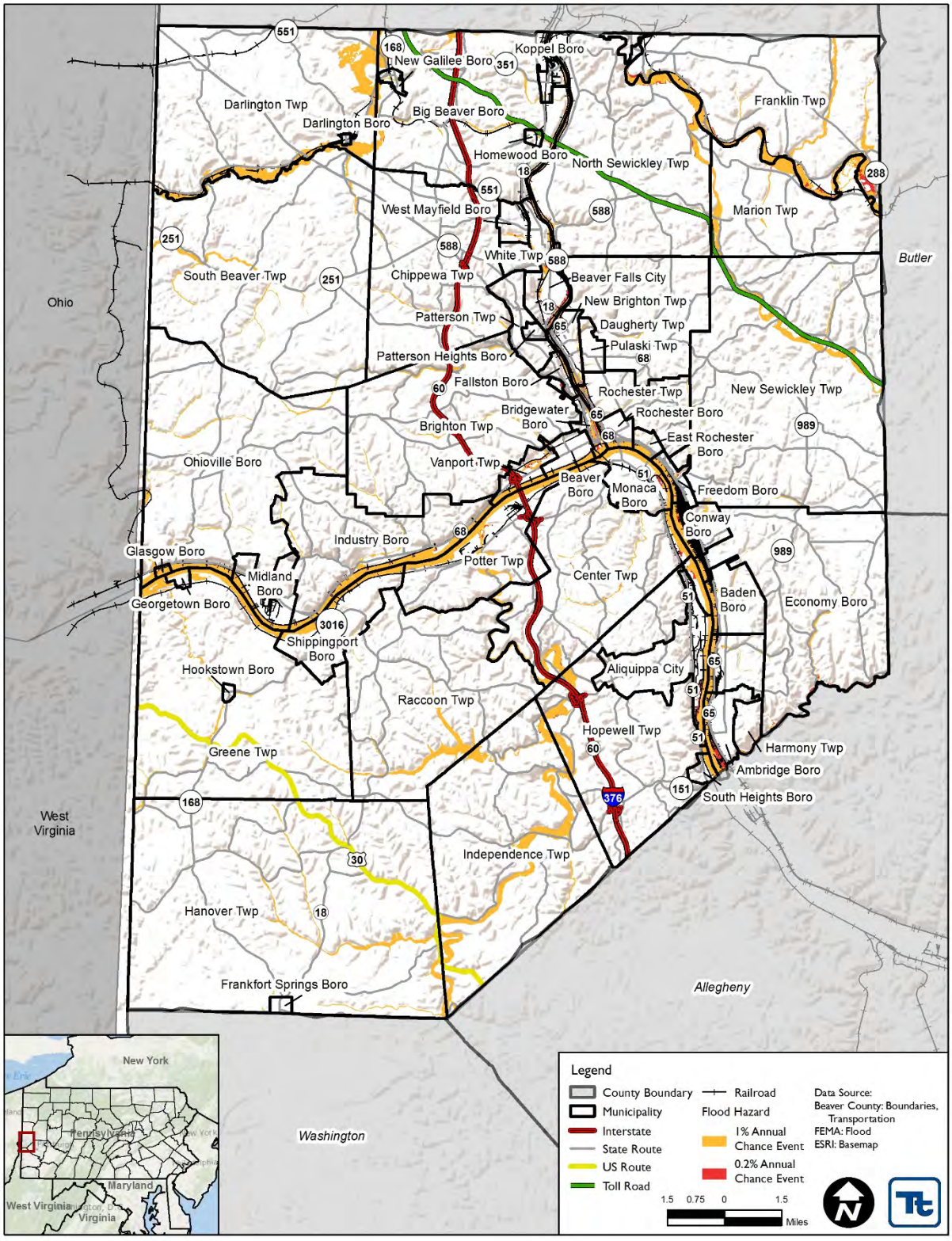
Flood Insurance Study

In addition to FIRM and DFIRMs, FEMA also provides Flood Insurance Studies (FIS) of entire counties and individual jurisdictions. These studies aid in administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. They are narrative reports of countywide flood hazards, including descriptions of flood areas studied and engineered methods used, principal flood problems, flood protection measures, and graphic profiles of flood sources (FEMA 2008). The countywide FIS for Beaver County was last completed in August 2015, at the same time as the DFIRM revisions.

Ice-Jam Hazard Areas

Ice jams are common in northeastern United States, and the Commonwealth of Pennsylvania is not an exception. The Ice Jam Database, maintained by the Ice Engineering Group at the USACE Cold Regions Research and Engineering Laboratory (CRREL), currently consists of over 19,000 records from across the United States. According to the USACE-CRREL, Beaver County underwent or may have been impacted by 11 historical ice jam incidents between 1780 and 2015 (USACE 2015). Ice Jams have formed along Connoquennessing Creek, Ohio River, Beaver River, and Big Sewickley Creek. Historical events are further mentioned in the "Previous Occurrences" section of this hazard profile.

Figure 4.3.5-3. NFIP Floodplains in Beaver County



Source: FEMA 2015

4.3.5.2 Range of Magnitude

Both localized and widespread floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents, or bacteria and disease are spread by moving or stagnant floodwaters. Most property damage results from inundation by sediment-filled water. A large amount of rainfall over a short period of time can result in flash floods. Small amounts of rain can cause flooding in areas with frozen soil or saturated soils from a previous event, or if the rain is concentrated in areas with impervious surfaces (PEMA 2013).

Several factors determine severity of floods, including intensity and duration, topography, ground cover, and rate of snowmelt. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Many areas in Pennsylvania have relatively steep slopes that promote quick surface water runoff. Most storms track from west to east; however, some originate in the Great Lakes or the Atlantic Ocean (PEMA 2013).

Rainfall in Pennsylvania is about average for the eastern United States. Amounts of precipitation can be divided into the following six categories:

- Very light rain – precipitation rate of <0.01 inch per hour
- Light rain – precipitation rate between 0.01 inch and 0.04 inch per hour
- Moderate rain – precipitation rate between 0.04 inch and 0.16 inch per hour
- Heavy rain – precipitation rate between 0.16 inch and 0.63 inch per hour
- Very heavy rain – precipitation rate between 0.63 inch and 2 inches per hour
- Extreme rain – precipitation rate greater than 2 inches per hour (PEMA 2013).

Severity of a flood depends not only on the amount of water that accumulates within a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams in an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows, and any more water that accumulates must flow as runoff (Harris 2001).

Riverine and Flash Floods

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat:

- Minor Flooding – minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding – some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding – extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations are necessary (NWS 2011).

Beaver County's worst example of flooding in recent history occurred in in July 2007, when 4 inches of rain fell in 2 hours, causing flash flooding across the County. This event disrupted both County operations and the daily lives of many citizens, and caused millions of dollars of damage.

One of the County's worst floods was associated with Hurricane Agnes in 1972. The County underwent widespread flooding and flash flooding. The damage was so severe that the County was declared a major disaster area in June 1972. Resulting damages were estimated at $7,462,686.

The 2015 FEMA FIS for Beaver County also documents the major flooding problems in the County, including the history of the most significant floods from major waterways. These are listed in Table 4.3.5-3.

Table 4.3.5-3. Major Floods and Range of Magnitude in Beaver County

Water Source	Date of Flood	Gage Height or Stage (feet)	Discharge (cfs)	Estimated Recurrence Interval (years)
Beaver River at the City of Beaver Falls	March 27, 1913	17.4	105,000	150
	January 22, 1959	14.42	70,100	26
	January 25, 1937	13.80	64,500	16
	October 16, 1954	13.33	58,800	11
	March 10, 1964	13.24	57,900	10.5
	January 27, 1952	13.16	57,100	10
	December 30, 1942	13.15	57,00	10
	May 28, 1946	12.96	56,200	9
Connoquenessing Creek at Hazen Road Bridge	June 29, 1924	16.66	21,500	150
	October 16, 1954	15.51	18,000	50
	March 10, 1964	14.77	16,000	25
	January 27, 1952	14.54	15,200	20
	July 1, 1974	13.93	13,900	13
	April 20, 1940	13.90	13,900	13
	April 5, 1957	13.86	13,500	10
	June 24, 1972	13.32	11,800	8
Dashield Lock and Dam Upper Gage Ohio River Mile 13.3	March 19, 1936	44.4	557,000	N/A
	December 31, 1942	37.3	396,000	N/A
	June 23, 1972	34.4	372,000	N/A
	April 27, 1937	34.0	351,000	N/A
	March 7, 1945	33.5	343,000	N/A
	January 26, 1937	32.9	338,000	N/A
	October 16, 1954	32.8	327,000	N/A
	March 11, 1964	31.4	313,000	N/A
	January 23, 1937	31.0	310,000	N/A
	January 28, 1952	30.4	283,000	N/A
	January 23, 1959	30.2	275,000	N/A
Ohio River at Sewickley	March 18, 1936	34.75	574,000	500+
	December 31, 1942	27.39	400,000	115

Water Source	Date of Flood	Gage Height or Stage (feet)	Discharge (cfs)	Estimated Recurrence Interval (years)
	June 24, 1972	24.42	370,000	65
	April 27, 1937	23.93	334,000	29
	March 7, 1945	23.61	331,000	27
	October 16, 1954	22.76	318,000	19
	March 10, 1964	21.20	295,000	11
	January 29, 1952	20.27	282,000	8.5
	April 15, 1948	19.989	277,000	7
Raccoon Creek at Moffats Mills	August 15, 1922	9.80	10,000	67
	June 29, 1924	9.40	9,120	46
	January 27, 1922	7.9	8,590	37
	March 5, 1963	9.00	7,490	22
	May 13, 2923	8.60	7,440	21
	March 30, 1928	8.50	7,240	20
	March 7, 1945	8.23	6,660	14
	February 24, 1975	8.50	6,500	13
	August 6, 1956	8.52	6,430	12

Source: FEMA FIS 2015

4.3.5.3 Past Occurrence

Many sources provided historical information regarding previous occurrences and losses associated with flooding events throughout the Commonwealth of Pennsylvania and Beaver County. With so many sources reviewed for the purpose of this Hazard Mitigation Plan (HMP), loss and impact information regarding many events could vary depending on the source. Therefore, accuracy of monetary figures discussed is based only on available information identified during research for this HMP.

According to the National Oceanic and Atmospheric Administration's National Climatic Data Center (NOAA NCDC) storm event database, Beaver County underwent 54 flood events between January 1, 1950, and August 31, 2015 (the date range of data availability). Total property damages as a result of these flood events were estimated at $40,510,000. This total also includes damages to other counties.

Between 1954 and 2015, the Commonwealth of Pennsylvania underwent 55 FEMA-declared, flood-related disaster declarations (DR) or emergencies classified as one or a combination of the following disaster types: severe storms, mudslides, flash flooding, tropical storms, tropical depressions, high winds, and rains. Typically, these disasters covered a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations (FEMA 2015). Beaver County was included in 14 of the 55 declarations, as listed in Table 4.3.5-4.

Based on all sources researched, known flooding events that have affected Beaver County and its municipalities, resulting in property damages, are listed in Table 4.3.5-4. No injuries or fatalities caused by flooding have been recorded in Beaver County. With flood documentation for the Commonwealth of

Pennsylvania so extensive, not all sources have been identified or researched. Therefore, Table 4.3.5-4 may not include all events that have occurred throughout the County.

Table 4.3.5-4. Flooding Events between 1950 and 2015 in Beaver County

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
August 20, 1955	Floods, Rains	DR-40	Yes	All jurisdictions in Pennsylvania are eligible to apply for assistance under the Hazard Mitigation Grant Program.
March 15, 1956	Flood	DR-50	Yes	All jurisdictions in Pennsylvania are eligible to apply for assistance under the Hazard Mitigation Grant Program.
May 21, 1956	Severe Storm	DR-58	Yes	All jurisdictions in Pennsylvania are eligible to apply for assistance under the Hazard Mitigation Grant Program.
August 9, 1956	Flood	DR-61	Yes	President's Declaration Of Major Disaster for Beaver, Greene, and Washington Counties. All jurisdictions in Pennsylvania are eligible to apply for assistance under the Hazard Mitigation Grant Program.
January 23, 1959	Floods	DR-89	Yes	All jurisdictions in Pennsylvania are eligible to apply for assistance under the Hazard Mitigation Grant Program.
May 1968	Flash Flood	N/A	N/A	$5,000 in estimated costs.
April 1970	Flood	N/A	N/A	Severe Storm/Thunderstorm. $262 in estimated costs.
June 23, 1972	Flood	DR-340	Yes	Flooding due to Tropical Storm Agnes, resulting in Presidential Disaster Declaration. $7,462,686 in estimated costs.
June 3, 1985	Severe Storms, High Winds, Tornadoes	DR-737	Yes	IA and PubA issued to Beaver County, among other Pennsylvania counties.
July 1990	Flood	N/A	N/A	$50,000 in estimated costs.
March 10, 1994	Winter Storm, Severe Storm	DR-1015	Yes	IA and PubA issued to Beaver County, among other Pennsylvania counties.
June 1995	Flood	N/A	N/A	Flooding along roadways in Aliquippa and Hopewell. $15,000 in estimated costs
January 1996	Flood	N/A	N/A	Flooding along Ohio River, resulting in Presidential Disaster Declaration. $9,600,000 in estimated costs.
January 19, 1996	Flash Flood	N/A	N/A	Numerous small streams and several roads were flooded across the County. Extensive damage occurred due to major river flooding along the Ohio River and at the mouth of the Beaver River.
January 19, 1996	Flash Flood	N/A	N/A	Runoff from widespread rains between 1 and 2 inches over saturated soils continued to flood small streams and roads across the County before the water receded on the

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				morning of the 20th.
January 19, 1996	Flood	N/A	N/A	The Allegheny and Monongahela Rivers meet at the Point in Pittsburgh to form the Ohio River. A tremendous amount of runoff and snowmelt, combined with cresting of the Monongahela and the Allegheny Rivers in phase, resulted in the maximum possible crest possible at the start of the Ohio River at Pittsburgh. The Monongahela River usually crests 4 to 8 hours earlier than the Allegheny River. The Ohio River at Pittsburgh crested at 34.6 feet—9.6 feet above its 25-foot flood stage at 10 a.m. on the 20th. In Beaver County, 257 homes were affected, 14 with major damage and 15 destroyed. At least 42 businesses were affected, 2 of which were destroyed. Commercial and industrial damages to real estate, equipment, and supplies alone totaled over $4 Million. Bridges were also damaged by floating debris in the river. About 400 people throughout the County had to be evacuated.
January 21, 1996	Flooding	DR-1093	Yes	IA and PubA issued to Beaver County, among other Pennsylvania counties.
March 1996	Flood	N/A	N/A	Flooding along Connoquenessing, Brush, and Raccoon Creeks. $6,000 in estimated costs.
March 19, 1996	Flash Flood	N/A	N/A	Brush Creek near Unionville was out of its banks. Water was a couple of feet from a road along the stream.
March 20, 1996	Flash Flood	N/A	N/A	Flooding in lowlands occurred when Raccoon Creek, near Shafers, went over its banks.
March 20, 1996	Flood	N/A	N/A	Connoquenessing Creek went out of its banks after widespread rainfall of 1.00 to 1.75 inches fell across the watershed, mainly in Butler County on March 19th. Flooding of low-lying areas along the creek required closure of roads and evacuation of five houses. Flood waters damaged about $6,000 worth of power tools at a business. The flooding occurred mostly in Franklin Township in the northeast part of Beaver County.
May 17, 1996	Flash Flood	N/A	N/A	Heavy thunderstorm rains led to some street flooding in Aliquippa. Kennedy Boulevard was closed and a few area basements were flooded. $8,000 in estimated costs.
June 1996	Flood	N/A	Yes	Presidential DR; flooding (along Crow's Run and Elkhorn Run) and mudslides caused by prolonged, heavy rain. $7,500,000 in estimated costs.

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
June 18, 1996	Flooding	DR-1120	Yes	IA and PubA issued to Beaver County, among other Pennsylvania counties.
June 19, 1996	Flash Flood	N/A	N/A	Flooding and mudslides were reported in Freedom. Some houses were evacuated. The ground gave way under one house in Center Township. Flooding was reported at Crow's Run in New Sewickley Township and along Elkhorn Run in Monaca. Widespread and prolonged thunderstorms with very heavy rain produced numerous storm total reports of 2 to 3 inches. Along Elkhorn Run, several autos were destroyed by the raging flood waters. Several homes were evacuated. Flood waters washed out a private bridge. Two other county-owned bridges were damaged or destroyed during the flood. A bridge and water main line was washed out in Rochester. Some homes were pushed off their foundations. Mudslides were reported along Route 51 in Monaca and Aliquippa. Numerous roads were flooded and closed. Throughout the County, 193 homes and 19 commercial buildings sustained damage, including over $4 million in damages to a shopping center.
June 24, 1996	Flash Flood	N/A	N/A	Several roads were flooded in Monaca.
January 1998	Flood	N/A	N/A	Flooding along Ohio River and Connoquenessing Creek. $20,000 in estimated costs.
January 8, 1998	Flooding, Severe Storms, and Tornadoes	DR-1219	N/A	IA and PubA issued to Beaver County, among other Pennsylvania counties.
January 8, 1998	Flash Flood	N/A	N/A	Numerous roads were flooded throughout the County; a few were closed.
January 9, 1998	Flash Flood	N/A	N/A	Route 68 in Industry was closed due to heavy flooding induced by thunderstorm rains. A restaurant in Bridgewater had 5 feet of water in the basement. Thirty-two homes had flooded basements throughout the County. Connoquenessing Creek flooded some roads in Franklin Township. Two automobiles were stranded in flood waters in Rochester. Two private bridges were washed out in Daugherty Township; one bridge reportedly was washed downstream into the other.
June 2, 1998	Flash Flood	N/A	N/A	Thunderstorm rains flooded Green Garden Road and State Route 18 in Raccoon Township.
June 2, 1998	Flash Flood	N/A	N/A	Mudslides and minor street flooding reported in Aliquippa.
April 1999	Flood	N/A	N/A	Countywide flooding and mudslides. $50,000 in estimated costs.
April 9, 1999	Flash Flood	N/A	N/A	Over 1.5 inches of rain from thunderstorms produced minor flooding across the County. A portion of Freedom-Crider Road near Park Quarry Road was closed due to

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				a small mudslide. Route 51 near Monaca was restricted to one lane by a mudslide. A mudslide was also reported on Route 68 near the Shippingport Bridge. Street flooding was reported in downtown Beaver. In addition, the Beaver County 911 Center received dozens of calls reporting flooded basements.
February 2000	Flooding	N/A	Yes	Governor Tom Ridge, Governor's Proclamation and SBA loans for Allegheny, Beaver, Fayette, Greene, Washington, and Westmoreland Counties.
July 28, 2000	Flash Flood	N/A	N/A	Heavy thunderstorms passing over western Pennsylvania produced rainfall of up to 2 inches in an hour over several counties, inducing numerous instances of flash flooding. Minor road flooding in Ambridge. $5,000 in estimated costs.
August 2000	Flooding	N/A	Yes	SBA – Physical Disaster Loans & Economic Injury Disaster Loan issued for Allegheny, Armstrong, Beaver, Butler, Cambria, Fayette, Indiana, Somerset, Washington, and Westmoreland Counties
August 2002	Severe Storms	N/A	Yes	SBA – Economic Injury Disaster Loan issued for Armstrong, Beaver, Butler, Washington, and Westmoreland Counties.
August 12, 2002	Flash Flood	N/A	N/A	Flooding along Rochester Road (North Sewickley). $5,000 in estimated costs.
August 12, 2002	Flash Flood	N/A	N/A	Heavy thunderstorm rains produced several instances of basement flooding in the Monaca area. $15,000 in estimated costs.
January 1, 2003	Flood	N/A	N/A	Brady's Run Creek and Two Mile Run went out of their banks in Brighton Township.
May 10, 2003	Flash Flood	N/A	N/A	State Route 68 flooded.
July 8, 2003	Flash Flood	N/A	N/A	Road washed out in Hanover Twp. $1,000 in estimated costs.
August 9, 2003	Flash Flood	N/A	N/A	Routes 30 and 51 in Monaca closed by 3 feet of flood waters. Several cars were stranded and under water on Route 51. Many basements flooded in Rochester. In Beaver, a mud slide occurred from River Road onto the railroad tracks. $40,000 in estimated costs.
September 9, 2003	Flash Flood	N/A	N/A	Herman Rd in Marion Twp flooded. Soap Run Rd in Franklin Twp flooded. Flood waters running into house in Fombell. $5,000 in estimated costs.
November 19, 2003	Flash Flood	N/A	N/A	Flash flooding of Brush Creek in Brush Creek Park. After 5 p.m. on November 19th, five roads were closed by flooding.
November 19, 2003	Flash Flood	N/A	N/A	Roads flooded in Pinehurst.

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
January 4, 2004	Flood	N/A	N/A	Traverse Creek flooded near Harshaville.
January 4, 2004	Flood	N/A	N/A	Raccoon Creek caused flooding of Backbone Rd, Park Rd, Ridge Rd, and Route 30 near Harshaville. By 9 p.m., mud slides were reported on Reno St in Rochester; SR 151 in Independence; and SR 4047 in Ohioville. By 240 a.m. on the 5th, flooding from Connoquenessing Creek closed Route 65 near Ellwood City, between Chapel Dr and Rte 288.
February 3, 2004	Flood	N/A	N/A	Ice jam caused flooding of Hookstown Grade Rd near Beaver Falls.
February 6, 2004	Flood	N/A	N/A	By 730 a.m., combined effects of rain, snow melt, and ice jam movement flooded basements in southern Allegheny County; and near Everson in Westmoreland Co. By 810 a.m., Armstrong, Beaver, and Butler Counties reported widespread flooding. By 130 p.m., Connoquenessing Creek in Beaver County had moderate flooding; ice jams caused flooding in southern Fayette County. Elsewhere, flooding became widespread across several more counties. $85,000 in estimated costs.
May 22, 2004	Flood	N/A	N/A	At 11 a.m. EDT, Enon Valley report road flooding; roads in Darlington were flooded by the North Fork of the Little Beaver Creek; Routes 251 and 588 were flooded near Beaver Falls; other roads flooded near Big Beaver. By 5 p.m. EDT on the 22nd, in Darlington, houses were flooded along the North Fork of Little Beaver Creek. Routes 51, 168, 351, and 551 flooded. At least 60 families had to be evacuated after their homes were surrounded by water. Some residents went to the rooftops to wait for rescue. By 9:30 p.m. on the 22nd, Route 51 was still flooded and some houses were still surrounded by flood waters in or near Darlington. By 3 a.m. on the 23rd, flood waters had receded somewhat, but Route 51 near Darlington remained flooded until just before noon. A total of 350 homes and businesses had flood damage. Of those homes, 160 were in Darlington Twp. Five inches of rain fell in 24 hours. $3,000,000 in estimated costs.
May 22, 2004	Flash Flood	N/A	N/A	Shenango Rd closed by flooding.
June 2004	Heavy Rain, High Winds, and Flooding	N/A	Yes	SBA – Physical Damage and Economic Injury loans issued for Allegheny, Beaver, Butler, Lawrence, Mercer, and Washington Counties.
June 15, 2004	Flash Flood	N/A	N/A	Basements and roads flooded. $4,000 in estimated costs.
August 21, 2004	Flood	N/A	N/A	Raccoon Creek flooded in Independence and Raccoon townships, in southern Beaver County; and Connoquenessing Creek flooded in Franklin Township, in the northern part of the County. By 7 p.m. EDT, creeks named Service and Traverse also flooded in Independence Twp, closing Park Rd, School Rd, Backbone Rd at Rte 30, Service

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				Creek Rd, and Independence Rd at Tank Farm Rd. Some roads re-opened by 9 p.m. EDT. (See also Butler Co)
September 8, 2004	Flood	DR-1555	Yes	Rain from the remnants of Hurricane Frances began early on the 8th and ended by dawn on the 9th. By 540 p.m. EDT on the 8th, many roads had been closed by flooding countywide, including in Center and Chippewa Townships. By 1030 p.m. on the 8th, many roads had flooded, especially in Darlington and Hopewell from Connoquenessing Creek. At this time, the Hopewell shopping plaza began to flood. By 9 a.m. EDT on the 9th, in Bridgewater, 80 boats had broken loose from their dock. Later, nearly 250 boats were seen piled up against a bridge. At time unknown, there were mud slides on Rte 18 in Potter Twp, and Rte 68 near Shippingport. By the end of the storm, 300 homes had been damaged across the County; 35 roads were flooded, and 39 towns were flooded. Total rain: 4 inches in Beaver (FRANCES). Governor Edward G. Rendell; Presidential Major Disaster (IA to Individuals and Households).
September 17, 2004	Flood	DR-1557	Yes	At 325 p.m. EDT on the 17th, Rte 30 and all roads in Industry had been closed by flooding. Much damage along Rte 68 corridor in western part of the County. Bridgewater and Glasgow flooded. Total of 625 structures damaged or destroyed, including 43 businesses, mainly in Hopewell Twp. Hundreds of runaway boats were lost, but 93 were recovered. Several marinas were ripped from the shore and broke up as they slammed into bridges, with numerous boats still attached. Roads partly washed out: Rtes 65, 288, 588, Hoenig Rd, Hartzell School Rd, Shady Rest Rd, Franklin Rd, Green Garden Rd. On the Ohio River, Montgomery Dam rose to flood stage (33 feet) at 4 a.m. EDT on the 18th, crested at 41.0 feet at 10 p.m. on the 18th, and fell below flood stage at 2 p.m. EDT on the 19th. Total rain: 4 inches in Monaca.
January 5, 2005	Flood	N/A	N/A	By 945 p.m. on the 5th, Ambridge and Leetsdale reported flooding; and Barclay Hills Rd west of Vanport flooded after 2 inches of rain. 200 homes flooded in some way. Roads still flooded at noon on the 6th. On the Ohio River, Montgomery was above flood stage (33 feet) from 12 p.m. on the 6th to 3 p.m. on the 7th; it crested at 36.9 feet at 9 p.m. on the 6th. $300,000 in estimated costs.
September 14, 2006	Flood	N/A	N/A	Tropical Depression Ernesto, street flooding in Rochester and Monaca. Streets and basements flooded in Rochester and Monaca, including Rochester Police Station. $10,000 in estimated costs.
March 2, 2007	Flood	N/A	N/A	Snow melt and rainfall combined to cause flooding in Beaver County with Little Beaver Creek, Raccoon Creek, and Connoquenessing Creek above flood stage. Numerous roads were closed due to flooding.

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
March 15, 2007	Flood	N/A	N/A	A strong cold front produced severe weather across portions of Western Pennsylvania, Southeast Ohio, and Northern West Virginia. As low pressure slowly moved east of the region, heavy rains with some snow melt then caused flooding of some streams and creeks. Roads were closed due to flooding across the County.
July 2007	Severe Storms and Flooding	N/A	Yes	SBA – Physical Damage and Economic Injury loans issued for Allegheny, Beaver, Butler, Lawrence, and Washington Counties.
July 5, 2007	Flash Flood	N/A	N/A	A retired NWS employee reported flash flooding in Aliquippa, Monaca, and surrounding towns from rainfall of 3 to over 4 inches in 2 hours. Over 500 buildings and homes sustained damage across Beaver County, with approximately 50 families displaced from homes. A trained spotter reported State Road 68 was closed due to flash flooding between Industry and Midland. $10,000,000 in estimated costs.
July 5, 2007	Flood	N/A	N/A	EM reported standing water on roads in Aliquippa and Monaca, as well as in surrounding towns. The water was slowly receding.
August 2007	Severe Storms and Flooding	N/A	Yes	SBA – Physical Damage and Economic Injury loans issued for Allegheny, Armstrong, Beaver, Butler, Cambria, Fayette, Indiana, Somerset, and Westmoreland Counties.
August 9, 2007	Flash Flood	N/A	N/A	Severe storms/flash flooding in Aliquippa. EM reported flash flooding closing Route 18 between Greengarden RD and Route 151. EM reported flash flooding on RT 51 closing the road between the Aliquippa Bridge and Monaca. $75,000 in estimated costs.
August 20, 2007	Flash Flood	N/A	N/A	EM reported a number of roads flooded and water in some homes. The Koppel bridge was closed due to flooding. EM reported a number of cars trapped in flood waters near the Koppel bridge due to flash flooding. Motorists were assisted from cars by police. Franklin Township near Fombell reported a number of cars trapped in flash flood waters that had to be assisted from vehicles by police department.
February 5, 2008	Flood	N/A	N/A	Heavy rain caused Connoquenessing Creek to rise and flood Hartsell Road between Fombell bridge and Route 588. $10,000 in estimated costs.
June 2009	Severe Storms and Flooding	N/A	Yes	SBA – Physical Damage and Economic Injury loans issued for Allegheny, Armstrong, Beaver, Butler, Cambria, Crawford, Erie, Fayette, Indiana, Somerset, Warren, Washington, and Westmoreland Counties.
June 17, 2009	Flash Flood	N/A	N/A	EM reported Kennedy Blvd and Franklin Ave in Aliquippa closed due to flash flooding. EM reported 4th Street near Route 65 closed due to flash flooding. EM

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				reported Independence Rd closed due to flash flooding. $200,000 in estimated costs
May 31, 2010	Flood	N/A	N/A	EM reported Big Sewickley Creek flooding in Economy Borough, near Bell Acres, and in Lee Township. One home had basement flooding, and debris was piled around a bridge crossing the creek. $75,000 in estimated costs.
June 1, 2010	Flood	N/A	N/A	EM reported Big Sewickley Creek Road flooded from near Davis Road to Camp Meeting Road.
June 2, 2010	Flood	N/A	N/A	A county official reported U.S. 30 closed between SR 168 and Long Road due to flooding.
July 9, 2010	Flash Flood	N/A	N/A	The Fire Department reported Harkins Mill Road in New Sewickley Township closed due to flash flooding.
December 1, 2010	Flood	N/A	N/A	Firefighters rescued numerous residents trapped by rising waters of Connoquesnessing Creek along Rustic Park Drive. Country Club Drive was closed due to flooding. School also affected. Flooding in Fombell closed roadways, requiring people to leave their homes.
February 28, 2011	Flood	N/A	N/A	The public reported Hartzell School Road closed between SR 588 and Fombell Road. Other roads flooded across the County. Public reported SR 551 closed in both directions between Topper Hill Road and SR 208.
March 10, 2011	Flood	N/A	N/A	County official reports of a few roads closed due to flooding in Hopewell and Darlington townships.
July 18, 2011	Flood	N/A	N/A	Beaver Times newspaper reports of flooding on Route 65 near Fourth Street, just north of Ambridge. Water was waist deep and vehicles stalled.
August 19, 2011	Flood	N/A	N/A	EM reported 13th St flooded with standing water. Law enforcement reported standing water and flooding on Sassafra Lane. Law enforcement reported flooding with standing water on State Street and Duss Ave. EM reported standing water and flooding of Ohio River Blvd. EM reported standing water and flooding on Tevebaugh Rd in Baden. EM reported flooding and a mudslide on Constitution Blvd. A newspaper reported flooding with mud and debris into businesses on Franklin Ave.
August 19, 2011	Flash Flood	N/A	N/A	EM reported flash flooding with 2 to 3 feet of water flowing across Sohn Road with debris. EM reported flash flooding in Beaver with debris flow in streets and water in a few buildings.
September 26, 2011	Flood	N/A	N/A	The Beaver County Times reported flooding in Ellwood City, Koppel, Beaver Falls,

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				Industry, and Chippewa and Franklin Townships. A wall on the First Baptist Church in Ellwood City buckled after water washed away a portion of the foundation. In addition, debris from Brady's Run creek washed out a footbridge and damaged another footbridge in Brady's Run Park. Beaver County officials reported Route 69 closed due to high water.
May 7, 2012	Flood	N/A	N/A	Several roads in Hopewell Township closed due to flooding, with up to 2 feet of water over roads near the community park.
September 1, 2012	Flash Flood	N/A	N/A	EM reported flash flooding with roads closed and debris blocking drains. EM reported flash flooding and a mudslide in SR 51. EM reported flash flooding on Duss Ave.
October 26-November 8, 2012	Hurricane Sandy	Federal Emergency Declaration (EM-3356)	Yes	Beaver County, along with the rest of the counties in Pennsylvania, was eligible for federal assistance as a result of Superstorm Sandy.
June 25, 2013	Flood	N/A	N/A	State official reported flooding along Duss Avenue. State official reported flooding along Kennedy Boulevard and Franklin Avenue.
July 10, 2013	Flash Flood	N/A	N/A	Flash flooding occurred on US 30 in Hanover and Independence Townships. EM reported flash flooding, with a house surrounded by water and a water rescue taking place. Flash flooding reported along US 30 and under the US 30 bridge in the Raccoon Creek area.
February 21, 2014	Flood (Ice Jam)	N/A	N/A	Milder temperatures ahead of a cold front combined with moderate rainfall produced ice jam flooding on numerous streams and creeks. EM reported several roads flooded due to numerous small stream and creeks out of their banks. These were most numerous from New Sewickley Township to Independence Township.
March 14, 2015	Flood	N/A	N/A	State official reported that several roads along Connoquenessing Creek were closed due to high water. These roads include Narrows Run Road at the intersection of Soap Run Road, Waterfront Street in North Sewickley, and Bessor Road in Old Furnace. Several homes were evacuated around the 100 block of Hartzell School Road and Dambach Lane.
May 31, 2015	Flood	N/A	N/A	State official reported that several roads along Connoquenessing Creek were closed due to high water. These roads include Narrows Run Road at the intersection of Soap Run Road, Waterfront Street in North Sewickley, and Bessor Road in Old Furnace. Several homes were evacuated around the 100 block of Hartzell School Road and

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
				Dambach Lane.
June 15, 2015	Flash Flood	N/A	N/A	The 911 Call Center reported flash flooding with Dehaven Road closed. The 911 Call Center reported flash flooding with Haney Road at State Route 551 closed. The 911 call center reported flash flooding on multiple roads in and around Ellwood City. The 911 Call Center reported multiple roads closed with a mud slide in and around Darlington to Big Beaver. A mud slide closed Route 551, and some homes were evacuated due to flooding in Darlington. The public reported flash flooding with water quickly flowing over Route 51, with some debris from a land slide as well. Law enforcement reported flash flooding from Soap Run Road to Hickernell Road and South Tower Road. Law enforcement reported debris from flash flooding on the BPRR tracks from previous flash flooding. Law enforcement reported evacuation of the Locust Street Trailer Court due to flash flooding. Law enforcement reported Hollowview Road and Aley Hill Road closed due to flash flooding. Law enforcement reported flash flooding closing Snyder Drive in New Sewickley Township.
September 9, 2015	Flood	N/A	N/A	County received multiple storm-related calls about flooded roadways and basements. Most were clear after the rain; however, several streets had to close. Closures included Brodhead Road at the underpass before Monaca and Green Street at Liberty Avenue (due to a sinkhole). About three residences had no access out of Liberty Avenue.

Sources: NOAA-NCDC 2010; NOAA-NCDC 2014; PEMA 2010; FEMA 2010

Notes:

Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

BPRR	Buffalo and Pittsburgh Railroad
DR	Federal Disaster Declaration
EDT	Eastern Daylight Time
EM	Emergency Management
FEMA	Federal Emergency Management Agency
IA	Individual Assistance
NCDC	National Climate Data Center
NOAA	National Oceanic Atmospheric Administration
PubA	Public Assistance
SBA	Small Business Administration
SHELDUS	Spatial Hazard Events and Losses Database for the U.S

Based on review of the CRREL database, Table 4.3.5-5 lists the ice-jam events that have occurred in or near the County between 1780 and 2013. Events listed below that occurred outside of the County were included because they were close enough to the County borders to cause possible flooding impacts on Beaver County. Information regarding losses associated with these reported ice jams was limited.

Table 4.3.5-5. Ice-Jam Events in Beaver County between 1780 and 2013

City (Additional Geographic Identifier)	River	Jam Date	Water Year	Gage Number	Impact
Aliquippa	Ohio River	1/28/1936	1936	--	The U.S. Engineer Office in Pittsburgh, PA reported an ice jam on Jan. 28, 1936, on the Ohio River at Aliquippa. River was frozen with ice over 5 inches thick. Low-temperature and insufficient discharge and stage to move the ice field combined with the narrow channel at the head of Crow Island to keep the jam in place until the gorge broke up and moved out upon an increase in river discharge due to a rise in the Monongahela River from rain and melting snow. A gorge formed at Logstown Bar immediately above Lock and Dam number 4 on Feb. 28, 1936, as an extension of this jam. No damages reported.
Ambridge	Big Sewickley Creek	3/12/1978	1978	03086100	USGS reported an ice jam on March 12, 1978, at Ambridge, PA on Big Sewickley Creek. Water discharge was 60 cubic feet per second.
Ambridge	Big Sewickley Creek	2/23/1977	1977	03086100	USGS reported an ice jam on February 23, 1977, at Ambridge, PA on Big Sewickley Creek. Water discharge was 32 cubic feet per second. Stage was 5.89 feet.
Ambridge	Big Sewickley Creek	1/14/1976	1976	03086100	USGS reported an ice jam on January 14, 1976, at Ambridge, PA on Big Sewickley Creek. Water discharge was 104 cubic feet per second.
Ambridge	Big Sewickley Creek	2/19/1971	1971	03086100	USGS reported an ice jam on February 19, 1971, at Ambridge, PA on the Big Sewickley Creek. Estimated water discharge was 80 cubic feet per second. Stage was 5.92 ft.
Ambridge	Big Sewickley Creek	1/29/1970	1970	03086100	USGS reported an ice jam on 29 January 1970 at Ambridge, PA on the Big Sewickley Creek. The estimated water discharge was 233 cubic feet per second. The stage was 6.55 ft.
Ambridge	Big Sewickley Creek	12/27/1968	1969	03086100	USGS reported an ice jam on December 27, 1968, at Ambridge, PA on Big Sewickley Creek. Water discharge was 12 cubic feet per second. Stage was 6.07 feet.
Ambridge	Big Sewickley Creek	1/29/1968	1968	03086100	USGS reported an ice jam on January 29, 1968, at Ambridge, PA on Big Sewickley Creek. Water discharge was 120 cubic feet per second. Stage was 7.22 feet.
Beaver Falls	Beaver River	2/03/2004	2004	03107500	NWS reported ice jam flooding on Hookstown Grade Road near the Links Bridge on the Beaver River near Beaver Falls, PA on Feb. 3, 2004. No other information available.

City (Additional Geographic Identifier)	River	Jam Date	Water Year	Gage Number	Impact
Beaver Falls	Beaver River	3/18/1941	1941	03107500	Weather Bureau reported the gage on the Beaver River obstructed by rough ice at Beaver Falls, PA during March 18-19, 1941 (Stages 5.7 and 5.4, respectively). Flood stage 15 feet; normal pool is 3.6 feet.
Franklin Township	Connoquenessing Creek	2/21/2014	2014	--	On Feb. 21st at 429 p.m. EST, Beaver County Officials continued to report flooding due to snow melt and ice jams. Recent reports include flooding in Franklin Township along Connoquenessing Creek.

Source: CRREL 2015

Notes:

Although events were reported for Beaver County, information pertaining to every event was not easily ascertainable; therefore, this table may not list all ice jams in the County.

cfs Cubic feet per second
CRREL Cold Regions Research and Engineering Laboratory
USGS U.S. Geological Survey

4.3.5.4 Future Occurrence

Given the history of flood events that have impacted Beaver County, future flooding events of varying degrees are likely to occur. That the elements required for flooding exist and that major flooding has occurred throughout the County in the past suggest future risk to many people and properties from the flood hazard.

A structure within a 1-percent annual chance floodplain has a 26-percent chance of undergoing flood damage during the term of a 30-year mortgage. Figure 4.3.5-3 shown previously illustrates the FEMA DFIRM 1-percent annual chance flood zones within Beaver County.

In Section 4.4, the identified hazards of concern for Beaver County were ranked for relative risk. Probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Based on historical records, NFIP data, and the Pennsylvania State Hazard Mitigation Plan, probability of occurrence of flood events in Beaver County is considered *highly likely* (100-percent annual probability). Section 4.4 includes further information on PEMA's risk factor methodology.

Annual flooding is anticipated in Beaver County. Some flooding events may induce secondary hazards such as water quality and supply concerns, infrastructure damage, deterioration and failure, utility failures, power outages, transportation delays/accidents/inconveniences, and public health and safety concerns.

4.3.5.5 Vulnerability Assessment

To understand risk, a community must evaluate the assets exposed or vulnerable within the identified hazard area. For the flood hazard, the 1-percent (100-year) and 0.2-percent (500-year) annual chance flood events are examined. The following sections evaluate and estimate potential impact of flooding in Beaver County, presenting:

- Overview of vulnerability

- Data and methodology used for the evaluation
- Impact on (1) life, health, and safety; (2) general building stock; (3) critical facilities; (4) the economy; (5) the environment; and (6) future growth and development
- Effects of climate change on vulnerability
- Impact on the environment
- Further data collections that will assist in understanding this hazard over time.

Overview of Vulnerability

Flood is a significant concern for Beaver County. To assess risk, exposures to the 1- and 0.2-percent annual chance flood events were examined, and potential losses were calculated for the 1- percent annual chance flood event. The flood hazard exposure and loss estimate analysis is presented below.

Data and Methodology

The 1- and 0.2-percent annual chance flood events were examined to evaluate Beaver County's risk from and vulnerability to the flood hazard. Polygons representing the 1- and 0.2-percent annual chance events from the DFIRM dated August 2015 were used to estimate exposure. Figure 4.3.5-3 shown earlier in this section illustrates the flood boundaries used for this vulnerability assessment.

The 1-percent annual chance flood depth grid, dated April 2010, available from the Pennsylvania Spatial Data Clearinghouse, was incorporated into Hazards United States (HAZUS) (version 3.0) to estimate potential losses within the County. According to FEMA Region III, the 2010 depth grid is based on the data used to develop the 2015 DFIRM. Additional flood hazard areas in the County were not included in this depth grid as depicted in the DFIRM. Flood depths in these areas were generated by use of the HAZUS – Multi-Hazard (MH) Enhanced Quick Look tool and the 1/3 arc-second Digital Elevation Map (DEM) model provided by the U.S. Geological Survey (USGS).

The version of the HAZUS-MH model applied to conduct Beaver County's vulnerability assessment uses 2010 U.S. Census demographic data. Beaver County's current spatial data do not support a countywide HAZUS-MH general building stock update at this time; therefore, the dasymetric census block configuration from HAZUS-MH was used.

To estimate exposure to the building stock, default dasymetric building stock data from HAZUS-MH 3.0 were used for replacement cost value. Data from HAZUS-MH are at the census block level and are calculated by use of 2014 RS Means valuations. To estimate the number of structures within the hazard area, a point spatial layer was created by use of the County's partial building footprint layer and the County's parcels and tax data.

Impact on Life, Health, and Safety

Impacts of flooding on life, health, and safety depend on several factors including severity of the event and whether or not adequate warning time is provided to residents. Assumedly, the population living in or near floodplain areas that could be impacted by a flood would be exposed. However, exposure should not be limited only to those who reside within a defined hazard zone, but everyone who may be affected by a hazard event (e.g., people are at risk while traveling in flooded areas, or their access to emergency services is compromised during an event); the degree of that impact varies and is not strictly measurable. Bridgewater Borough has noted that their vulnerability to flooding has decreased over time, due to flood prevention measures installed ten or more years ago.

Cascading impacts may also include exposure to pathogens such as mold. After flood events, excess moisture and standing water contribute to growth of mold in buildings. Mold may present a health risk to building occupants, especially those with already compromised immune systems such as infants, children, the elderly, and pregnant women. The degree of impact will vary and is not strictly measurable. Molds can grow in as short a period as 24-48 hours in wet and damaged areas of buildings that have not been properly cleaned. Very small mold spores can easily be inhaled, creating potential for allergic reactions, asthma episodes, and other respiratory problems. Buildings should be properly cleaned and dried out to safely prevent mold growth (Centers for Disease Control and Prevention [CDC] 2015).

Molds and mildews are not the only public health risk associated with flooding. Floodwaters can be contaminated by pollutants such as sewage, human and animal feces, pesticides, fertilizers, oil, asbestos, and rusting building materials. Common public health risks associated with flood events also include:

- Unsafe food
- Contaminated drinking and washing water and poor sanitation
- Mosquitos and animals
- Carbon monoxide poisoning
- Secondary hazards associated with re-entering/cleaning flooded structures
- Mental stress and fatigue.

Current loss estimation models such as HAZUS-MH are not equipped to measure public health impacts. The best level of mitigation for these impacts is to be aware that they can occur, educate the public on prevention, and be prepared to deal with these vulnerabilities in responding to flood events.

To estimate the population exposed to the 1-percent annual chance flood event, the FEMA DFIRM floodplain boundaries were overlaid upon the 2010 U.S. Census population data in Geographic Information Systems (GIS). Census blocks are not consistent with boundaries of the floodplain, and gross overestimate or underestimate of exposed population can occur via use of the centroid or intersect of the Census block with these zones. Limitations of these analyses are recognized, and thus results are used only to provide a general estimate.

The 2010 Census blocks with their centroids located in the flood boundaries were used to calculate the estimated population exposed to this hazard. Table 4.3.5-6 lists the estimated population within the 1-percent annual chance flood zone by municipality. Use of this approach resulted in an estimate of 2,932 people within the 1-percent annual chance floodplain (1.7%), and 3,460 people within the 0.2-percent annual chance floodplain (2.0%)

Table 4.3.5-6. Estimated Beaver County Population Exposed to the 1- and 0.2-Percent Flood Hazard (2010 Census)

Municipality	Total Population	1-Percent Annual Chance Event		0.2-Percent Annual Chance Event	
		Population in Hazard Area	Percent Population in Boundary	Population in Hazard Area	Percent Population in Boundary
City of Aliquippa	9,438	4	<1%	4	<1%
Ambridge Borough	7,050	9	<1%	9	<1%
Baden Borough	4,135	29	<1%	29	<1%
Beaver Borough	4,531	0	0%	0	0%
City of Beaver Falls	8,987	418	4.7%	471	5.2%
Big Beaver Borough	1,970	21	1.1%	21	1.1%

Municipality	Total Population	1-Percent Annual Chance Event		0.2-Percent Annual Chance Event	
		Population in Hazard Area	Percent Population in Boundary	Population in Hazard Area	Percent Population in Boundary
Bridgewater Borough	704	247	35.1%	361	51.3%
Brighton Township	8,227	21	<1%	21	<1%
Center Township	11,795	0	0%	0	0%
Chippewa Township	7,620	0	0%	0	0%
Conway Borough	2,176	0	0%	0	0%
Darlington Borough	254	0	0%	0	0%
Darlington Township	1,962	302	15.4%	302	15.4%
Daugherty Township	3,187	0	0%	20	<1%
East Rochester Borough	567	0	0%	0	0%
Eastvale Borough	225	0	0%	0	0%
Economy Borough	8,970	8	<1%	33	<1%
Fallston Borough	266	0	0%	0	0%
Frankfort Springs Borough	130	0	0%	0	0%
Franklin Township	4,052	249	6.1%	326	8.0%
Freedom Borough	1,569	0	0%	45	2.9%
Georgetown Borough[1]	174	0	0%	0	0%
Glasgow Borough	60	35	58.3%	35	58.3%
Greene Township	2,356	9	<1%	9	<1%
Hanover Township	3,690	13	<1%	13	<1%
Harmony Township	3,197	0	0%	0	0%
Homewood Borough	109	0	0%	0	0%
Hookstown Borough	147	9	6.1%	9	6.1%
Hopewell Township	12,593	61	<1%	61	<1%
Independence Township	2,503	112	4.5%	112	4.5%
Industry Borough	1,835	6	<1%	6	<1%
Koppel Borough	762	0	0%	0	0%
Marion Township	913	116	12.7%	116	12.7%
Midland Borough	2,635	0	0%	0	0%
Monaca Borough	5,737	41	<1%	41	<1%
New Brighton Borough	6,025	256	4.2%	421	7.0%
New Galilee Borough	379	32	8.4%	32	8.4%
New Sewickley Township	7,360	75	1.0%	75	1.0%
North Sewickley Township	5,488	388	7.1%	388	7.1%
Ohioville Borough	3,533	8	<1%	8	<1%
Patterson Township	3,029	0	0%	0	0%
Patterson Heights Borough	636	0	0%	0	0%
Potter Township	548	1	<1%	1	<1%
Pulaski Township	1,500	8	<1%	8	<1%
Raccoon Township	3,064	0	0%	0	0%
Rochester Borough	3,657	0	0%	0	0%
Rochester Township	2,802	299	10.7%	328	11.7%
Shippingport Borough	214	0	0%	0	0%
South Beaver Township	2,717	51	1.9%	51	1.9%

Municipality	Total Population	1-Percent Annual Chance Event		0.2-Percent Annual Chance Event	
		Population in Hazard Area	Percent Population in Boundary	Population in Hazard Area	Percent Population in Boundary
South Heights Borough	475	0	0%	0	0%
Vanport Township	1,321	102	7.7%	102	7.7%
West Mayfield Borough	1,239	2	<1%	2	<1%
White Township	1,394	0	0%	0	0%
BEAVER COUNTY (TOTAL)	**170,539**	**2,932**	**1.7%**	**3,460**	**2.0%**

Sources: U.S. Census 2010, FEMA 2011

Note: % Percent
[1] = Georgetown Borough is currently suspended from the NFIP.

The table above shows that approximately 1.7 percent of the total County population is exposed to the 1-percent annual chance flood event, and that approximately 2.0 percent of the total County population is exposed to the 0.2-percent annual chance flood event. Glasgow Borough and Bridgewater Borough have the largest populations within the floodplain—58.3 percent of Glasgow's population is exposed to the 1-percent and 0.2-percent annual chance events; 35.1 percent of Bridgewater's population is exposed to the 1-percent event, and 51.3% of its population is exposed to the 0.2-percent event. For this project, potential population exposed is used as a guide for planning purposes.

Of the population exposed, the most vulnerable include the economically disadvantaged and the population over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on net economic impact on their families. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention that may not be available because of isolation during a flood event, and they may have more difficulty evacuating.

Using 2010 U.S. Census data, HAZUS-MH 3.0 estimates potential sheltering needs based on a 1-percent annual chance flood event. During the 1-percent flood event, HAZUS-MH 3.0 estimates 3,843 households will be displaced, and 1,652 people will seek short-term sheltering, representing less than 1 percent of the Beaver County population seeking short-term shelter. These statistics, by municipality, are listed in Table 4.3.5-7. The estimated displaced population and number of persons seeking short-term sheltering differ from the number of persons exposed to the 1-percent annual chance flood (Table 4.3.5-6), because the displaced population numbers take into consideration that not all residents will be significantly impacted enough to be displaced or to require short-term sheltering during a flood event.

Table 4.3.5-7. Estimated Population Displaced or Seeking Short-Term Shelter from the 1-Percent Annual Chance Flood Event

Municipality	Total Population (2010 U.S. Census)	1-Percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
City of Aliquippa	9,438	347	189
Ambridge Borough	7,050	7	1
Baden Borough	4,135	7	0
Beaver Borough	4,531	0	0

Municipality	Total Population (2010 U.S. Census)	1-Percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
City of Beaver Falls	8,987	525	303
Big Beaver Borough	1,970	52	3
Bridgewater Borough	704	206	58
Brighton Township	8,227	76	10
Center Township	11,795	152	32
Chippewa Township	7,620	20	0
Conway Borough	2,176	38	37
Darlington Borough	254	6	1
Darlington Township	1,962	300	135
Daugherty Township	3,187	20	2
East Rochester Borough	567	3	0
Eastvale Borough	225	10	0
Economy Borough	8,970	97	16
Fallston Borough	266	10	0
Frankfort Springs Borough	130	0	0
Franklin Township	4,052	360	249
Freedom Borough	1,569	27	1
Georgetown Borough[1]	174	3	0
Glasgow Borough	60	30	2
Greene Township	2,356	31	2
Hanover Township	3,690	50	3
Harmony Township	3,197	38	14
Homewood Borough	109	0	0
Hookstown Borough	147	9	1
Hopewell Township	12,593	96	27
Independence Township	2,503	198	46
Industry Borough	1,835	17	1
Koppel Borough	762	1	0
Marion Township	913	83	32
Midland Borough	2,635	0	0
Monaca Borough	5,737	84	38
New Brighton Borough	6,025	307	258
New Galilee Borough	379	51	8
New Sewickley Township	7,360	123	33
North Sewickley Township	5,488	169	83
Ohioville Borough	3,533	20	0
Patterson Township	3,029	6	1
Patterson Heights Borough	636	0	0
Potter Township	548	12	1
Pulaski Township	1,500	35	9
Raccoon Township	3,064	23	0
Rochester Borough	3,657	7	1
Rochester Township	2,802	42	1

Municipality	Total Population (2010 U.S. Census)	1-Percent Annual Chance Event	
		Displaced Households	Persons Seeking Short-Term Sheltering
Shippingport Borough	214	7	0
South Beaver Township	2,717	43	1
South Heights Borough	475	0	0
Vanport Township	1,321	80	52
West Mayfield Borough	1,239	15	1
White Township	1,394	0	0
BEAVER COUNTY (TOTAL)	**170,539**	**3,843**	**1,652**

Source: HAZUS-MH 3.0

Note: The population displaced and seeking shelter was calculated using 2010 U.S. Census data.
[1] = Georgetown Borough is currently suspended from the NFIP.

Total number of injuries and casualties resulting from typical riverine flooding is generally limited because of advance weather forecasting, blockades, and warnings. Therefore, injuries and deaths generally are not anticipated if proper warning occurs and precautions are in place. Warning time for flash flooding is often limited. Flash flood events are frequently associated with other natural hazard events such as earthquakes, landslides, or severe weather, which limits their predictability and compounds the hazard. Populations without adequate warning of the event are highly vulnerable to this hazard. Ongoing mitigation efforts should help to avoid the most likely cause of injury—persons trying to cross flooded roadways or channels. Mitigation action items addressing this issue are included in Section 6 (Mitigation Strategies) of this Plan.

Impact on General Building Stock

After consideration of the population exposed and vulnerable to the flood hazard, the built environment was evaluated. Exposure to the flood hazard includes those buildings within the flood zone. Potential damage is the modeled loss that could occur to the exposed inventory, including structural and content value.

To estimate the number of structures within the hazard area, a point spatial layer was created using the County's partial building footprint layer and the County's parcels and tax data. The number of buildings with their centroids in the floodplain was determined. To estimate replacement cost value exposure, default dasymetric building stock data from HAZUS-MH 3.0 were used. Replacement cost values of the dasymetric Census blocks with their centroids in the floodplain were totaled. Table 4.3.5-8 lists building stock exposure per municipality, and Table 4.3.5-9 lists number of exposed structures per watershed.

In total, 1,962 structures, or 2.2% of the building stock, are within the 1-percent annual chance flood zone; and 2,290 structures, or 2.6% of the building stock, are within the 0.2-percent flood zone. Approximately $647 million of building/contents are within the 1-percent annual chance flood zone in Beaver County. This represents approximately 2.0 percent of the County's total general building stock replacement value inventory ($32 billion). Also, an estimated $1.1 billion of building/contents is within the 0.2-percent annual chance flood zone (3.3% of the County's total).

As discussed in the Methodology section, Beaver County's current spatial data did not support a countywide HAZUS-MH general building stock update. Therefore, the HAZUS-MH flood model estimated potential damages to buildings in Beaver County using the dasymetric dataset. Development of the dasymetric dataset involved removing homogeneous undeveloped areas (such as areas covered by bodies of water, parks, or

forests) from the Census blocks. Cumulative building exposure is distributed only in developed sub-Census Block areas. As a result, more accurate flood loss determinations were produced using this dataset. Potential damage estimated to the Beaver County general building stock inventory associated with the 1-percent annual chance flood exceeds $252 million. Building stock potential loss estimates per municipality are listed in Table 4.3.5-10.

Table 4.3.5-8. Estimated General Building Stock Exposure to the 1-Percent Annual Chance Flood Event

Municipality	Total # Buildings	Total RCV (Structure and Contents)	Total (All Occupancies)							
			1-Percent Annual Chance Event				0.2-Percent Annual Chance Event			
			# Buildings	% Total	Total RCV (Structure and Contents	% Total	# Buildings	% Total	Total RCV (Structure and Contents	% Total
City of Aliquippa	5,365	$1,752,914,000	17	<1%	$5,670,000	<1%	27	<1%	$6,206,000	<1%
Ambridge Borough	2,931	$2,001,497,000	9	<1%	$4,638,000	<1%	21	<1%	$111,897,000	5.6%
Baden Borough	1,529	$660,129,000	3	<1%	$0	0.0%	3	<1%	$0	0.0%
Beaver Borough	2,412	$1,086,483,000	13	<1%	$7,830,000	<1%	14	<1%	$7,830,000	<1%
City of Beaver Falls	4,543	$2,039,706,000	238	5.2%	$142,141,000	7.0%	321	7.1%	$153,201,000	7.5%
Big Beaver Borough	1,258	$332,759,000	24	1.9%	$14,658,000	4.4%	24	1.9%	$14,658,000	4.4%
Bridgewater Borough	444	$259,715,000	168	37.8%	$70,581,000	27.2%	257	57.9%	$136,845,000	52.7%
Brighton Township	4,059	$1,601,126,000	31	<1%	$7,268,000	<1%	31	<1%	$7,268,000	<1%
Center Township	5,497	$2,276,591,000	27	<1%	$1,253,000	<1%	27	<1%	$1,253,000	<1%
Chippewa Township	4,206	$1,776,474,000	7	<1%	$0	0.0%	7	<1%	$0	0.0%
Conway Borough	945	$302,730,000	2	<1%	$0	0.0%	2	<1%	$5,826,000	1.9%
Darlington Borough	211	$46,660,000	3	1.4%	$0	0.0%	3	1.4%	$0	0.0%
Darlington Township	1,876	$333,062,000	311	16.6%	$79,538,000	23.9%	311	16.6%	$79,538,000	23.9%
Daugherty Township	1,358	$472,132,000	6	<1%	$0	0.0%	8	<1%	$7,692,000	1.6%
East Rochester Borough	246	$104,380,000	4	1.6%	$8,916,000	8.5%	7	2.8%	$9,204,000	8.8%
Eastvale Borough	139	$47,783,000	4	2.9%	$0	0.0%	4	2.9%	$0	0.0%
Economy Borough	4,033	$1,548,629,000	35	<1%	$954,000	<1%	64	1.6%	$5,410,000	<1%
Fallston Borough	285	$107,209,000	45	15.8%	$3,174,000	3.0%	56	19.6%	$63,045,000	58.8%
Frankfort Springs Borough	99	$15,141,000	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Franklin Township	1,794	$674,586,000	191	10.6%	$28,896,000	4.3%	209	11.6%	$63,232,000	9.4%
Freedom Borough	673	$221,079,000	21	3.1%	$3,586,000	1.6%	31	4.6%	$6,658,000	3.0%
Georgetown Borough[1]	152	$24,605,000	1	<1%	$0	0.0%	1	<1%	$0	0.0%
Glasgow Borough	46	$7,275,000	31	67.4%	$5,175,000	71.1%	33	71.7%	$5,175,000	71.1%
Greene Township	1,926	$316,388,000	36	1.9%	$654,000	<1%	36	1.9%	$654,000	<1%
Hanover Township	2,701	$494,877,000	31	1.1%	$1,171,000	<1%	31	1.1%	$1,171,000	<1%
Harmony Township	1,620	$579,530,000	12	<1%	$0	0.0%	16	1.0%	$0	0.0%
Homewood Borough	88	$18,635,000	1	1.1%	$0	0.0%	1	1.1%	$0	0.0%
Hookstown Borough	143	$19,579,000	6	4.2%	$1,029,000	5.3%	6	4.2%	$1,029,000	5.3%
Hopewell Township	6,411	$2,387,019,000	38	<1%	$36,770,000	1.5%	38	<1%	$36,770,000	1.5%
Independence Township	1,925	$339,039,000	115	6.0%	$20,174,000	6.0%	115	6.0%	$20,174,000	6.0%
Industry Borough	1,278	$308,388,000	54	4.2%	$12,469,000	4.0%	55	4.3%	$12,469,000	4.0%

Municipality	Total # Buildings	Total RCV (Structure and Contents)	Total (All Occupancies)							
			1-Percent Annual Chance Event				0.2-Percent Annual Chance Event			
			# Buildings	% Total	Total RCV (Structure and Contents	% Total	# Buildings	% Total	Total RCV (Structure and Contents	% Total
Koppel Borough	233	$86,828,000	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Marion Township	423	$277,866,000	44	10.4%	$15,082,000	5.4%	45	10.6%	$15,082,000	5.4%
Midland Borough	1,232	$475,952,000	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Monaca Borough	3,404	$1,104,111,000	54	1.6%	$5,091,000	<1%	56	1.6%	$5,091,000	<1%
New Brighton Borough	2,209	$1,167,805,000	24	1.1%	$22,534,000	1.9%	35	1.6%	$118,083,000	10.1%
New Galilee Borough	82	$148,470,000	0	0.0%	$23,812,000	16.0%	0	0.0%	$23,812,000	16.0%
New Sewickley Township	2,910	$1,135,707,000	38	1.3%	$9,284,000	<1%	38	1.3%	$9,284,000	<1%
North Sewickley Township	2,478	$920,989,000	94	3.8%	$56,889,000	6.2%	98	4.0%	$56,889,000	6.2%
Ohioville Borough	2,525	$450,834,000	27	1.1%	$0	0.0%	27	1.1%	$0	0.0%
Patterson Township	361	$119,704,000	1	<1%	$0	0.0%	1	<1%	$0	0.0%
Patterson Heights Borough	1,566	$496,741,000	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
Potter Township	598	$154,809,000	5	<1%	$0	0.0%	5	<1%	$0	0.0%
Pulaski Township	610	$204,440,000	13	2.1%	$1,313,000	<1%	14	2.3%	$1,313,000	<1%
Raccoon Township	2,225	$485,396,000	7	<1%	$574,000	<1%	7	<1%	$574,000	<1%
Rochester Borough	1,472	$699,044,000	15	1.0%	$5,714,000	<1%	20	1.4%	$26,842,000	3.8%
Rochester Township	1,362	$506,537,000	17	1.2%	$9,142,000	1.8%	21	1.5%	$12,851,000	2.5%
Shippingport Borough	294	$55,657,000	20	6.8%	$0	0.0%	20	6.8%	$0	0.0%
South Beaver Township	2,480	$564,677,000	61	2.5%	$1,642,000	<1%	61	2.5%	$1,642,000	0.3%
South Heights Borough	219	$85,658,000	1	<1%	$0	0.0%	1	<1%	$0	0.0%
Vanport Township	591	$277,942,000	32	5.4%	$39,322,000	14.1%	57	9.6%	$39,322,000	14.1%
West Mayfield Borough	748	$210,567,000	25	3.3%	$450,000	<1%	25	3.3%	$450,000	<1%
White Township	653	$182,868,000	0	0.0%	$0	0.0%	0	0.0%	$0	0.0%
BEAVER COUNTY (TOTAL)	**89,178**	**$32,075,305,000**	**1,962**	**2.2%**	**$647,394,000**	**2.0%**	**2,290**	**2.6%**	**$1,068,440,000**	**3.3%**

Source: HAZUS-MH 3.0; Beaver County; FEMA 2015

Notes:
[1] = Georgetown Borough is currently suspended from the NFIP.

% Percent
RCV Replacement cost value (structure and contents)

Table 4.3.5-9. Estimated General Building Stock Exposure by Watershed to the 1- and 0.2-Percent Annual Chance Flood Events

Watershed	Total Number of Buildings	1% Annual Chance Flood Boundary		0.2% Annual Chance Flood Boundary	
		Number of Buildings	% of Total	Number of Buildings	% of Total
Beaver River	18,584	509	2.7%	690	3.7%
Big Sewickley Creek	2,715	41	1.5%	74	2.7%
Brady Run	3,212	79	2.5%	98	3.1%
Connoquenessing Creek	4,861	348	7.2%	371	7.6%
Flaugherty Run	450	0	0.0%	0	0.0%
Little Beaver Creek	6,034	391	6.5%	391	6.5%
Ohio River	41,881	397	<1%	469	1.1%
Raccoon Creek	8,474	174	2.1%	174	2.1%
Service Creek	1,606	21	1.3%	21	1.3%
Slippery Rock Creek	184	0	0.0%	0	0.0%
Traverse Creek	1,177	2	<1%	2	<1%
Beaver County (Total)	**89,178**	**1,962**	**2.2%**	**2,290**	**2.6%**

Source: Beaver County, FEMA 2015, Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) 2014

Table 4.3.5-10. Estimated General Building Stock Potential Loss to the 1-Percent Annual Chance Flood Event

Municipality	Total Replacement Cost Value	1% Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
City of Aliquippa	$1,752,914,000	$16,633,000	<1%	$8,389,000	<1%	$4,885,000	<1%	$3,359,000	<1%
Ambridge Borough	$2,001,497,000	$10,948,000	<1%	$54,000	<1%	$2,478,000	<1%	$8,416,000	<1%
Baden Borough	$660,129,000	$306,000	<1%	$186,000	<1%	$112,000	<1%	$8,000	<1%
Beaver Borough	$1,086,483,000	$2,722,000	<1%	$0	0.0%	$2,714,000	<1%	$8,000	<1%
City of Beaver Falls	$2,039,706,000	$45,427,000	2.2%	$9,098,000	<1%	$17,351,000	<1%	$18,978,000	<1%
Big Beaver Borough	$332,759,000	$2,833,000	<1%	$1,093,000	<1%	$1,448,000	<1%	$292,000	<1%
Bridgewater Borough	$259,715,000	$13,841,000	5.3%	$1,972,000	<1%	$8,716,000	3.4%	$3,153,000	1.2%
Brighton Township	$1,601,126,000	$2,365,000	<1%	$1,369,000	<1%	$965,000	<1%	$31,000	<1%
Center Township	$2,276,591,000	$7,678,000	<1%	$3,394,000	<1%	$3,541,000	<1%	$743,000	<1%
Chippewa Township	$1,776,474,000	$335,000	<1%	$249,000	<1%	$20,000	<1%	$66,000	<1%
Conway Borough	$302,730,000	$2,909,000	1.0%	$1,838,000	<1%	$74,000	<1%	$997,000	<1%
Darlington Borough	$46,660,000	$368,000	<1%	$35,000	<1%	$0	0.0%	$333,000	<1%
Darlington Township	$333,062,000	$23,669,000	7.1%	$7,251,000	2.2%	$5,484,000	1.6%	$10,934,000	3.3%
Daugherty Township	$472,132,000	$294,000	<1%	$229,000	<1%	$47,000	<1%	$18,000	<1%
East Rochester Borough	$104,380,000	$1,479,000	1.4%	$53,000	<1%	$1,375,000	1.3%	$51,000	<1%
Eastvale Borough	$47,783,000	$304,000	<1%	$285,000	<1%	$9,000	<1%	$10,000	<1%
Economy Borough	$1,548,629,000	$997,000	<1%	$0	0.0%	$34,000	<1%	$963,000	<1%
Fallston Borough	$107,209,000	$8,159,000	7.6%	$316,000	<1%	$2,241,000	2.1%	$5,602,000	5.2%
Frankfort Springs Borough	$15,141,000	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Franklin Township	$674,586,000	$15,374,000	2.3%	$11,550,000	1.7%	$2,614,000	<1%	$1,210,000	<1%
Freedom Borough	$221,079,000	$677,000	<1%	$278,000	<1%	$52,000	0.0%	$347,000	<1%
Georgetown Borough[1]	$24,605,000	$53,000	<1%	$53,000	<1%	$0	0.0%	$0	0.0%
Glasgow Borough	$7,275,000	$1,097,000	15.1%	$1,097,000	15.1%	$0	0.0%	$0	0.0%
Greene Township	$316,388,000	$420,000	<1%	$383,000	<1%	$8,000	0.0%	$29,000	<1%
Hanover Township	$494,877,000	$1,449,000	<1%	$503,000	<1%	$603,000	<1%	$343,000	<1%

Municipality	Total Replacement Cost Value	1% Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
Harmony Township	$579,530,000	$1,869,000	<1%	$430,000	<1%	$718,000	<1%	$721,000	<1%
Homewood Borough	$18,635,000	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Hookstown Borough	$19,579,000	$149,000	<1%	$149,000	<1%	$0	0.0%	$0	0.0%
Hopewell Township	$2,387,019,000	$9,614,000	<1%	$2,003,000	<1%	$1,752,000	<1%	$5,859,000	<1%
Independence Township	$339,039,000	$5,964,000	1.8%	$4,267,000	1.3%	$289,000	<1%	$1,408,000	<1%
Industry Borough	$308,388,000	$7,185,000	2.3%	$657,000	<1%	$6,526,000	2.1%	$2,000	<1%
Koppel Borough	$86,828,000	$5,000	<1%	$5,000	<1%	$0	0.0%	$0	0.0%
Marion Township	$277,866,000	$3,206,000	1.2%	$1,745,000	<1%	$289,000	<1%	$1,172,000	<1%
Midland Borough	$475,952,000	$13,000	<1%	$0	0.0%	$13,000	<1%	$0	0.0%
Monaca Borough	$1,104,111,000	$7,254,000	<1%	$5,565,000	<1%	$407,000	<1%	$1,282,000	<1%
New Brighton Borough	$1,167,805,000	$9,109,000	<1%	$3,095,000	<1%	$2,982,000	<1%	$3,032,000	<1%
New Galilee Borough	$148,470,000	$5,142,000	3.5%	$1,536,000	1.0%	$2,395,000	1.6%	$1,211,000	<1%
New Sewickley Township	$1,135,707,000	$4,076,000	<1%	$2,990,000	<1%	$553,000	<1%	$533,000	<1%
North Sewickley Township	$920,989,000	$11,156,000	1.2%	$3,281,000	<1%	$2,509,000	<1%	$5,366,000	<1%
Ohioville Borough	$450,834,000	$209,000	<1%	$159,000	<1%	$19,000	<1%	$31,000	<1%
Patterson Township	$119,704,000	$1,746,000	1.5%	$0	0.0%	$418,000	<1%	$1,328,000	1.1%
Patterson Heights Borough	$496,741,000	$361,000	<1%	$295,000	<1%	$66,000	<1%	$0	0.0%
Potter Township	$154,809,000	$1,033,000	<1%	$438,000	<1%	$593,000	<1%	$2,000	<1%
Pulaski Township	$204,440,000	$355,000	<1%	$264,000	<1%	$49,000	<1%	$42,000	<1%
Raccoon Township	$485,396,000	$494,000	<1%	$412,000	<1%	$48,000	<1%	$34,000	<1%
Rochester Borough	$699,044,000	$2,990,000	<1%	$56,000	<1%	$861,000	<1%	$2,073,000	<1%
Rochester Township	$506,537,000	$774,000	<1%	$452,000	<1%	$142,000	<1%	$180,000	<1%
Shippingport Borough	$55,657,000	$281,000	<1%	$68,000	<1%	$100,000	<1%	$113,000	<1%
South Beaver Township	$564,677,000	$12,332,000	2.2%	$562,000	<1%	$7,330,000	1.3%	$4,440,000	<1%
South Heights Borough	$85,658,000	$27,000	<1%	$0	0.0%	$0	0.0%	$27,000	<1%
Vanport Township	$277,942,000	$6,853,000	2.5%	$709,000	<1%	$5,192,000	1.9%	$952,000	<1%

Municipality	Total Replacement Cost Value	1% Annual Chance Event							
		All Occupancies		Residential		Commercial		Industrial, Religious, Education and Government	
		Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total	Estimated Loss	% of Total
West Mayfield Borough	$210,567,000	$285,000	<1%	$211,000	<1%	$60,000	0.0%	$14,000	<1%
White Township	$182,868,000	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
BEAVER COUNTY (TOTAL)	**$32,075,305,000**	**$252,819,000**	**<1%**	**$79,950,000**	**<1%**	**$88,082,000**	**<1%**	**$84,787,000**	**<1%**

Source: HAZUS-MH 3.0

[1] = Georgetown Borough is currently suspended from the NFIP.

Note: % Percent

NFIP Statistics

In addition to total building stock modeling, individual data available regarding flood policies, claims, repetitive loss (RL) properties, and severe repetitive loss (SRL) properties were analyzed. According to section 1361A of the National Flood Insurance Act (NFIA), as amended, 42 *United States Code* (U.S.C.) 4102a, the definition of an SRL property is a residential property covered by an NFIP flood insurance policy, and for which at least one of the following sets of claim payments have occurred:

- At least four NFIP claim payments (including building and contents) over $5,000 each, with the cumulative amount of these claims payments exceeding $20,000
- At least two separate claims payments (building payments only), with the cumulative amount of the building portion of these claims payments exceeding the market value of the building.

Moreover, for both of the above, at least two of the referenced claims must have occurred within any 10-year period, and must have been submitted separately on dates more than 10 days apart.

An RL property is defined by FEMA as an NFIP-insured structure that incurred flood-related damage on two occasions, and for which the cost of repair equaled or exceeded 25 percent of the market value of the structure at the time of each such flood.

Beaver County has 11 RL (2 nonresidential and 8 single family) and 8 SRL (2 nonresidential and 6 single family) properties spread across six municipalities. Table 4.3.5-11 categorizes numbers of RL and SRL properties by municipality and by occupancy class (non-residential or residential).

Table 4.3.5-11. Summary of Repetitive Loss Properties by Municipality

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family
City of Aliquippa	0	0	0	0	0	0	0	0	0	0
Ambridge Borough	0	0	0	0	0	0	0	0	0	0
Baden Borough	0	0	0	0	0	0	0	0	0	0
Beaver Borough	0	0	0	0	0	0	0	0	0	0
City of Beaver Falls	0	0	0	0	0	0	0	0	0	0
Big Beaver Borough	0	0	0	0	0	0	0	0	0	0
Bridgewater Borough	0	0	*1*	0	0	0	0	*1*	0	0
Brighton Township	0	0	0	0	0	0	0	0	0	0
Center Township	0	0	0	0	0	0	0	0	0	0
Chippewa Township	0	0	0	0	0	0	0	0	0	0
Conway Borough	0	0	0	0	0	0	0	0	0	0
Darlington Borough	0	0	0	0	0	0	0	0	0	0
Darlington Township	0	0	0	0	0	0	0	0	0	0
Daugherty Township	0	0	0	0	0	0	0	0	0	0
East Rochester Borough	0	0	0	0	0	0	0	0	0	0
Eastvale Borough	0	0	0	0	0	0	0	0	0	0
Economy Borough	0	0	0	0	0	0	0	0	0	0
Fallston Borough	0	0	0	0	0	0	0	0	0	0
Frankfort Springs Borough	0	0	0	0	0	0	0	0	0	0
Franklin Township	0	0	0	0	*6*	0	0	0	0	*4*
Freedom Borough	0	0	0	0	0	0	0	0	0	0
Georgetown Borough[1]	0	0	0	0	0	0	0	0	0	0
Glasgow Borough	0	0	0	0	0	0	0	0	0	0
Greene Township	0	0	0	0	0	0	0	0	0	0
Hanover Township	0	0	0	0	0	0	0	0	0	0
Harmony Township	0	0	0	0	0	0	0	0	0	0

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family
Homewood Borough	0	0	0	0	0	0	0	0	0	0
Hookstown Borough	0	0	0	0	0	0	0	0	0	0
Hopewell Township	0	0	0	0	0	0	0	0	0	0
Independence Township	0	0	0	0	0	0	0	0	0	0
Industry Borough	0	0	0	0	0	0	0	0	0	0
Koppel Borough	0	0	0	0	0	0	0	0	0	0
Marion Township	0	0	0	0	0	0	0	0	0	*2*
Midland Borough	0	0	0	0	0	0	0	0	0	0
Monaca Borough	0	0	0	0	0	0	0	0	0	0
New Brighton Borough	0	0	*1*	0	0	0	0	0	0	0
New Galilee Borough	0	0	0	0	0	0	0	0	0	0
New Sewickley Township	0	0	0	0	0	0	0	0	0	0
North Sewickley Township	0	0	0	0	*2*	0	0	0	0	0
Ohioville Borough	0	0	0	0	0	0	0	0	0	0
Patterson Township	0	0	0	0	0	0	0	0	0	0
Patterson Heights Borough	0	0	0	0	0	0	0	0	0	0
Potter Township	0	0	0	0	0	0	0	0	0	0
Pulaski Township	0	0	0	0	0	0	0	0	0	0
Raccoon Township	0	0	0	0	0	0	0	0	0	0
Rochester Borough	0	0	0	0	0	0	0	0	0	0
Rochester Township	0	0	0	0	0	0	0	0	0	0
Shippingport Borough	0	0	0	0	0	0	0	0	0	0
South Beaver Township	0	0	0	0	*1*	0	0	0	0	0
South Heights Borough	0	0	0	0	0	0	0	0	0	0
Vanport Township	0	0	0	0	0	0	0	0	0	0
West Mayfield Borough	0	0	0	0	0	0	0	0	0	0
White Township	0	0	0	0	0	0	0	0	0	0

Municipality	Repetitive Loss Properties					Severe Repetitive Loss Properties				
	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family	2-4 Family	Assumed Condo	Non Residential	Other Residential	Single Family
BEAVER COUNTY (TOTAL)	0	0	*2*	0	*9*	0	0	*2*[2]	0	*6*

Source: PEMA 2015
Note: [1] = Georgetown Borough is currently suspended from the NFIP.
[2] = Ellwood City, which participates in the Lawrence County HMP update, contains land within Beaver County. This jurisdiction is the site of the second non-residential SRL property and is not listed individually in the table due to its participation being with St. Lawrence County's HMP.

Table 4.3.5-12 summaries NFIP policies and claims for Beaver County.

Table 4.3.5-12. NFIP Policies, Claims, and Repetitive Loss Statistics

Municipality	# Policies (1)	# Claims (Losses) (1)	# Repetitive Loss Properties (1)	Total Loss Payments (2)
City of Aliquippa	21	41	0	$662,008
Ambridge Borough	4	7	0	$103,372
Baden Borough	1	0	0	$0
Beaver Borough	4	3	0	$1,445
City of Beaver Falls	37	18	0	$11,741
Big Beaver Borough	3	1	0	$0
Bridgewater Borough	84	52	1 RL / 1 SRL	$1,256,141
Brighton Township	5	5	0	$4,783
Center Township	14	21	0	$21,999
Chippewa Township	5	1	0	$0
Conway Borough	3	3	0	$0
Darlington Borough	0	0	0	$0
Darlington Township	16	23	0	$206,859
Daugherty Township	2	1	0	$0
East Rochester Borough	8	2	0	$4,485
Eastvale Borough	0	0	0	$0
Economy Borough	20	17	0	$224,987
Fallston Borough	3	10	0	$148,904
Frankfort Springs Borough	0	0	0	$0
Franklin Township	66	210	6 RL / 4 SRL	$3,361,809
Freedom Borough	7	3	0	$7,113
Georgetown Borough[1]	0	2	0	$32,358
Glasgow Borough	0	0	0	$0
Greene Township	1	1	0	$9,125
Hanover Township	1	0	0	$0
Harmony Township	4	1	0	$5,990
Homewood Borough	0	0	0	$0
Hookstown Borough	0	2	0	$5,098
Hopewell Township	19	16	0	$807,541
Independence Township	9	6	0	$74,823
Industry Borough	4	22	0	$61,950
Koppel Borough	0	0	0	$0

Municipality	# Policies (1)	# Claims (Losses) (1)	# Repetitive Loss Properties (1)	Total Loss Payments (2)
Marion Township	8	49	0 RL / 2 SRL	$533,602
Midland Borough	0	2	0	$24,505
Monaca Borough	3	5	0	$21,559
New Brighton Borough	12	19	1	$208,851
New Galilee Borough	4	5	0	$65,321
New Sewickley Township	3	1	0	$456
North Sewickley Township	42	113	2	$2,095,923
Ohioville Borough	2	0	0	$0
Patterson Township	1	0	0	$0
Patterson Heights Borough	0	0	0	$0
Potter Township	1	2	0	$24,173
Pulaski Township	0	0	0	$0
Raccoon Township	0	0	0	$0
Rochester Borough	4	2	0	$3,542
Rochester Township	9	5	0	$21,125
Shippingport Borough	0	0	0	$0
South Beaver Township	1	3	1	$46,144
South Heights Borough	0	0	0	$0
Vanport Township	2	2	0	$25,606
West Mayfield Borough	2	0	0	$0
White Township	0	0	0	$0
BEAVER COUNTY (TOTAL)	**435**	**676**	**11**	**$10,083,338**

Source: FEMA 2015

Notes:

[1] = Georgetown Borough is currently suspended from the NFIP.

(1) Policies, claims, RL, and SRL statistics provided by FEMA, and are current as of May 31, 2015. Communities with SRL properties are noted in the column (eight total SRL properties, with one in Ellwood City Borough). The number of claims represents claims closed by May 31, 2015.

(2) Total building and content loss information was collected from the claims file provided by PEMA.

FEMA Federal Emergency Management Agency
PEMA Pennsylvania Emergency Management Agency
RL Repetitive loss
SRL Severe repetitive loss

Impact on Critical Facilities

In addition to consideration of general building stock at risk, risk of flood to critical facilities and utilities was evaluated. HAZUS-MH was used to estimate potential for flood loss to critical facilities exposed to the flood

risk. Using depth/damage function curves, HAZUS estimates percent of damage to building and contents of critical facilities. HAZUS-MH estimates that few emergency and utility facilities within the County would be nonfunctional for more than 1 day, and most would undergo relatively minimal damages. Twenty-five hazardous materials (HazMat) facilities are within the floodplain (1 and 0.2 percent events).

To address impacts on short-term functionality of critical facilities and utilities by a hazard during a disaster event, other facilities of neighboring municipalities may have to increase support response functions. Mitigation planning should consider means to reduce impacts on critical facilities and utilities, and ensure that sufficient emergency and school services remain functional when a significant event occurs. Actions addressing shared services agreements are included in Section 6 (Mitigation Strategy) of this Plan.

Table 4.3.5-13 lists critical facilities and utilities within the 1-percent annual change flood boundary. Table 4.3.5-14 lists critical facilities and utilities within the 0.2 percent annual change flood boundary.

Table 4.3.5-13. Critical Facilities and Utilities Within the 1-Percent Annual Chance Flood Boundary

Municipality	Facility Types								
	County Building	Fire Station	Municipal Building	Natural Gas	Police Station	Potable Water Facility	School	Wastewater Facility	Well
City of Aliquippa	0	0	0	0	0	0	0	0	0
Ambridge Borough	0	0	0	0	0	0	0	0	12
Baden Borough	0	0	0	0	0	0	0	1	2
Beaver Borough	0	0	0	0	0	1	1	0	3
City of Beaver Falls	0	0	0	0	0	0	0	0	5
Big Beaver Borough	0	0	0	0	0	0	0	0	1
Bridgewater Borough	0	0	0	0	0	0	0	0	0
Brighton Township	1	0	0	0	0	0	0	0	4
Center Township	0	0	0	0	0	0	0	0	3
Chippewa Township	0	0	0	0	0	0	0	0	1
Conway Borough	0	0	0	0	0	0	0	1	1
Darlington Borough	0	0	0	0	0	0	0	0	0
Darlington Township	0	1	1	0	1	0	0	0	16
Daugherty Township	0	0	0	0	0	0	0	0	0
East Rochester Borough	0	0	0	0	0	0	0	0	0
Eastvale Borough	0	0	0	0	0	0	0	0	0
Economy Borough	0	0	0	0	0	0	0	0	1
Fallston Borough	0	0	0	0	0	0	0	0	2
Frankfort Springs Borough	0	0	0	0	0	0	0	0	0
Franklin Township	0	0	0	3	0	0	0	0	11
Freedom Borough	0	0	0	0	0	0	0	0	6
Georgetown Borough[1]	0	0	0	0	0	0	0	0	0
Glasgow Borough	0	0	0	0	0	0	0	0	1

Municipality	Facility Types								
	County Building	Fire Station	Municipal Building	Natural Gas	Police Station	Potable Water Facility	School	Wastewater Facility	Well
Greene Township	0	0	0	0	0	0	0	0	3
Hanover Township	0	0	0	0	0	0	0	0	7
Harmony Township	0	0	0	0	0	0	0	0	1
Homewood Borough	0	0	0	0	0	0	0	0	0
Hookstown Borough	0	0	0	0	0	0	0	0	0
Hopewell Township	0	0	0	0	0	0	0	0	3
Independence Township	0	0	0	0	0	0	0	0	4
Industry Borough	0	0	0	0	0	0	0	0	0
Koppel Borough	0	0	0	0	0	0	0	0	0
Marion Township	0	0	0	2	0	0	0	0	11
Midland Borough	0	0	0	0	0	0	0	0	1
Monaca Borough	0	0	0	0	0	0	0	0	17
New Brighton Borough	0	0	0	0	0	0	0	1	0
New Galilee Borough	0	1	0	0	0	0	0	0	2
New Sewickley Township	0	0	0	2	0	0	0	0	2
North Sewickley Township	0	0	0	0	0	0	0	0	1
Ohioville Borough	0	0	0	0	0	0	0	0	1
Patterson Township	0	0	0	0	0	0	0	0	0
Patterson Heights Borough	0	0	0	0	0	0	0	0	0
Potter Township	0	0	0	0	0	0	0	0	3
Pulaski Township	0	0	0	0	0	0	0	0	0
Raccoon Township	0	0	0	0	0	0	0	0	0
Rochester Borough	0	0	0	0	0	0	0	1	1
Rochester Township	0	0	0	0	0	0	0	0	0
Shippingport Borough	0	0	0	0	0	0	0	0	1
South Beaver Township	0	0	0	1	0	0	0	0	5
South Heights Borough	0	0	0	0	0	0	0	0	0
Vanport Township	1	0	0	0	0	0	0	0	1
West Mayfield Borough	0	0	0	0	0	0	0	0	0
White Township	0	0	0	0	0	0	0	0	0
BEAVER COUNTY (TOTAL)	**2**	**2**	**1**	**8**	**1**	**1**	**1**	**4**	**133**

Source: Beaver County 2015

Note: [1] = Georgetown Borough is currently suspended from the NFIP.

Table 4.3.5-24. Critical Facilities and Utilities Within the 0.2-Percent Annual Chance Flood Boundary

Municipality	Facility Types								
	County Building	Fire Station	Municipal Building	Natural Gas	Police Station	Potable Water Facility	School	Wastewater Facility	Well
City of Aliquippa	0	0	0	0	0	0	0	0	0
Ambridge Borough	0	0	0	0	0	1	0	0	15
Baden Borough	0	0	0	0	0	0	0	1	2
Beaver Borough	0	0	0	0	0	1	1	0	3
City of Beaver Falls	0	0	0	0	0	0	0	0	7
Big Beaver Borough	0	0	0	0	0	0	0	0	1
Bridgewater Borough	0	1	1	0	1	0	0	0	0
Brighton Township	1	0	0	0	0	0	0	0	4
Center Township	0	0	0	0	0	0	0	0	3
Chippewa Township	0	0	0	0	0	0	0	0	1
Conway Borough	0	0	0	0	0	0	0	1	1
Darlington Borough	0	0	0	0	0	0	0	0	0
Darlington Township	0	1	1	0	1	0	0	0	16
Daugherty Township	0	0	0	0	0	0	0	0	0
East Rochester Borough	0	0	0	0	0	0	0	0	0
Eastvale Borough	0	0	0	0	0	0	0	0	0
Economy Borough	0	0	0	0	0	0	0	0	2
Fallston Borough	0	0	0	0	0	0	0	0	2
Frankfort Springs Borough	0	0	0	0	0	0	0	0	0
Franklin Township	0	0	0	3	0	0	0	0	12
Freedom Borough	0	0	0	0	0	0	0	0	6
Georgetown Borough[1]	0	0	0	0	0	0	0	0	0
Glasgow Borough	0	0	0	0	0	0	0	0	1
Greene Township	0	0	0	0	0	0	0	0	3
Hanover Township	0	0	0	0	0	0	0	0	7
Harmony Township	0	0	0	0	0	0	0	0	1
Homewood Borough	0	0	0	0	0	0	0	0	0
Hookstown Borough	0	0	0	0	0	0	0	0	0
Hopewell Township	0	0	0	0	0	0	0	0	3
Independence Township	0	0	0	0	0	0	0	0	4
Industry Borough	0	0	0	0	0	0	0	0	0
Koppel Borough	0	0	0	0	0	0	0	0	0
Marion Township	0	0	0	2	0	0	0	0	11
Midland Borough	0	0	0	0	0	0	0	0	1
Monaca Borough	0	0	0	0	0	0	0	0	17

Municipality	Facility Types								
	County Building	Fire Station	Municipal Building	Natural Gas	Police Station	Potable Water Facility	School	Wastewater Facility	Well
New Brighton Borough	0	0	0	0	0	0	0	1	0
New Galilee Borough	0	1	0	0	0	0	0	0	2
New Sewickley Township	0	0	0	2	0	0	0	0	2
North Sewickley Township	0	0	0	0	0	0	0	0	1
Ohioville Borough	0	0	0	0	0	0	0	0	1
Patterson Township	0	0	0	0	0	0	0	0	0
Patterson Heights Borough	0	0	0	0	0	0	0	0	0
Potter Township	0	0	0	0	0	0	0	0	3
Pulaski Township	0	0	0	0	0	0	0	0	0
Raccoon Township	0	0	0	0	0	0	0	0	0
Rochester Borough	0	0	0	0	0	0	0	1	1
Rochester Township	0	0	0	0	0	0	0	0	0
Shippingport Borough	0	0	0	0	0	0	0	0	1
South Beaver Township	0	0	0	1	0	0	0	0	5
South Heights Borough	0	0	0	0	0	0	0	0	0
Vanport Township	1	0	0	0	0	0	0	0	1
West Mayfield Borough	0	0	0	0	0	0	0	0	0
White Township	0	0	0	0	0	0	0	0	0
BEAVER COUNTY (TOTAL)	**2**	**3**	**2**	**8**	**2**	**2**	**1**	**4**	**140**

Source: Beaver County 2015

Note: [1] = Georgetown Borough is currently suspended from the NFIP.

Impact on the Economy

For impact on the economy, estimated losses from a flood event are considered. Losses include but are not limited to general building stock damages, agricultural losses, business interruption, and impacts on tourism and tax base within Beaver County. Damages to general building stock can be quantified by use of HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime, and social economic factors are less susceptible to measurement with a high degree of certainty. For the purposes of this analysis, general building stock damages are discussed further.

Flooding can cause extensive damage to public utilities and disruptions in delivery of services. Loss of power and communications may occur, and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and road blocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges.

Direct building losses are estimated costs to repair or replace damage caused to buildings. Estimated potential damage to general building stock inventory associated with the 1-percent flood is approximately $252 million,

which represents less than 1 percent of the County's overall total general building stock inventory. These dollar value losses from the County's total building inventory replacement value, in addition to damages to roadways and infrastructure, would impact the local economy.

HAZUS-MH estimates the amount of debris generated from a 1-percent annual chance flood event. The model breaks down debris into three categories because of the different types of equipment needed to handle debris: (1) finishes (dry wall, insulation, etc.), (2) structural (wood, brick, etc.), and (3) foundations (concrete slab and block, rebar, etc.). Table 4.3.5-15 summarizes the debris HAZUS-MH 3.0 estimates to result from a 1-percent annual chance flood event—17,000+ tons of debris. Notably, this table lists estimated debris generated only by riverine flooding, and does not include additional potential damage and debris possibly generated by force of wind.

Table 4.3.5-3. Estimated Debris Generated from the 1-Percent Annual Chance Flood Event

Municipality	1% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
City of Aliquippa	2,808	778	1,098	931
Ambridge Borough	20	11	5	4
Baden Borough	42	17	16	10
Beaver Borough	0	0	0	0
City of Beaver Falls	2,595	1,181	827	587
Big Beaver Borough	200	97	56	47
Bridgewater Borough	432	173	140	120
Brighton Township	109	57	30	23
Center Township	257	148	72	38
Chippewa Township	11	10	1	1
Conway Borough	236	163	42	30
Darlington Borough	5	3	1	1
Darlington Township	1,717	682	552	482
Daugherty Township	25	17	4	4
East Rochester Borough	8	7	1	1
Eastvale Borough	34	20	7	7
Economy Borough	70	51	9	10
Fallston Borough	62	40	14	8
Frankfort Springs Borough	0	0	0	0
Franklin Township	1,201	596	314	291
Freedom Borough	41	24	10	7
Georgetown Borough[1]	4	1	1	1
Glasgow Borough	148	140	4	3
Greene Township	45	13	17	15
Hanover Township	32	25	2	4
Harmony Township	303	46	149	109
Homewood Borough	0	0	0	0
Hookstown Borough	15	10	2	3
Hopewell Township	180	87	49	43
Independence Township	487	228	128	132
Industry Borough	1,109	149	526	435

Municipality	1% Flood Event			
	Total (tons)	Finish (tons)	Structure (tons)	Foundation (tons)
Koppel Borough	1	1	0	0
Marion Township	334	148	97	89
Midland Borough	0	0	0	0
Monaca Borough	1,386	375	566	445
New Brighton Borough	282	250	16	16
New Galilee Borough	221	123	55	43
New Sewickley Township	321	148	88	85
North Sewickley Township	554	308	117	129
Ohioville Borough	13	11	1	2
Patterson Township	0	0	0	0
Patterson Heights Borough	57	20	22	16
Potter Township	133	41	48	44
Pulaski Township	40	24	7	9
Raccoon Township	28	12	8	8
Rochester Borough	6	5	0	0
Rochester Township	55	33	13	9
Shippingport Borough	13	6	4	4
South Beaver Township	193	120	38	35
South Heights Borough	0	0	0	0
Vanport Township	1,224	142	677	405
West Mayfield Borough	39	19	12	8
White Township	0	0	0	0
BEAVER COUNTY (TOTAL)	**17,097**	**6,559**	**5,843**	**4,695**

Source: HAZUS-MH 3.0

Note: [1] = Georgetown Borough is currently suspended from the NFIP.

Impact on the Environment

As discussed, floodplains serve beneficial and natural functions on ecological/environmental, social, and economic levels. Areas in the floodplain that typically provide these natural functions and benefits are wetlands, riparian areas, sensitive areas, and habitats for rare and endangered species. Floods, however, can also lead to negative impacts on the environment. Loss of riparian buffers, land use change within a watershed, and introduction of non-natural contaminants may be environmental issues when floods occur (Montz and Tobin 1997, Rubin 2013).

To determine exposure of natural and beneficial land in Beaver County to the flood hazard, acreages of wetlands and forested land were calculated. Table 4.3.5-4 lists results of these calculations.

Table 4.3.5-16. Acreage of Natural and Beneficial Land Within the Floodplain

Wetlands	Area in the 1-Percent Annual Chance Floodplain (acres)	Area in the 0.2-Percent Annual Chance Floodplain (acres)
Wetlands	5,634	5,719
Forest	318	319

Sources: USGS National Land Cover Data (NLCD) 2014, FEMA 2015

The basic environmental impact of major flooding is morphological, and shape of a river valley is often determined more by a catastrophic event than a long, gradual, methodical process. This is a primary factor in formation of natural habitat for flora and fauna, and may influence habitats beyond the river corridor (Hickey and Salas 1995).

Flooding can cause a wide range of environmental impacts including but not limited to erosion and loss of vegetation and habitats. These in turn may lead to decreased protection of the waterbody from adjacent land uses, and to degraded water quality. Moreover, floods may generate large amounts of tree and construction debris (refer to Table 5.4.5-15), disperse household hazardous waste into the fluvial system, and contaminate water supplies and wildlife habitats with extremely toxic substances. Floods of greater depth are likely to result in greater environmental damage than floods of lesser depth. Long-duration floods could exacerbate environmental problems because cleanup likely would be delayed and contaminants could remain in the environment for a longer period of time. Cleanup after a flood raises additional environmental concerns. The volume of debris to be collected, the extent to which public utilities (water supply systems and sewer operations) have been damaged, and the quantity of agricultural and industrial pollutants entering water bodies might present additional issues (Montz and Tobin 1997, Rubin 2013).

Future Growth and Development

As discussed in Section 2.4, areas targeted for future growth and development have been identified across the County. Any areas of growth could be impacted by the flood hazard if within identified hazard areas. The County intends to discourage development within vulnerable areas and to encourage higher regulatory standards on the local level.

Effect of Climate Change on Vulnerability

Climate is defined not simply as average temperature and precipitation but also by type, frequency, and intensity of weather events. Both globally and at the local scale, climate change can alter prevalence and severity of extremes such as flood events. While predicting changes of flood events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society, and the environment (U.S. Environmental Protection Agency [EPA] 2006).

PADEP was directed by the Climate Change Act (Act 70 of 2008) to initiate a study of potential impacts of global climate change on the Commonwealth. The June 2009 Pennsylvania Climate Impact Assessment's main findings indicate that Pennsylvania is very likely to undergo increased temperatures in the 21st century. An increase in variability of temperature and precipitation may lead to increased frequency and/or severity of storm events. Summer floods and general stream flow variability are projected to increase due to increased variability in precipitation. Even with the anticipated increase in winter precipitation as rain rather than snow, increased winter temperatures and a reduced snowpack may decrease rain-on-snow events and thus major

flooding events in Pennsylvania. This conclusion, however, remains speculative until further studies can validate it. Future improvements in modeling smaller-scale climatic processes are expected, and will lead to improved understanding of how the changing climate will alter temperature, precipitation, storms, and flood events in Pennsylvania (Shortle et al. 2009).

Additional Data and Next Steps

A HAZUS-MH riverine flood analysis of Beaver County was based on the most current and best available data, including building and critical facility inventories, FEMA DFIRM, and 1-percent annual chance flood event depth grid. For future plan updates, more accurate exposure and loss estimates may be produced by updating the default general building stock inventory in HAZUS-MH with a countywide inventory based on countywide available footprints and associated building attributes, and conducting the loss estimates at the structure level.

According to FEMA Region 3, Beaver County is part of an ongoing total exposure in the floodplain (TEIF) project. This project will utilize 2010 U.S. Census data, as well as up-to-date RS Means valuations to determine total replacement value in the floodplain. These data, when available, may be integrated into the HMP update.

Section 6 (Mitigation Strategy) of this Plan includes discussions of specific mitigation actions addressing improved data collection, and further vulnerability analysis.

MUNICIPAL FLOODPLAIN MAPS

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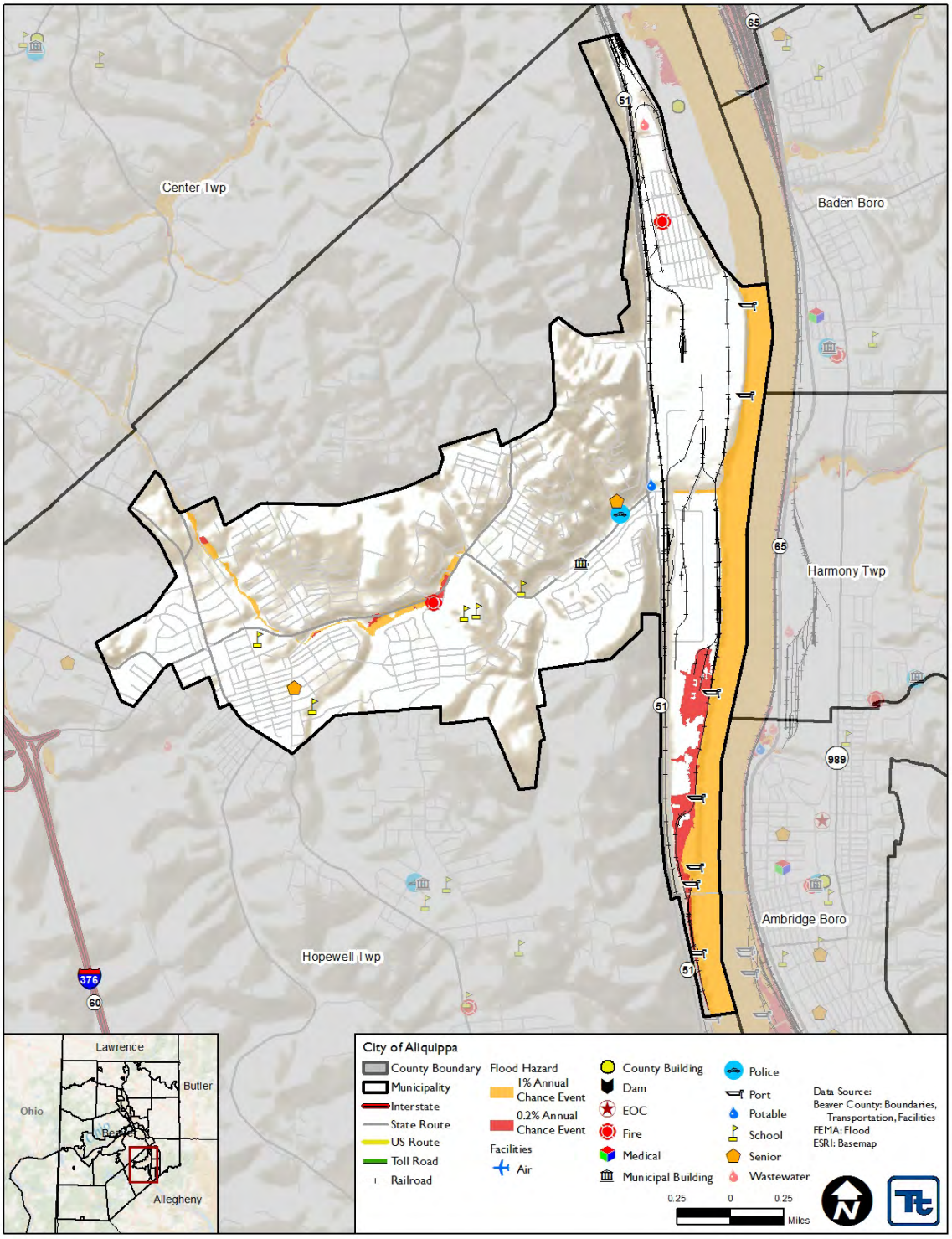

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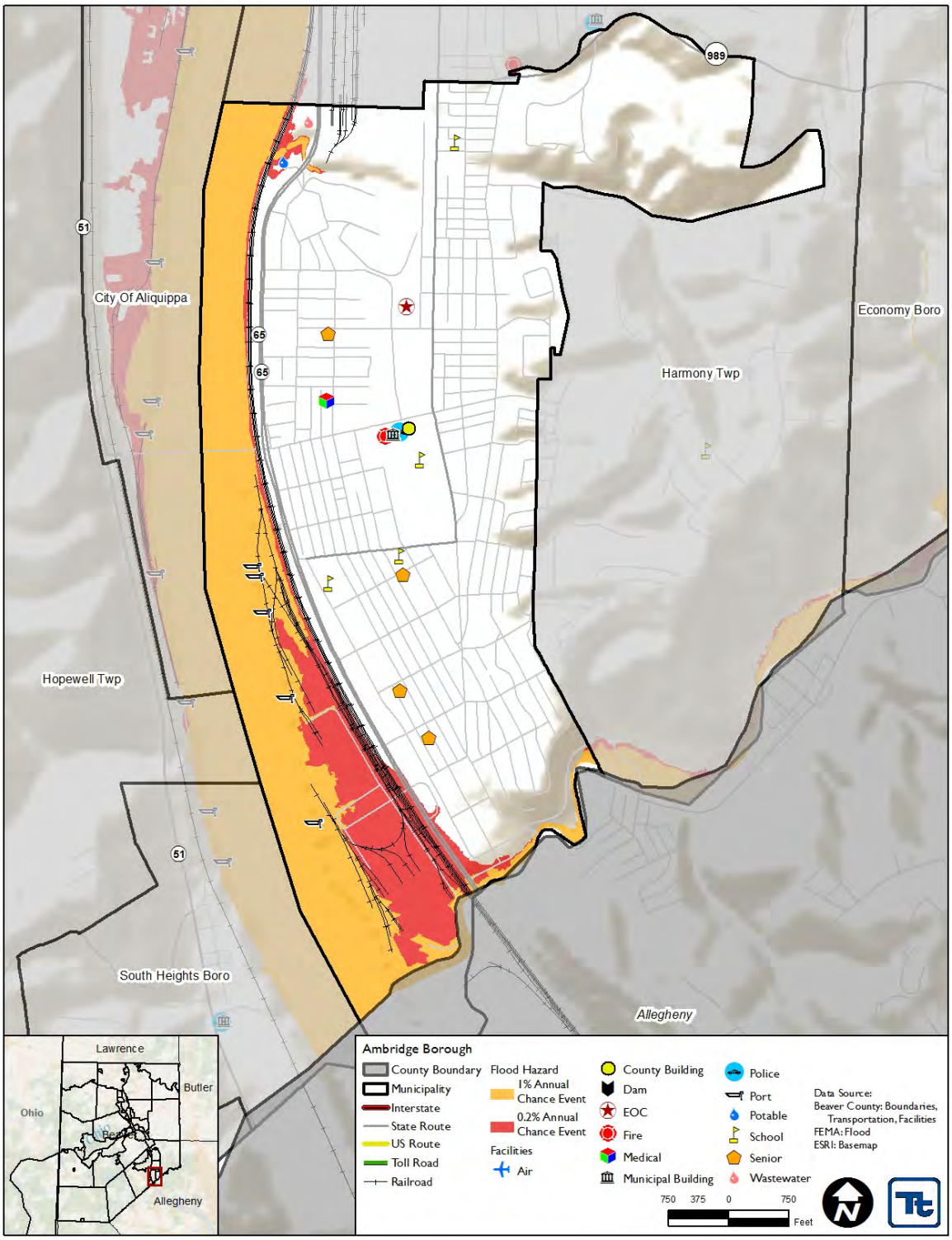

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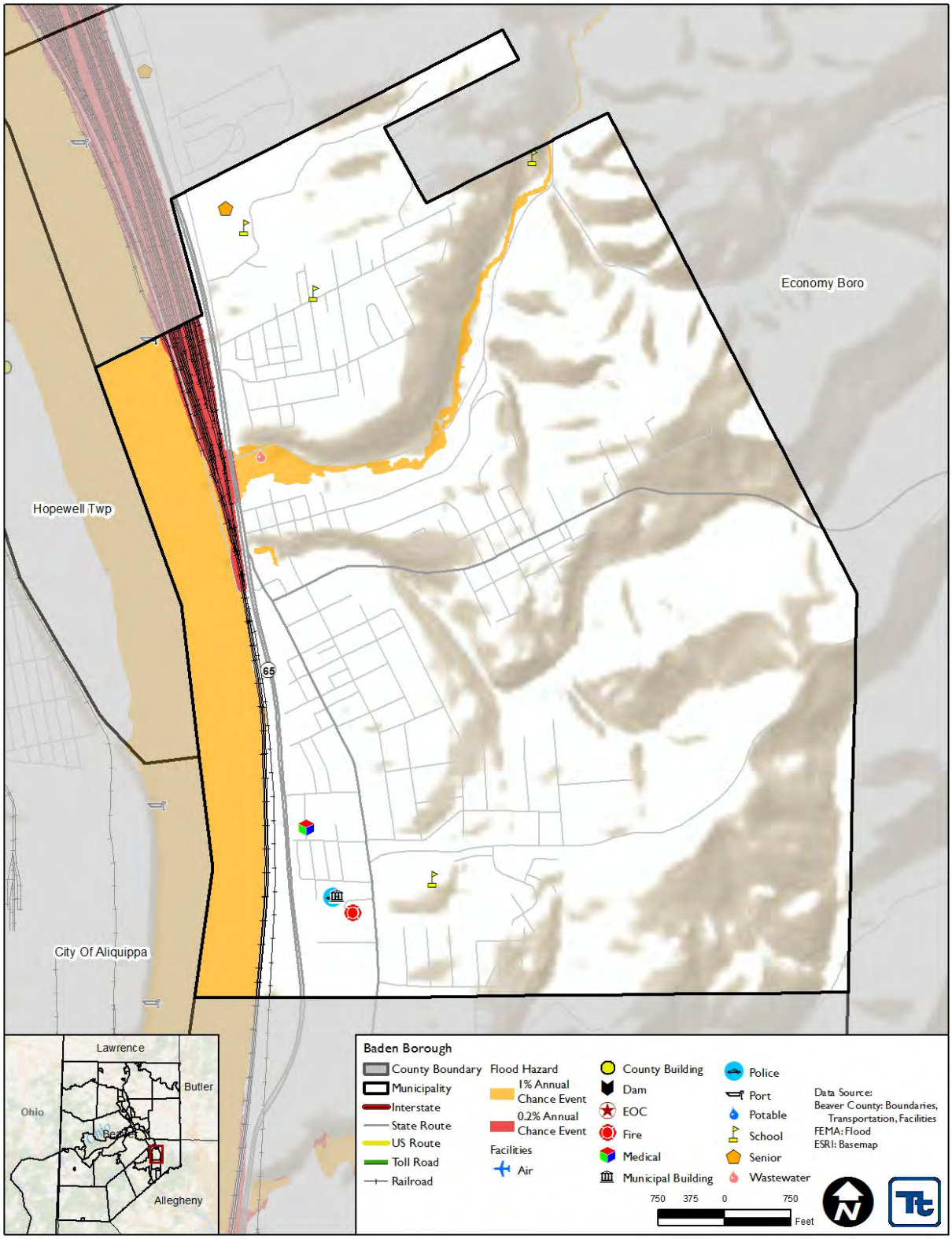

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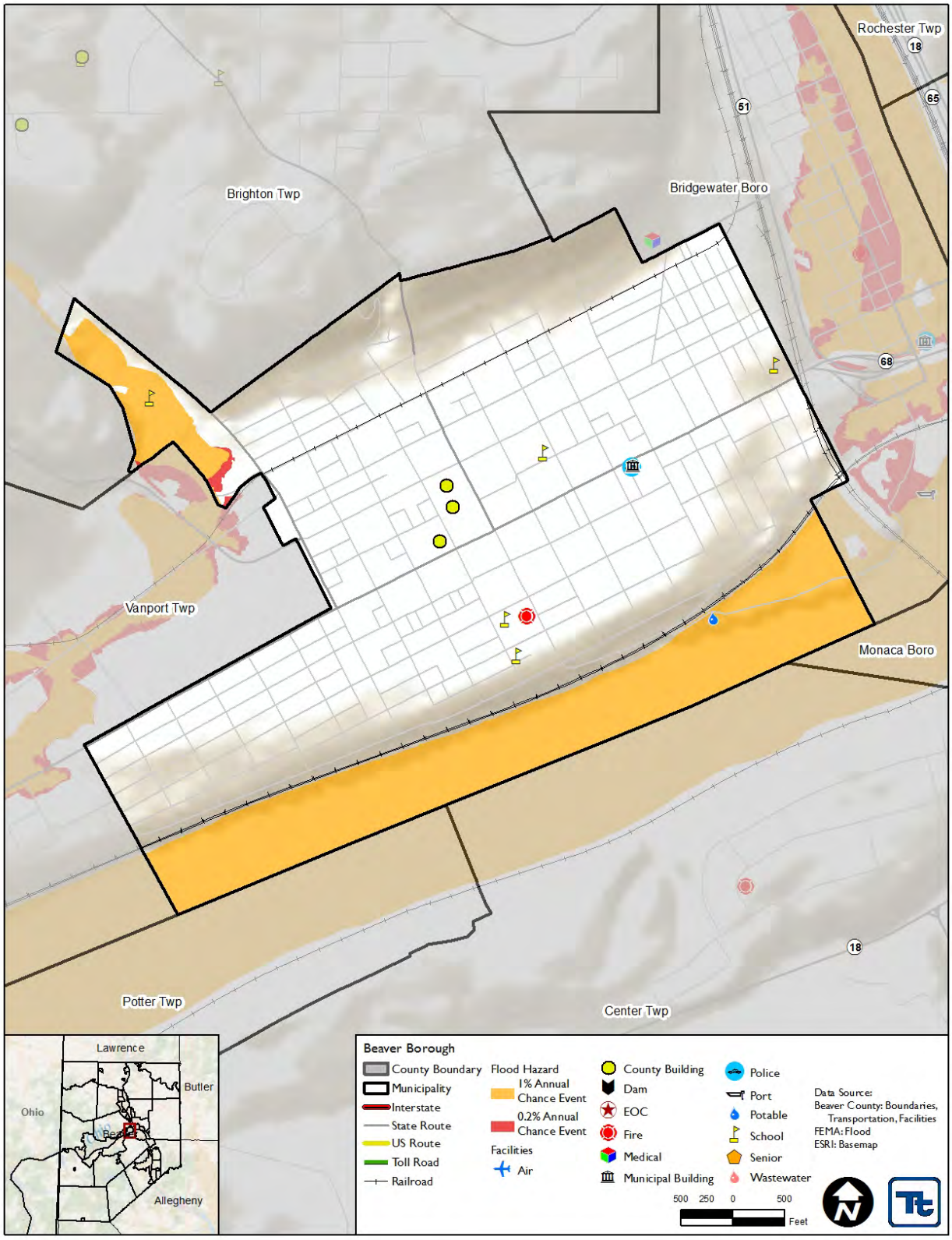

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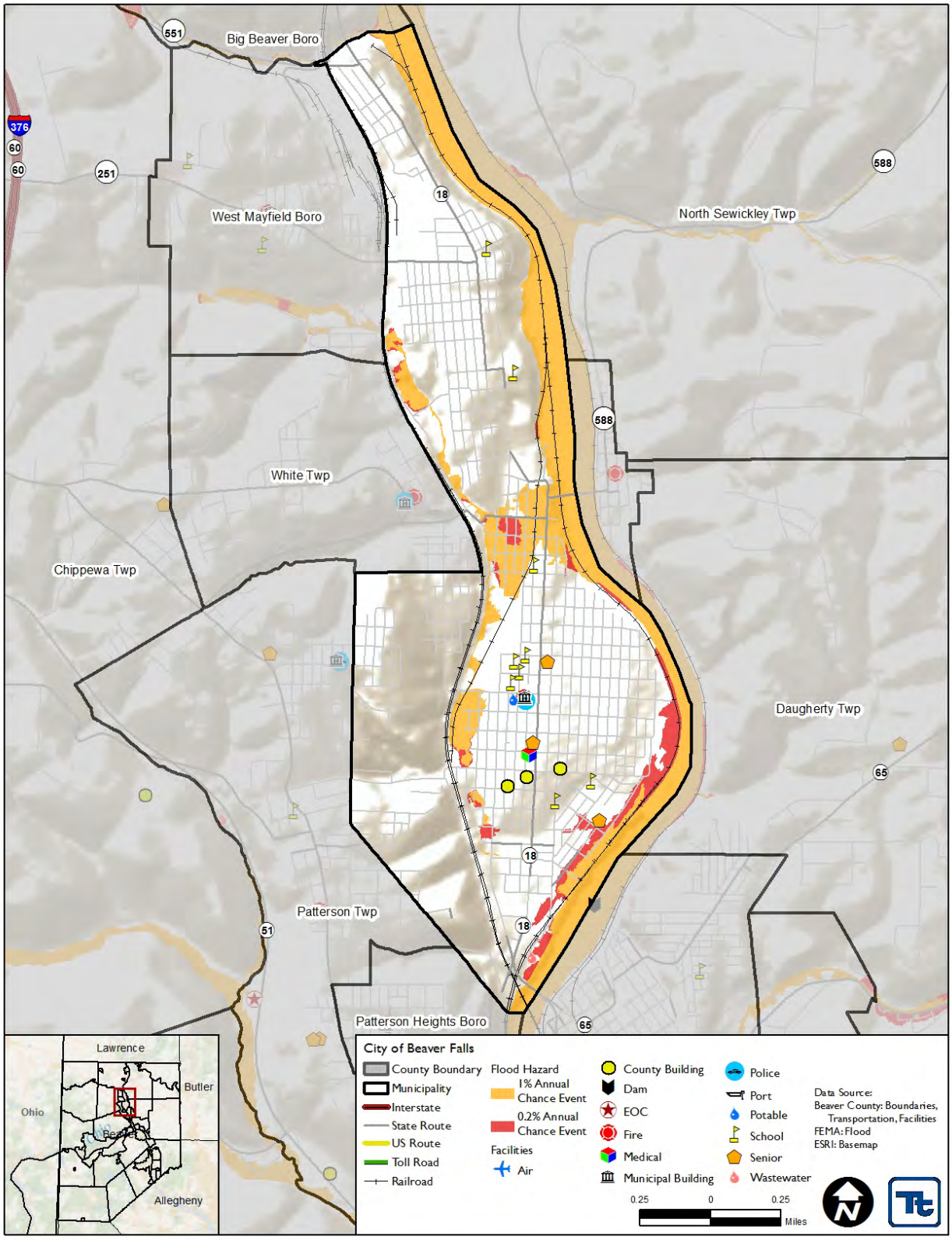

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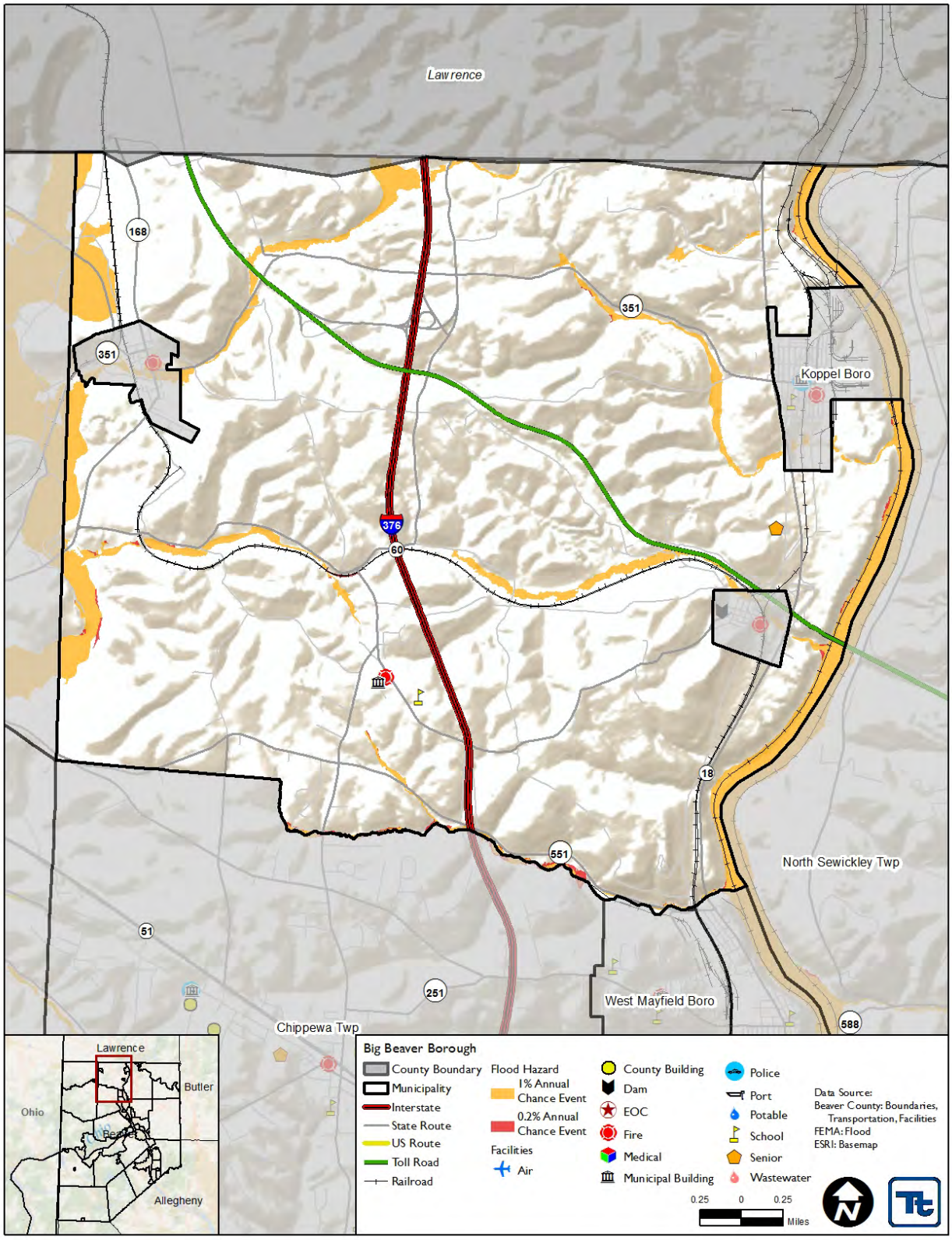

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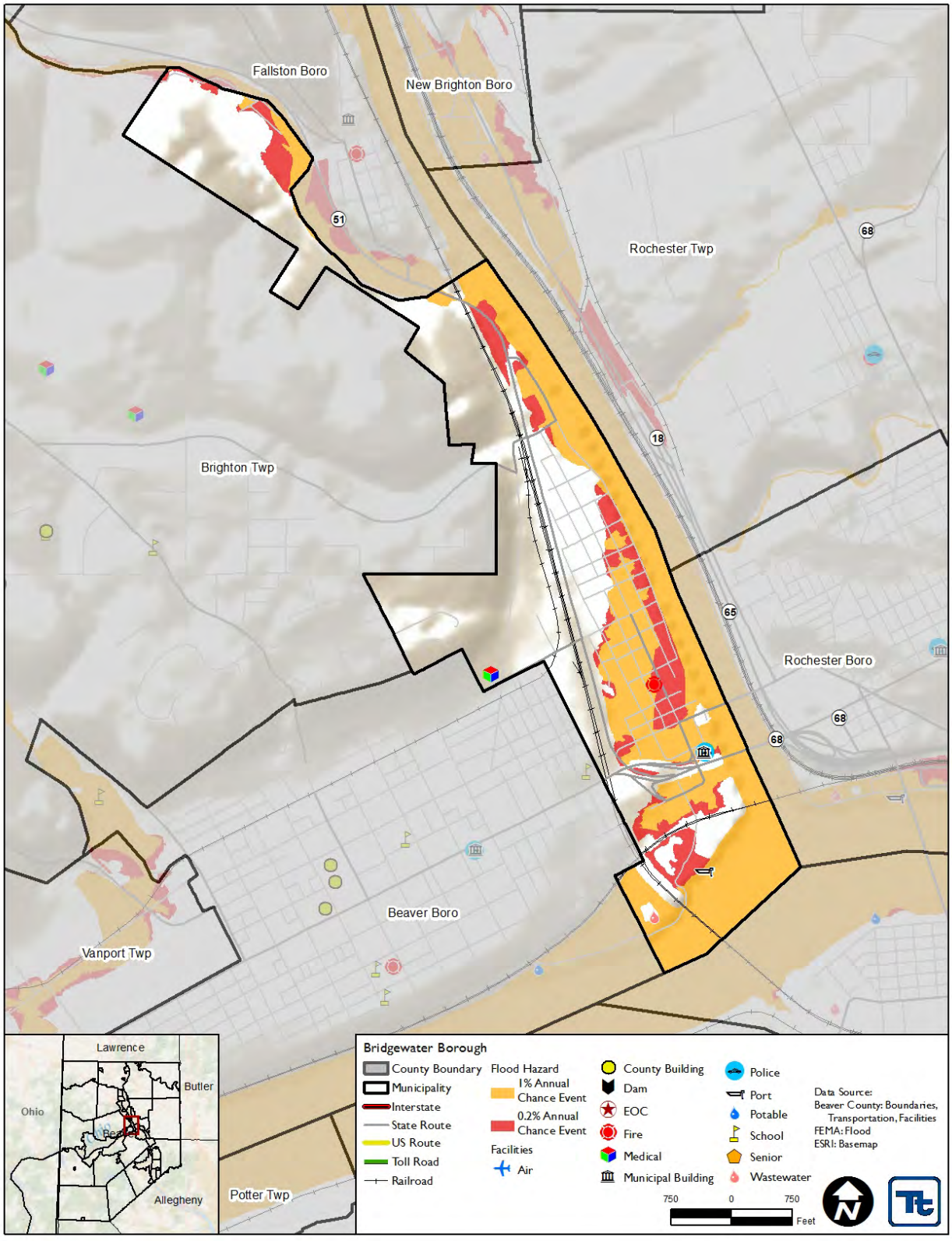

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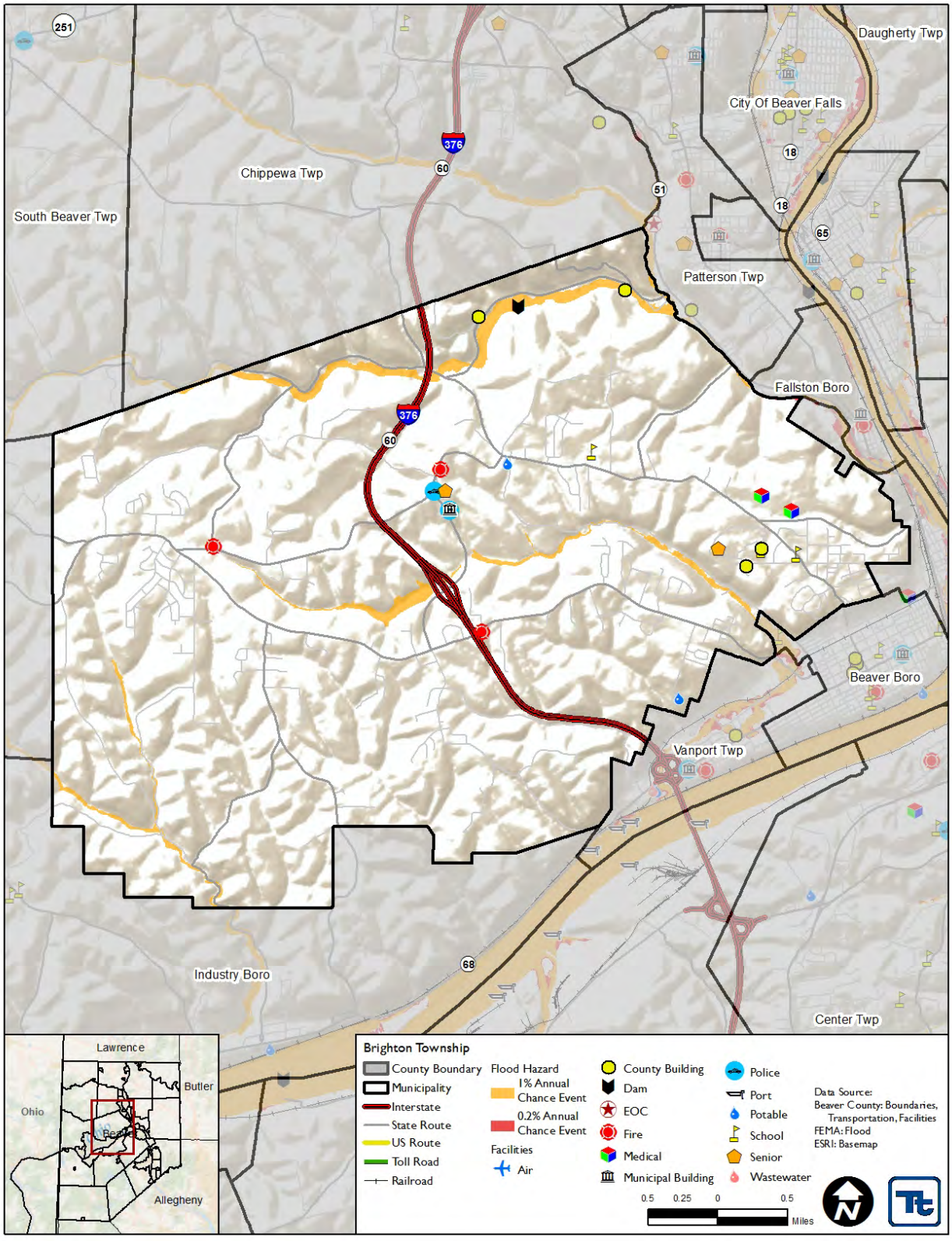

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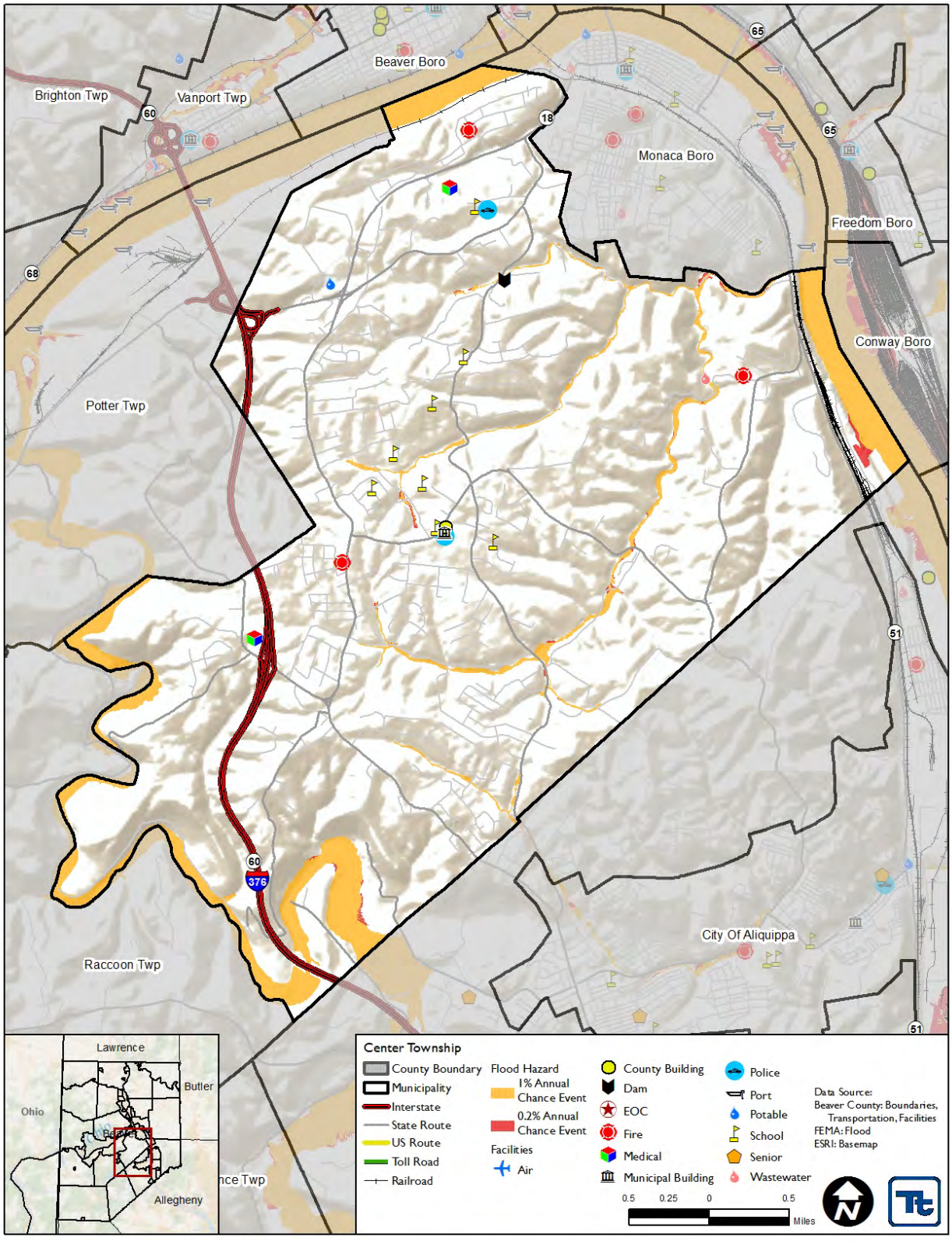

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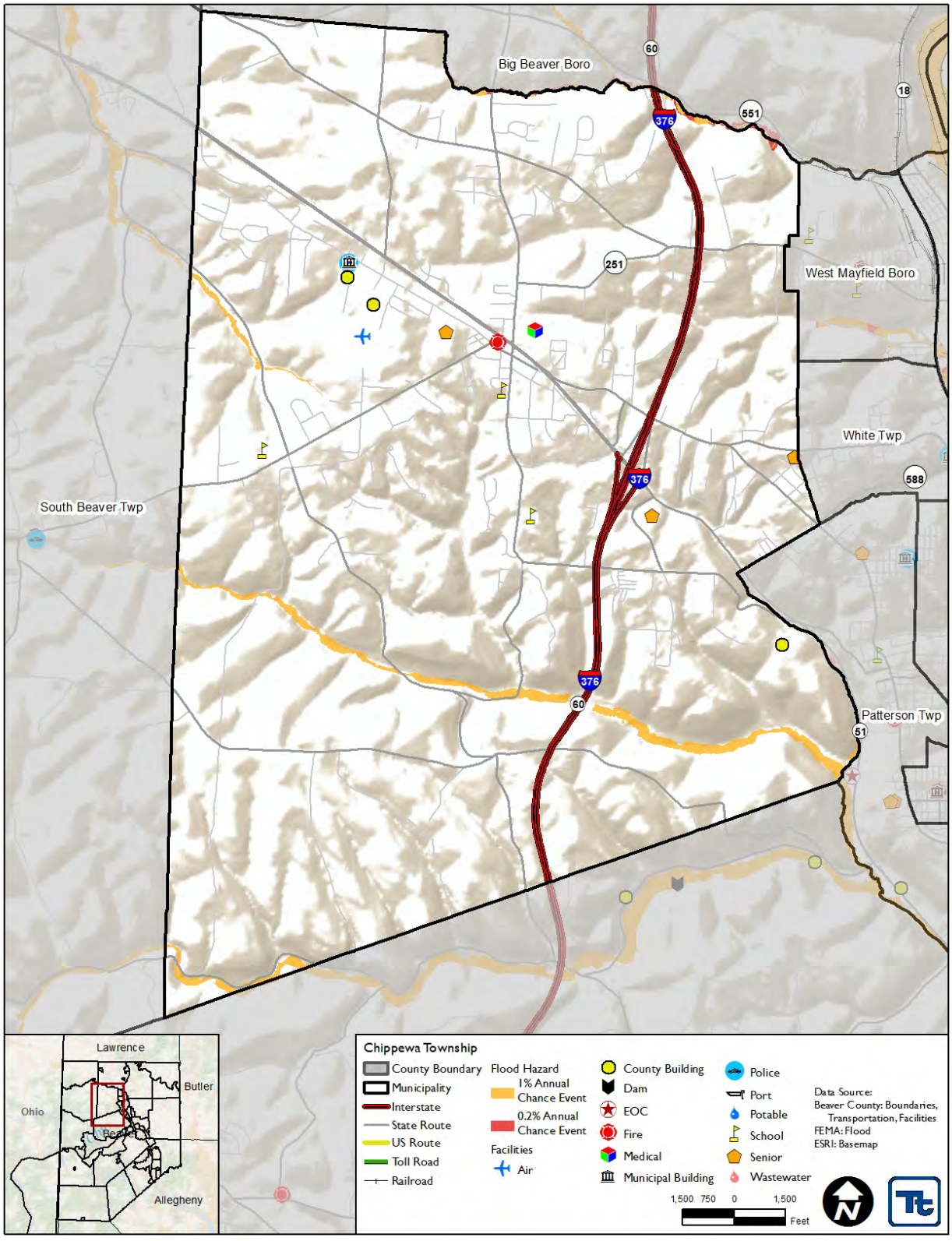

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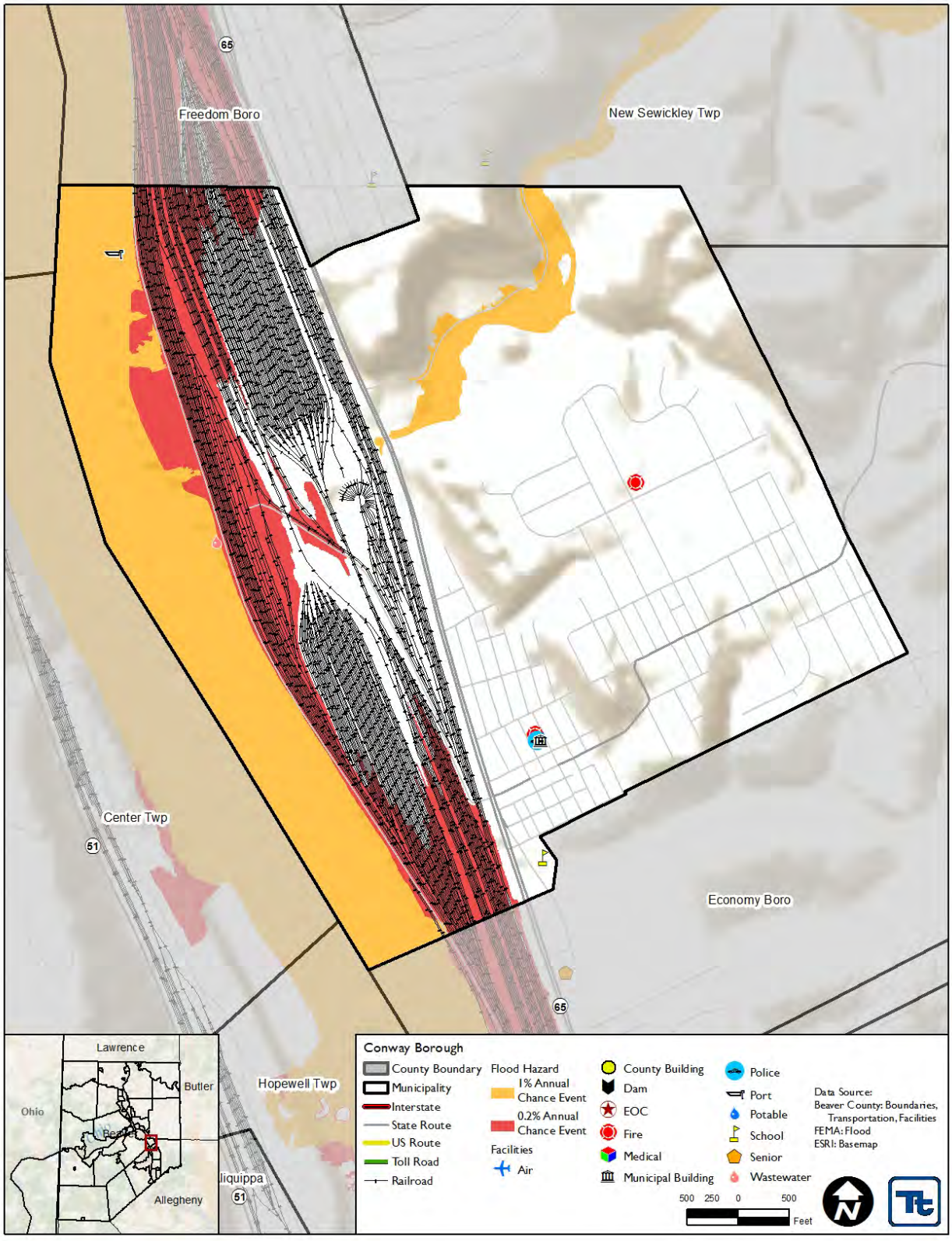

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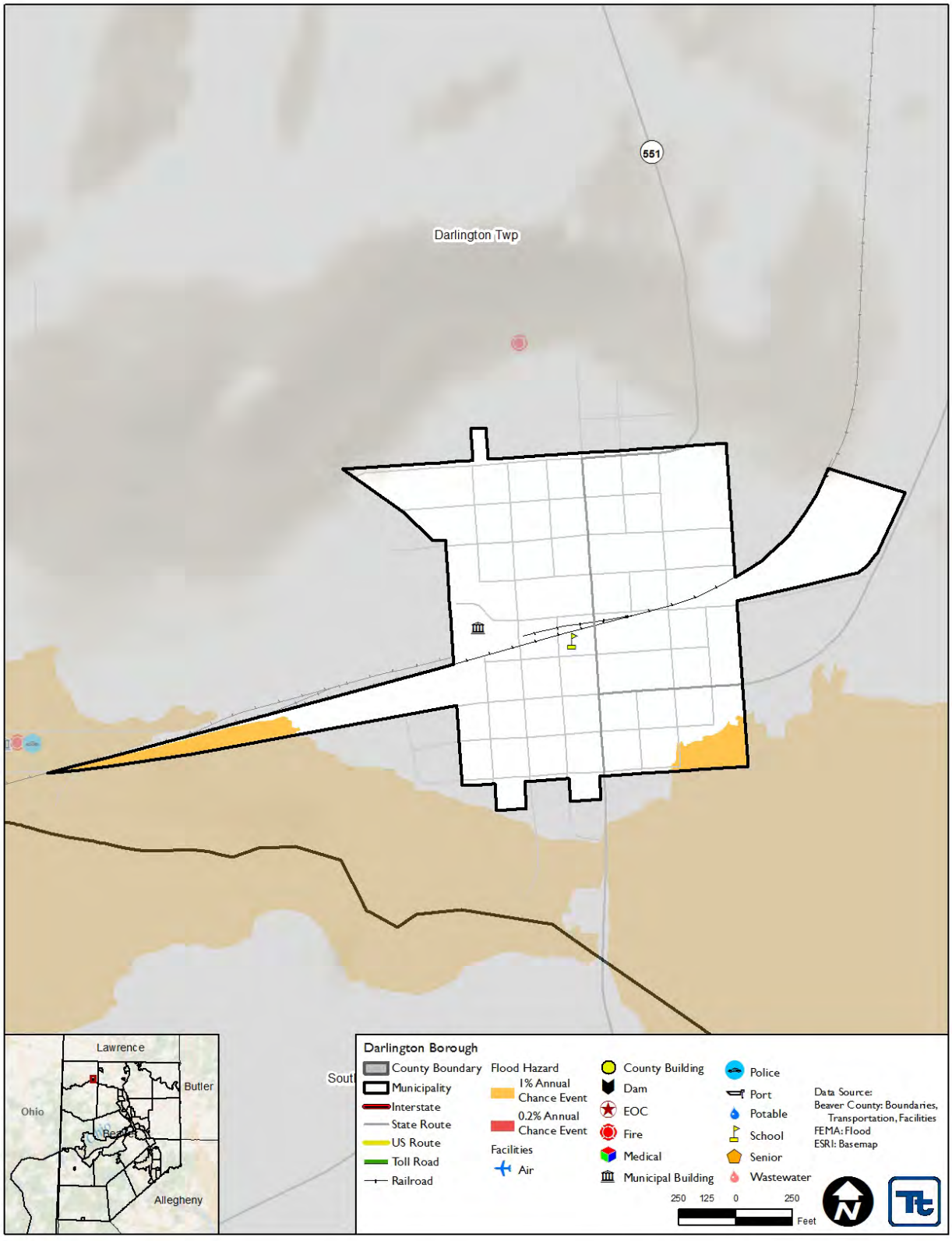

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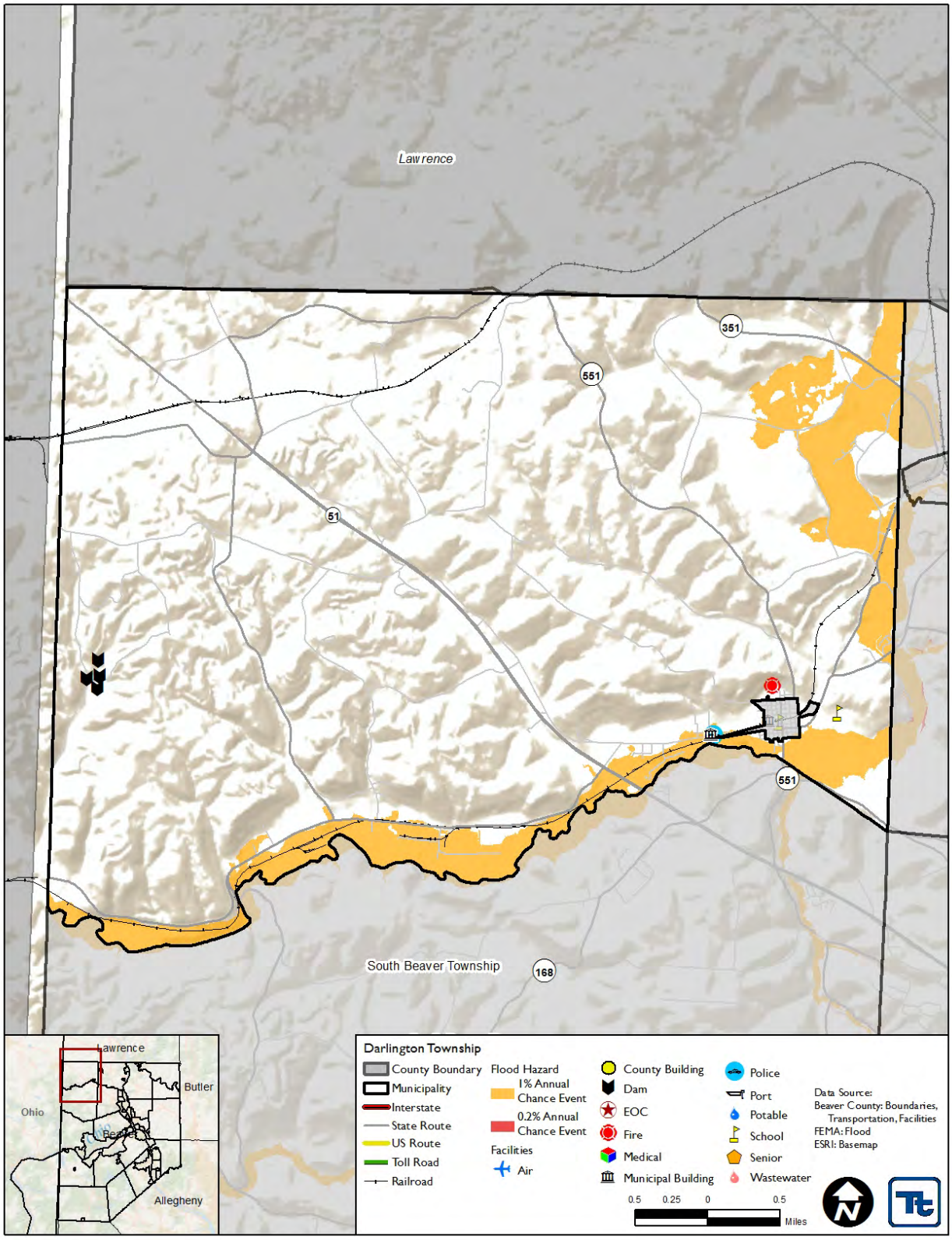

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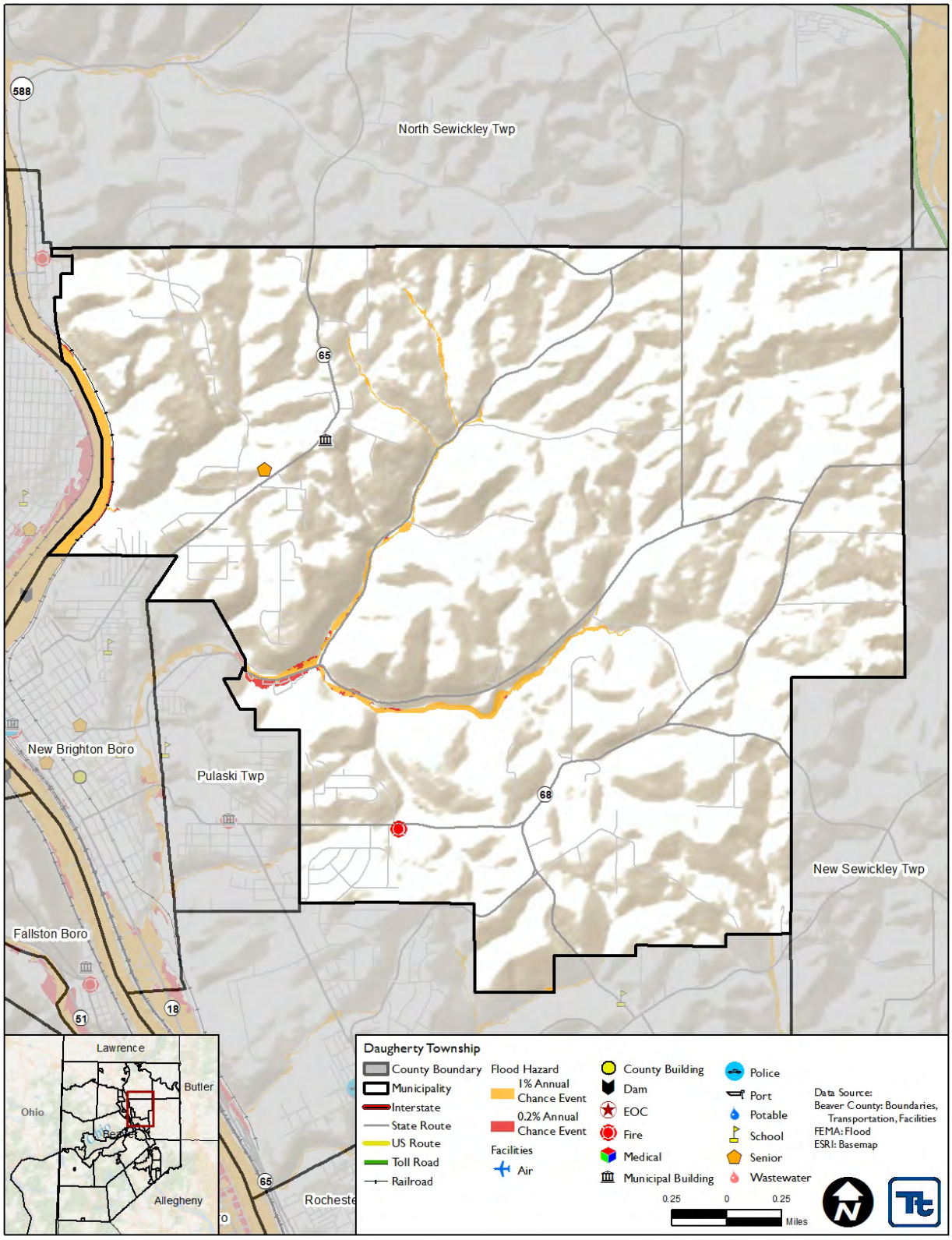

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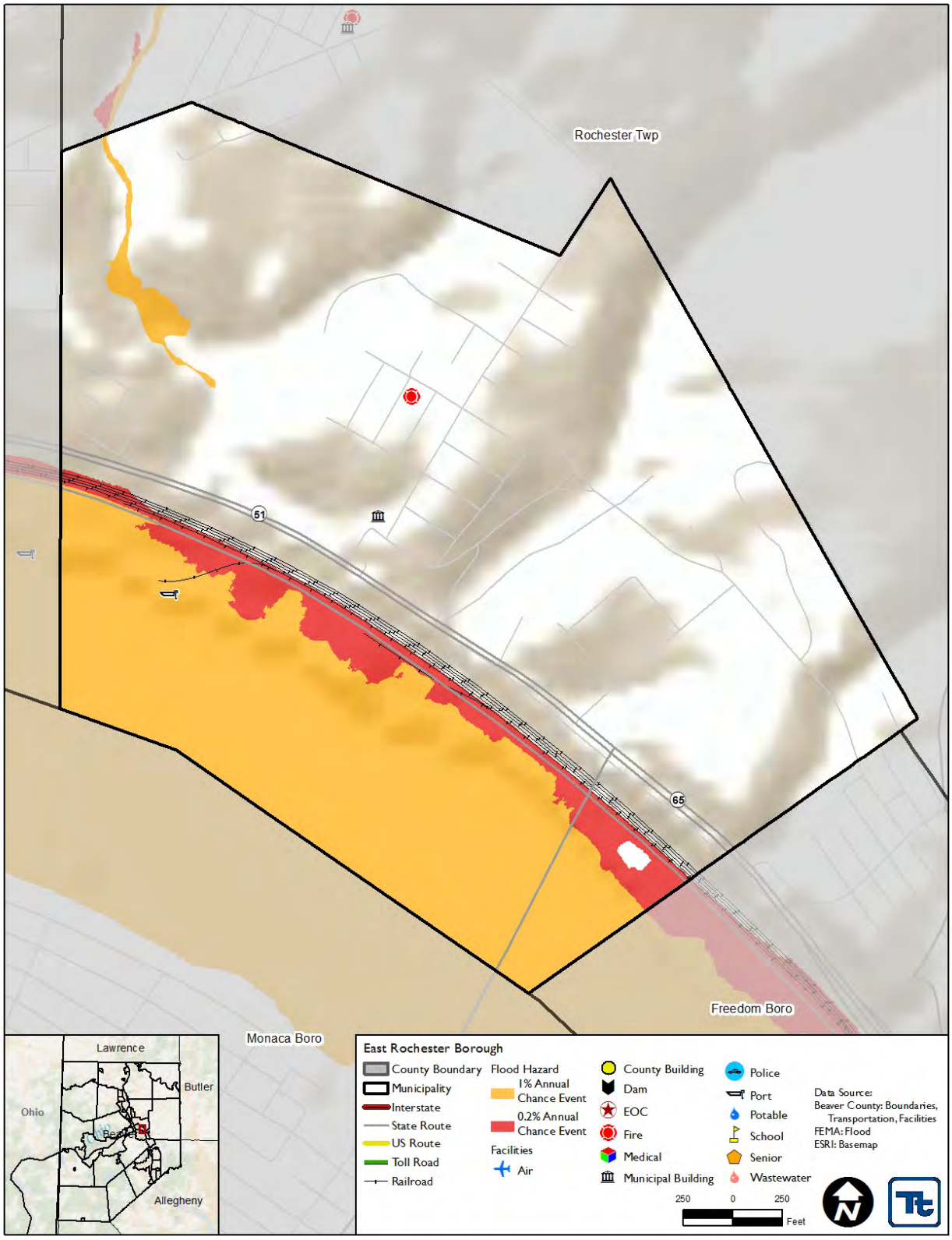

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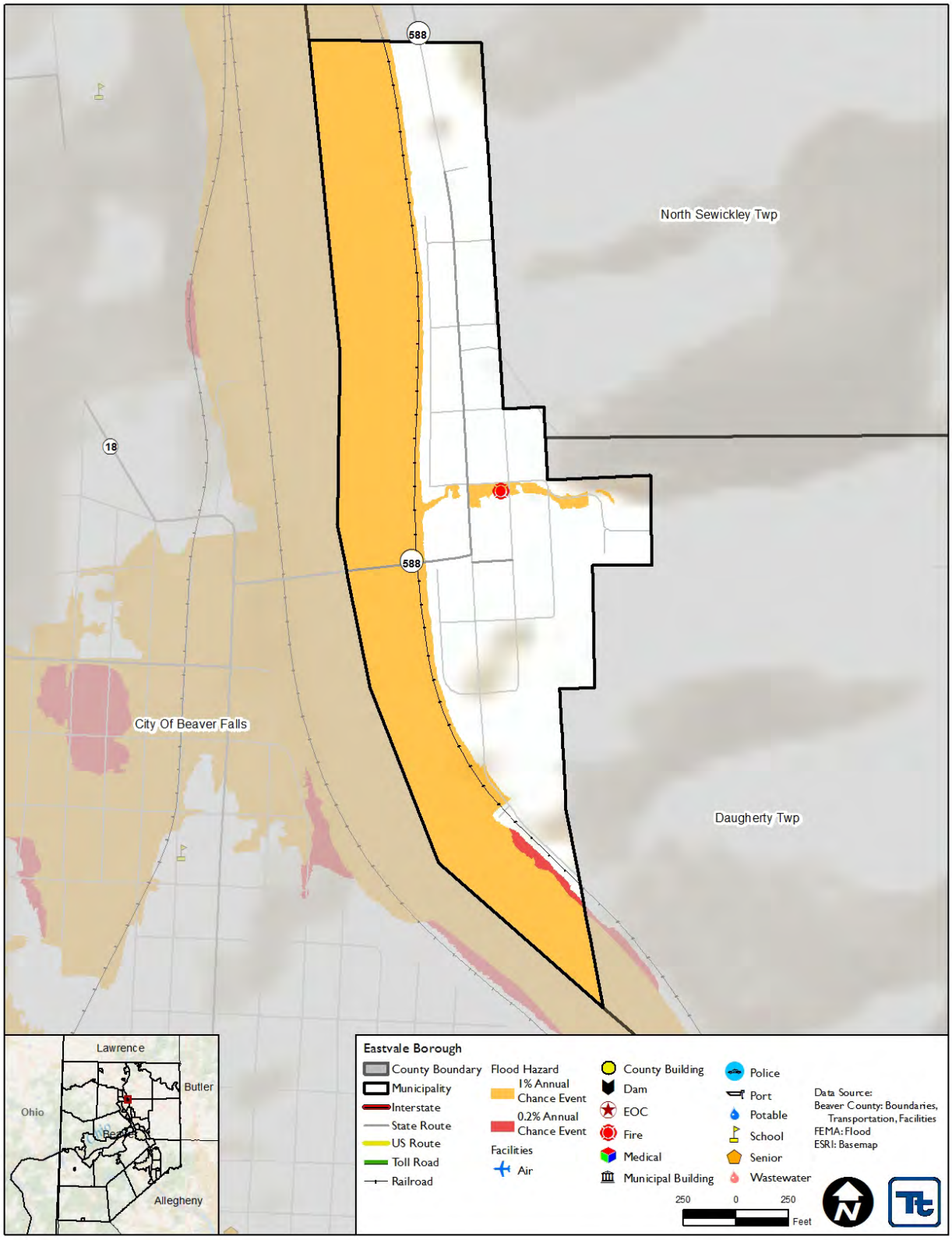

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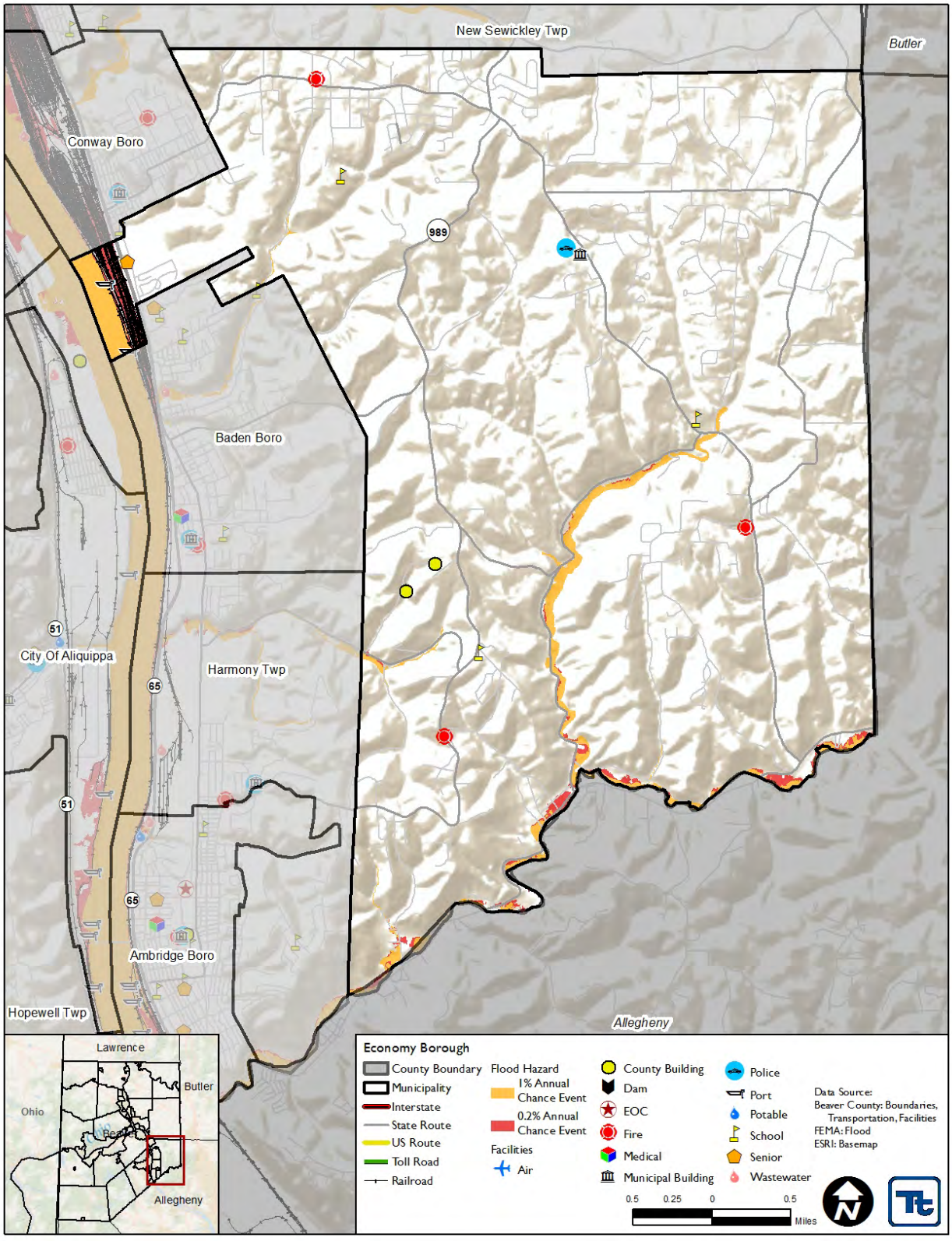

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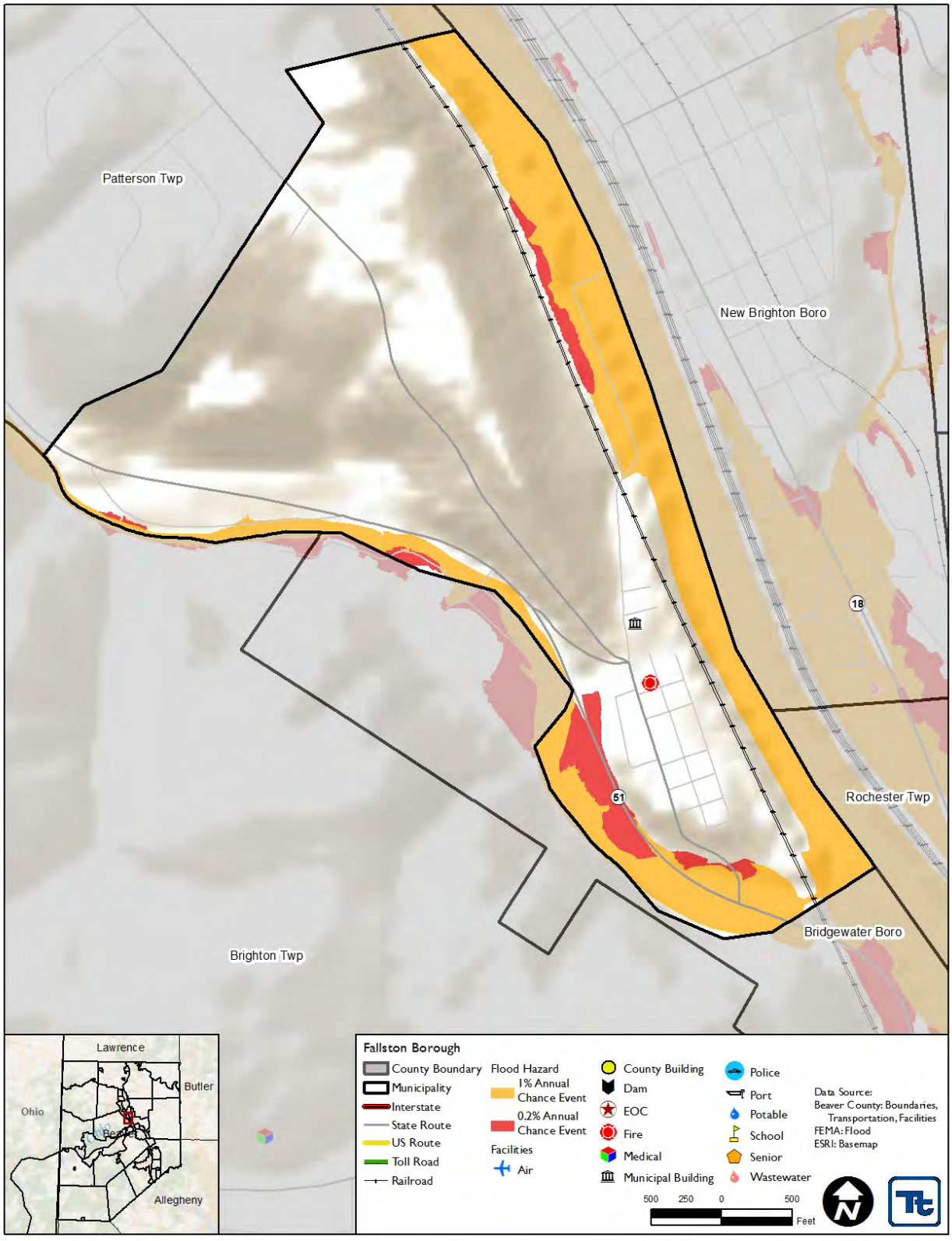

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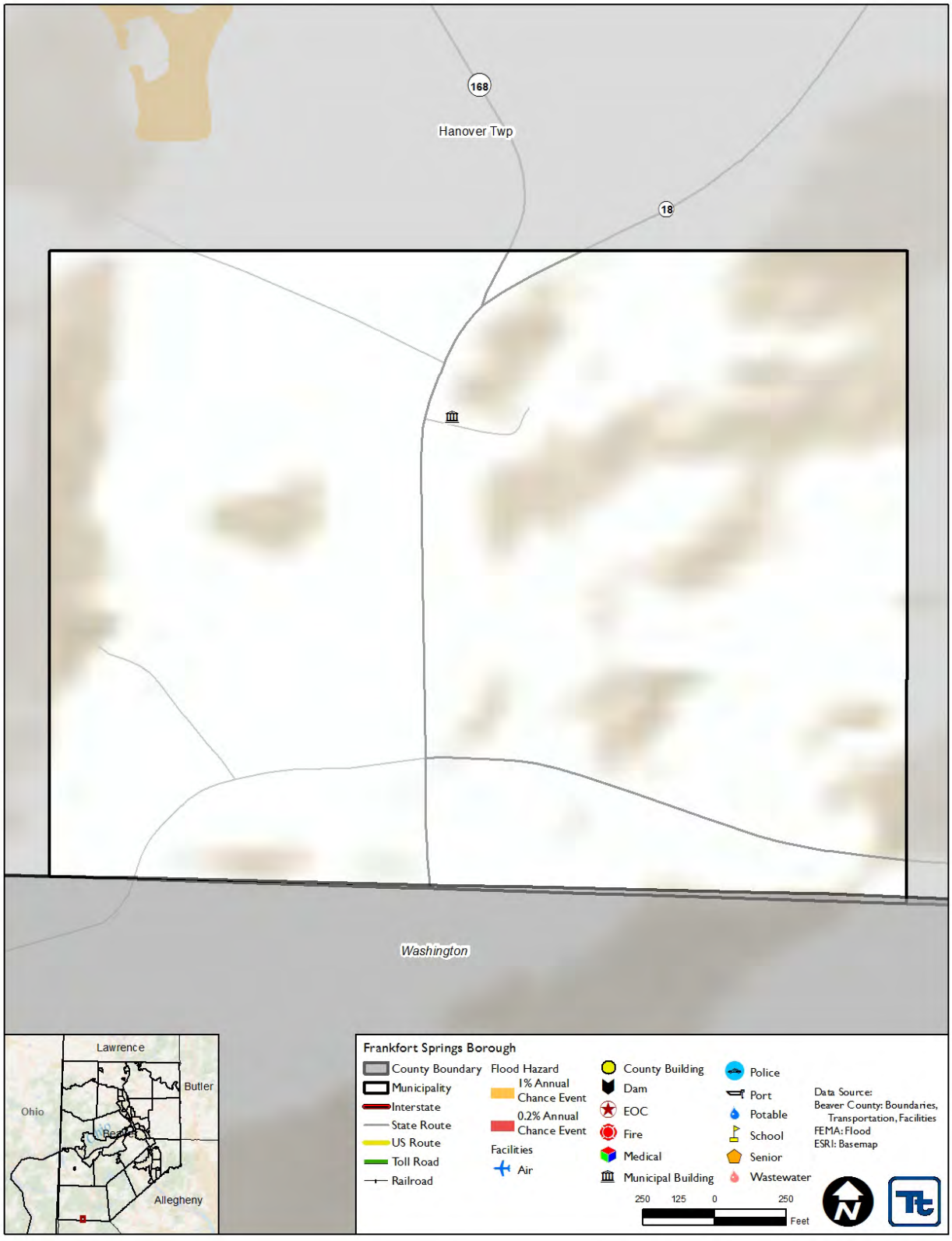

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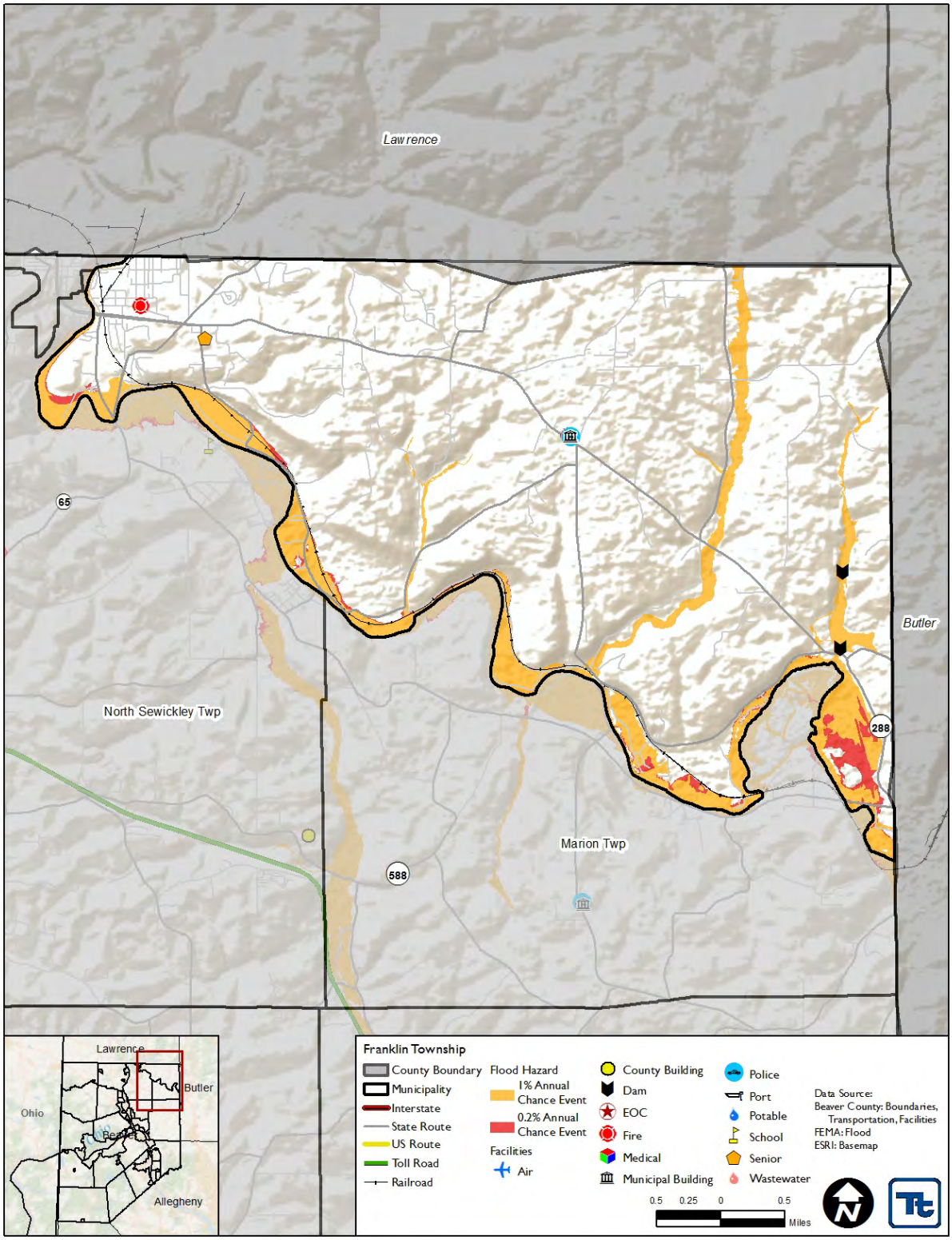

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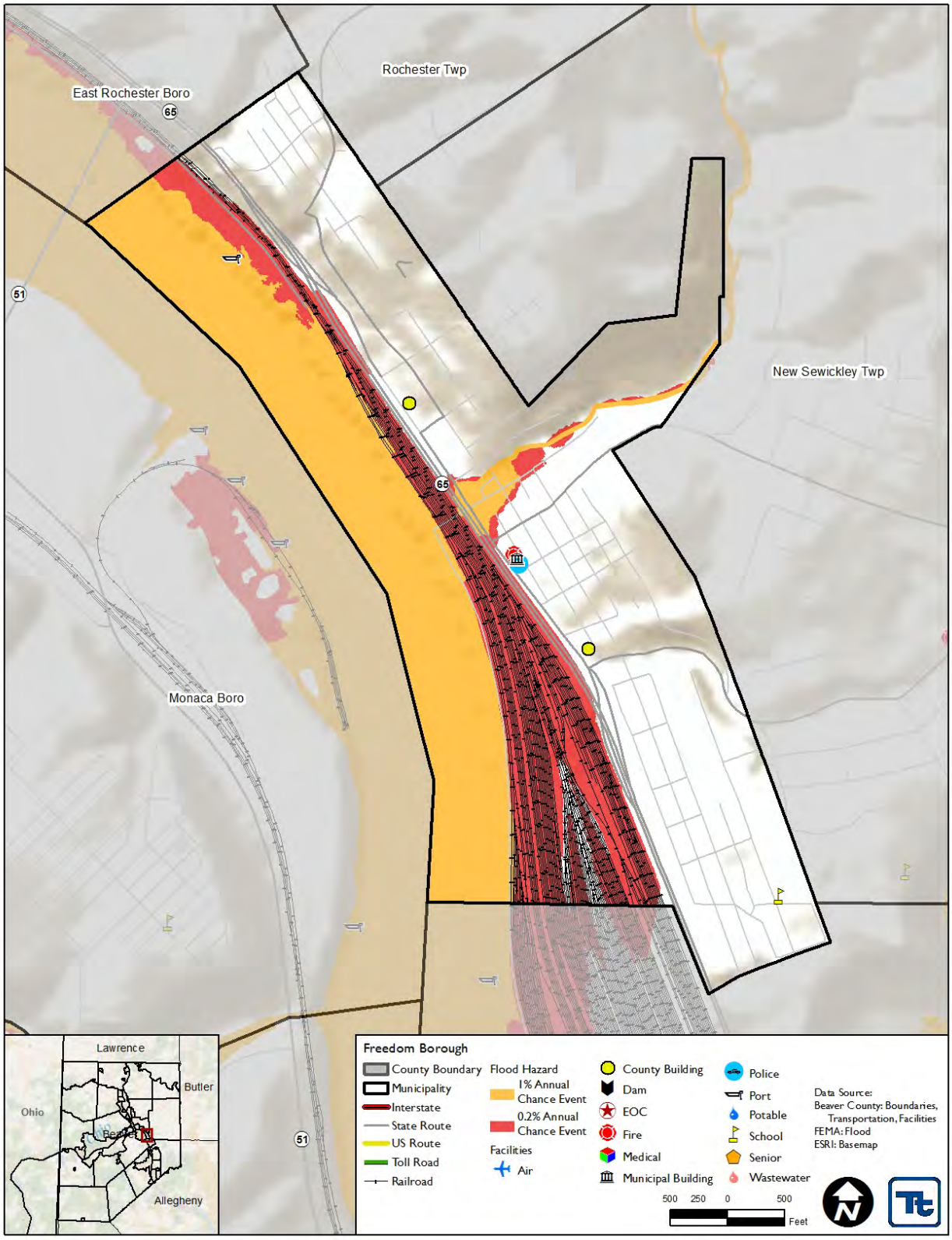

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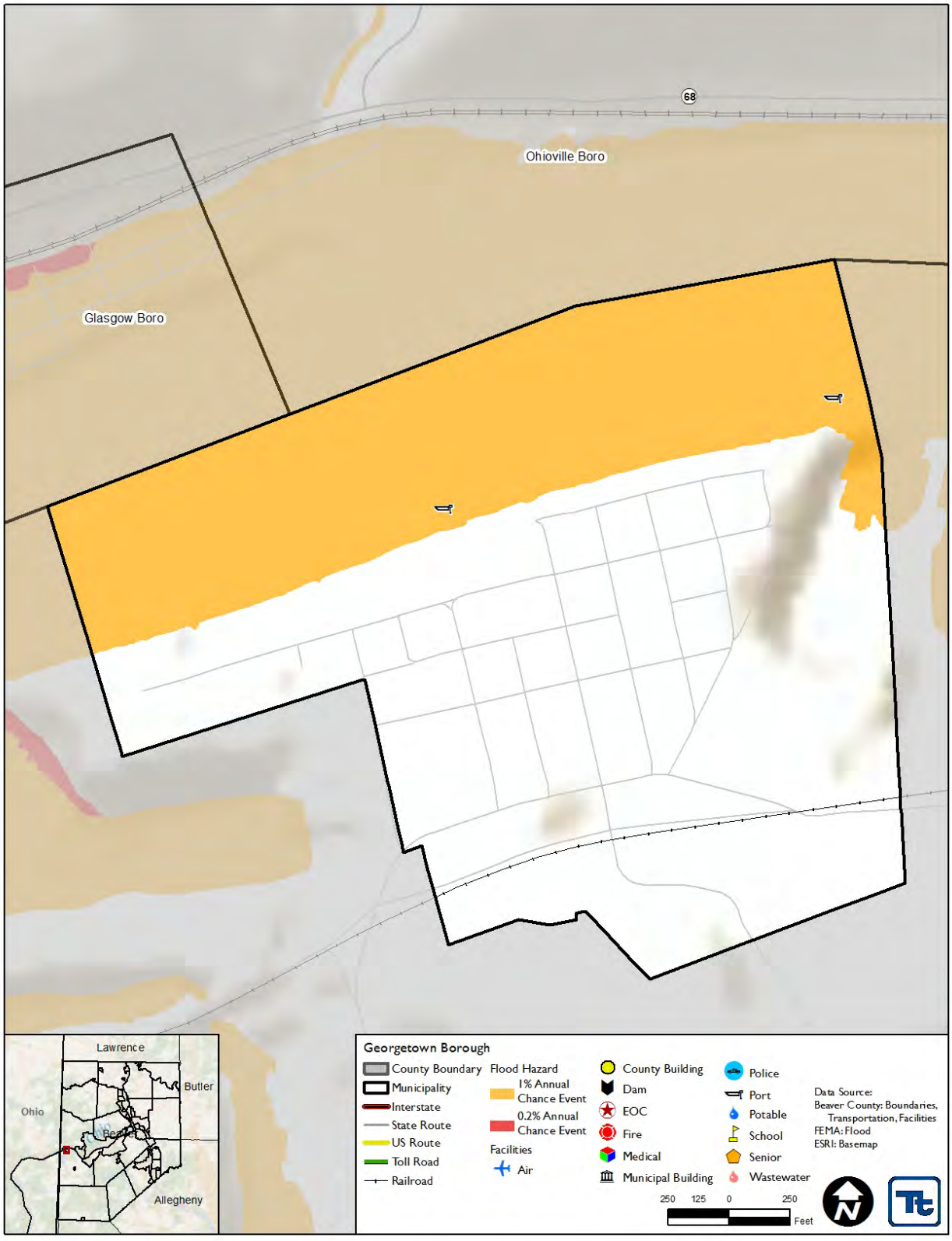

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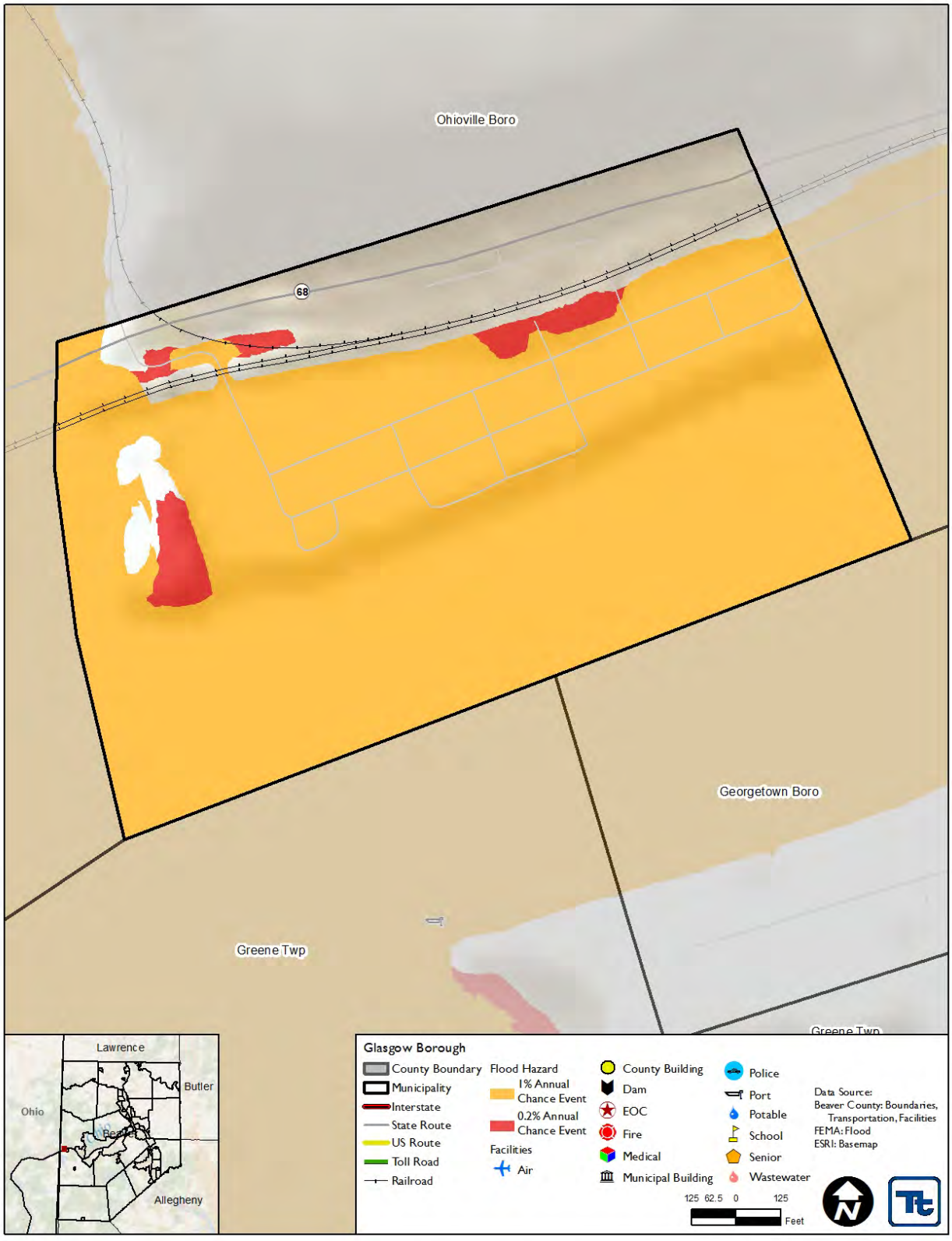

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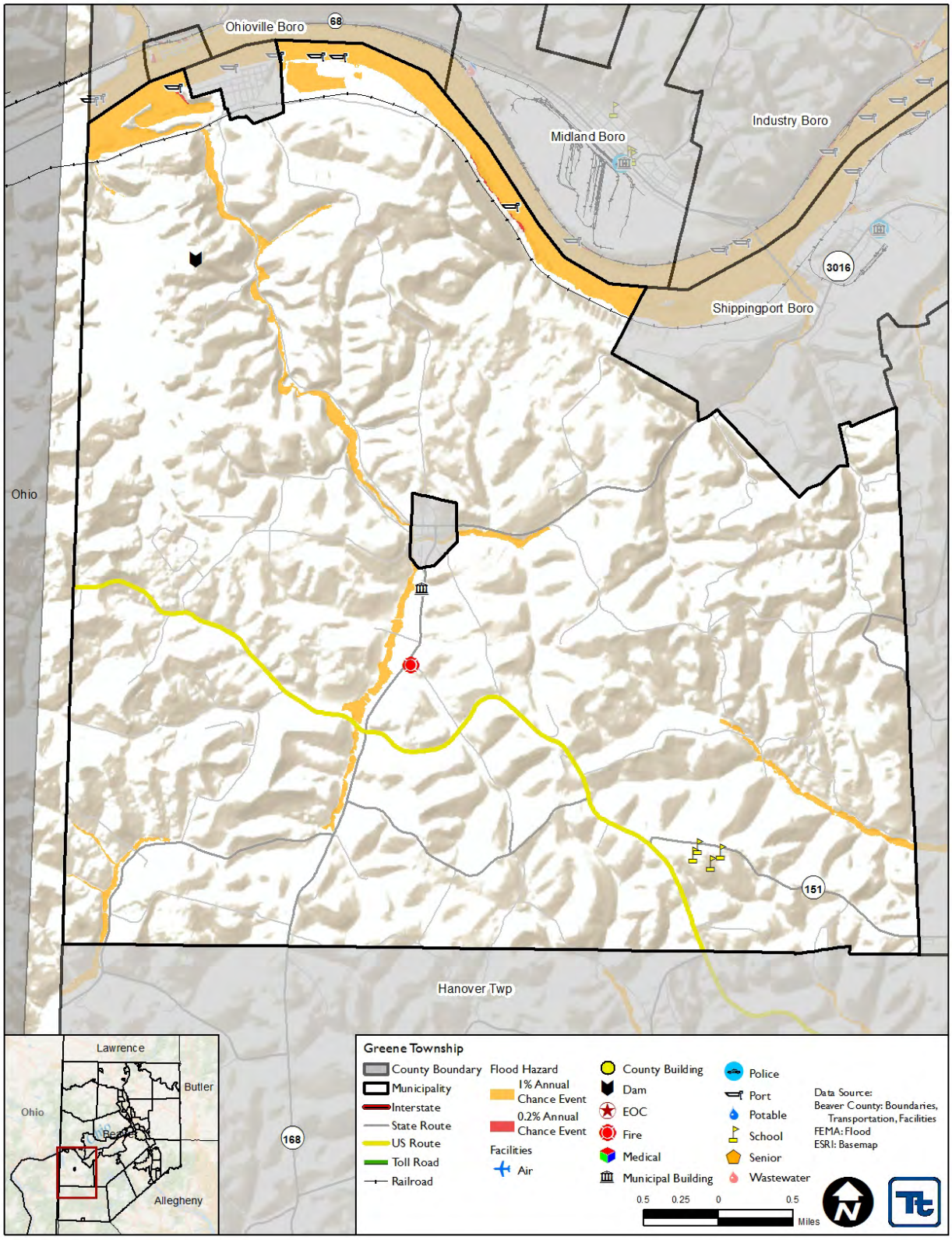

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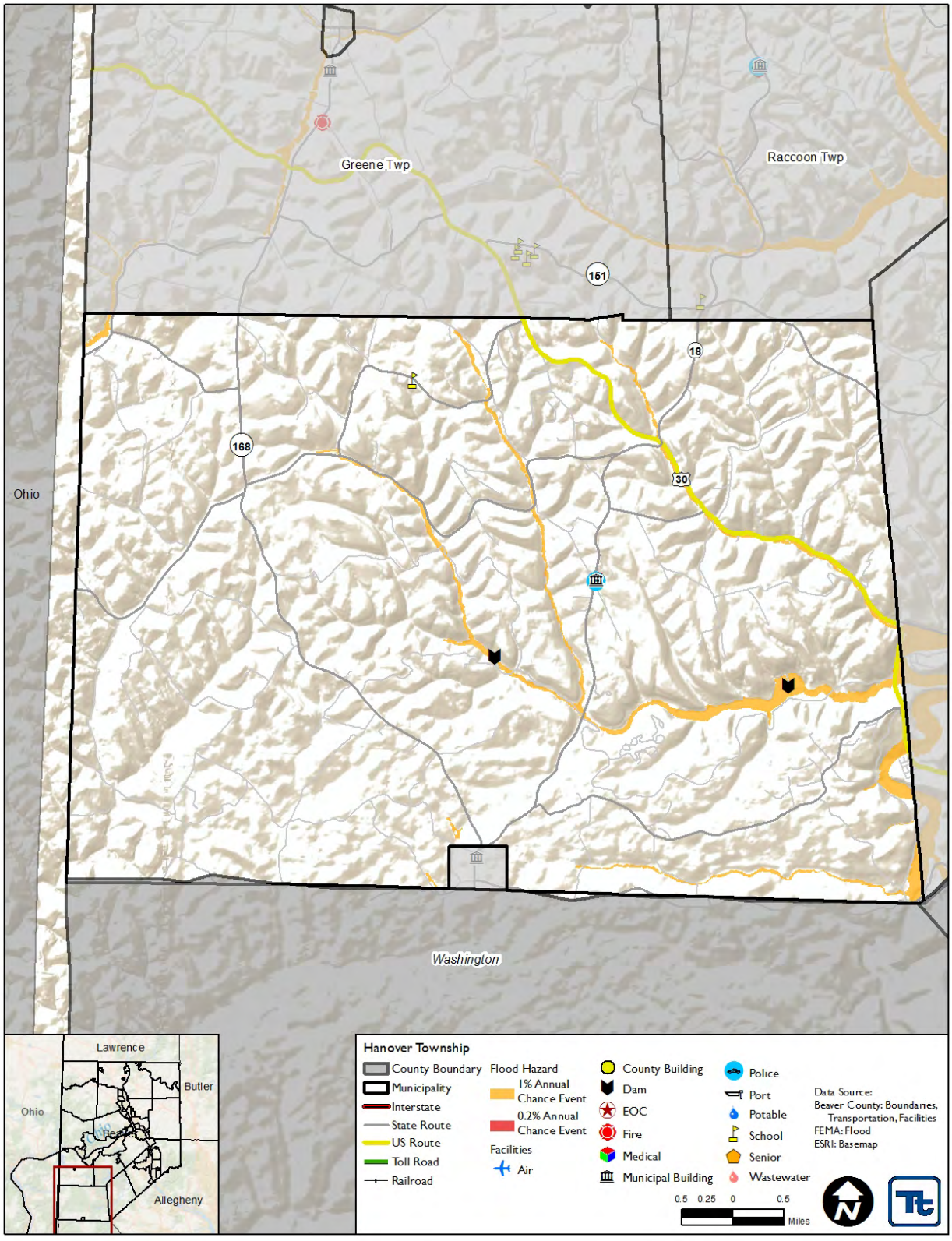

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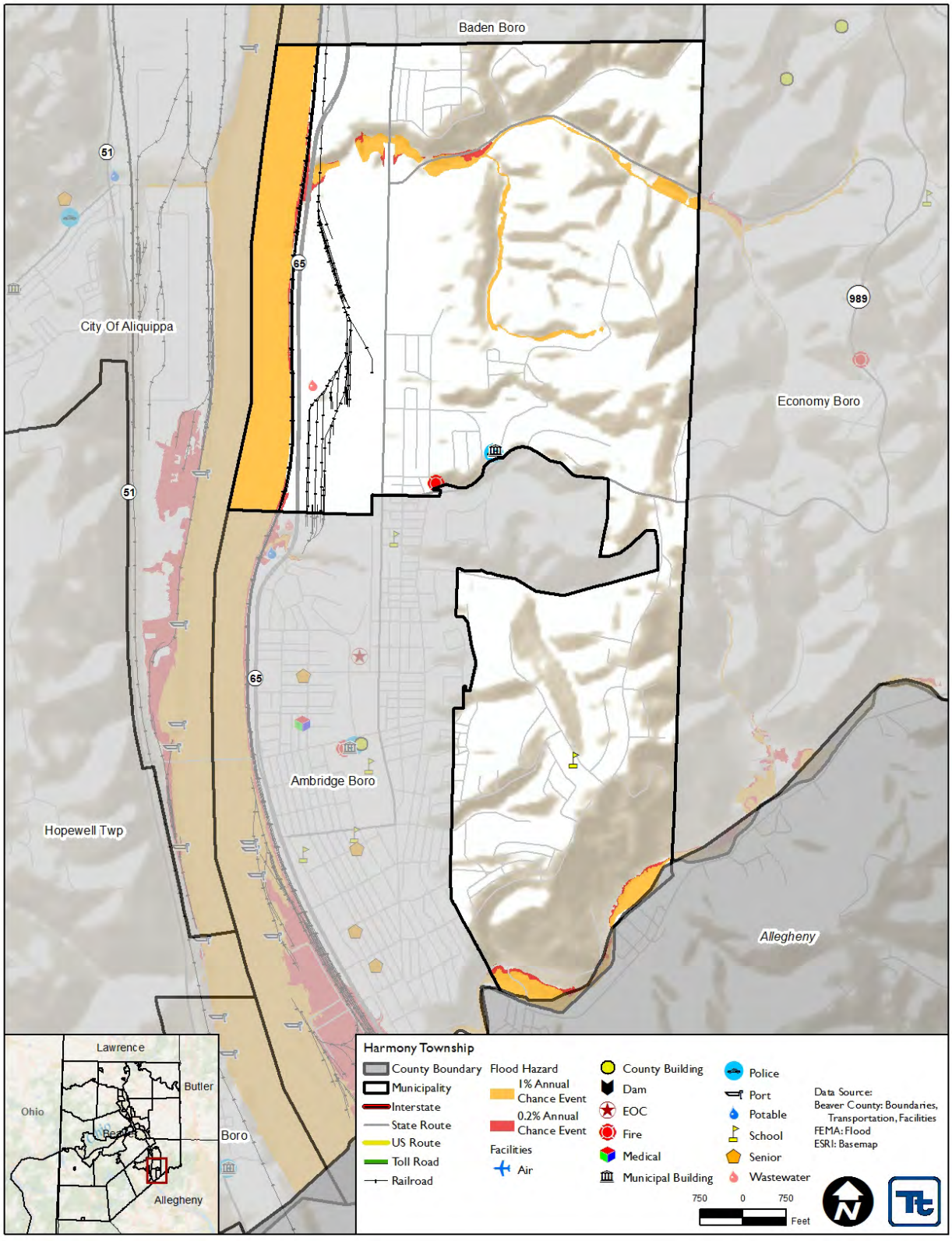

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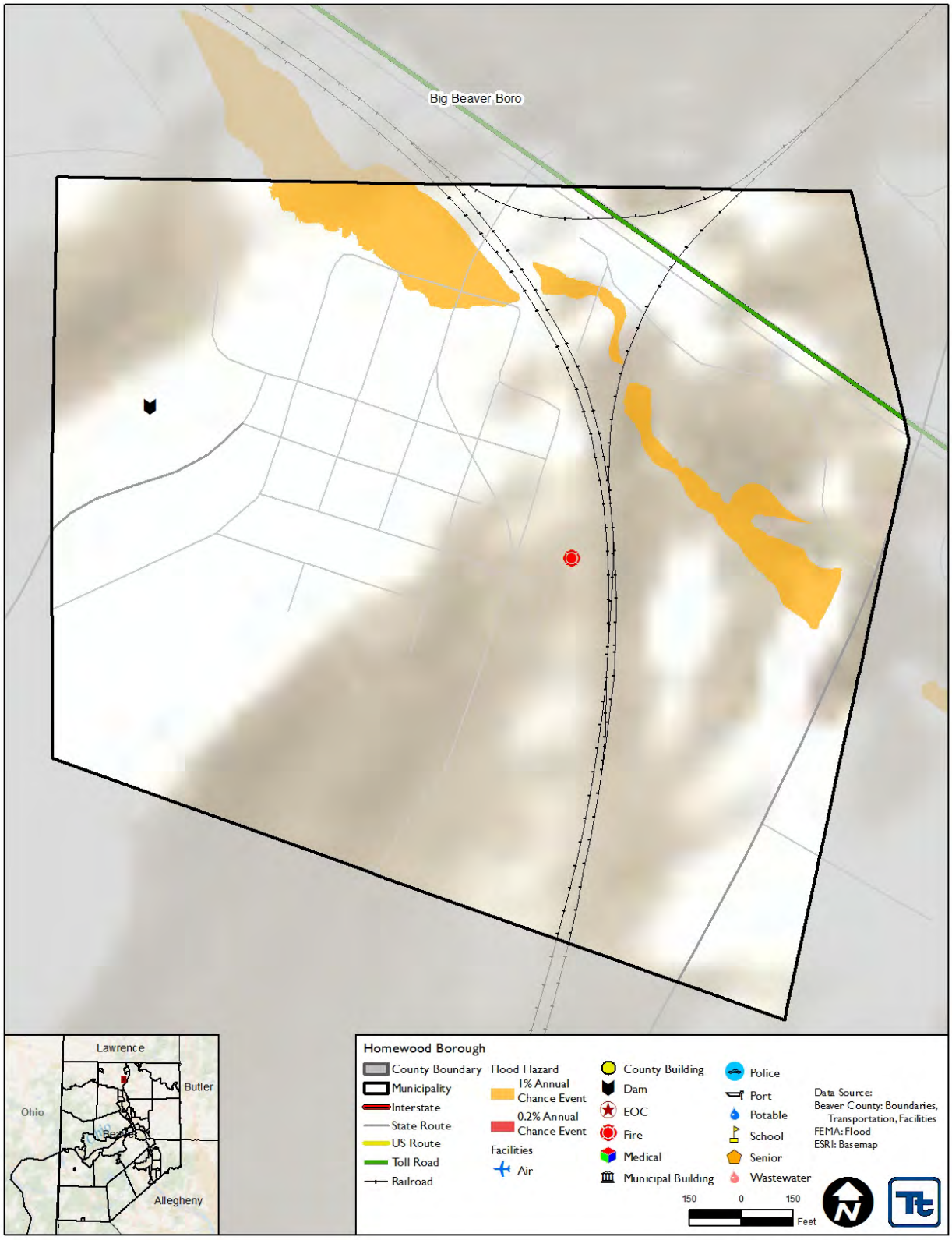

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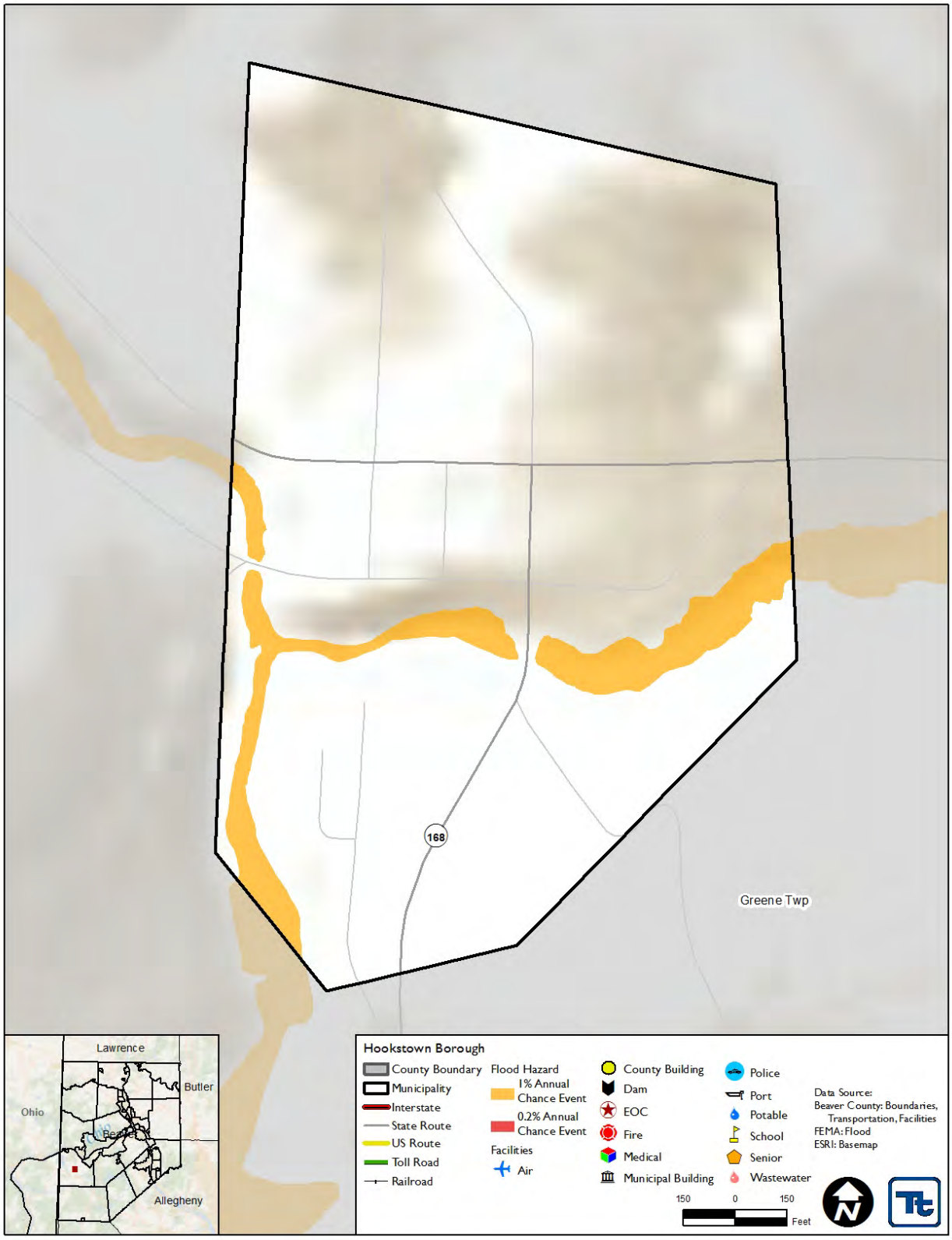

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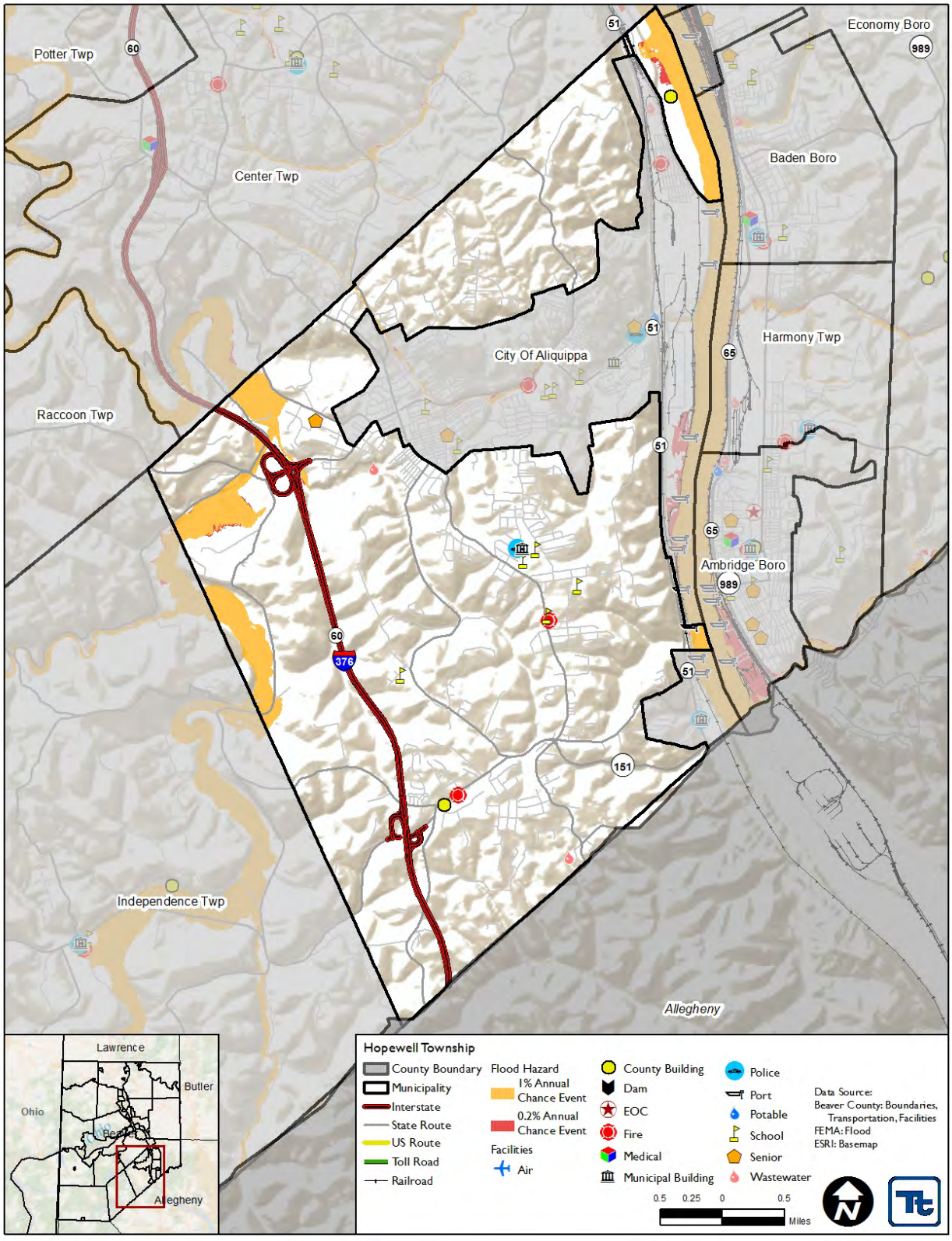

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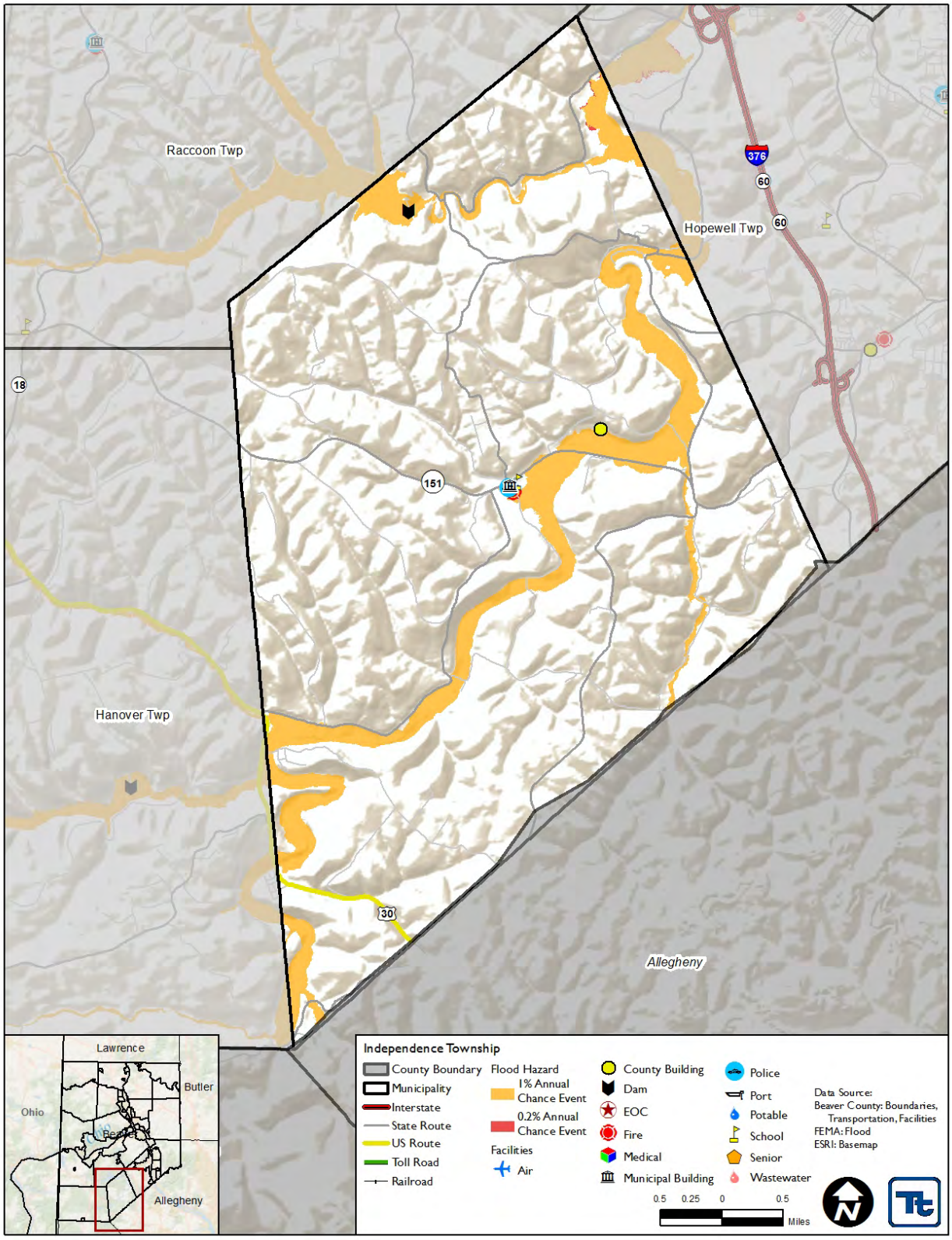

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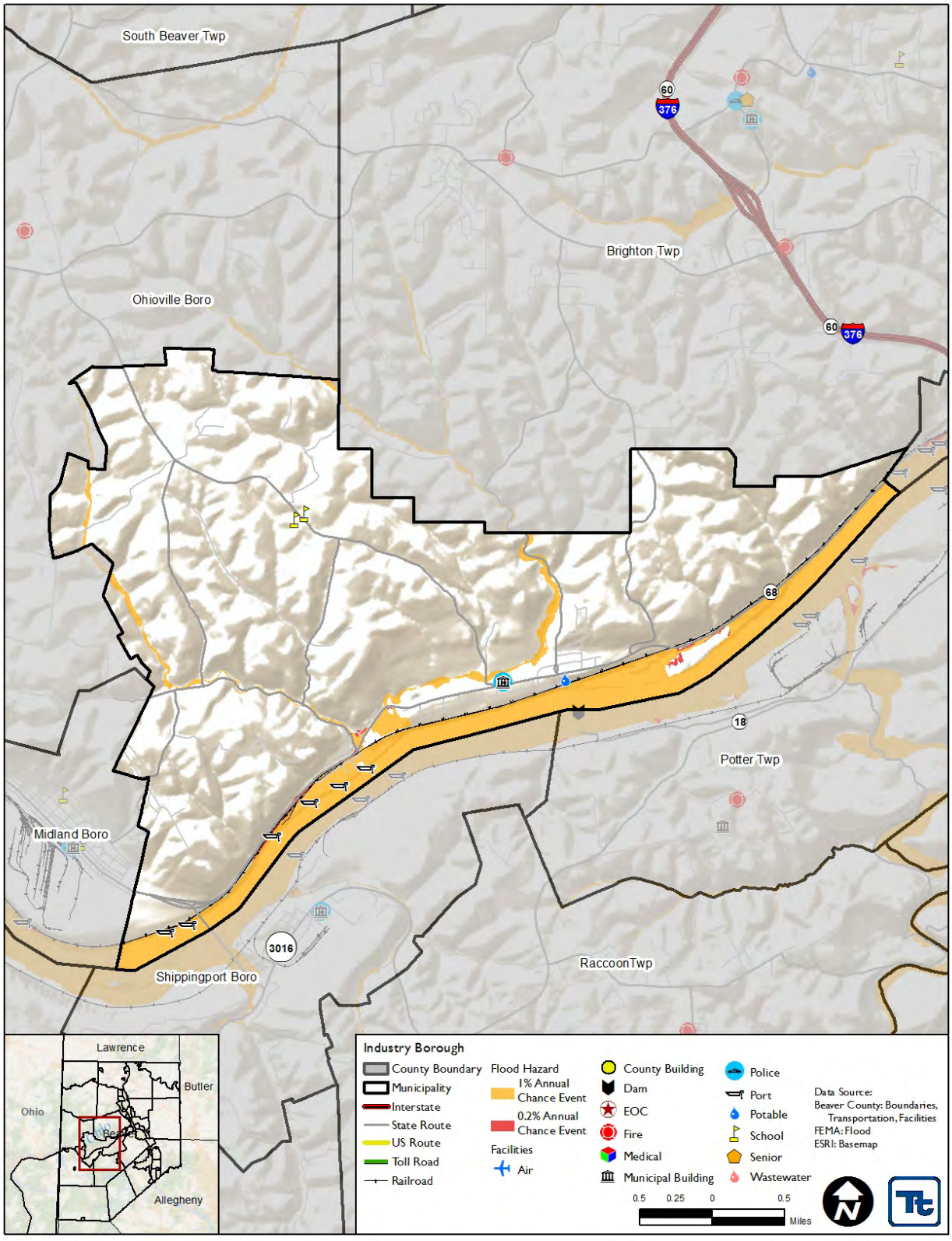

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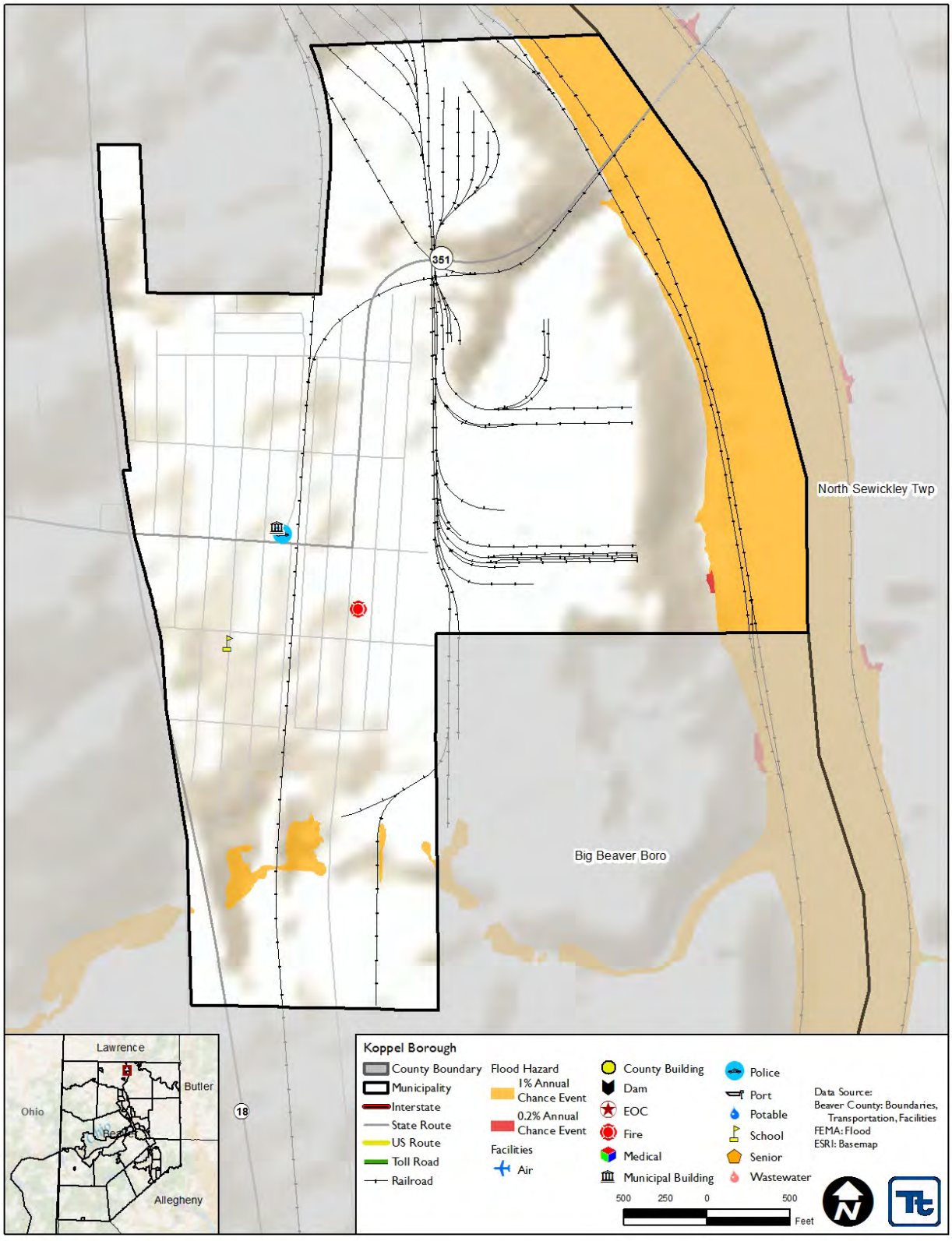

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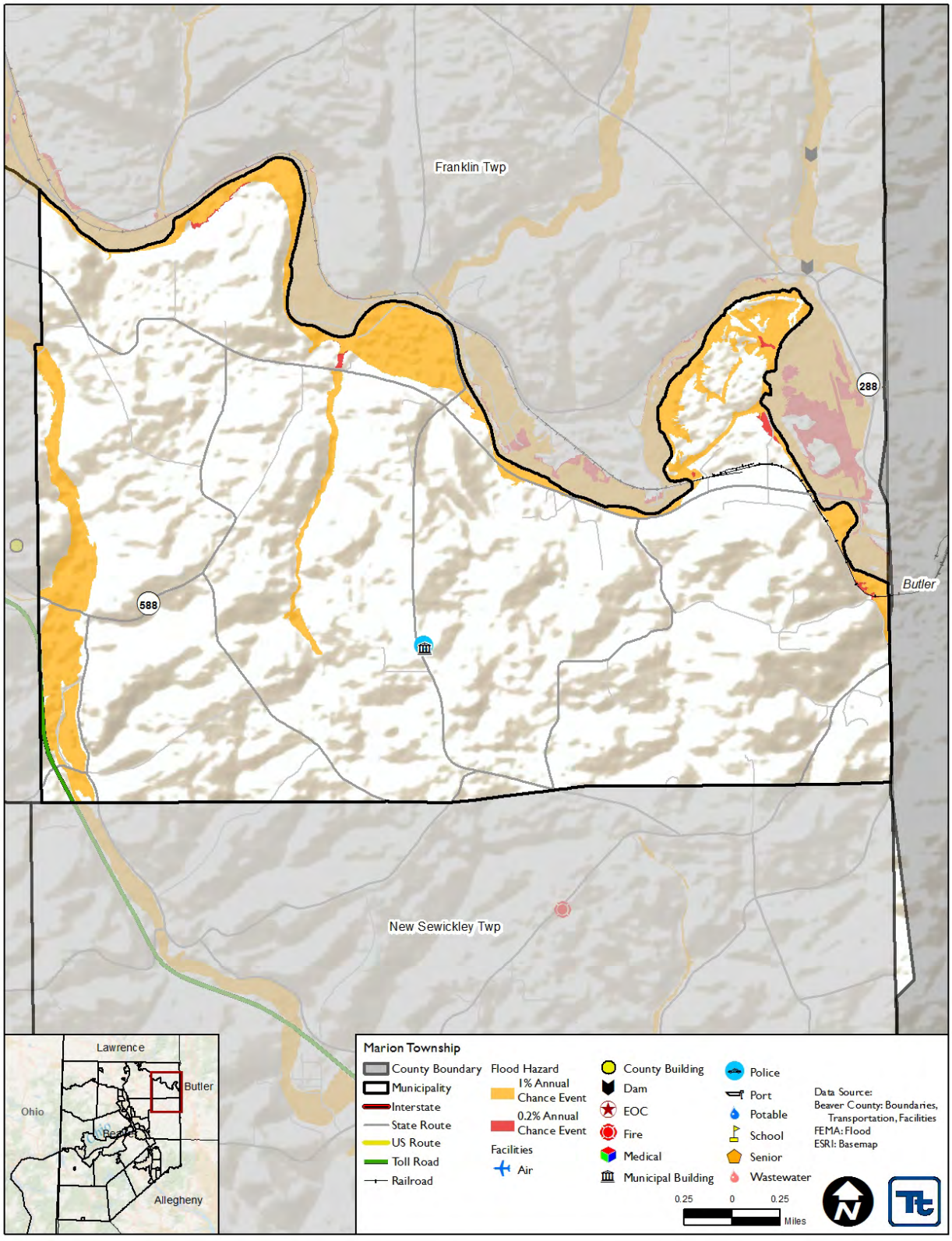

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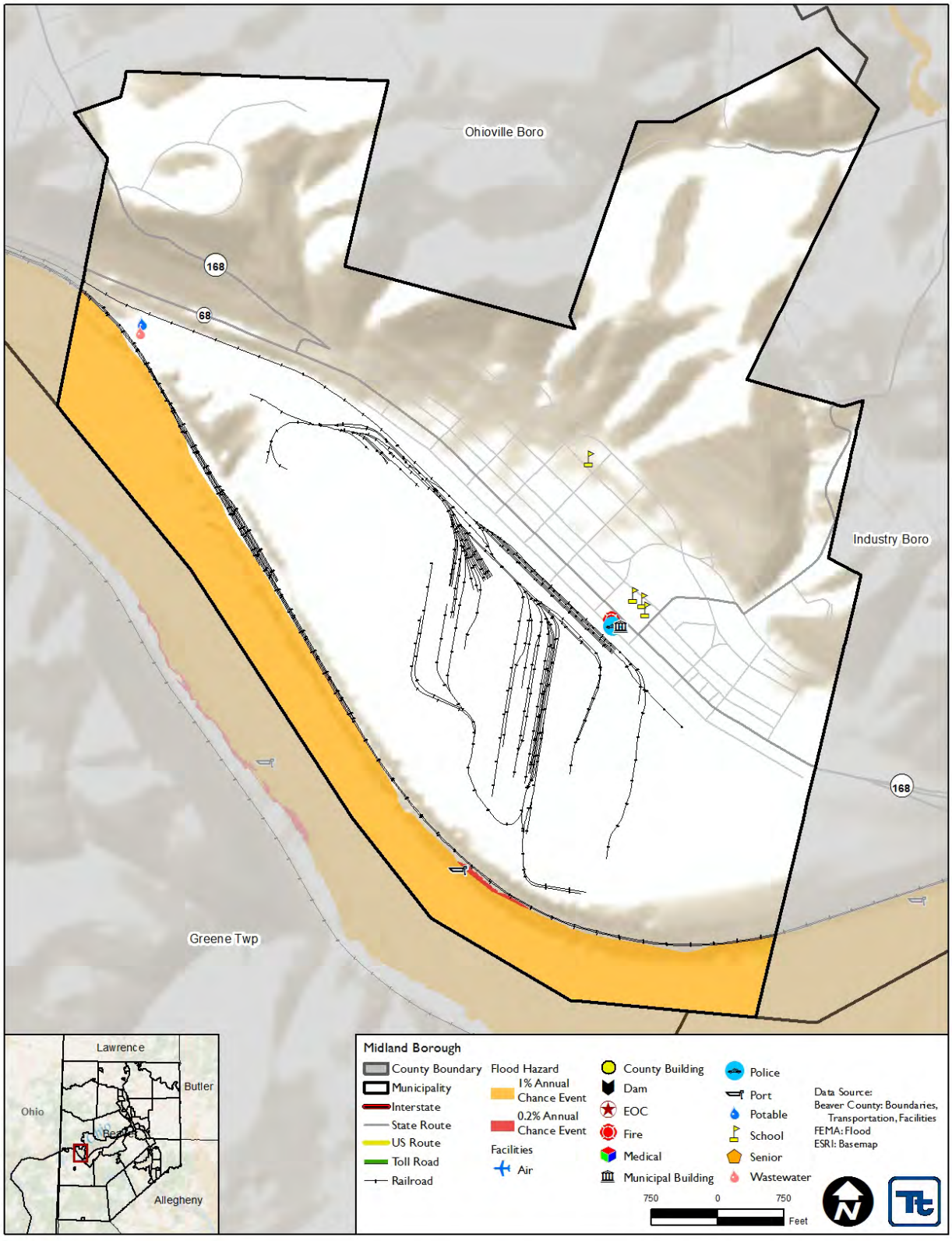

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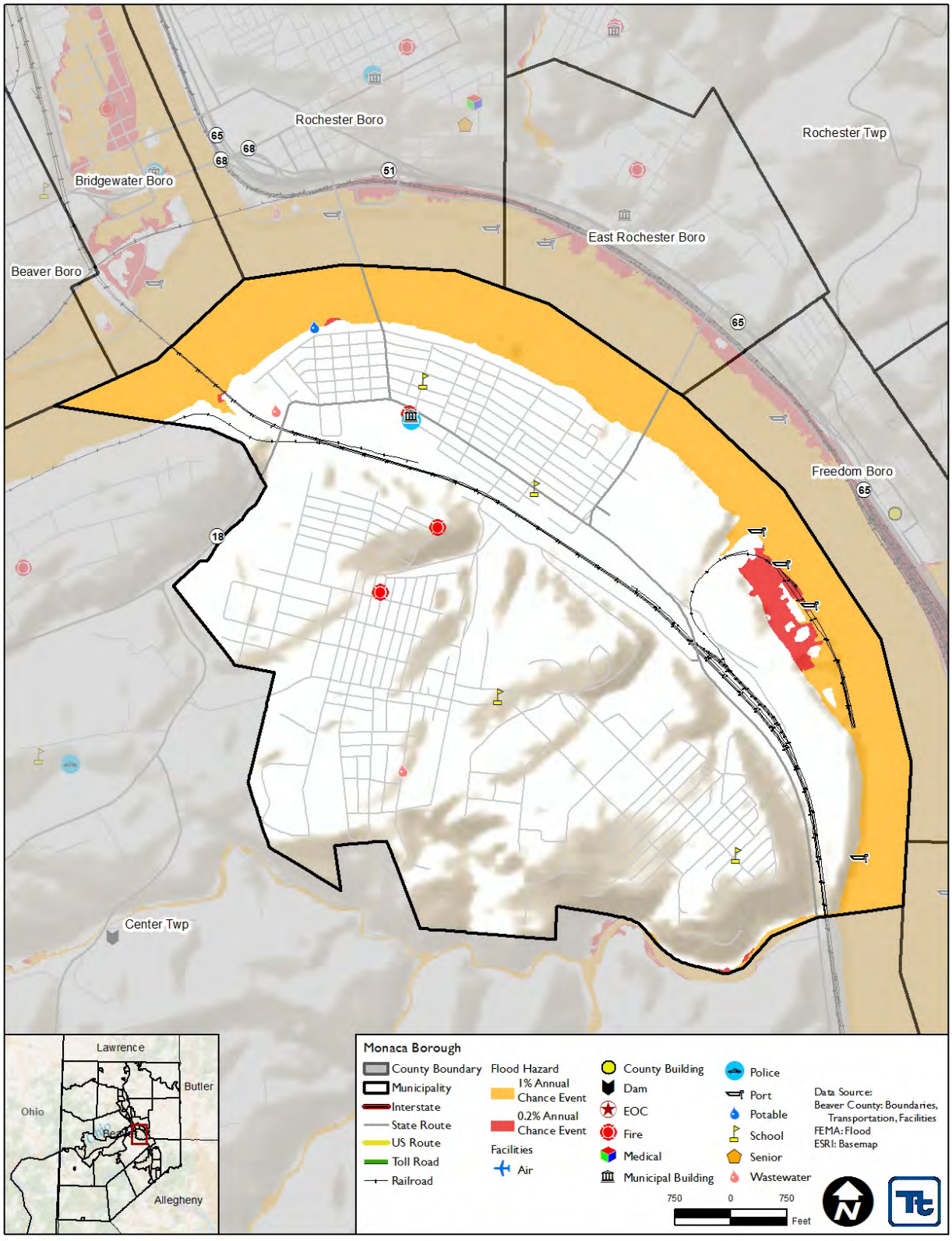

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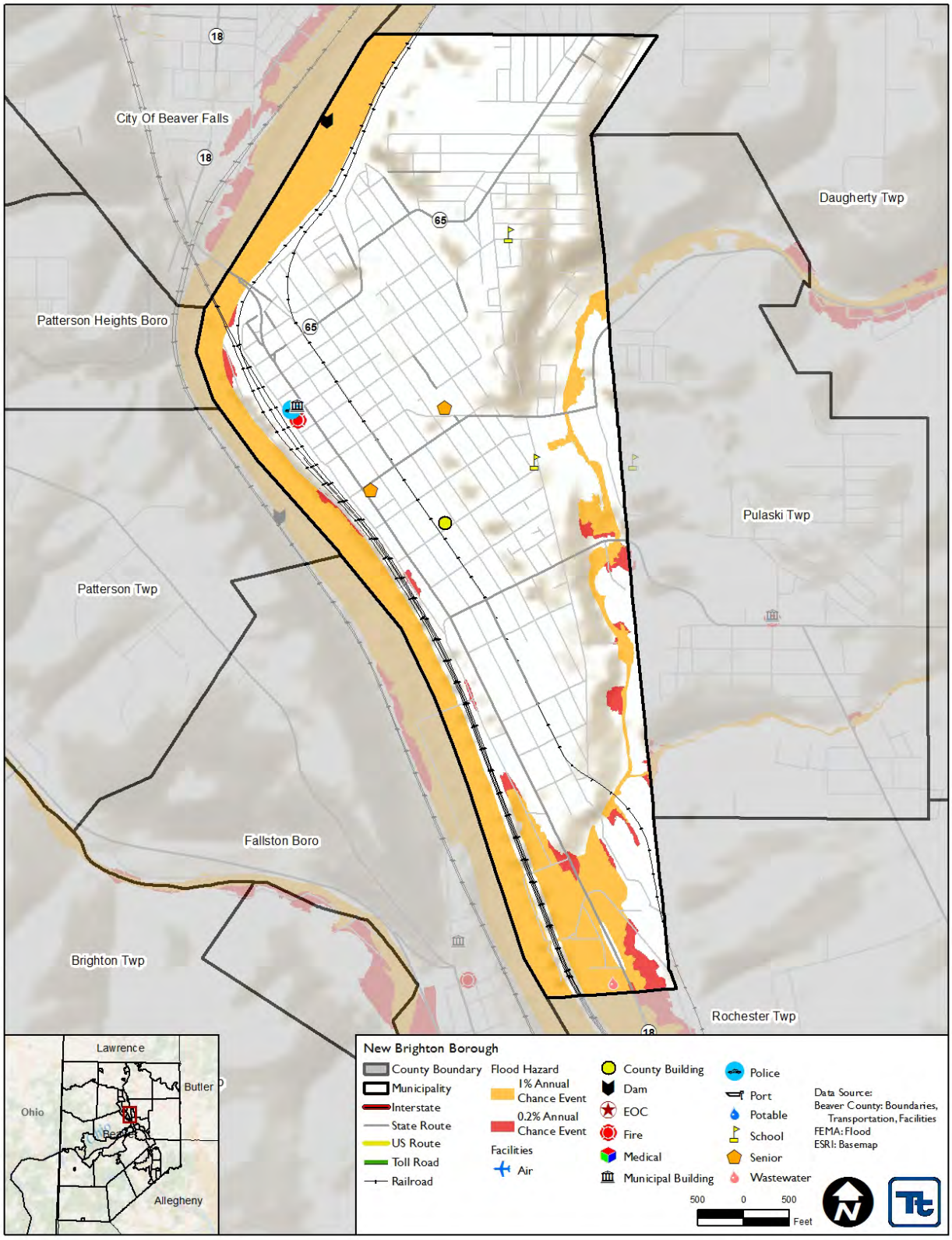

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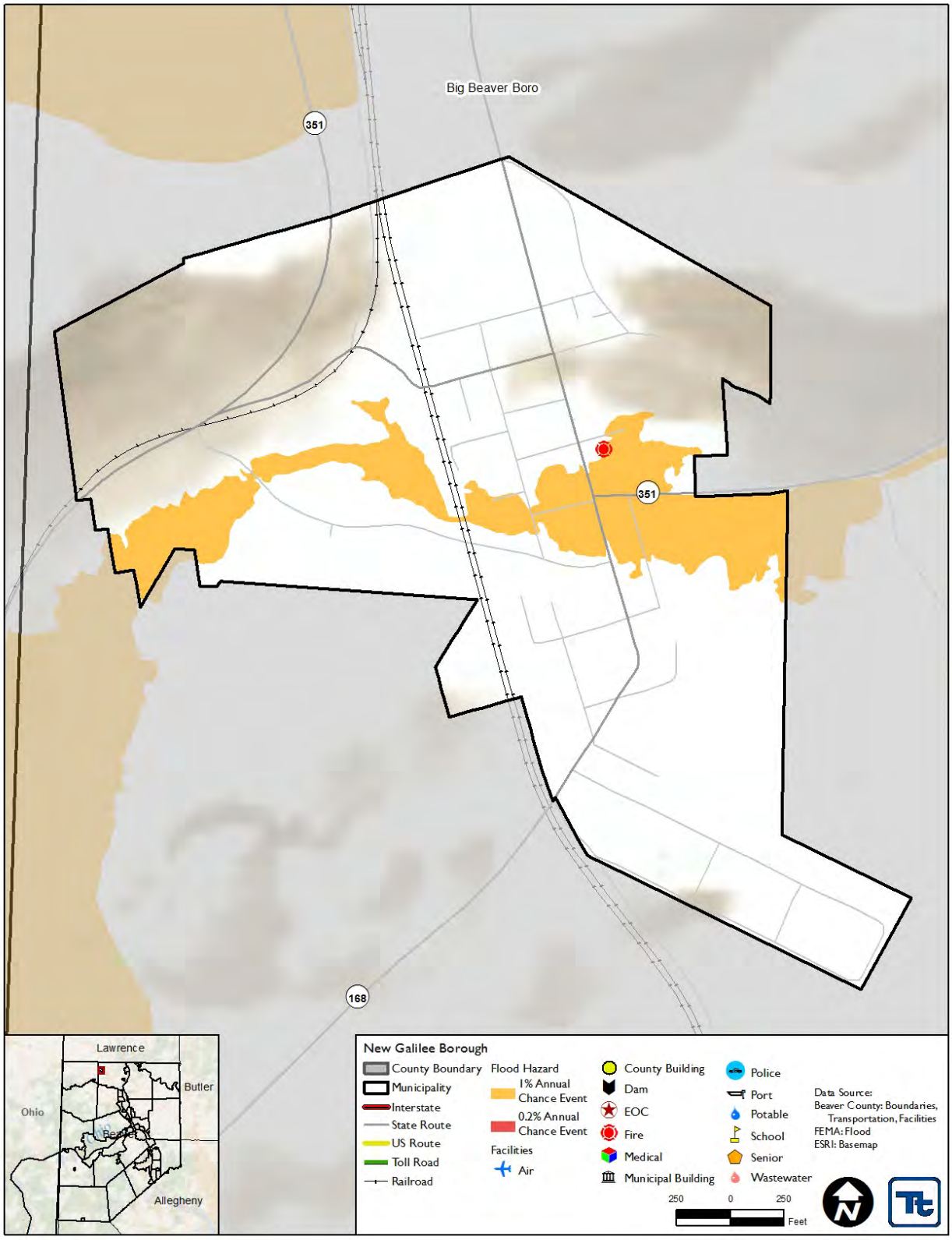

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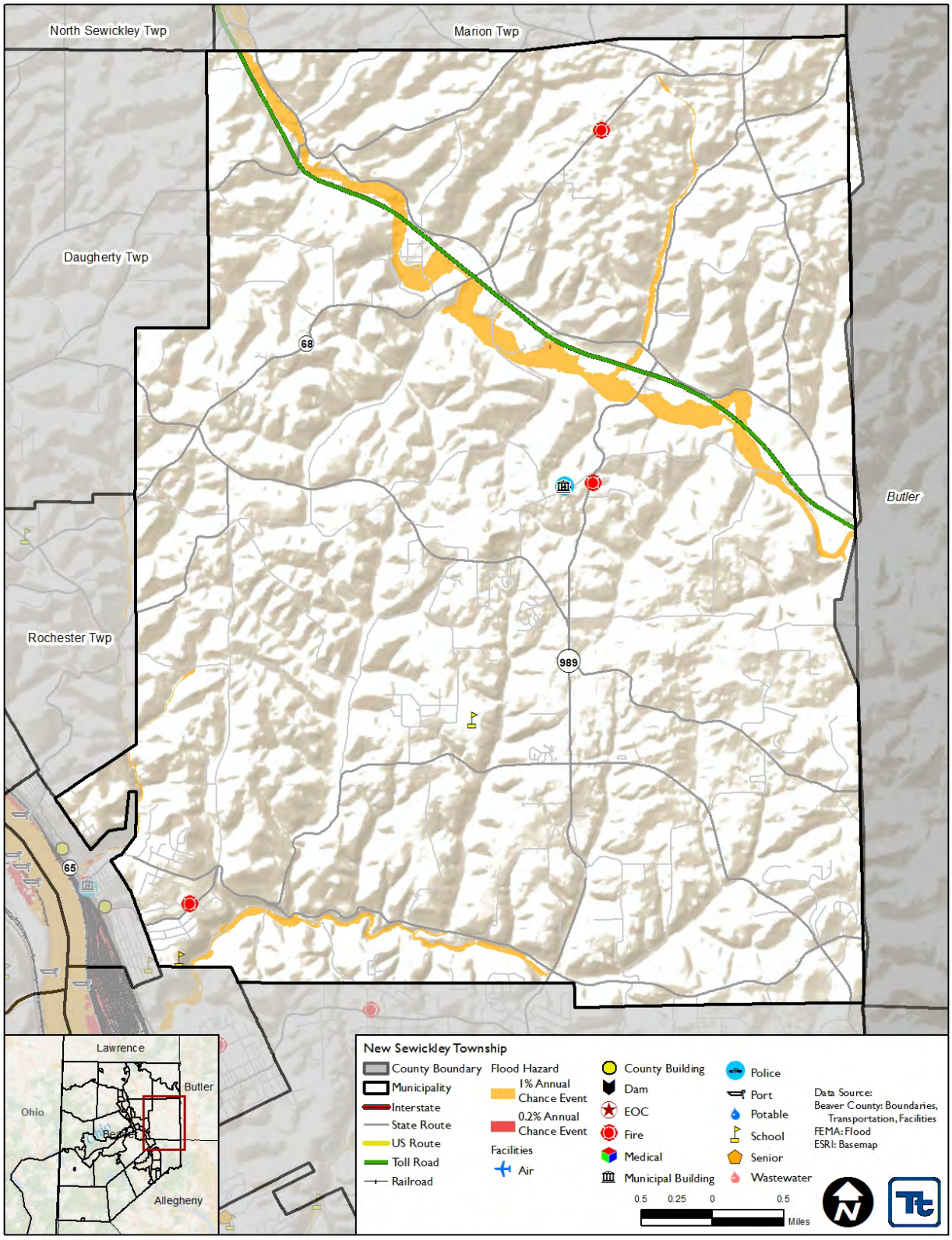

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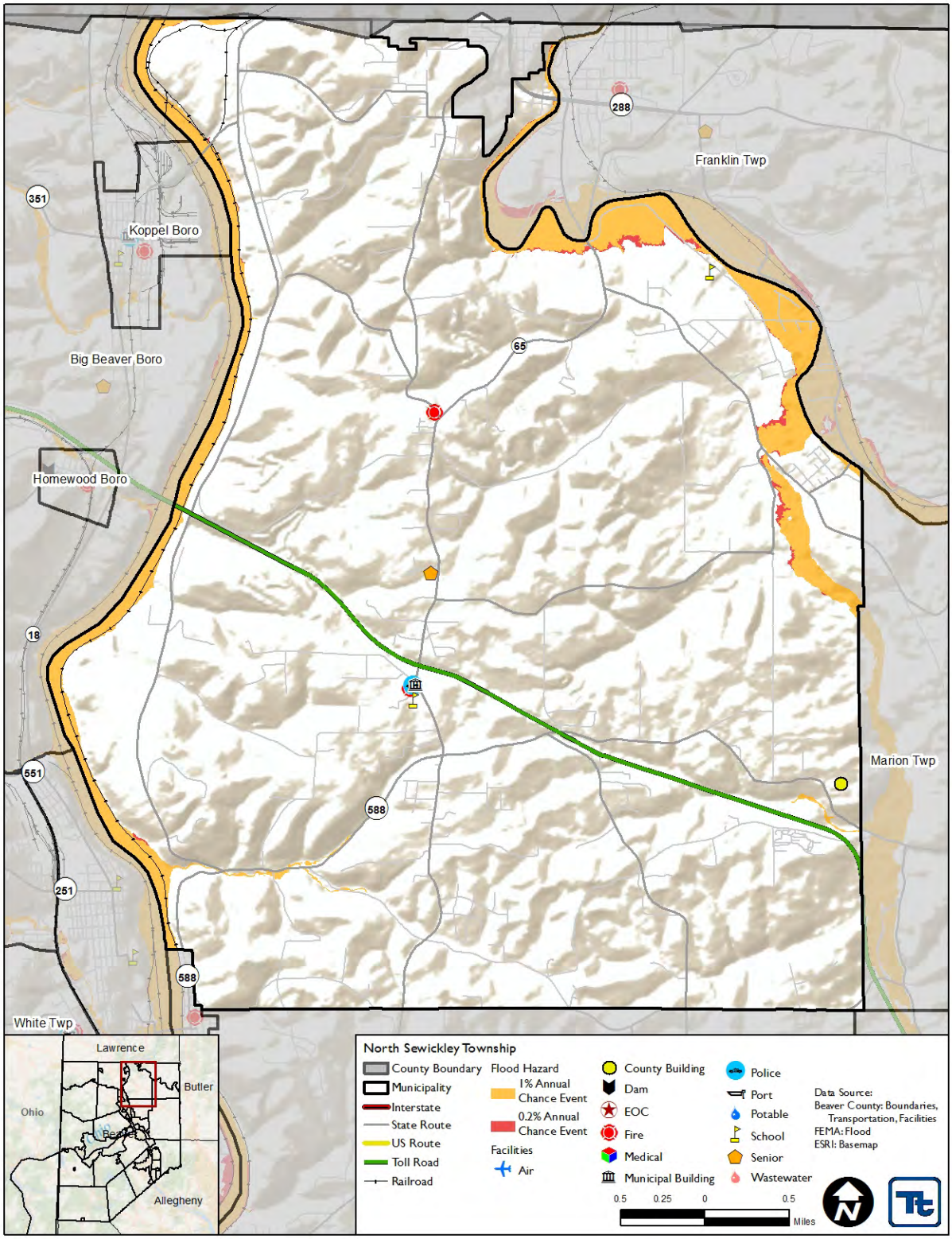

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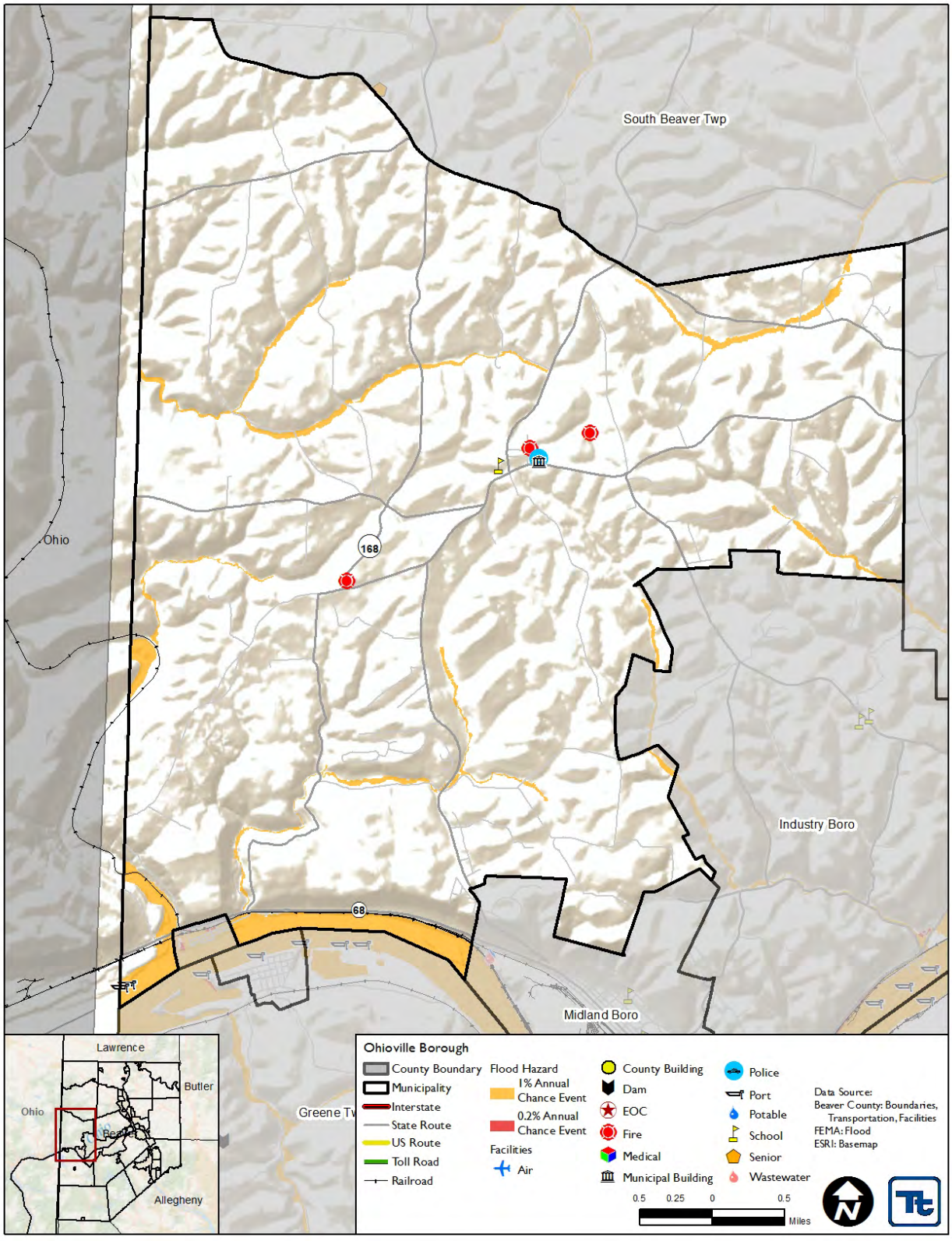

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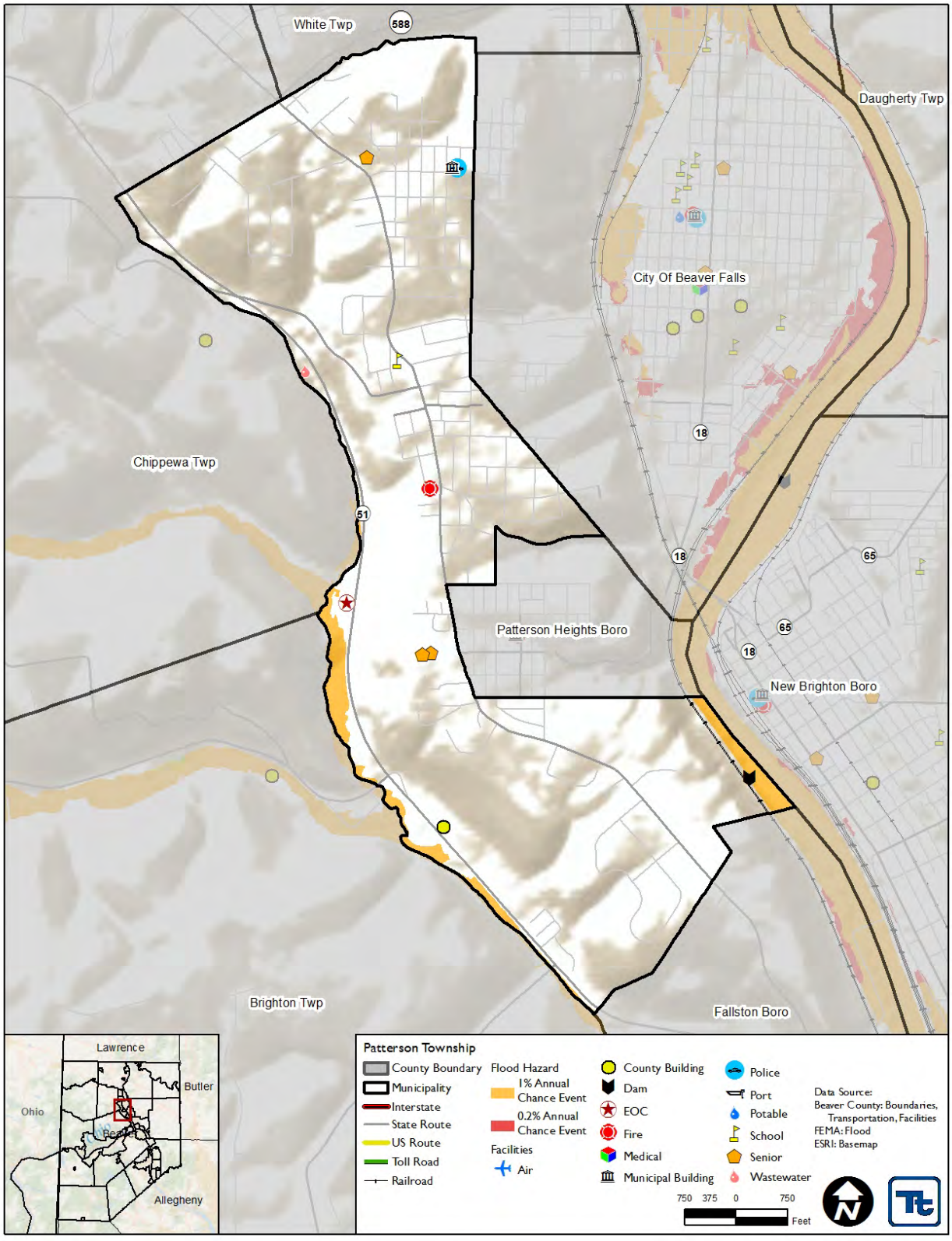

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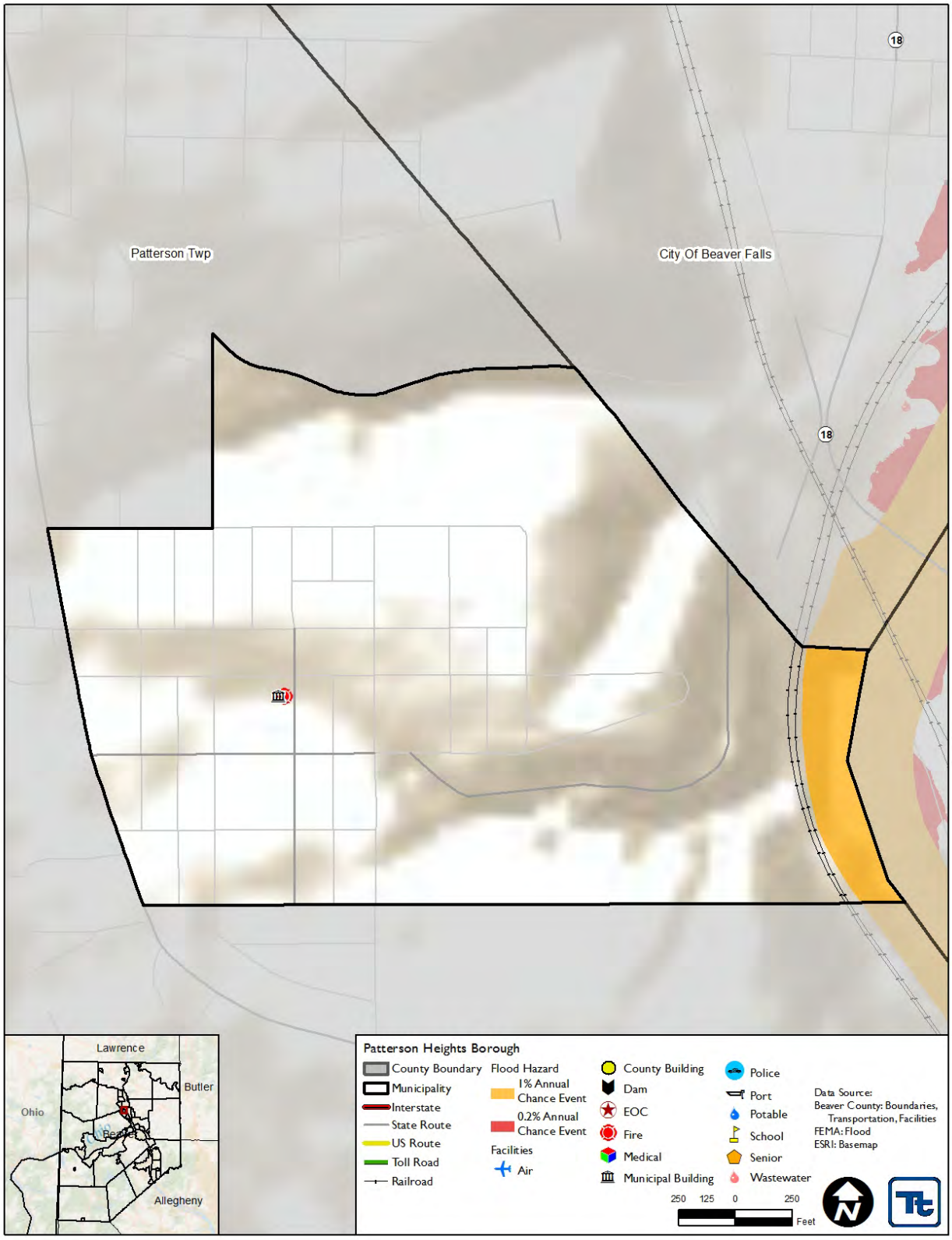

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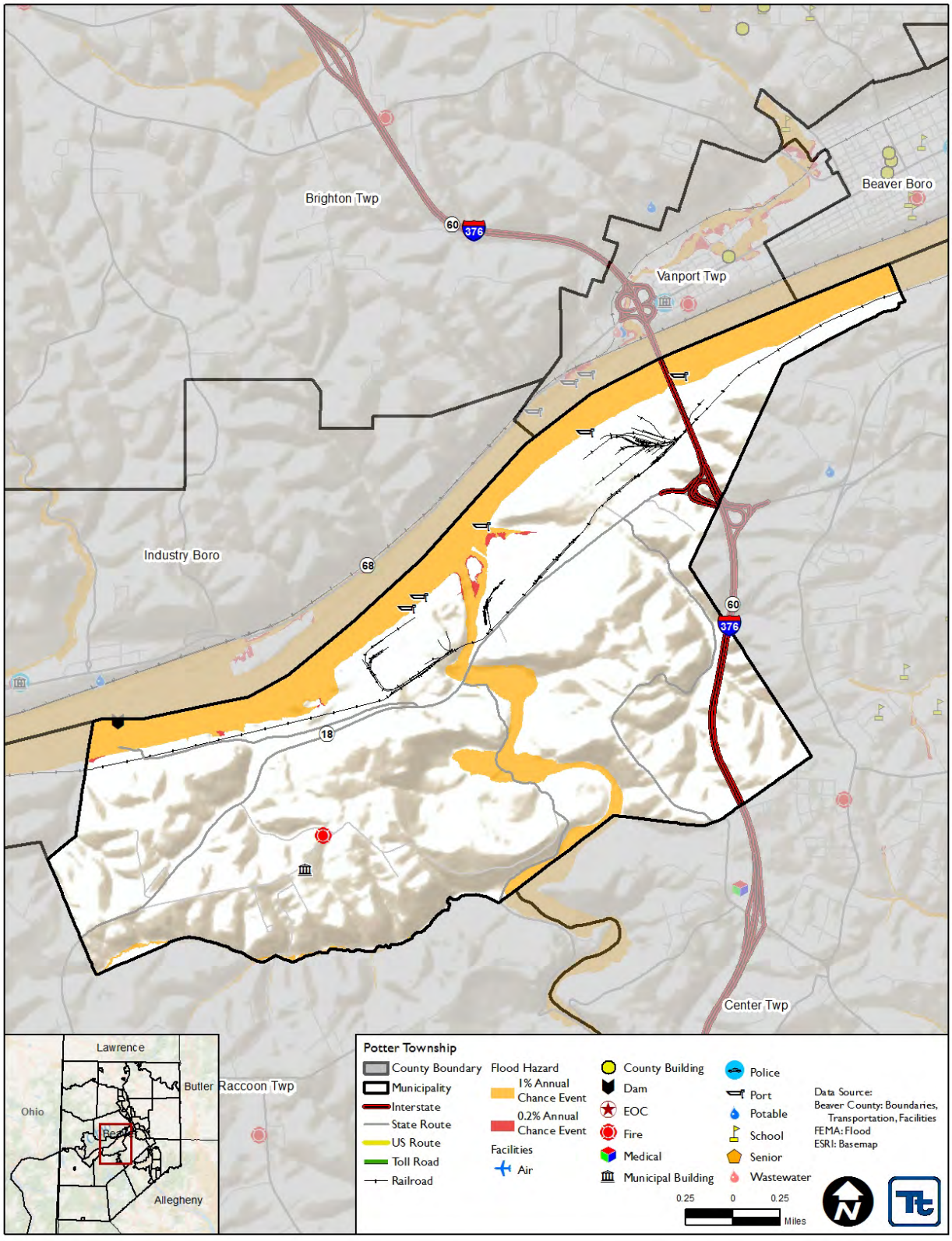

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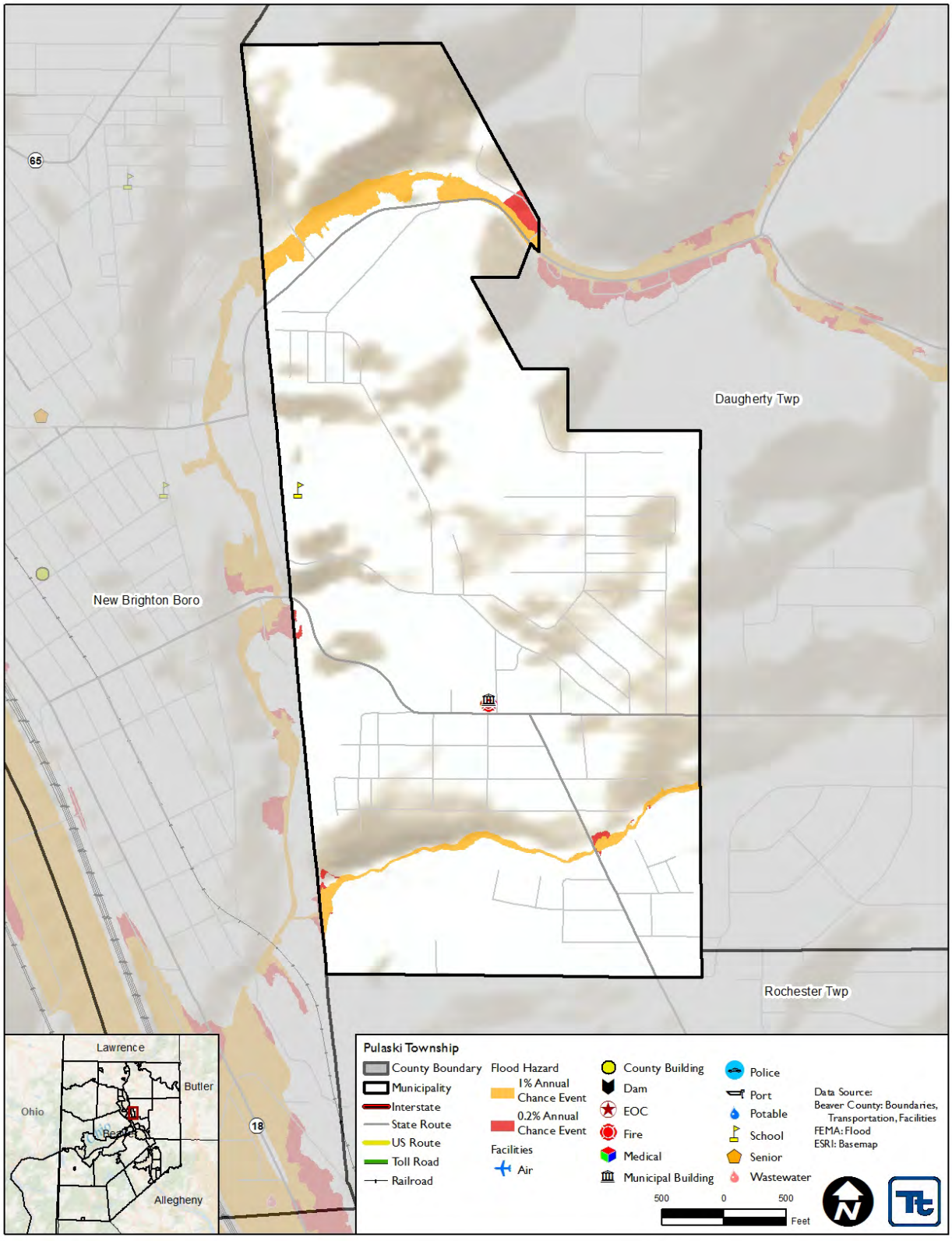

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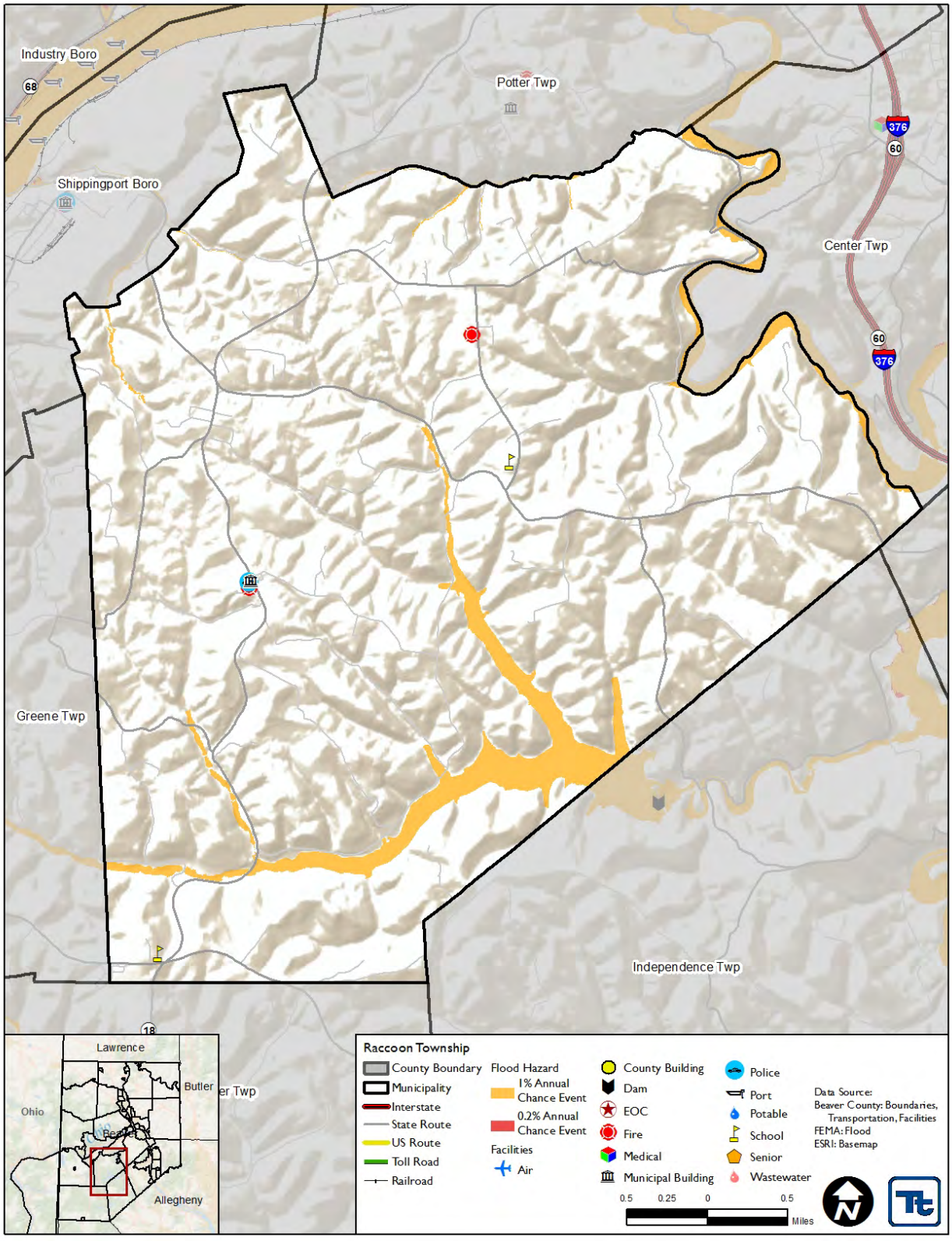

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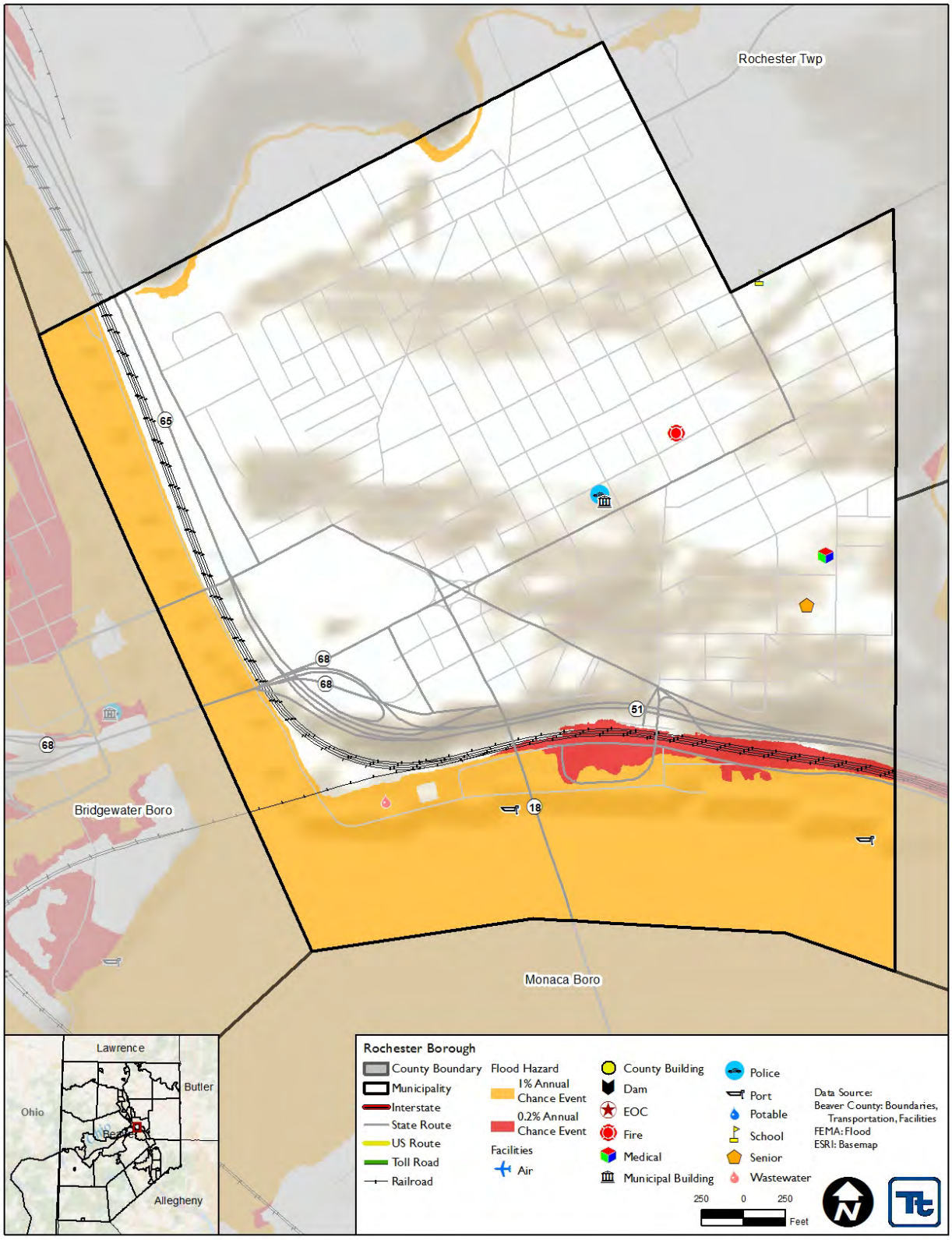

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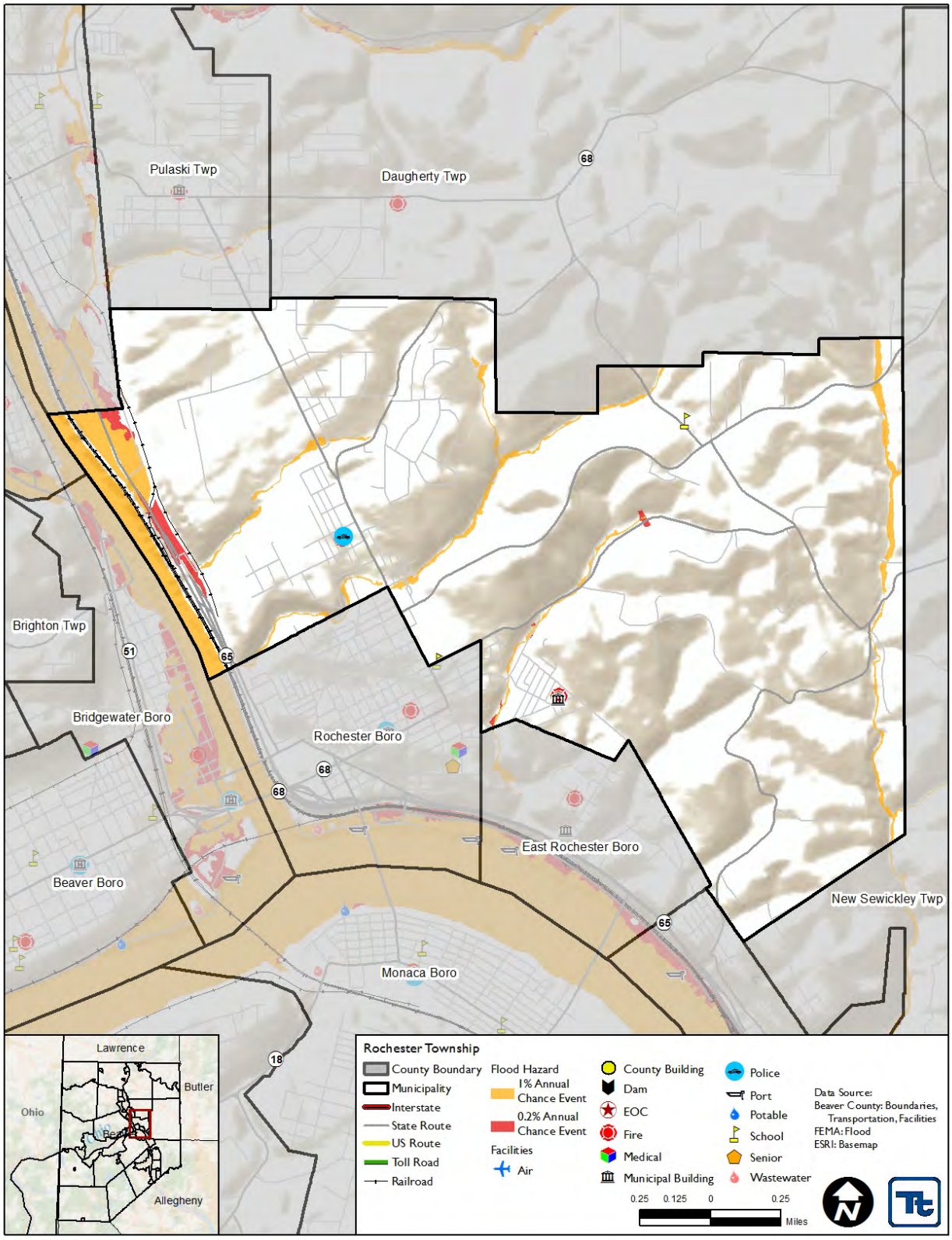

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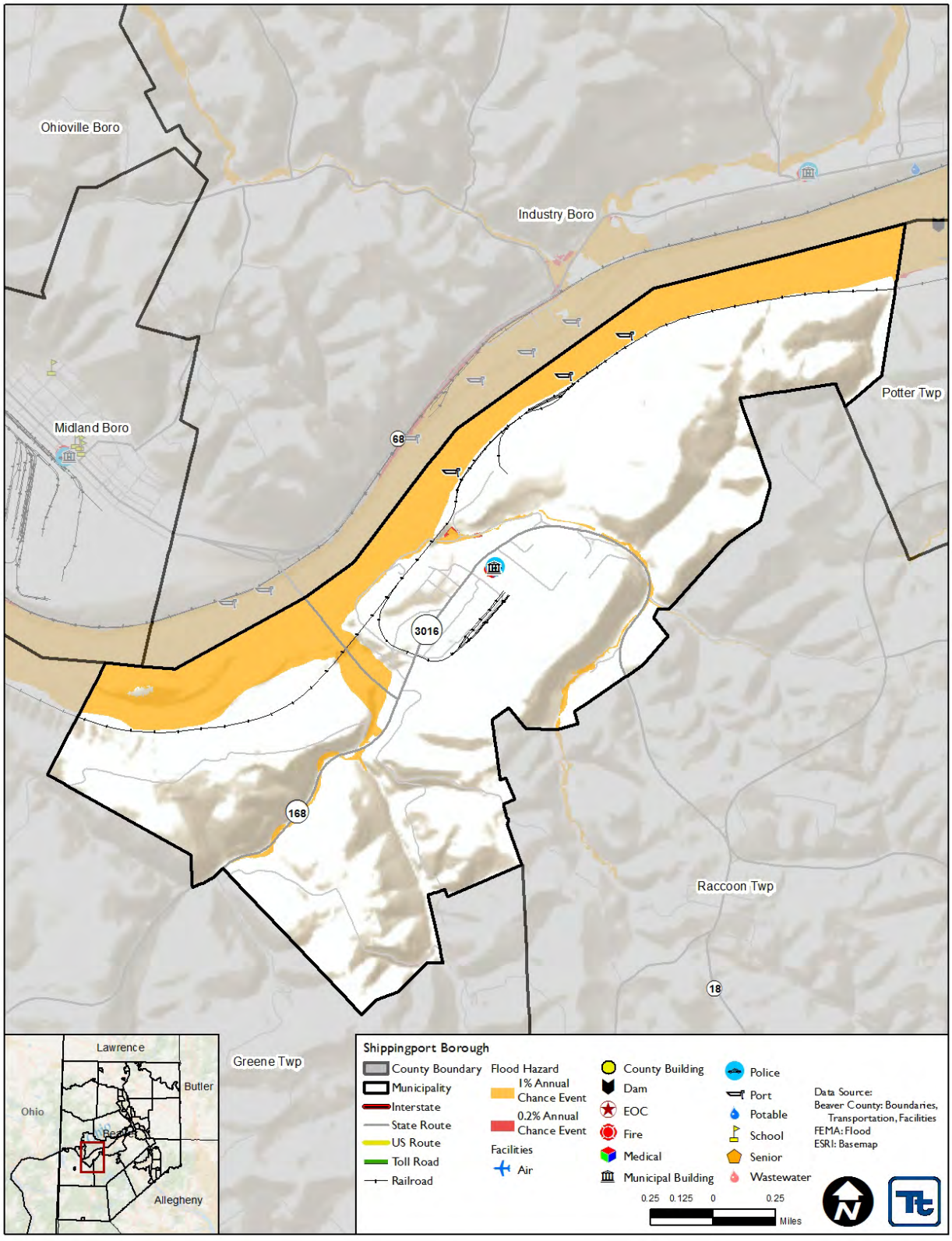

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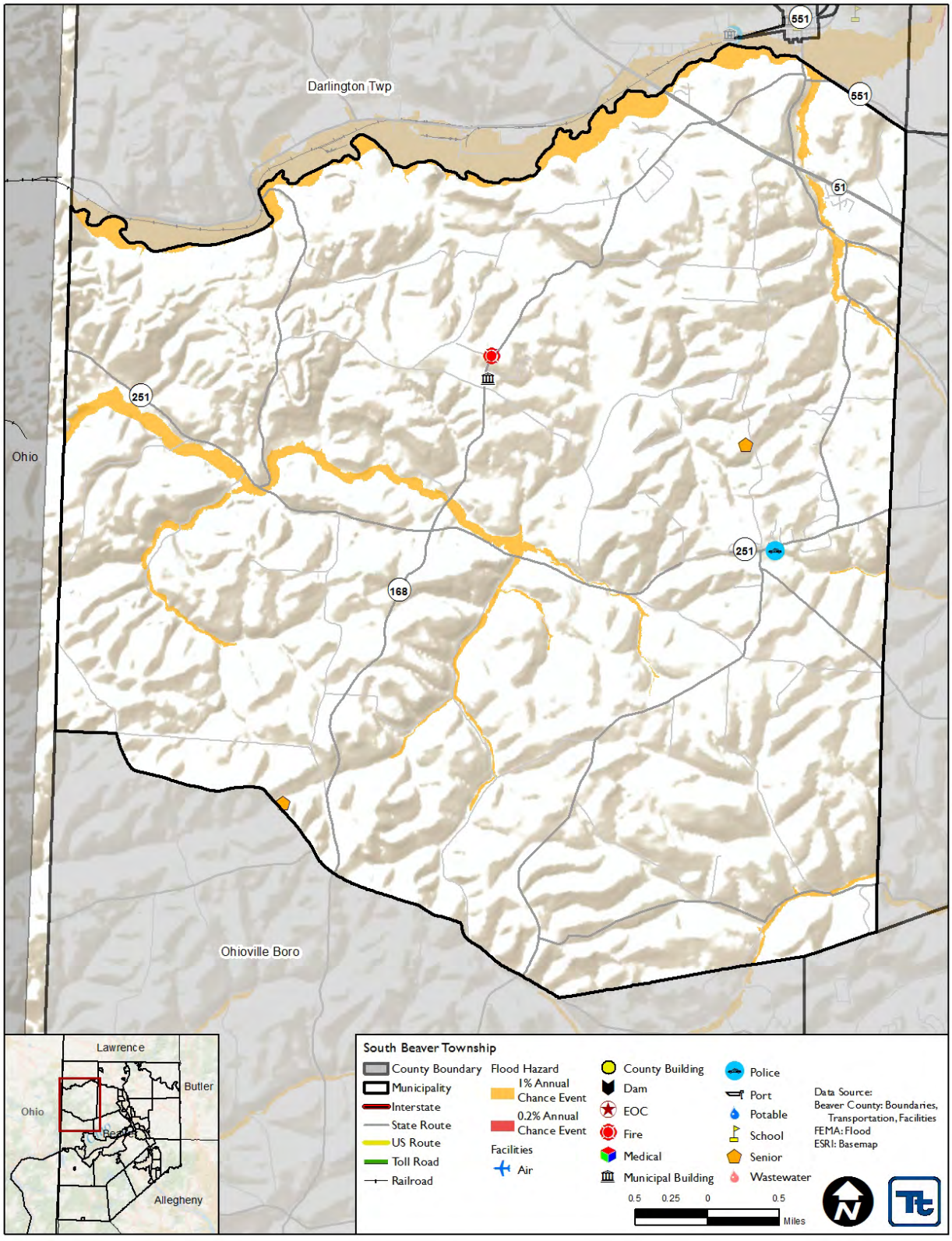

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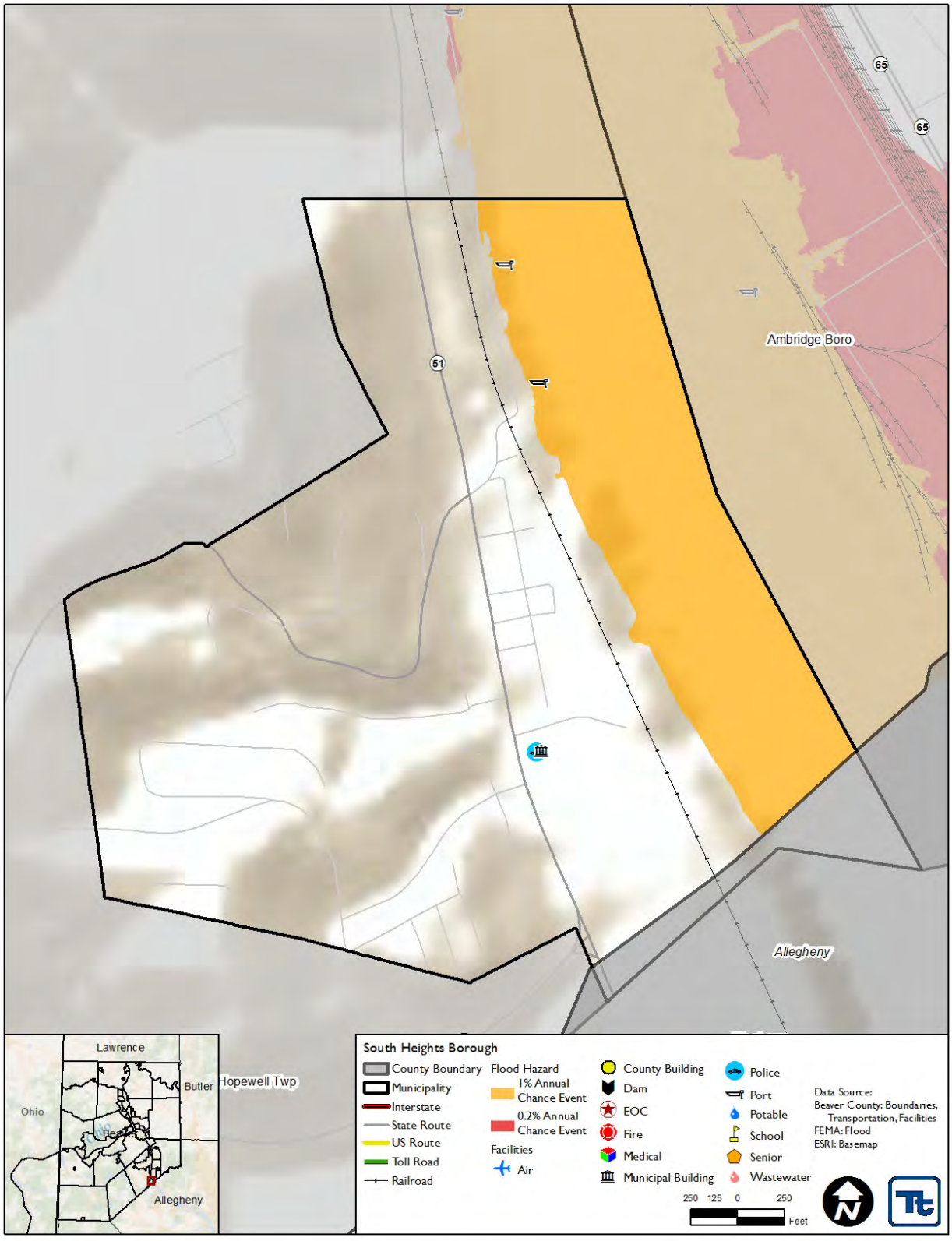
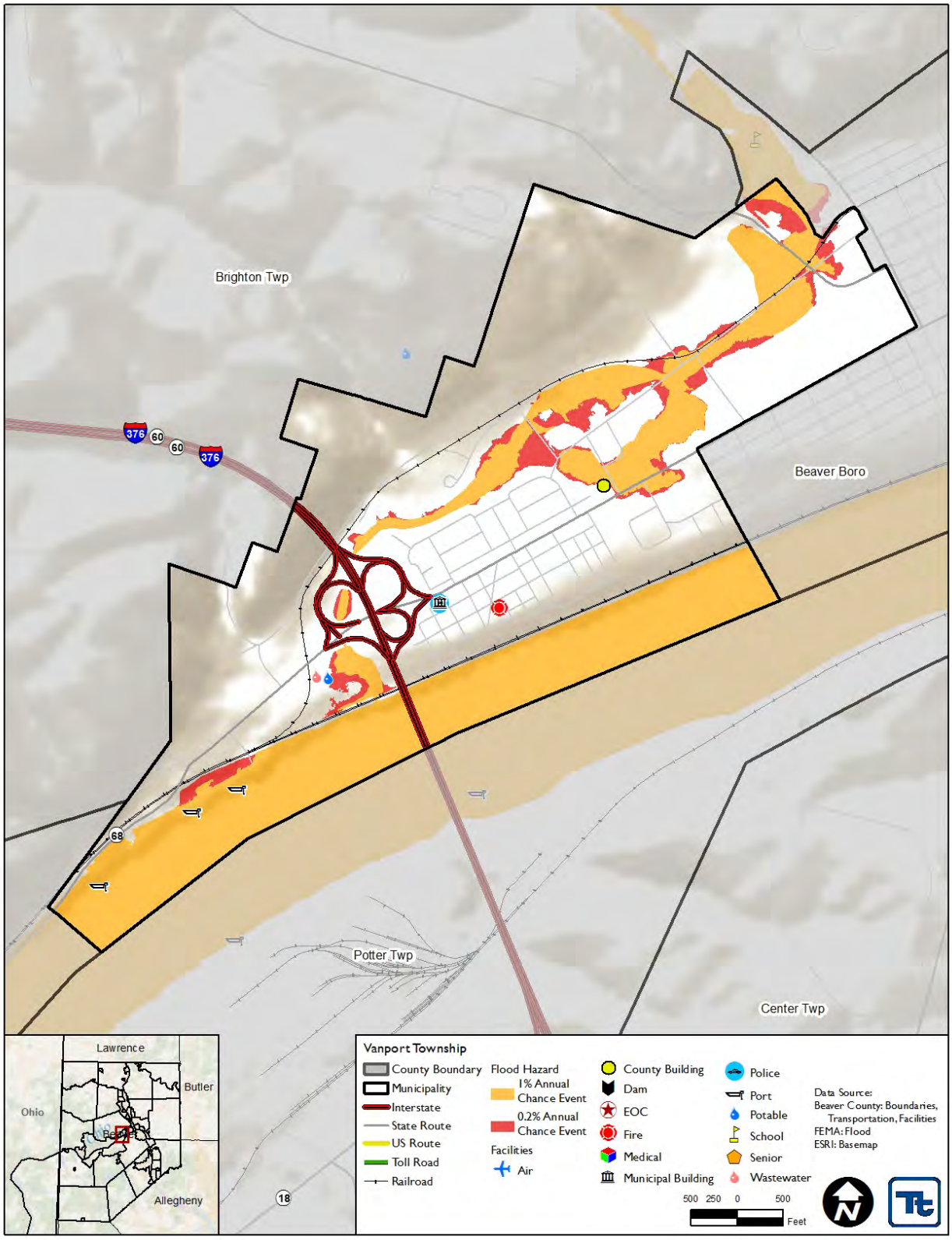
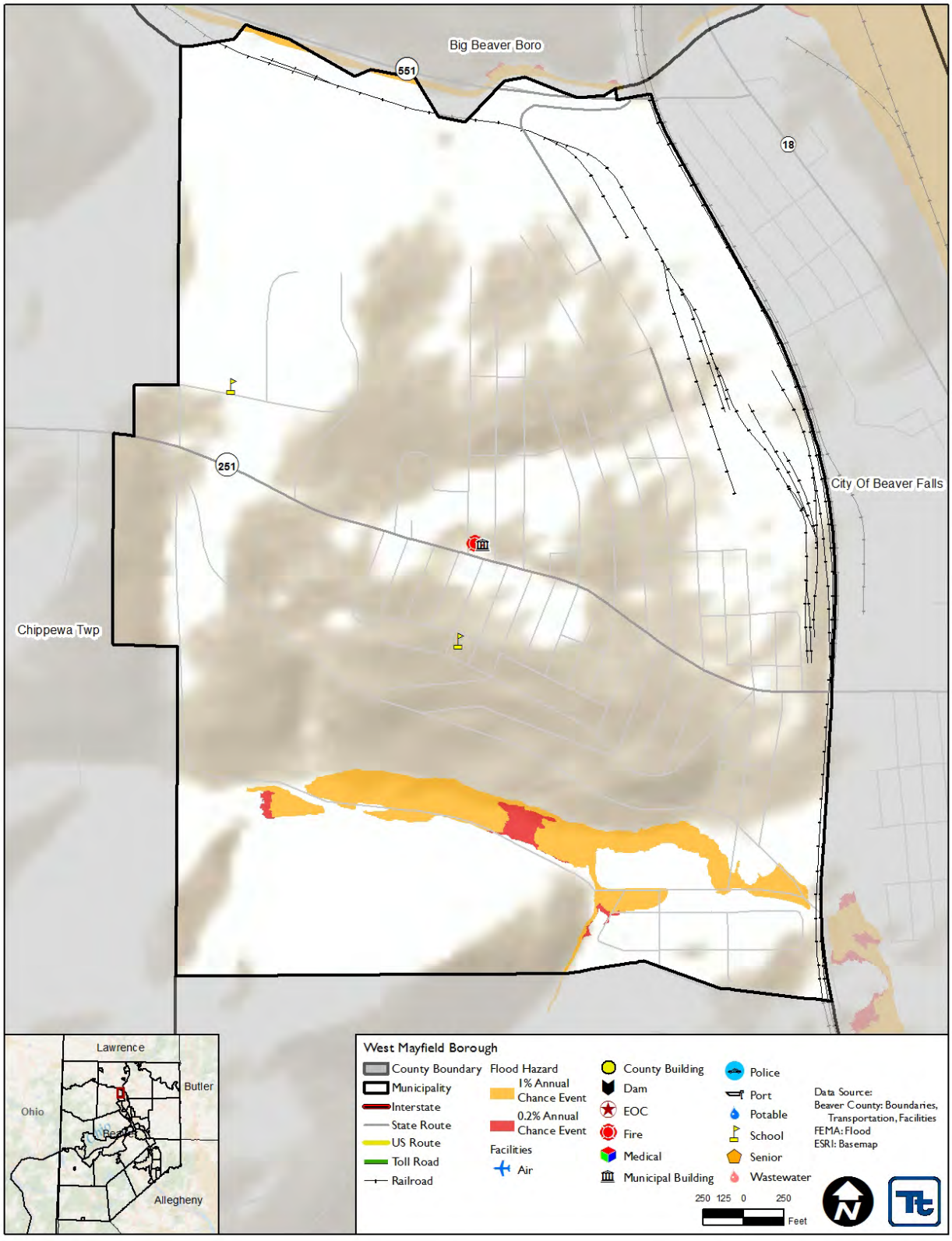


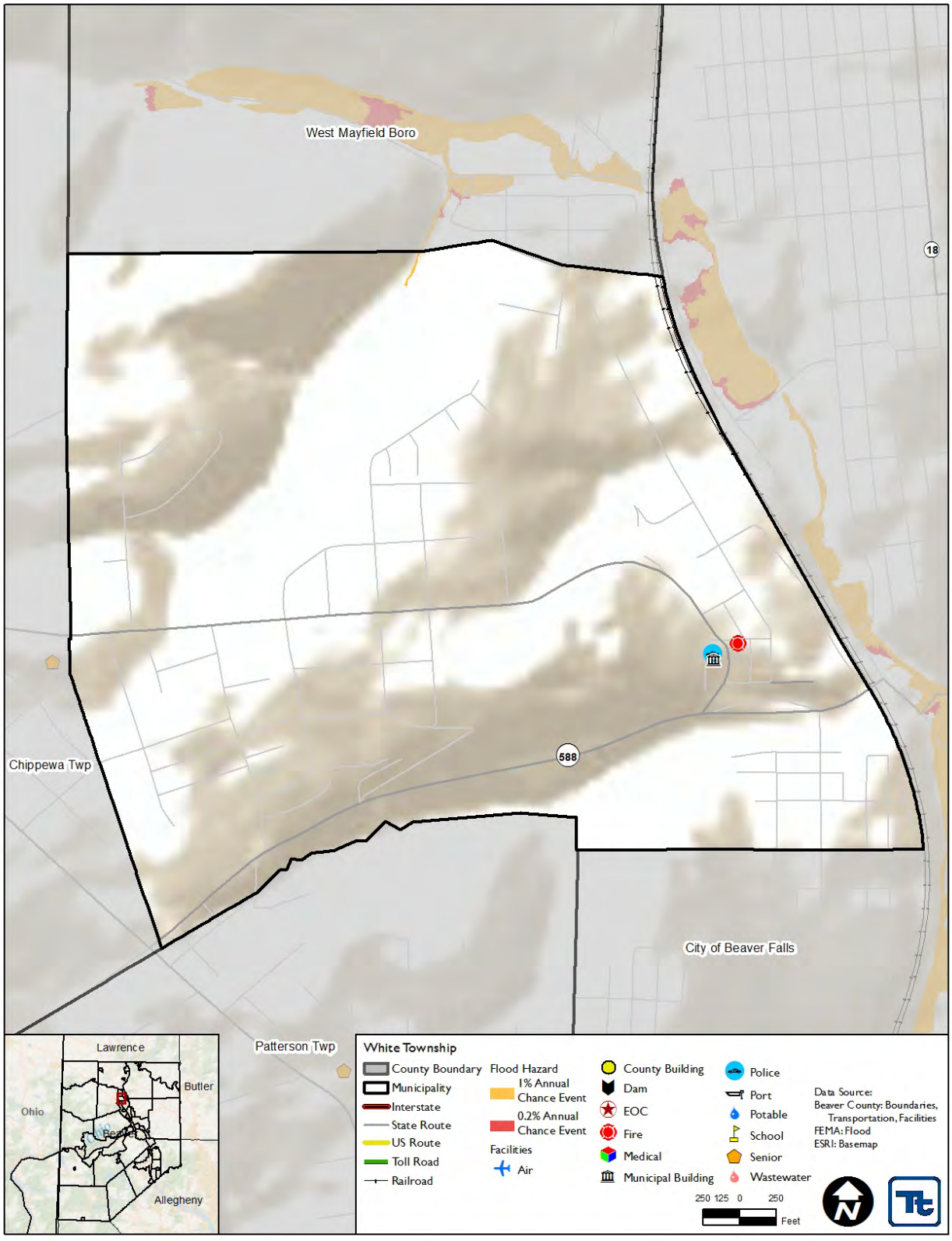
Vanport Township



West Mayfield Borough



White Township



4.3.6 Landslide

This section provides a profile and vulnerability assessment of the landslide hazard. A landslide is described in the Commonwealth of Pennsylvania 2013 Standard All-Hazard Mitigation Plan (PA HMP) as downward and outward movement of slope-forming soil, rock, and vegetation reacting to the force of gravity. Materials can move up to 120 miles per hour (mph) or more; slides can last a few seconds or a few minutes, or can be gradual, slower movements over several hours or days. Several different types of landslides include:

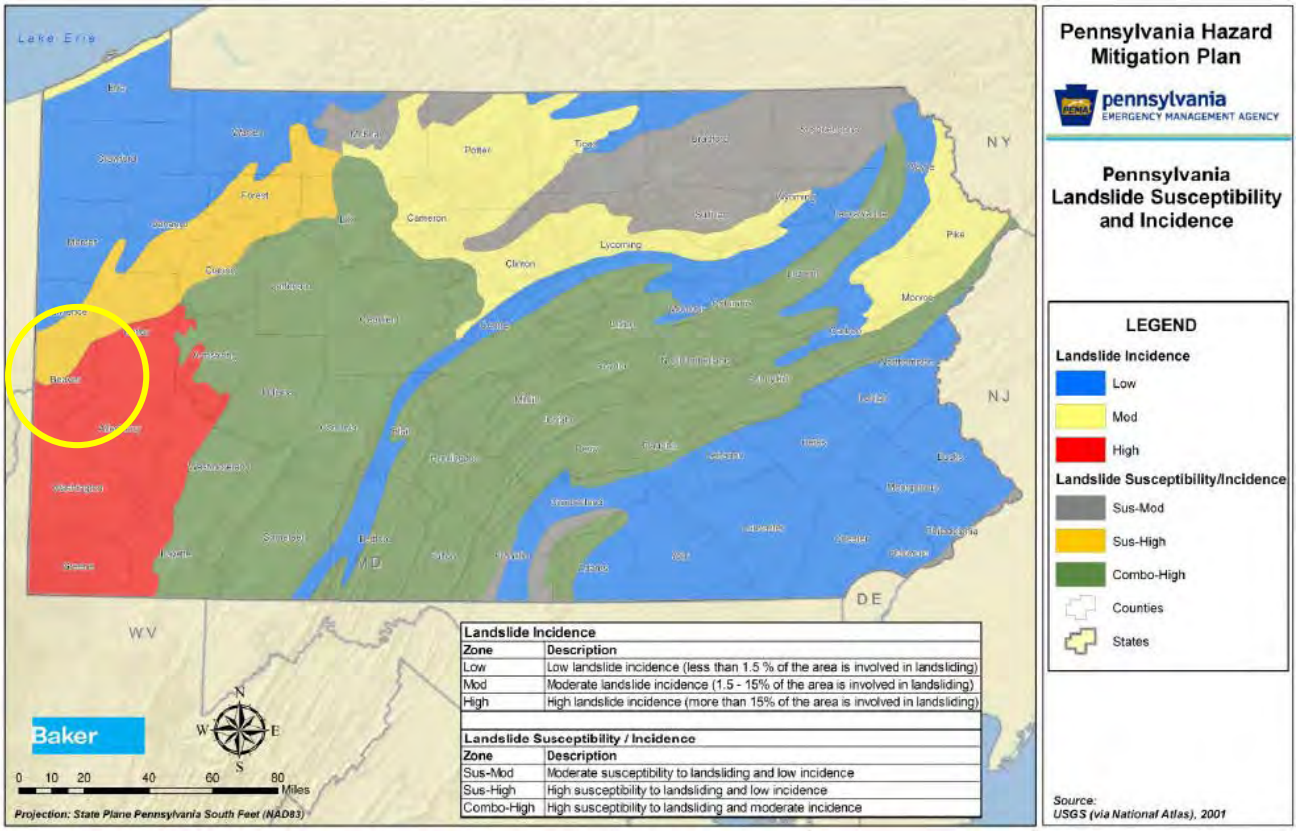
- *Rock Fall* – a mass detaches from a steep slope or cliff and descends by free fall, bounding, or rolling.
- *Rock Topple* – a mass tilts or rotates forward as a unit.
- *Slide* – a mass displaces on one or more recognizable surfaces, which may be curved or planar.
- *Flow* – a mass moves downslope with a fluid motion. A significant amount of water may or may not be part of the mass (Pennsylvania Emergency Management Agency [PEMA] 2013).

Landslides may be triggered by either natural or human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes through construction or erosion, earthquakes, and changes in groundwater levels. Areas generally prone to landslide hazards include previous landslide areas, bases of steep slopes, bases of drainage channels, developed hillsides, and areas recently burned by forest and brush fires (Delano and Wilshusen 2001). Human activities that contribute to slope failure include altering the natural slope gradient, increasing soil water content, and removing vegetation cover.

4.3.6.1 Location and Extent

According to the 2013 PA HMP, landslides have occurred in many parts of Pennsylvania but have been most abundant and troublesome in much of the western and north-central portions of the State and in adjacent states. Rockfalls and other slope failures can occur in areas of Beaver County with moderate to steep slopes. Areas undergoing erosion, decline in vegetation cover, and earthquakes are also susceptible to landslides. Figure 4.3.6-1 shows areas of low, moderate, and high landslide susceptibility as identified by the U.S. Geological Survey (USGS). The southern half of the County has a high landslide incidence, with more than 15% of the area having undergone landslides, while the northern half of Beaver County ranks as moderately susceptible with a low number of incidents. Harmony Township and Highlight Ambridge noted presence of steep slopes within their municipal boundaries. Industry Borough and South Heights Borough also noted that the number of landslides has increased over the past several years, leading to a greater frequency in road closures.

Figure 4.3.6-1. U.S. Geological Survey. Landslide Incidence and Susceptibility.



Source: PEMA 2013

Notes:

Highlight added.
Beaver County is within the yellow circle.

4.3.6.2 Range of Magnitude

Landslides damage transportation routes, utilities, and buildings. They can also create travel delays and other side effects. Fortunately, deaths and injuries caused by landslides are rare in Pennsylvania, and most landslides in the State are moderate to slow moving, damaging things rather than people. Almost all known deaths caused by landslides have occurred when rockfalls or other slides along highways have involved vehicles. Storm-induced debris flows are the only other type of landslide likely to cause death and injuries. Hazards from these events will also increase as residential and recreational development increases on and near steep mountain slopes.

The Pennsylvania Department of Transportation and large municipalities incur substantial costs due to landslide damage, and extra construction costs for new roads in known landslide-prone areas. A 1991 estimate showed average spending of $10 million per year on landslide repair contracts across the Commonwealth, and a similar amount of mitigation costs for grading projects (Pennsylvania Department of Conservation and Natural Resources [DCNR] 2015).

The worst-case scenario for a landslide in Beaver County would be an event similar to one that occurred in the County in 1942. In that event, 150 cubic yards of rock fell from a highway cut onto a bus. Twenty-two people were killed and four others were injured (PEMA 2013). The most likely landslide would occur in an unpopulated area, and likely would not be detected.

4.3.6.3 Past Occurrence

Outside of impacts on important transportation routes, the history of landslides is not documented as completely (if at all) as other hazards, primarily because landslides are not always seen, and therefore historical landslide occurrences in Beaver County are not well known. The National Climatic Data Center (NCDC) does not have any records of landslides in the County (National Oceanic and Atmospheric Administration [NOAA]-NCDC 2013). In addition to the major landslide in 1942 cited above, other notable incidents include the following:

- 1980 – Landslides along both a section of Route 168 in Midland and on Brady's Run Park Road
- 1996 – Landslides in Economy Borough and Harmony Township
- March 2006 – A mudslide in Raccoon Township that led to a road closure for at least a week. No injuries were reported (WPXI 2006)
- July 2011 – Mudslides and flooding in the County after heavy thunderstorms (Miller 2011)
- April 2015 – Mudslide in Ohioville Borough (Knowledge Center 2015)
- May 2015 – Mudslide with partial road closure in Patterson Township (Knowledge Center 2015).

Mudslides are also common, occurring primarily along roadbeds with inadequate drainage. Within the County, mudslides have resulted in numerous road closings and hundreds of thousands of dollars in reconstruction/repairs.

Pennsylvania has no history of federally declared disasters as a result of landslides or mudslides. One federally declared disaster included mudslides, in June 2006. Beaver County was not included in that declaration. PEMA notes only one disaster incident including mudslides, in April 2005, which did not include Beaver County. This event was eligible for individual assistance, public assistance, and hazard mitigation.

4.3.6.4 Future Occurrence

Mismanaged, intense development in steeply sloped areas could increase the frequency of landslides in Beaver County. Building and road construction are contributing factors to development of landslides, as they can often undermine or steepen otherwise stable soil.

Any events that occur in undeveloped areas would take place in steeply sloped areas that do not feature extensive land development or many structures. Increased deforestation and soil disturbances caused by development on sloped areas further increase these risks. As timbering and development of sloped land continue, the risk of significant landslides increases.

Based on available historical data and soil susceptibility, future occurrence of landslides can be considered *likely* as defined by the Risk Factor Methodology probability criteria (refer to Section 4.4).

4.3.6.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the hazard area identified. The following section discusses potential impact of the landslide hazard on Beaver County, including:

- Overview of vulnerability

- Data and methodology used for the evaluation
- Impact on (1) life; (2) health and safety; (3) general building stock; (4) critical facilities, economy; and (5) future growth and development
- Effect of climate change on vulnerability
- Additional data and next steps.

Overview of Vulnerability

Vulnerability to ground failure hazards is a function of location, soil type, geology, type of human activity, use, and frequency of events. Effects of landslides on people and structures can be reduced by total avoidance of hazard areas or by restricting, prohibiting, or imposing conditions on hazard-zone activity. Local governments can reduce effects of landslides through land use policies and regulations. Individuals can reduce their exposure to hazards by educating themselves on the past hazard history of the site and by making inquiries to planning and engineering departments of local governments (National Atlas 2007).

Overall, the entire County is vulnerable to this hazard, as the County is within the high-incidence and high-susceptibility/low-incidence hazard area. Further information regarding these hazard areas is presented below.

Data and Methodology

Unlike for flood, wind, and earthquake hazards, no standard loss estimation models have been developed for the landslide hazard. In an attempt to estimate Beaver County's vulnerability, the Geology — Landslide Incidence and Susceptibility geographic information system (GIS) layer from the National Atlas was used to coarsely define the general landslide susceptible area ("approximate hazard area") (Figure 4.3.6-1). Limitations of this analysis are recognized, and results are used only to provide a general estimate. Over time, additional data will be collected to allow better analysis of this hazard. Available information and a preliminary assessment are provided below.

According to Radbruch-Hall and others, the Landslide Incidence and Susceptibility GIS layer from National Atlas:

> "….was prepared by evaluating formations or groups of formations shown on the geologic map of the United States (King and Beikman 1974) and classifying them as having high, medium, or low landslide incidence (number of landslides) and being of high, medium, or low susceptibility to landsliding. Thus, those map units or parts of units with more than 15 percent of their area involved in landsliding were classified as having high incidence; those with 1.5 to 15 percent of their area involved in landsliding, as having medium incidence; and those with less than 1.5 percent of their area involved, as having low incidence. This classification scheme was modified where particular lithofacies are known to have variable landslide incidence or susceptibility. In continental glaciated areas, additional data were used to identify surficial deposits that are susceptible to slope movement. Susceptibility to landsliding was defined as the probable degree of response of the areal rocks and soils to natural or artificial cutting or loading of slopes or to anomalously high precipitation. High, medium, and low susceptibility are delimited by the same percentages used in classifying the incidence of landsliding. For example, it was estimated that a rock or soil unit characterized by high landslide susceptibility would respond to widespread artificial cutting by some movement in 15 percent or more of the affected area. We did not evaluate the effect of earthquakes on slope stability, although many catastrophic landslides have been generated by ground shaking during earthquakes. Areas susceptible to ground failure under

static conditions would probably also be susceptible to failure during earthquakes" (Radbruch-Hall 1982).

To estimate exposure to the building stock, the default dasymetric building stock data from Hazards U.S. (HAZUS) – Multi-Hazard (MH) 3.0 was used for replacement cost value. Data from HAZUS-MH is at the census block level and is calculated by use of 2014 RS Means valuations. To estimate the number of structures within the hazard area, a point spatial layer was created using the County's partial building footprint layer and the County's parcels and tax data.

Impact on Life, Health, and Safety

As discussed above, all of the County is within the high-incidence and high-susceptibility/low-incidence hazard areas. Therefore, the entire County's population (U.S. Census 2010 population of 170,539) could be impacted by a landslide event. Landslide events can cause direct and indirect (impact on buildings) damage to the County's population.

To estimate populations within the hazard areas, the hazard area boundaries (shown in Figure 4.3.6-1) were overlaid upon the 2010 Census population data (U.S. Census 2010). Census blocks with their centers (centroids) within the boundary of the landslide incidence hazard areas were used to calculate the estimated population considered exposed to this hazard. The Census blocks do not align exactly with the hazard areas, and thus these estimates should be considered for planning purposes only. Additionally, the hazard area boundaries are only available at a municipal level and more detailed breakdowns are not available; this presents another reason to only use these estimates for planning purposes.

Table 4.3.6-1 lists populations exposed by municipality (U.S. Census 2010). The population downslope of the landslide hazard areas is particularly vulnerable to this hazard. Due to the nature of Census block data, it is difficult to determine demographics of populations vulnerable to mass movements of geological material. Using this approach, 60,594 people (35.5% of the population) are exposed to the high-susceptibility/low-incidence hazard area, and 109,945 people (64.5% of the population) are exposed to the high-incidence hazard area. Please note while reviewing the table that exposure rates do not equate to actual potential impacts. Although an entire jurisdiction may be located in the high-incidence area, most landslide events are localized. Therefore, while a large number of residents may have a high exposure risk to landslide events, few residents will actually be significantly impacted during a landslide event.

Table 4.3.6-1. Estimated Beaver County Population Vulnerable to the Landslide Hazard Areas

Municipalities	Total Population (2010 U.S. Census)	High-Incidence Landslide Hazard Area		High-Susceptibility/Low-Incidence Landslide Hazard Area	
		Population Exposed	% Total	Population Exposed	% Total
City of Aliquippa	9,438	0	0%	9,438	100%
Ambridge Borough	7,050	0	0%	7,050	100%
Baden Borough	4,135	0	0%	4,135	100%
Beaver Borough	4,531	0	0%	4,531	100%
City of Beaver Falls	8,987	8,987	100%	0	0%
Big Beaver Borough	1,970	1,970	100%	0	0%
Bridgewater Borough	704	5	<1%	699	99.3%
Brighton Township	8,227	7,155	87.0%	1,072	13.0%
Center Township	11,795	0	0%	11,795	100%

Municipalities	Total Population (2010 U.S. Census)	High-Incidence Landslide Hazard Area		High-Susceptibility/Low-Incidence Landslide Hazard Area	
		Population Exposed	% Total	Population Exposed	% Total
Chippewa Township	7,620	7,620	100%	0	0%
Conway Borough	2,176	0	0%	2,176	100%
Darlington Borough	254	254	100%	0	0%
Darlington Township	1,962	1,962	100%	0	0%
Daugherty Township	3,187	2,055	64.5%	1,132	35.5%
East Rochester Borough	567	0	0%	567	100%
Eastvale Borough	225	225	100%	0	0%
Economy Borough	8,970	0	0%	8,970	100%
Fallston Borough	266	266	100%	0	0%
Frankfort Springs Borough	130	0	0%	130	100%
Franklin Township	4,052	2,985	73.7%	1,067	26.3%
Freedom Borough	1,569	0	0%	1,569	100%
Georgetown Borough	174	0	0%	174	100%
Glasgow Borough	60	0	0%	60	100%
Greene Township	2,356	0	0%	2,356	100%
Hanover Township	3,690	0	0%	3,690	100%
Harmony Township	3,197	0	0%	3,197	100%
Homewood Borough	109	109	100%	0	0%
Hookstown Borough	147	0	0%	147	100%
Hopewell Township	12,593	0	0%	12,593	100%
Independence Township	2,503	0	0%	2,503	100%
Industry Borough	1,835	376	20.5%	1,459	79.5%
Koppel Borough	762	762	100%	0	0%
Marion Township	913	0	0%	913	100%
Midland Borough	2,635	0	0%	2,635	100%
Monaca Borough	5,737	0	0%	5,737	100%
New Brighton Borough	6,025	6,025	100%	0	0%
New Galilee Borough	379	379	100%	0	0%
New Sewickley Township	7,360	0	0%	7,360	100%
North Sewickley Township	5,488	5,367	97.8%	121	2.2%
Ohioville Borough	3,533	2,888	81.7%	645	18.3%
Patterson Township	3,029	3,029	100%	0	0%
Patterson Heights Borough	636	636	100%	0	0%
Potter Township	548	0	0%	548	100%
Pulaski Township	1,500	1,500	100%	0	0%

Municipalities	Total Population (2010 U.S. Census)	High-Incidence Landslide Hazard Area		High-Susceptibility/Low-Incidence Landslide Hazard Area	
		Population Exposed	% Total	Population Exposed	% Total
Raccoon Township	3,064	0	0%	3,064	100%
Rochester Borough	3,657	0	0%	3,657	100%
Rochester Township	2,802	57	2.0%	2,745	98.0%
Shippingport Borough	214	0	0%	214	100%
South Beaver Township	2,717	2,717	100%	0	0%
South Heights Borough	475	0	0%	475	100%
Vanport Township	1,321	0	0%	1,321	100%
West Mayfield Borough	1,239	1,239	100%	0	0%
White Township	1,394	1,394	100%	0	0%
BEAVER COUNTY (TOTAL)	**170,539**	**60,594**	**35.5%**	**109,945**	**64.5%**

Sources: United States Census 2010, Godt 2001

Impact on General Building Stock

Similar to the population, the building stock data are presented by census block. For this analysis, the HAZUS-MH 3.0 dasymetric census blocks were used. In general, the built environment within the landslide incidence zones and the population, structures, and infrastructure downslope are vulnerable to this hazard. Using the default general building stock, the replacement cost values of the census blocks with their centroids in the hazard area were totaled. Approximately $20.5 billion in replacement cost is exposed to the high-incidence hazard area (63.8%), while approximately $11.6 billion in replacement cost is exposed to the high-susceptibility/low-incidence hazard area (36.2%)

To estimate the number of structures exposed to the hazard boundary, the point spatial layer of structures generated for the County was overlaid by the hazard area. In total, 56,519 structures, or 63.4% of the building stock, would be exposed to the high-incidence hazard area, while 32,659 structures, or 36.6% of the building stock, would be exposed to the high-susceptibility/low-incidence hazard area. Table 4.3.6-2 lists building stock exposure per municipality.

Table 4.3.6-2. Estimated General Building Stock Exposure to the Landslide Hazard Areas

Municipality	Total Number of Buildings	Total Replacement Value (Structure and Contents)	High Incidence Landslide Hazard Area				High Susceptibility/Low Incidence Landslide Hazard Area			
			# Buildings	% Total	RCV Exposed	% Total	# Buildings	% Total	RCV Exposed	% Total
City of Aliquippa	5,365	$1,752,914,000	5,365	100%	$1,752,914,000	100%	0	0%	$0	0%
Ambridge Borough	2,931	$2,001,497,000	2,931	100%	$2,001,497,000	100%	0	0%	$0	0%
Baden Borough	1,529	$660,129,000	1,529	100%	$660,129,000	100%	0	0%	$0	0%
Beaver Borough	2,412	$1,086,483,000	2,412	100%	$1,086,483,000	100%	0	0%	$0	0%
City of Beaver Falls	4,543	$2,039,706,000	0	0%	$0	0%	4,543	100%	$2,039,706,000	100%
Big Beaver Borough	1,258	$332,759,000	0	0%	$0	0%	1,258	100%	$332,759,000	100%
Bridgewater Borough	444	$259,715,000	412	92.8%	$256,035,000	98.6%	32	7.2%	$3,680,000	1.4%
Brighton Township	4,059	$1,601,126,000	310	7.6%	$76,187,000	4.8%	3,749	92.4%	$1,524,939,000	95.2%
Center Township	5,497	$2,276,591,000	5,497	100%	$2,276,591,000	100%	0	0%	$0	0%
Chippewa Township	4,206	$1,776,474,000	0	0%	$0	0%	4,206	100%	$1,776,474,000	100%
Conway Borough	945	$302,730,000	945	100%	$302,730,000	100%	0	0%	$0	0%
Darlington Borough	211	$46,660,000	0	0%	$0	0%	211	100%	$46,660,000	100%
Darlington Township	1,876	$333,062,000	0	0%	$0	0%	1,876	100%	$333,062,000	100%
Daugherty Township	1,358	$472,132,000	521	38.4%	$168,390,000	35.7%	837	61.6%	$303,742,000	64.3%
East Rochester Borough	246	$104,380,000	246	100%	$104,380,000	100%	0	0%	$0	0%
Eastvale Borough	139	$47,783,000	0	0%	$0	0%	139	100%	$47,783,000	100%
Economy Borough	4,033	$1,548,629,000	4,033	100%	$1,548,629,000	100%	0	0%	$0	0%
Fallston Borough	285	$107,209,000	0	0%	$0	0%	285	100%	$107,209,000	100%
Frankfort Springs Borough	99	$15,141,000	99	100%	$15,141,000	100%	0	0%	$0	0%
Franklin Township	1,794	$674,586,000	490	27.3%	$219,423,000	32.5%	1,304	72.7%	$455,163,000	67.5%
Freedom Borough	673	$221,079,000	673	100%	$221,079,000	100%	0	0%	$0	0%
Georgetown Borough	152	$24,605,000	152	100%	$24,605,000	100%	0	0%	$0	0%
Glasgow Borough	46	$7,275,000	46	100%	$7,275,000	100%	0	0%	$0	0%
Greene Township	1,926	$316,388,000	1,926	100%	$316,388,000	100%	0	0%	$0	0%
Hanover Township	2,701	$494,877,000	2,701	100%	$494,877,000	100%	0	0%	$0	0%
Harmony Township	1,620	$579,530,000	1,620	100%	$579,530,000	100%	0	0%	$0	0%

Municipality	Total Number of Buildings	Total Replacement Value (Structure and Contents)	High Incidence Landslide Hazard Area				High Susceptibility/Low Incidence Landslide Hazard Area			
			# Buildings	% Total	RCV Exposed	% Total	# Buildings	% Total	RCV Exposed	% Total
Homewood Borough	88	$18,635,000	0	0%	$0	0%	88	100%	$18,635,000	100%
Hookstown Borough	143	$19,579,000	143	100%	$19,579,000	100%	0	0%	$0	0%
Hopewell Township	6,411	$2,387,019,000	6,411	100%	$2,387,019,000	100%	0	0%	$0	0%
Independence Township	1,925	$339,039,000	1,925	100%	$339,039,000	100%	0	0%	$0	0%
Industry Borough	1,278	$308,388,000	971	76.0%	$248,062,000	80.4%	307	24.0%	$60,326,000	19.6%
Koppel Borough	233	$86,828,000	0	0%	$0	0%	233	100%	$86,828,000	100%
Marion Township	423	$277,866,000	400	94.6%	$277,610,000	99.9%	23	5.4%	$256,000	0.1%
Midland Borough	1,232	$475,952,000	1,232	100%	$475,952,000	100%	0	0%	$0	0%
Monaca Borough	3,404	$1,104,111,000	3,404	100%	$1,104,111,000	100%	0	0%	$0	0%
New Brighton Borough	2,209	$1,167,805,000	0	0%	$0	0%	2,209	100%	$1,167,805,000	100%
New Galilee Borough	82	$148,470,000	0	0%	$0	0%	82	100%	$148,470,000	100%
New Sewickley Township	2,910	$1,135,707,000	2,910	100%	$1,135,707,000	100%	0	0%	$0	0%
North Sewickley Township	2,478	$920,989,000	43	1.7%	$16,655,000	1.8%	2,435	98.3%	$904,334,000	98.2%
Ohioville Borough	2,525	$450,834,000	451	17.9%	$93,732,000	20.8%	2,074	82.1%	$357,102,000	79.2%
Patterson Township	361	$119,704,000	0	0%	$0	0%	361	100%	$119,704,000	100%
Patterson Heights Borough	1,566	$496,741,000	0	0%	$0	0%	1566	100%	$496,741,000	100%
Potter Township	598	$154,809,000	598	100%	$154,809,000	100%	0	0%	$0	0%
Pulaski Township	610	$204,440,000	0	0%	$0	0%	610	100%	$204,440,000	100%
Raccoon Township	2,225	$485,396,000	2,225	100%	$485,396,000	100%	0	0%	$0	0%
Rochester Borough	1,472	$699,044,000	1,472	100%	$699,044,000	100%	0	0%	$0	0%
Rochester Township	1,362	$506,537,000	1,322	97.1%	$498,361,000	98.4%	40	2.9%	$8,176,000	1.6%
Shippingport Borough	294	$55,657,000	294	100%	$55,657,000	100%	0	0%	$0	0%
South Beaver Township	2,480	$564,677,000	0	0%	$0	0%	2,480	100%	$564,677,000	100%
South Heights Borough	219	$85,658,000	219	100%	$85,658,000	100%	0	0%	$0	0%
Vanport Township	591	$277,942,000	591	100%	$277,942,000	100%	0	0%	$0	0%

Municipality	Total Number of Buildings	Total Replacement Value (Structure and Contents)	High Incidence Landslide Hazard Area				High Susceptibility/Low Incidence Landslide Hazard Area			
			# Buildings	% Total	RCV Exposed	% Total	# Buildings	% Total	RCV Exposed	% Total
West Mayfield Borough	748	$210,567,000	0	0%	$0	0%	748	100%	$210,567,000	100%
White Township	653	$182,868,000	0	0%	$0	0%	653	100%	$182,868,000	100%
BEAVER COUNTY (TOTAL)	**89,178**	**$32,075,305,000**	**56,519**	**63.4%**	**$20,466,616,000**	**63.8%**	**32,659**	**36.6%**	**$11,608,689,000**	**36.2%**

Source: HAZUS-MH 3.0; Beaver County; Godt, 2001

Notes:

Based on the HAZUS-MH 3.0 default general building stock inventory.

% Percent
RCV Replacement cost value (structure and contents)

Critical Facilities and the Economy

To estimate exposure, the approximate hazard areas were overlaid upon the essential and municipal facilities. In addition to critical facilities, a significant amount of infrastructure can be exposed to mass movements of geological material:

- *Roads* – Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads, isolating neighborhoods, posing traffic problems, and causing delays of public and private transportation. This can result in economic losses for businesses.
- *Bridges* – Landslides can significantly impact road bridges. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, rendering them hazardous for use.
- *Power Lines* – Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.
- *Rail Lines* – Similar to roads, rail lines are important for response and recovery operations after a disaster. Landslides can block travel along the rail lines, which would become especially troublesome, because detouring a rail line would not be as easy as detouring a local road or highway.

Several other types of infrastructure may also be exposed to landslides, including water and sewer infrastructure. At this time, all critical facilities, infrastructure, and transportation corridors within the hazard areas are considered vulnerable until more information becomes available. Tables 5.4.5-4 and 5.4.5-5 list critical facilities within, respectively the high-incidence hazard area and the high-susceptibility/low-incidence hazard area.

Table 5.4.5-1. Critical Facilities in the High-Incidence Landslide Hazard Area

Municipality	Facility Types													
	County Building	Dam	Emergency Operation Center	Fire Station	Medical	Municipal Building	Natural Gas Facility	Police Station	Port	Potable Water Facility	School	Senior	Wastewater Facility	Well
City of Aliquippa	1	0	0	2	0	1	0	1	7	1	5	2	1	24
Ambridge Borough	1	0	1	1	1	1	0	1	5	1	4	4	1	19
Baden Borough	0	0	0	1	1	1	0	1	0	0	4	1	1	4
Beaver Borough	3	0	0	1	0	1	0	1	0	1	5	0	0	14
City of Beaver Falls	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Beaver Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bridgewater Borough	0	0	0	1	2	1	0	1	1	0	0	0	1	2
Brighton Township	0	0	0	0	0	0	0	0	0	1	0	0	0	4
Center Township	1	1	0	3	2	1	0	2	0	1	8	0	1	23
Chippewa Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Municipality	Facility Types													
	County Building	Dam	Emergency Operation Center	Fire Station	Medical	Municipal Building	Natural Gas Facility	Police Station	Port	Potable Water Facility	School	Senior	Wastewater Facility	Well
Conway Borough	0	0	0	2	0	1	0	1	1	0	1	0	1	3
Darlington Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Darlington Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daugherty Township	0	0	0	1	0	0	0	0	0	0	0	0	0	53
East Rochester Borough	0	0	0	1	0	1	0	0	1	0	0	0	0	0
Eastvale Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Economy Borough	2	0	0	3	0	1	1	1	2	0	3	1	0	89
Fallston Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frankfort Springs Borough	0	0	0	0	0	1	1	0	0	0	0	0	0	2
Franklin Township	0	2	0	0	0	1	8	1	0	0	0	0	0	58
Freedom Borough	3	0	0	1	0	1	0	1	1	0	1	0	0	7
Georgetown Borough	0	0	0	0	0	0	0	0	2	0	0	0	0	8
Glasgow Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Greene Township	0	1	0	1	0	1	1	0	4	0	4	0	0	165
Hanover Township	0	2	0	1	0	1	2	1	0	0	1	0	0	186
Harmony Township	0	0	0	1	0	1	0	1	0	0	1	0	1	11
Homewood Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hookstown Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Hopewell Township	2	0	0	2	0	1	0	1	1	0	5	1	2	49
Independence Township	1	1	0	1	0	1	2	1	0	0	1	0	0	152
Industry Borough	0	0	0	1	0	1	0	1	6	1	0	0	0	19
Koppel Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marion Township	0	0	0	0	0	1	9	1	0	0	0	0	0	73
Midland Borough	0	0	0	1	0	1	0	1	1	1	5	0	1	5
Monaca Borough	0	0	0	3	0	1	0	1	4	1	4	0	2	35
New Brighton Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Galilee Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Sewickley Township	0	0	0	3	0	1	13	1	0	0	2	0	0	352
North Sewickley Township	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Ohioville Borough	0	0	0	0	0	0	2	0	2	0	0	0	0	9
Patterson Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Patterson Heights Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potter Township	0	1	0	1	0	1	0	0	5	0	0	0	0	35

Municipality	Facility Types													
	County Building	Dam	Emergency Operation Center	Fire Station	Medical	Municipal Building	Natural Gas Facility	Police Station	Port	Potable Water Facility	School	Senior	Wastewater Facility	Well
Pulaski Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raccoon Township	0	0	0	2	0	1	0	1	0	0	2	0	0	108
Rochester Borough	0	0	0	1	2	1	0	1	2	0	1	1	1	5
Rochester Township	0	0	0	2	0	1	0	1	0	0	1	0	0	19
Shippingport Borough	0	0	0	1	0	1	2	1	3	0	0	0	0	7
South Beaver Township	0	0	0	0	0	1	0	1	2	0	0	0	0	8
South Heights Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanport Township	1	0	0	1	0	1	0	1	3	1	0	0	1	5
West Mayfield Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEAVER COUNTY (TOTAL)	**15**	**8**	**1**	**39**	**8**	**29**	**41**	**26**	**53**	**9**	**58**	**10**	**14**	**1,567**

Sources: Beaver County, Godt 2001

Table 5.4.5-5. Critical Facilities in the High-Susceptibility/Low-Incidence Landslide Hazard Area

Municipality	Facility Types													
	Air	County Building	Dam	Emergency Operation Center	Fire Station	Medical	Municipal Building	Natural Gas Facility	Police Station	Potable Water Facility	School	Senior	Wastewater Facility	Well
City of Aliquippa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ambridge Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baden Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaver Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
City of Beaver Falls	0	3	0	0	1	1	1	0	1	1	9	3	1	12
Big Beaver Borough	0	0	0	0	1	0	1	1	0	0	1	1	0	32
Bridgewater Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brighton Township	0	4	1	0	3	3	1	1	2	2	3	2	0	46
Center Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chippewa Township	1	3	0	0	1	1	1	5	1	0	3	3	0	39
Conway Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Darlington Borough	0	0	0	0	0	0	1	0	0	0	1	0	0	0

Municipality	Facility Types													
	Air	County Building	Dam	Emergency Operation Center	Fire Station	Medical	Municipal Building	Natural Gas Facility	Police Station	Potable Water Facility	School	Senior	Wastewater Facility	Well
Darlington Township	0	0	4	0	2	0	1	3	1	0	1	0	0	96
Daugherty Township	0	0	0	0	0	0	1	0	0	0	0	1	0	16
East Rochester Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastvale Borough	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Economy Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fallston Borough	0	0	0	0	1	0	1	0	0	0	0	0	0	5
Frankfort Springs Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Franklin Township	0	0	0	0	2	0	0	0	0	0	0	1	0	41
Freedom Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Georgetown Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glasgow Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greene Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hanover Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harmony Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Homewood Borough	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Hookstown Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hopewell Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Independence Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry Borough	0	0	0	0	0	0	0	2	0	0	2	0	0	6
Koppel Borough	0	0	0	0	1	0	1	0	1	0	1	0	0	12
Marion Township	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Midland Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Monaca Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Brighton Borough	0	1	1	0	1	0	1	0	1	0	2	2	1	5
New Galilee Borough	0	0	0	0	1	0	0	0	0	0	0	0	0	10
New Sewickley Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Sewickley Township	0	1	0	0	2	0	1	1	1	0	2	1	0	38
Ohioville Borough	0	0	0	0	3	0	1	5	1	0	1	0	0	47
Patterson Township	0	1	1	1	1	0	1	0	1	0	1	3	1	1
Patterson Heights Borough	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Potter Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pulaski Township	0	0	0	0	1	0	1	0	0	0	1	0	0	1
Raccoon Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Municipality	Facility Types													
	Air	County Building	Dam	Emergency Operation Center	Fire Station	Medical	Municipal Building	Natural Gas Facility	Police Station	Potable Water Facility	School	Senior	Wastewater Facility	Well
Rochester Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rochester Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shippingport Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Beaver Township	0	0	0	0	2	0	1	13	1	0	0	3	0	119
South Heights Borough	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanport Township	0	0	0	0	0	0	0	0	0	0	0	0	0	0
West Mayfield Borough	0	0	0	0	1	0	1	0	0	0	2	0	0	1
White Township	0	0	0	0	1	0	1	0	1	0	0	0	0	1
BEAVER COUNTY (TOTAL)	**1**	**13**	**8**	**1**	**28**	**5**	**18**	**31**	**12**	**3**	**30**	**20**	**3**	**538**

Sources: Beaver County, Godt 2001

Geologic hazards can impose direct and indirect impacts on society. Direct costs include actual damage sustained by buildings, property, and infrastructure. Indirect costs, such as cleanup costs, business interruption, loss of tax revenues, reduced property values, and loss of productivity are difficult to measure. Additionally, ground failure threatens transportation corridors, fuel and energy conduits, and communication lines (USGS 2003). Estimated potential damages to general building stock can be quantified as discussed above. For the purposes of this analysis, general building stock damages are discussed further.

A landslide event alters the landscape. In addition to changes in topography, vegetation and wildlife habitats may be damaged or destroyed, and soil and sediment runoff will accumulate downslope, potentially blocking waterways and roadways and impacting quality of streams and other water bodies. Additional environmental impacts include loss of forest productivity. Considering both landslide hazard areas, the entire building stock is potentially exposed to a landslide event. These dollar value losses to Beaver County's total building inventory would impact Beaver County's tax base and the local economy.

As discussed above, the entire County is exposed to the hazard area; therefore, all major roadways and transportation routes could be impacted by a landslide event.

Future Growth and Development

Areas targeted for potential future growth and development within the next 5 to 10 years have been identified across Beaver County. Refer to Section 2.4 of this HMP. New development within the high-incidence or high-susceptibility/low-incidence landslide hazard areas expectedly will be exposed to these risks.

Effect of Climate Change on Vulnerability

Climate is defined not just as average temperature and precipitation but also by type, frequency, and intensity of weather events. Both globally and at the local scale, climate change could alter prevalence and severity of extremes such as severe storms, including those that may bring intense or prolonged precipitation

(U.S. Environmental Protection Agency [EPA] 2006). An increase in rainfall intensity and duration will saturate the soil, potentially erode the local landscape, and impair slope stability, leading to an increase of landslide events in Beaver County.

While predicting changes in these types of events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future climate change impacts on human health, society, and the environment (EPA 2006). Potential effects of climate change on the County's vulnerability to landslide events must be considered as understanding of impacts of regional climate change increases.

Additional Data and Next Steps

More detailed landslide susceptibility zones can be generated so that communities can more accurately identify high hazard areas. A pilot study conducted for Schenectady County, New York, (described in the 2011 Draft New York State Hazard Mitigation Plan) developed higher-resolution landslide susceptibility zones. The methodology included use of the Natural Resource Conservation Services (NRCS) Digital Soil Survey soil units and their associated properties, including the American Association of State Highway and Transportation Officials (AASHTO) rating, liquid limit, hydrologic group, percentage of silt and clay, erosion potential, and slope, derived from high-resolution digital elevation models. Identifying historical damages to buildings and infrastructure incurred from landslides will also help with loss estimates and future modeling efforts, given a margin of uncertainty. Furthermore, research on rainfall thresholds for forecasting landslide potential may also be an option for Beaver County.

4.3.7 Levee Failure

Levees and flood walls are manmade structures designed to protect specific areas within a community from flooding. These structures fail when flood waters exceed the height of the protective levee structure, or when the maximum pressure exerted by the flood waters against the levee or flood wall exceeds its capability.

Levee failures, like dam failures, have the potential to place large numbers of people and great amounts of property at risk. Unlike dams, levees are built parallel to a river or another body of water to protect the population and structures behind it from risks to human health and property damage that could be caused by flooding events (Federal Emergency Management Agency [FEMA] 2008). Levees do not serve a purpose beyond providing flood protection and (less frequently) recreational space for community residents. Dams, on the other hand, can serve to store water or generate energy in addition to protecting areas from flooding.

Levee failures can be caused by a number of factors, and can be the cause of catastrophic effects. Damage to the area beyond a failed levee could be more significant than damage caused by the uninhibited flow of flood water (FEMA 2008). Levees are designed to provide a specific level of protection; therefore, excessive water from a flooding event could overtop a levee if the water volume exceeded the levee specifications. Additionally, because levees can fail if they are allowed to decay or deteriorate, regular maintenance is critical.

4.3.7.1 Location and Extent

Beaver County has only one levee system—the Darlington System—located in Darlington Township near North Fork Little Beaver Creek, as shown below in Figure 4.3.7-1. The system was created in 1960 and is owned and operated by Darlington Township (U.S. Army Corps of Engineers [USACE] 2015). According to the National Levee Database (NLD), the Darlington System actually consists of two levees: one is on the right bank and the other is on the left bank of North Fork Little Beaver Creek. The right bank levee is 0.1 mile in length, and the left bank levee is 0.25 mile long (USACE NLD 2015). The Pittsburgh District of the USACE has provided technical assistance for the maintenance and repair of the levee in the past.

Figure 4.3.7-1. Darlington System Levee

Source: USACE NLD 2015

4.3.7.2 Range of Magnitude

A levee failure or breach causes flooding in the developed land areas adjacent to the failed levee structure. The failure of a levee or other flood protection structure could be devastating depending on the level of flooding for which the structure is designed and the amount of land development present. Large volumes of water may be moving at high velocities, potentially causing severe damage to buildings, infrastructure, trees, and other large objects.

The environmental impacts of a levee failure can include significant water-quality and debris-disposal issues. Flood waters can back up sanitary sewer systems and inundate waste water treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. The contents of unsecured containers of oil, fertilizers, pesticides, and other chemicals get added to flood waters. Hazardous materials may be released and distributed widely across the floodplain. Water supplies and waste water treatment could be off line for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed. Contaminated sediment must be removed from buildings, yards, and properties. In addition, severe erosion is likely; such erosion can negatively impact local ecosystems.

The effects of a levee failure are exacerbated when the failure occurs abruptly or with little warning and if it results in deep, fast-moving water through highly-developed areas. Because Beaver County only has one levee system, the concern is greatest for the jurisdictions nearest the two levees in that system (Darlington Township and Big Beaver Borough). The worst-case scenario for levee failure in Beaver County would be if the Beaver Borough Sewage Treatment Plant were flooded due to levee failure. In this scenario, not only would the areas behind the levee be flooded, but the sewer treatment facility also would likely be temporary shutdown. This could reduce access to clean water and increase the potential for water contamination.

4.3.7.3 Past Occurrence

There have been no known levee failures in Beaver County.

4.3.7.4 Future Occurrence

Similarly to dam failures, levee failures can occur at any time given certain circumstances. However, the probability of future occurrence can be reduced through proper design, construction, and maintenance measures. Most levees are designed to meet a specified level of flooding. While FEMA focuses on mapping levees that will reduce the risk of a 1-percent annual chance flood, other levees may be designed to protect against smaller or larger floods. FEMA design specifications provide information regarding the percent annual chance flood a levee structure is expected to withstand, assuming that the levee has been adequately constructed and maintained. The probability of a levee failure in Beaver County cannot be determined, but based on the Risk Factor Methodology Probability Criteria in Section 4.1, it is considered *unlikely*.

4.3.7.5 Vulnerability Assessment

Because the impact of the existence of the Darlington System is not reflected on the Digital Flood Insurance Rate Maps (DFIRM), the areas, structures, and population vulnerable to the failure of the levees in this system cannot be determined. Failure of these levees during the 1-percent annual chance flood would result in flood waters reaching the areas shown on the DFIRMs.

Because Beaver County only has one levee system, the risk for levee failure is small. Levees typically contain a 2,000-foot buffer to help protect nearby populations and structures; however, private residences are located in the nearby vicinity of the levee system. The Darlington System is not located near any major population

centers, and only those homes or facilities in the buffer zone would be impacted. If there is a significant population increase in the areas protected by the levee system, the risk level will increase. Northwestern Elementary School is located less than 0.5 mile from the levee system.

4.3.8 Nuclear Incident

Nuclear hazards and incidents generally refer to incidents involving (1) a release of significant levels of radioactive materials or (2) exposure of workers or the general public to radiation. Primary concerns following a nuclear incident or accident are the impact on public health from direct exposure to a radioactive plume; inhalation of radioactive materials; ingestion of contaminated food, water, and milk; and long-term exposure to deposited radioactive materials in the environment that may lead to either acute (radiation sickness or death) or chronic (cancer) health effects.

4.3.8.1 Location and Extent

Within the Commonwealth of Pennsylvania are five nuclear power generation stations. The Beaver Valley Power Station (BVPS) is in central Beaver County, specifically in Shippingport Borough, and is the station of most relevance to County hazard profiling. BVPS maintains two pressurized water reactor units on a 453-acre site, producing 1,800 megawatts (mw) of electricity (FirstEnergy Nuclear Operating Company [FirstEnergy] 2012).

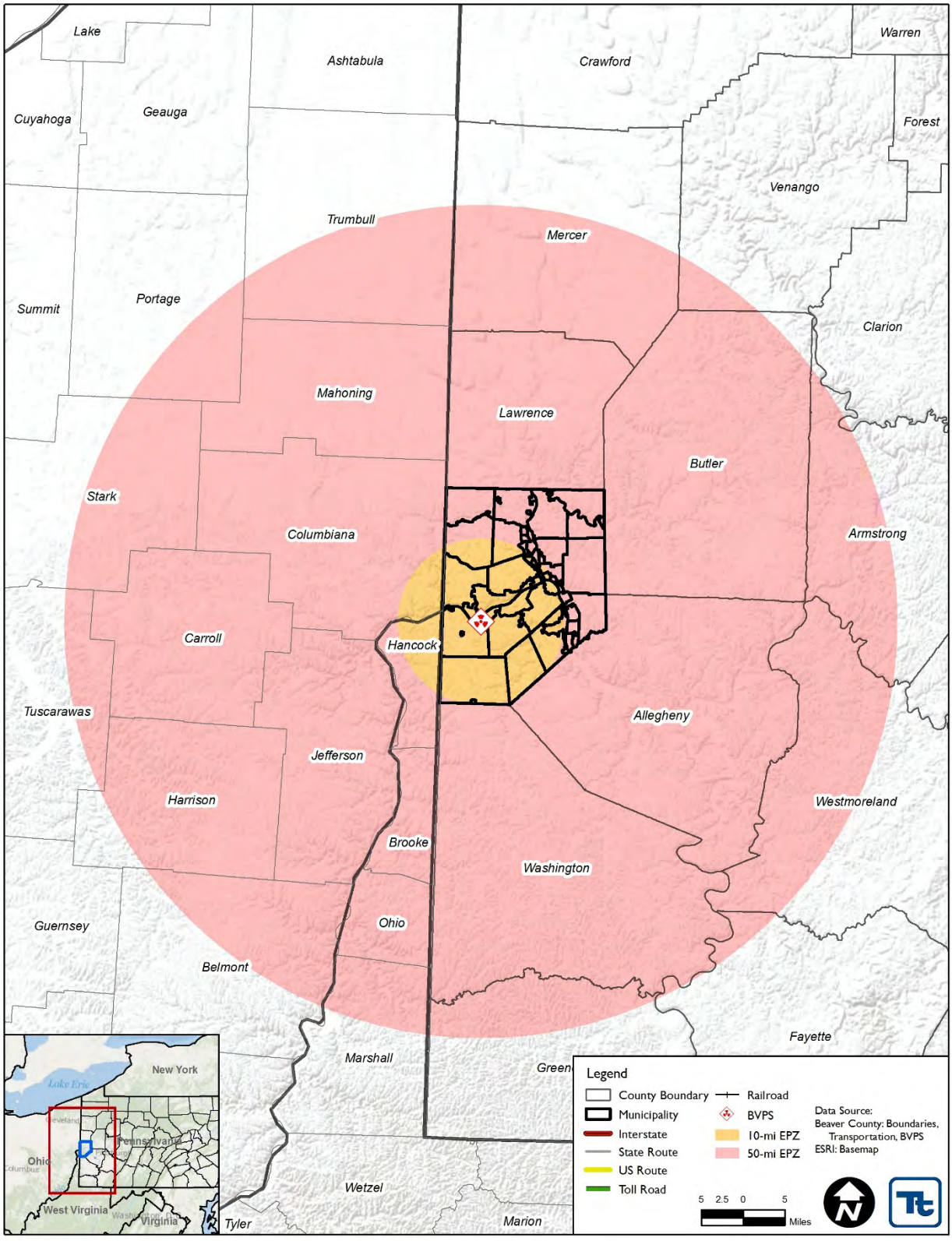
The nuclear industry has adopted pre-determined, site-specific Emergency Action Levels (EAL). The EALs provide the framework and guidance for observing, addressing, and classifying the severity of site-specific incidents and conditions that are communicated to off-site emergency response organizations (Nuclear Regulatory Commission [NRC] 2008). Additional EALs specifically deal with issues of security, such as threats of airborne attack, hostile action within the facility, or attack on the facility. These EALs ensure that appropriate notifications of a security threat will occur in a timely manner.

The NRC encourages the use of Probabilistic Risk Assessments (PRA) to estimate quantitatively the potential risk to public health and safety considering the design, operations, and maintenance practices at nuclear power plants. PRAs typically focus on accidents that can severely damage the core and that may challenge containment. Federal Emergency Management Agency (FEMA), Pennsylvania Emergency Management Agency (PEMA), and county governments have formulated Radiological Emergency Response Plans to prepare for radiological emergencies at the five nuclear power-generating facilities in the Commonwealth of Pennsylvania. These plans include a Plume Exposure Pathway Emergency Planning Zone (EPZ) (an area with a radius of 10 miles from each nuclear power facility), and an Ingestion Exposure Pathway EPZ (an area with a radius of 50 miles from each facility).

Should an accident occur at the BVPS facility, the area within the Ingestion Exposure Pathway EPZ could be affected by radioactive contamination. The amounts are of little concern in terms of external exposure. A bigger threat is internal exposure through the contamination of the food chain, particularly milk from local dairy cattle. Should an accident occur, State and federal agencies would sample and monitor milk, livestock feed, storage crops, and water supplies within the Ingestion Exposure Pathway EPZ. Beaver County Emergency Services may be asked to assist in gathering samples, and if requested by the State agencies, also participate in implementing control of foods, foodstuffs, and water.

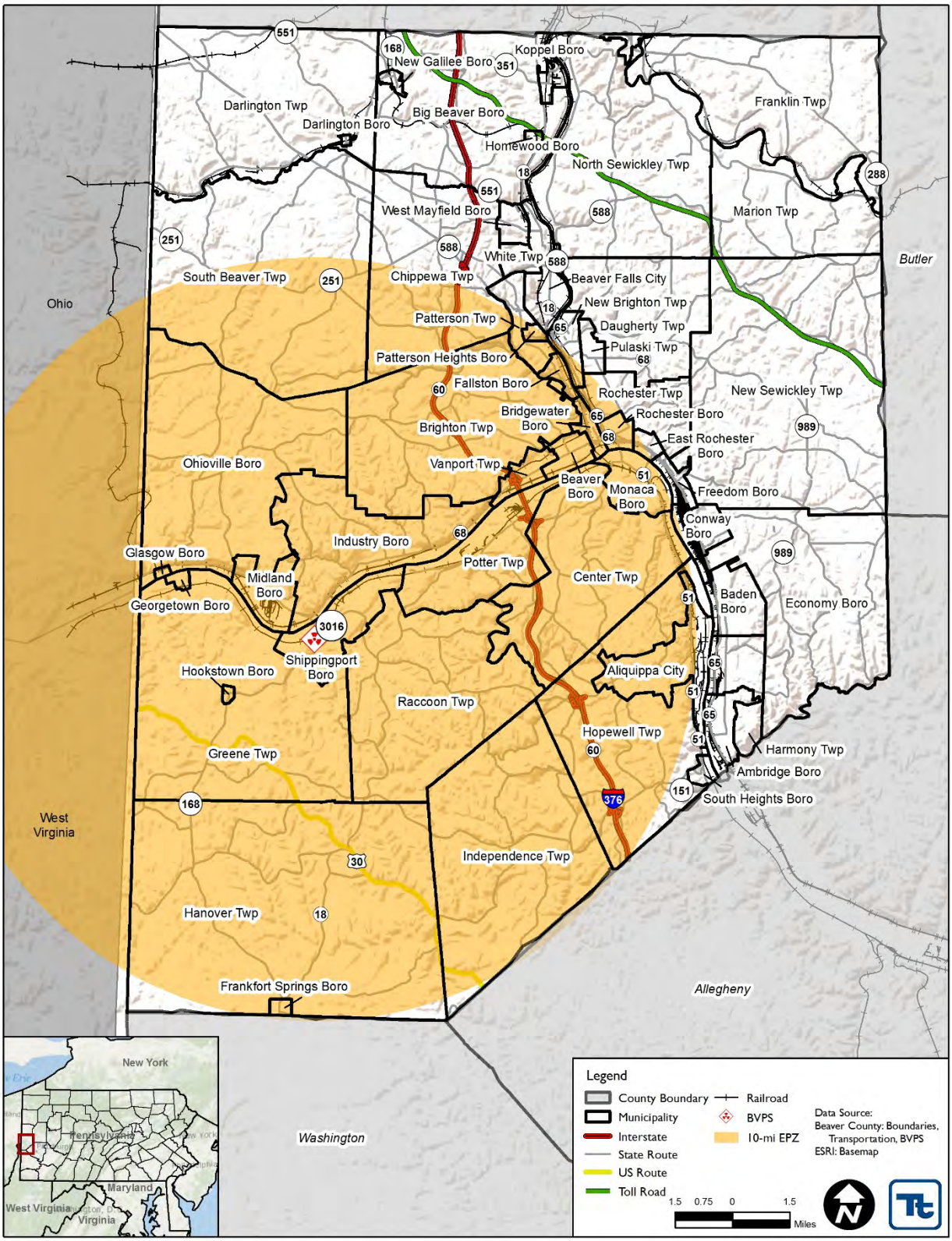
Figures 4.3.8-1 and 4.3.8-2 provide visual representations of the jurisdictions that fall within the two EPZs surrounding the BVPS facility in Beaver County. These jurisdictions are most vulnerable to an incident within that facility. Approximately 94,023 residents (roughly 54 percent of the County's population), 37,723 structures, and 127 critical facilities are located within the 10-mile EPZ (Beaver County 2010). All of the County, as well as neighboring jurisdictions, fall in the 50-mile EPZ. Critical infrastructure is discussed further in Section 2 of this Plan.

Figure 4.3.8-1. Beaver Valley Power Station



Source: Beaver County 2015

Figure 4.3.8-2: Beaver Jurisdictions in the 10-Mile EPZ



Source: Beaver County 2015

Table 4.3.8-1 indicates the jurisdictions within Beaver County that are within the 10-mile and 50-mile EPZs for the BVPS facility.

Table 4.3.8-1: Beaver Jurisdictions in the 10-Mile and 50-Mile EPZs

Jurisdiction	10-Mile Plume Exposure Pathway Zone	50-Mile Ingestion Exposure Pathway Zone
Beaver County	Yes	Yes
City of Aliquippa	Yes	Yes
Ambridge Borough	No	Yes
Baden Borough	No	Yes
Beaver Borough	Yes	Yes
City of Beaver Falls	No	Yes
Big Beaver Borough	No	Yes
Bridgewater Borough	Yes	Yes
Brighton Township	Yes	Yes
Center Township	Yes	Yes
Chippewa Township	Yes	Yes
Conway Borough	No	Yes
Darlington Borough	No	Yes
Darlington Township	No	Yes
Daugherty Township	No	Yes
East Rochester Borough	Yes	Yes
Eastvale Borough	No	Yes
Economy Borough	No	Yes
Fallston Borough	Yes	Yes
Frankfort Springs Borough	Yes	Yes
Franklin Township	No	Yes
Freedom Borough	No	Yes
Georgetown Borough	Yes	Yes
Glasgow Borough	Yes	Yes
Greene Township	Yes	Yes
Hanover Township	Yes	Yes
Harmony Township	No	Yes
Homewood Borough	No	Yes
Hookstown Borough	Yes	Yes
Hopewell Township	Yes	Yes
Independence Township	Yes	Yes
Industry Borough	Yes	Yes
Koppel Borough	No	Yes
Marion Township	No	Yes
Midland Borough	Yes	Yes
Monaca Borough	Yes	Yes
New Brighton Borough	Yes	Yes

Jurisdiction	10-Mile Plume Exposure Pathway Zone	50-Mile Ingestion Exposure Pathway Zone
New Galilee Borough	No	Yes
New Sewickley Township	No	Yes
North Sewickley Township	No	Yes
Ohioville Borough	Yes	Yes
Patterson Township	Yes	Yes
Patterson Heights Borough	Yes	Yes
Potter Township	Yes	Yes
Pulaski Township	No	Yes
Raccoon Township	Yes	Yes
Rochester Borough	Yes	Yes
Rochester Township	Yes	Yes
Shippingport Borough	Yes	Yes
South Beaver Township	Yes	Yes
South Heights Borough	No	Yes
Vanport Township	Yes	Yes
West Mayfield Borough	No	Yes
White Township	No	Yes

4.3.8.2 Range of Magnitude

In accordance with regulations specified by FEMA and NRC, each facility is required to notify jurisdictional agencies of an incident or occurrence within that facility. NRC uses four classification levels for nuclear incidents (NRC 2008). PEMA and facility owners with whom PEMA coordinates use the following notification levels based on an internal trigger:

- Unusual Event: Incidents are occurring or have occurred that indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring off-site response or monitoring is expected unless further degradation occurs.
- Alert: Incidents are in process or have occurred that involve actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the U.S. Environmental Protection Agency (EPA) Protective Action Guides (PAG).
- Site Area Emergency: Incidents are in process or have occurred that resulted in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed EPA PAGs except near the site boundary.
- General Emergency: Incidents are in process or have occurred that have caused actual or imminent substantial core damage or melting of reactor fuel with potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs over more than the immediate site area.

In the event of a nuclear facility disaster, radioactive contamination would be the main danger for Beaver County. Exposure to this radioactive contamination can cause radiation sickness as a result of physical and chemical changes in the cells of the body. If a person would receive a large dose of radiation, that person

would die in a very short time. Nonlethal doses in varying degrees would cause radiation sickness among the survivors.

The Plume Exposure Pathway refers to whole-body external exposure to radiation from a radioactive plume and from deposited materials and inhalation exposure from the passing radioactive plume. The duration of primary exposures could range in length from hours to days. Given that the entire County is within the 50-mile ingestion exposure pathway EPZ, the County should also focus on the impact of radiation exposure to water or foods such as milk, fresh vegetables, and other consumable products.

Nuclear facility accidents are classified into three categories, and exposure to radiation can stem from any of the three:

- Criticality accidents: Involves loss of control of nuclear assemblies or power reactors.
- Loss-of-coolant accidents: Occurs whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by the normally operating make-up system.
- Loss-of-containment accidents: Involves the release of radioactivity from materials such as tritium; fission products; plutonium; and natural, depleted, or enriched uranium. Points of release have been containment vessels at fixed facilities or damaged packages during transportation accidents.

A worst-case scenario for Beaver County would be a general emergency at BVPS, forcing the evacuation of County residents, disrupting daily life with the potential for long-term economic and health effects, including business interruptions, disruptions in the food supply, psychological stress to evacuees, and long-term risk of radiation sickness. During the immediate event aftermath, regions in the County or in neighboring counties and jurisdictions that are outside the prescribed 10-mile EPZ or evacuation areas may become temporary staging locations for the hundreds of thousands of residents that would be seeking safety outside of the 10-mile EPZ.

4.3.8.3 Past Occurrence

There have been no major incidents at the BVPS facility. Beaver County Emergency Services has been notified of multiple unusual events and two alerts in the past. Most events reported to the Knowledge Center have been exercises or drills performed at BVPS. No general or site area emergencies have occurred to date.

Pennsylvania is home to the only recorded nuclear emergency in the United States. In 1979, the Three Mile Island Nuclear Generating Station declared a general emergency following an internal system failure. Repercussions from this event were swift, with sweeping changes to NRC oversight that included assignment of responsibility to FEMA for outside support. Growth in the nuclear power industry immediately slowed, with the number of facilities decreasing over the next decade. In addition, public confidence in the nuclear industry decreased considerably.

While reports show conflicting information regarding medical impacts on the residential population following the disaster, costs of the cleanup phase of this incident exceeded $1 billion. No FEMA disaster declarations have since occurred regarding nuclear emergencies in Pennsylvania.

4.3.8.4 Future Occurrence

Within the United States, the low frequency of fixed-facility nuclear incidents that exceed the Alert level indicates the stability of the industry. Based on the Risk Factor Methodology Probability Criteria, probability of an incident at the BVPS facility is classified as *unlikely*. In addition, FirstEnergy, the parent company to

BVPS, continues to improve systems within the facility and communicate with local, state, and federal entities to establish emergency procedures for protecting the health and safety of the public (FirstEnergy 2011).

4.3.8.5 Vulnerability Assessment

Effects from a radiological incident at a fixed facility would vary depending on the product released (type of radiation), amount of radiation released, current weather conditions, and time of day. The priority following an incident at any of the facilities within the Commonwealth of Pennsylvania is the life and safety of all individuals within the area impacted. Secondary to health and safety would be effects on critical infrastructure, environment, property, and the economy.

Contamination of agriculture, livestock, and production can lead to loss of commerce with other regions of the State, country, and even the world. Recently, many countries halted imports of products from Japan for fear of contamination following the tsunami-related nuclear incident at the Fukishima Power Plant. This loss in revenue compounded losses that Japan and its region were already encountering following the initial disaster.

Impacts within the affected area can include loss of utility service, contamination of local crops and livestock, loss of residential property due to measurable quantities of nuclear materials, and increased risk to health and wellbeing of individuals within the area.

Recognizing the vulnerability, Beaver County maintains a Radiological Emergency Response Plan. This plan was developed in accordance with regulations specified by NRC and PEMA. The plan addresses actions to respond to and mitigate a possible radiological release. To support the radiological response plan, Beaver County participates in exercises designed to validate planning described within County documents. The County has coordinated and participated in command and mobile command exercises with neighboring jurisdictions relevant to the BVPS facility, and has toured BVPS as part of Region 13 and PEMA initiatives for planning awareness.

4.3.9 Pandemic

Pandemics are large-scale disease outbreaks, defined by how the disease spreads, not by how many fatalities are associated with it. A pandemic outbreak has several recognizable characteristics, including rapid, large-scale (potentially global) spread; overloaded healthcare systems; inadequate medical supplies; medical supply shortages; and a disrupted economy and society (Flu.gov 2015). Pandemics typically result from infectious diseases. An infectious disease, as defined by the World Health Organization (WHO), is caused by pathogenic organisms (e.g., bacteria, viruses, fungus, or parasites) that spread from one person to another, whether through direct or indirect contact. Zoonotic disease, a type of infectious disease, occurs when animals transmit a disease to humans (WHO 2015). Although any infectious disease can reach pandemic levels, influenza (flu) has the greatest likelihood of causing the next pandemic.

4.3.9.1 Location and Extent

Pandemic events cover a wide geographic area and can affect large populations; this can include multiple countries or continents. Size and extent of an infected population depends on how easily the illness is spread, mode of transmission, and amount of contact between infected and uninfected individuals. Locations with higher density populations are more susceptible to pandemic outbreaks, as the disease can be transmitted more easily. Additionally, vulnerable populations, especially the young and the elderly (who have weaker immune systems), are at greater risk for both contracting a disease and suffering fatal or severe consequences. Flu most frequently spreads through the air or by touch; when an infected person coughs, infected droplets go into the air or onto their hands, facilitating transmission of the disease to other people (WHO 2015).

When a pandemic or disease outbreak occurs, WHO and other public health institutions begin tracking the disease outbreak, treatment, and more. Ebola was a significant pandemic concern for American public health officials in 2014; however, the disease has primarily remained in Africa to date. Should a pandemic take hold in the United States, the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH) would be actively involved in managing the outbreak and treatment of the disease.

Although Ebola is still recognized as a global health threat, Beaver County is primarily concerned with the possibility of a pandemic flu outbreak. Influenza viruses with the potential to reach pandemic levels include the avian influenza A (H5N1) and avian influenza H7N9 (CDC 2015). Several years ago, the swine influenza (H1N1) was of particular concern. H1N1 was first detected in people in the United States in April 2009. On June 11, 2009, WHO signaled that a pandemic of 2009 H1N1 flu was underway (CDC 2009).

4.3.9.2 Range of Magnitude

Severity of a pandemic depends on a number of factors, as indicated above. These include aggressiveness of the disease, ease of transmission, and factors associated with the impacted community (e.g., access to medical care, demographic data, and population density). Advancements in medical technologies have greatly reduced the number of deaths caused by influenza, the disease most likely to reach pandemic scale in Pennsylvania. Consequently, global effects of various influenza outbreaks have declined over the past century. High-risk populations considered more vulnerable to various pandemic diseases are described in the vulnerability assessment.

Pandemic flu should not be confused with seasonal flu. Seasonal flu is a less severe concern because of its regularity of occurrence and predictability. The following Table 4.3.9-1 lists key differences between pandemic and seasonal flus.

Table 4.3.9-1. Seasonal Flu vs Pandemic Flu

Pandemic Flu	Seasonal Flu
Rarely happens (three times in 20th century).	Happens annually and usually peaks in January or February.
People have little or no immunity because they have no previous exposure to the virus.	Usually some immunity built up from previous exposure.
Healthy people may be at increased risk for serious complications.	Usually only people at high risk, not healthy adults, are at risk of serious complications.
Healthcare providers and hospitals may be overwhelmed.	Healthcare providers and hospitals can usually meet public and patient needs.
Vaccine probably would not be available in the early stages of a pandemic.	Vaccine available for annual flu season.
Effective antivirals may be in limited supply	Adequate supplies of antivirals are usually available.
Number of deaths could be high (U.S. death toll during the 1918 pandemic was approximately 675,000).	Seasonal flu-associated deaths in the U.S. over 30 years ending in 2007 have ranged from about 3,000 per season to about 49,000 per season.
Symptoms may be more severe	Symptoms include fever, cough, runny nose, and muscle pain.
May cause major impact on the general public, such as widespread travel restrictions and school or business closings.	Usually causes minor impact on the general public; some schools may close and sick people are encouraged to stay home.
Potential for severe impact on domestic and world economy.	Manageable impact on domestic and world economy.

Source: Flu.gov 2015

Approximately 12,470 Americans died from H1N1 within a roughly 1-year period from April 2009 to April 2010 (CDC, 2010). Between October 2014 and late May 2015, 6.4% of deaths were attributable to pneumonia and influenza—below the epidemic threshold of 6.6% (an epidemic occurs when incidence rate exceeds expected rate but is not at the magnitude of a pandemic) (CDC FluView 2015).

WHO described a series of pandemic phases in 1999 and revised these in 2005 and 2009 to provide a global framework and aid in pandemic preparedness and response planning. In addition to facilitating implementation of preparedness recommendations, the phases also help provide greater understanding of when an event is considered to have reached pandemic levels. The six phases are shown on Figure 4.3.9-1 below and are described as follows:

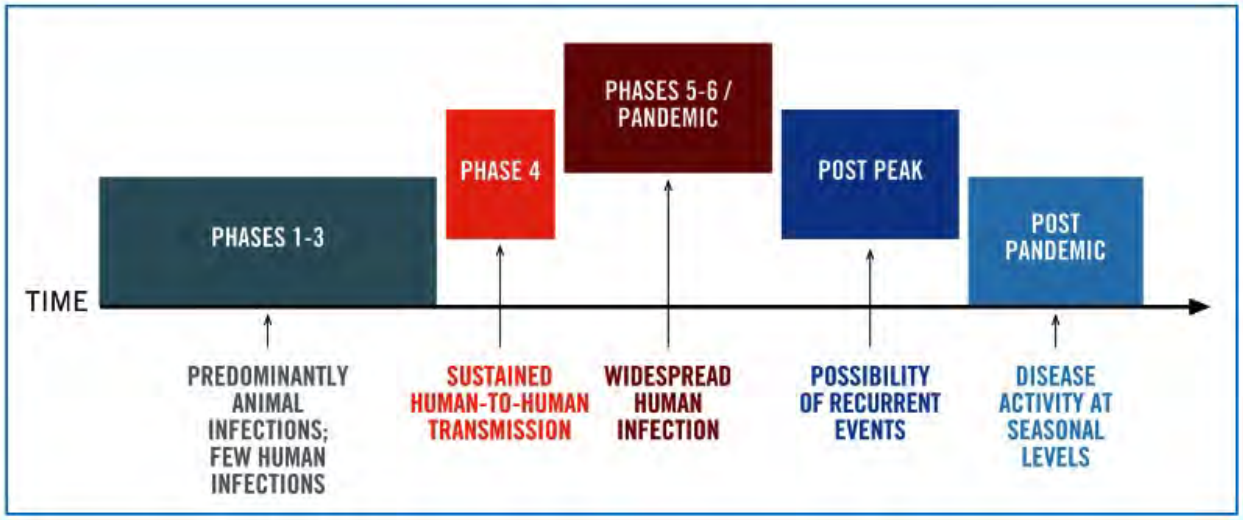
- Phase 1: No viruses circulating among animals have been reported among humans.
- Phase 2: An animal influenza virus circulating among domesticated or wild animals has caused known infection in humans and is now considered a potential pandemic threat.
- Phase 3: An animal or human-animal influenza reassortment virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain

community-level outbreaks. Limited human-to-human transmission may occur under some circumstances, such as close contact between an infected person and an unprotected caregiver.

- Phase 4: Verified human-to-human transmission of an animal or human-animal influenza reassortment virus is able to cause "community-level outbreaks." The ability to cause sustained disease outbreaks in a community marks a significant upwards shift in the risk of a pandemic. Any country that suspects or has verified such an event should urgently consult with WHO so that the situation can be jointly assessed and a decision made by the affected country if implementation of a rapid pandemic containment operation is warranted. Phase 4 indicates a significant increase in risk of a pandemic but does not necessarily mean that a pandemic is a forgone conclusion.
- Phase 5: There has been human-to-human spread of the virus into at least two countries in one WHO region. While most countries will not be affected at this stage, the declaration of Phase 5 is a strong signal that a pandemic is imminent, and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short.
- Phase 6: The pandemic phase is characterized by community-level outbreaks in at least one other country in a different WHO region, in addition to the criteria defined in Phase 5. Phase 6 indicates a global pandemic is underway.

Conclusion of Phase 6 leads to the post-peak period, wherein pandemic levels decrease in most countries with surveillance capabilities. Despite a decrease in activity, countries still must be prepared for additional waves of the pandemic. Pandemic waves can be separated by a period of months, leading to a long recovery time to guarantee entry of the pandemic into the post-pandemic phase (WHO 2009).

Figure 4.3.9-1. Pandemic Influenza Phases



Source: WHO 2009

A worst-case scenario would be entry of the United States into a Phase 6-designation of an influenza or other pandemic, whereby local community outbreaks would occur in Beaver County and the surrounding metropolitan area near Pittsburgh. This would affect most of the population, causing significant numbers of fatalities and disrupting normal living conditions. The most likely scenario is a seasonal flu or a Phase 3- or 4-designation. In these cases, a few residents might get sick, but most of the County would not be directly impacted.

4.3.9.3 Past Occurrence

Several pandemic influenza outbreaks have occurred over the past 100 years. A list of worldwide pandemic events appears in Table 4.3.9-2. Deaths occurred in the United States as a result of Spanish Flu, Asian flu, and Hong Kong Flu outbreaks. Spanish Flu (1918-1920) claimed 500,000 lives in the United States, with 350,000 cases reported in Pennsylvania. Most deaths resulting from Asian flu occurred between September 1957 and March 1958; within the United States, approximately 70,000 people died, and approximately 15% of the population of Pennsylvania was affected. The first cases of Hong Kong Flu in the United States were detected in September 1968, with deaths peaking between December 1968 and January 1969 (Global Security, 2009). As of August 2010, H1N1 was in a post-pandemic period.

Table 4.3.9-2. Previous Pandemic Outbreaks

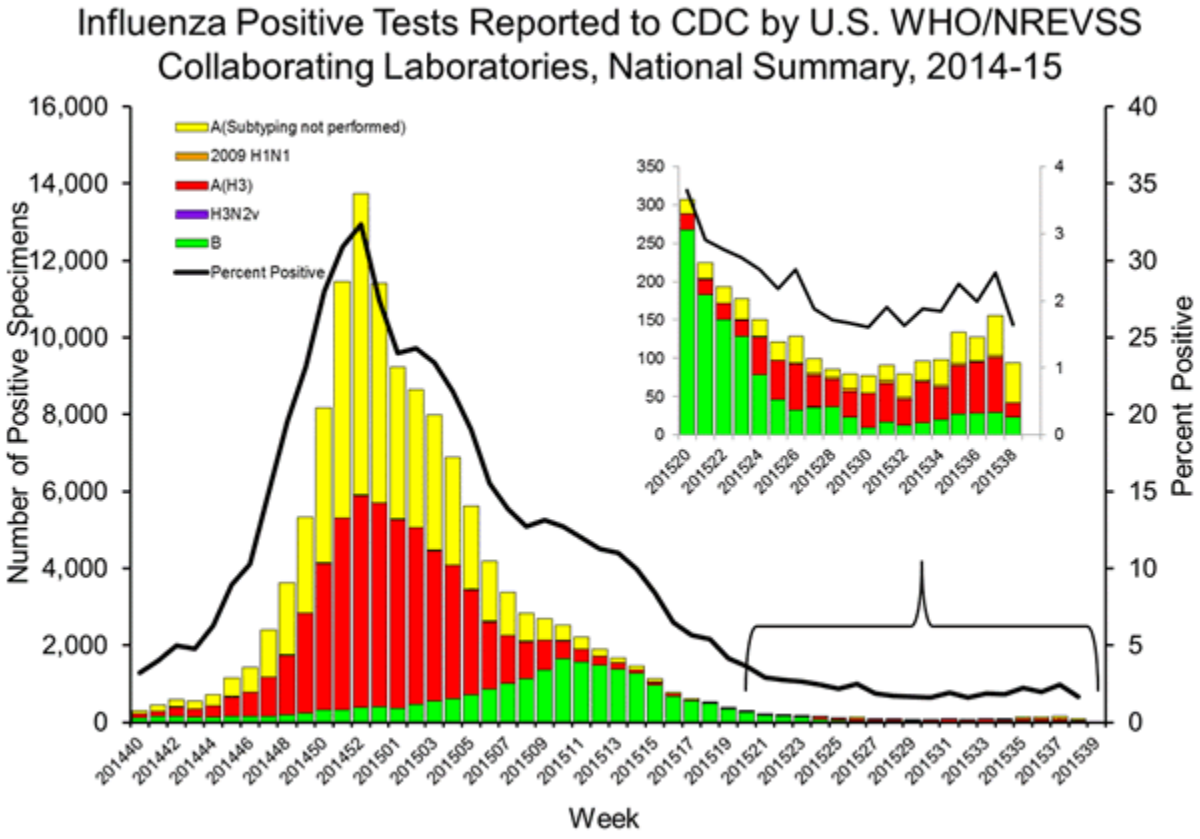
Date	Pandemic/Subtype	Worldwide Deaths (Approx.)
1918-1920	Spanish Flu/H1N1	50 Million
1957-1958	Asian Flu/H2N2	1.5-2 Million
1968-1969	Hong Kong Flu/H3N2	1 Million
2009-2010	Swine Flu/H1N1	> 18,000

Source: CDC 2010

The Pennsylvania Department of Health confirmed 61 cases of H1N1 with 2 deaths in Beaver County as of February 2010. Overall, the most recent pandemic outbreaks and concerns in the County were handled well, and the Emergency Services Center coordinated vaccinations with local hospitals to target vulnerable populations.

Epidemiologists and public health officials consistently track the rate of influenza or influenza-like-illnesses (ILI) to monitor potential pandemic threats. This also allows them to provide annual data on ILI seasonal outbreaks. Figure 4.3.9-2 below shows the national number of cases of ILI during the 2014-2015 season, distinguishing each type of ILI by a unique color.

Figure 4.3.9-2. ILI Cases in the United States, 2014-2015 Season



Source: CDC Weekly Flu 2015

In the mid-Atlantic region, which includes the State of Pennsylvania and Beaver County, the following numbers of positive ILI tests were reported:

- A (H1) – 0
- A (Unable to subtype) – O
- A (H3) – 14
- 2009 N1N1 – 1
- A (Subtyping not performed) – 2
- B – 8
- N3N2v – 0

4.3.9.4 Future Occurrence

Based on historical data, Beaver County is expected to undergo pandemic influenza outbreaks every 11 to 41 years. Exact timing of pandemic influenza outbreaks is unpredictable, and complete avoidance of these is impossible (U.S. Department of Health and Human Services [DHHS] 2009). Future occurrence is considered *possible*, as defined by the Risk Factor Methodology probability criteria (see Table 4.4-1).

4.3.9.5 Vulnerability Assessment

Depending on characteristics of the disease/virus, certain population groups can be at higher risk of infection. Regarding seasonal influenza, about 60% of hospitalizations and 90% of flu-related deaths occur among people 65 and older. However, during the relatively recent H1N1 pandemic, 90% of hospitalizations and 87% of H1N1-related deaths occurred in people younger than 65. As with seasonal flu, people with underlying health conditions faced a much higher probability of contracting H1N1. Schools, convalescent centers, and other institutions are highly conducive to faster transmission of pandemic diseases (CDC 2010). Section 2 of this Plan provides information on higher risk populations in Beaver County.

4.3.10 Radon Exposure

Radon is a natural gas that cannot be seen, smelled, or tasted. It is a noble gas that originates from natural radioactive decay of uranium and thorium. It is a large component of the natural radiation to which humans are exposed, and can pose a serious threat to public health when it accumulates in poorly ventilated residential and occupation settings. According to the U.S. Environmental Protection Agency (EPA) (EPA 402-R-03-003: EPA Assessment), radon is estimated to cause approximately 21,000 lung cancer deaths per year, second only to smoking as the leading cause of lung cancer (EPA 2003). An estimated 40 percent of the homes in Pennsylvania are believed to have elevated radon levels (Pennsylvania Department of Environmental Protection [PADEP] 2014). This section provides a profile and vulnerability assessment of the radon exposure hazard.

4.3.10.1 Location and Extent

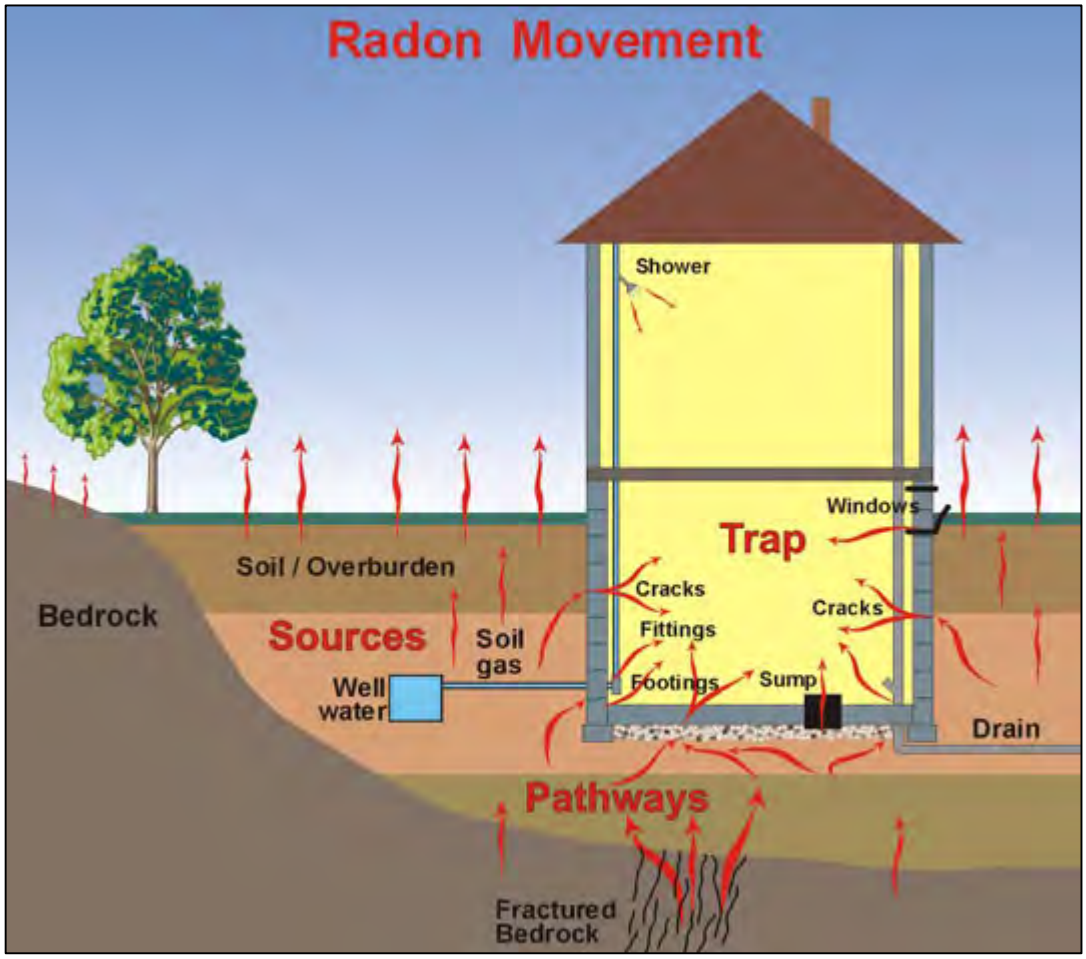
Radioactivity caused by airborne radon has been recognized for many years as an important component in the natural background radioactivity exposure of humans. Not until the 1980s were the wide geographic distribution of elevated radon levels in houses and the possibility of extremely high radon concentrations in houses recognized. In 1984, routine monitoring of employees leaving the Limerick nuclear power plant near Reading, Pennsylvania, showed that readings from one employee frequently exceeded expected radiation levels, yet only natural, nonfission-product radioactivity was detected on him. Radon levels in his home were detected around 2,500 picoCuries per liter (pCi/L), much higher than the 4 pCi/L guideline set by EPA or even the 67 pCi/L limit for uranium miners. As a result of this event, the Reading Prong section of Pennsylvania where this person lived became the focus of the first large-scale radon scare in the world.

Radon (Rn-222), which has a half-life of 3.8 days, is a widespread hazard. The distribution of radon correlates with the distribution of radium (Ra-226), its immediate radioactive parent, and with uranium, its original ancestor. Because of the short half-life of radon, the distance radon atoms travel from their parent before they decay is generally limited to extents of feet or tens of feet. Three sources of radon in houses are now recognized:

- Radon in soil air that flows into the house
- Radon dissolved in water from private wells and exsolved during water usage (This source is rarely a problem in Pennsylvania.)
- Radon emanating from uranium-rich building materials, such as concrete blocks or gypsum wallboard (This source also is not known to be a problem in Pennsylvania) (PEMA 2013).

Figure 4.3.10-1 illustrates radon entry points into a home.

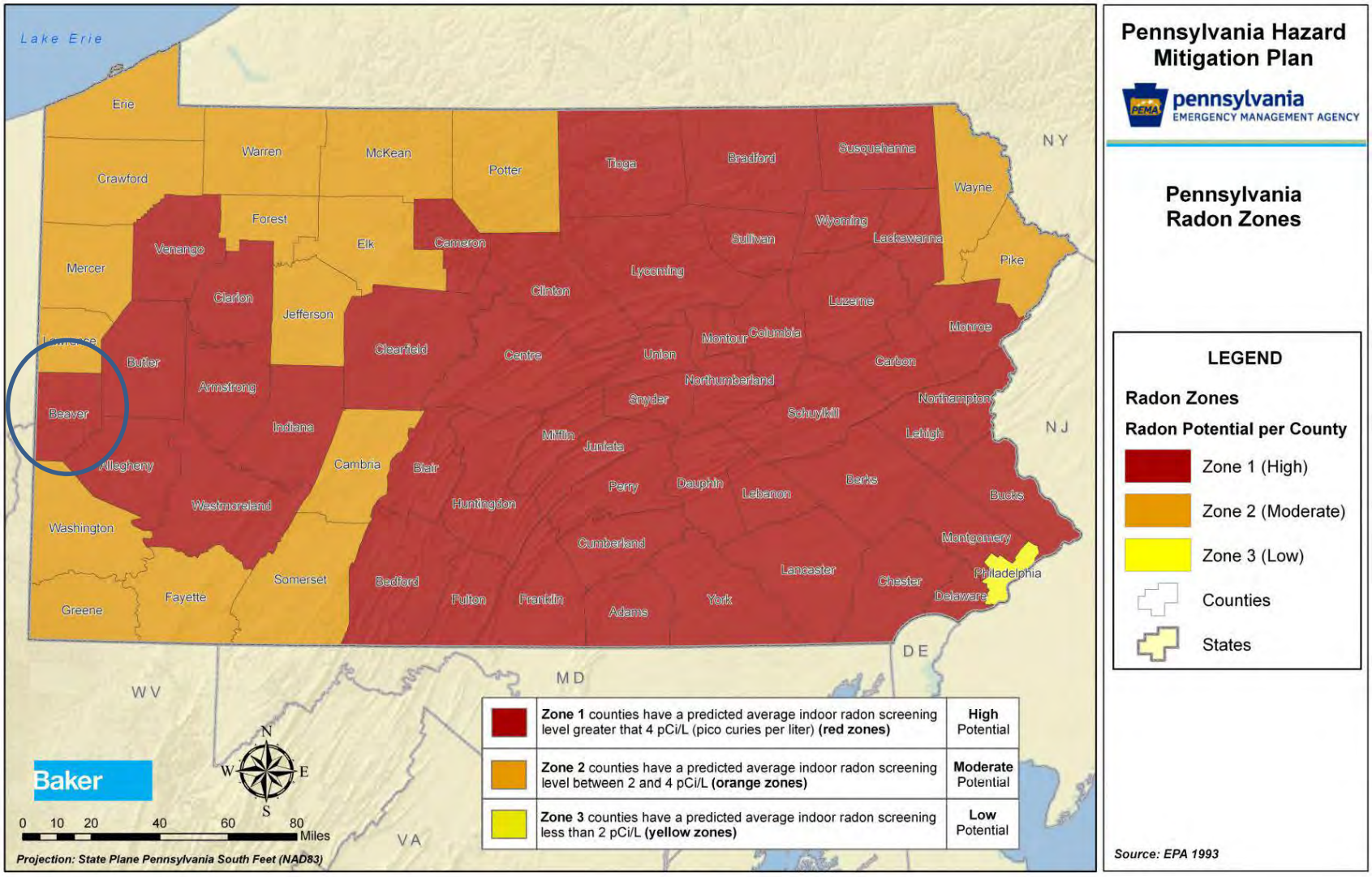
Figure 4.3.10-1. Sketch of Radon Entry Points into a House



Sources: PEMA 2010; Arizona Geological Survey 2006

Each county in Pennsylvania is classified as having a low, moderate, or high radon hazard potential. A majority of counties across the Commonwealth, particularly counties in eastern Pennsylvania, have a high hazard potential. While western Pennsylvania counties generally have lower radon hazard potential than those counties in the eastern part of the State, not all are completely immune from the threat of radon. High potential for radon exposure exists within nine western counties, including Beaver County. The average indoor radon screening level within high-exposure counties exceeds 4 pCi/L. Beaver County is in Zone 1 – High Radon Potential, as noted on Figure 4.3.10-2 below.

Figure 4.3.10-2. Radon Hazard Zones in Pennsylvania



Sources: PEMA 2013; EPA 1993 (blue highlight added)

High radon levels were initially thought to be exacerbated in tightly sealed houses, although it is now recognized that rates of air flow into and out of houses, plus the location of air inflow and the radon content of air in the surrounding soil, are key factors affecting radon concentrations. Air must be drawn into a house to compensate for outflows of air caused by a furnace, fan, thermal "chimney" effect, or wind effects. If the upper part of the house is tight enough to impede influx of outdoor air (radon concentration generally below 0.1 pCi/L), an appreciable fraction of the air may be drawn in from the soil or fractured bedrock through the foundation and slab beneath the house, or through cracks and openings for pipes, sumps, and similar features. Soil gas typically contains between a few hundred to a few thousand pCi/L of radon; therefore, even a small rate of soil gas inflow can lead to elevated radon concentrations in a house.

Radon concentration in soil gas depends on a number of soil properties, the importance of which are still being evaluated. In general, 10 to 50 percent of newly formed radon atoms escape the host mineral of their parent radium and gain access to the air-filled pore space. The radon content of soil gas clearly tends to be higher in soils containing higher levels of radium and uranium, especially if the radium occupies a site on or near the surface of a grain from which the radon can easily escape. The amount of pore space in the soil and its permeability for air flow, including cracks and channels, are important factors determining radon concentration in soil gas and its rate of flow into a house. Soil depth and moisture content, mineral host and form for radium, and other soil properties may also be important. Fractured zones may supply air having radon concentrations similar to those in deep soil for houses built on bedrock.

Areas where houses have high levels of radon can be divided into three groups in terms of uranium content in rock and soil:

- Areas of very elevated uranium content (above 50 parts per million [ppm]) around uranium deposits and prospects: Although very high levels of radon can occur in these areas, the hazard normally is restricted to within a few hundred feet of the deposit. In Pennsylvania, these localities occupy an insignificant area.

- Areas of common rock having higher than average uranium content (5 to 50 ppm): In Pennsylvania, these rock types include granitic and felsic alkali igneous rocks and black shales. High uranium values in rock or soil and high radon levels in houses in the Reading Prong are associated with Precambrian granitic gneisses commonly containing 10 to 20 ppm uranium, but locally containing more than 500 ppm uranium. Elevated uranium occurs in black shales of the Devonian Marcellus Formation and possibly the Ordovician Martinsburg Formation in Pennsylvania. High radon values are locally present in areas underlain by these formations. Beaver County is located in the Devonian Marcellus Formation; however, it is not part of the Ordovician Martinsburg Formation.

- Areas of soil or bedrock that have normal uranium content but properties that promote high radon levels in houses: This group is incompletely understood at present. Relatively high soil permeability can lead to high radon concentrations, the clearest example being houses built on glacial eskers. Limestone-dolomite soils also appear to be predisposed for high radon levels in houses, perhaps because of the deep clay-rich residuum where radium is concentrated by weathering on iron oxide or clay surfaces, coupled with moderate porosity and permeability. The importance of carbonate soils is indicated by exceedance of 4 pCi/L in 93 percent of a sample of houses built on limestone-dolomite soils near State College, Centre County, and exceedance of 20 pCi/L in 21 percent of that sample of houses, even though uranium levels in the underlying bedrock are all within the normal range of 0.5 to 5 ppm (PEMA 2013).

According to the Pennsylvania State Hazard Mitigation Plan (HMP), radon tends to exist as a gas or as a dissolved atomic component in groundwater. The most problematic source of radon in houses in Pennsylvania is radon in soil gas that flows into the house. Even a small rate of soil gas inflow can lead to elevated radon

concentrations in a house. The State HMP indicates that current data on abundance and distribution of radon in Pennsylvania homes are incomplete and biased, but the plan identifies general patterns (PEMA 2010).

4.3.10.2 Range of Magnitude

Exposure to radon is the second leading cause of lung cancer after smoking. Radon exposure is the number one cause of lung cancer among nonsmokers. As stated earlier, radon is responsible for about 21,000 lung cancer deaths every year, approximately 2,900 of which occur among people who have never smoked. Lung cancer is the only known effect on human health from exposure to radon in air and, thus far, no evidence indicates that children are at greater risk of lung cancer than adults (EPA 2015). The main hazard is actually from the radon daughter products (polonium-218, lead-214, bismuth-214), which may become attached to lung tissue and induce lung cancer by their radioactive decay. Table 4.3.10-1 lists the following information for smokers and nonsmokers: (1) cancer risks from exposure to radon at various levels, (2) comparisons of lung cancer risks from radon exposure to comparable cancer risks from other hazards, and (3) action thresholds.

Table 4.3.10-1. Radon Risk for Smokers and Nonsmokers

Radon Level (picoCuries per liter [pCi/L])	Cancer Rate per 1,000 People with Lifetime Exposure	Comparative Cancer Risk of Radon Exposure	ACTION THRESHOLD
SMOKERS			
20	About 260 people could get lung cancer	250 times the risk of drowning	Fix Structure
10	About 150 people could get lung cancer	200 times the risk of dying in a home fire	
8	About 120 people could get lung cancer	30 times the risk of dying in a fall	
4	About 62 people could get lung cancer	5 times the risk of dying in a car crash	
2	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 20 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4	About 3 people could get lung cancer	(Average outdoor radon level)	
NONSMOKERS			
20	About 36 people could get lung cancer	35 times the risk of drowning	Fix Structure
10	About 18 people could get lung cancer	20 times the risk of dying in a home fire	
8	About 15 people could get lung cancer	4 times the risk of dying in a fall	
4	About 7 people could get lung cancer	The risk of dying in a car crash	
2	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing structure between 2 and 4 pCi/L
1.3	About 2 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4	-	(Average outdoor radon level)	

Note: Risk may be lower for former smokers.
* Lifetime risk of lung cancer deaths from U.S. Environmental Protection Agency (EPA) Assessment of Risks from Radon in Homes (EPA 402-R-03-003).
** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.

Source: EPA 2015

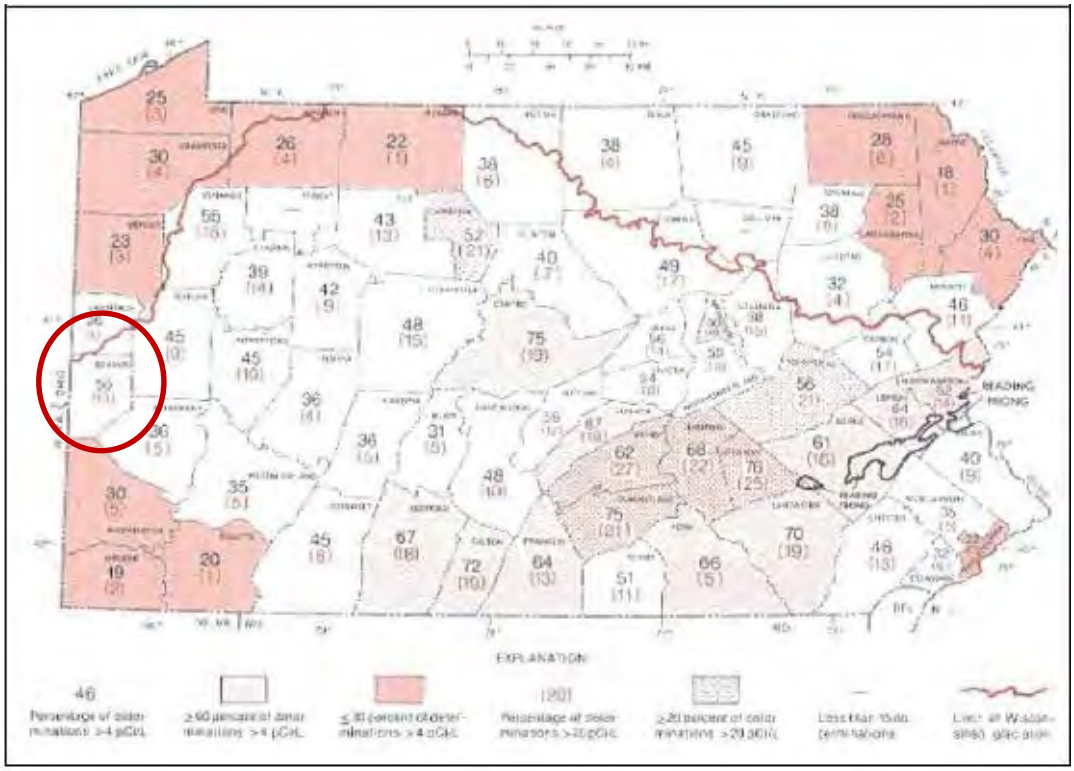
According to EPA, the average radon concentration in the indoor air of homes in the United States is about 1.3 pCi/L. EPA recommends that homes be fixed if the radon level is 4 pCi/L or more. However, EPA also recommends that Americans consider fixing their home if radon levels are between 2 and 4 pCi/L because there is no known safe level of exposure to radon. As listed in Table 4.3.10-1, a smoker exposed to radon has a much higher risk of lung cancer.

The worst-case scenario for radon exposure would be a large area of tightly sealed homes inducing high levels of exposure to residents over a prolonged period of time, without awareness of this by the residents. This worst-case scenario exposure could lead to a large number of people contracting cancer attributed to the radon exposure (PEMA 2010). The most likely scenario is a single household exposed to a very low concentration of radon, with no adverse health effects.

4.3.10.3 Past Occurrence

Current data on abundance and distribution of radon in Pennsylvania houses are considered incomplete and potentially biased, but some general patterns are evident, as shown in Figure 4.3.10-3.

Figure 4.3.10-3. Percentage of Pennsylvania Homes with Radon Levels Exceeding 4 pCi/L



Source: PEMA 2013 (red highlight added)

Values exceeding the EPA's guideline of 4 pCi/L occur in all regions of the Commonwealth. PADEP Bureau of Radiation Protection provides information for homeowners on how to test for radon in their houses. If results of a test reported to the Bureau exceed 4 pCi/L, the Bureau works to help the homeowner repair the house to mitigate high radon levels. The total number of tests reported to the Bureau since 1990 and test results by zip code are accessible on the Bureau's website and are summarized in Table 4.3.10-2 below. However, to best approximate the average for an area, this information is provided only if more than 30 tests within that area were reported.

Within Beaver County, all but two zip codes had reported results from a sufficient number of tests to allow the Bureau to report the findings, as shown in Table 4.3.10-2 (PADEP does not publish results unless a zip code has had at least 30 tests conducted). PADEP only publishes the average and maximum results for a zip code; it does not offer a range of results for a zip code, municipality, or region. The PADEP Radon Division recommends that all homeowners test for radon, regardless of test results within their respective zip codes. Despite a low average text result within a zip code, many homes in that zip code may have elevated radon levels.

Table 4.3.10-2. Radon Level Tests and Results by Beaver County Zip Codes

ZIP Code	Location	Area in Home	Number of Tests	Maximum Result (pCi/L)	Average Result (pCi/L)
15050	Hookstown	Basement	99	85.9	12.5
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15052	Industry	Basement	100	120.0	14.8
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15042	Freedom	Basement	308	117.1	7.5
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15026	Clinton	Basement	139	51.0	8.7
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15027	Conway	Basement	92	45.4	4.3
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15001	Aliquippa	Basement	1,736	125.2	7.0
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15003	Ambridge	Basement	472	95.7	6.9
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15005	Baden	Basement	746	104.3	6.7
		First Floor	39	14.7	3.4
15059	Midland	Basement	70	55.2	7.4
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15066	New Brighton	Basement	337	114.0	8.6
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15010	Beaver Falls	Basement	1,163	123.1	6.9
		First Floor	54	11.9	3.1
16136	Koppel	Basement	Insufficient Data	Insufficient Data	Insufficient Data
		First Floor	No Information Provided		
15061	Monaca	Basement	599	119.0	7.3
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
16115	Darlington	Basement	64	83.6	9.1
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15081	South Heights	Basement	434	91.3	10.0
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
16123	Fombell	Basement	65	55.6	8.8
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15009	Beaver	Basement	1,243	253.3	8.1
		First Floor	74	27.6	4.7
15043	Georgetown	Basement	55	87.1	12.0
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data

ZIP Code	Location	Area in Home	Number of Tests	Maximum Result (pCi/L)	Average Result (pCi/L)
15074	Rochester	Basement	225	70.2	6.0
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
16141	New Galilee	Basement	Insufficient Data	Insufficient Data	Insufficient Data
		First Floor	Insufficient Data	Insufficient Data	Insufficient Data
15077	Shippingport	Basement	Insufficient Data	Insufficient Data	Insufficient Data
		First Floor	No Information Provided		

Source: PADEP 2015

Notes: pCi/L picoCuries per liter

4.3.10.4 Future Occurrence

Radon exposure is inevitable, given present soil, geologic, and geomorphic factors across Pennsylvania. Residents who live in developments within areas where radon levels previously have been found significantly high will continue to be more susceptible to exposure. However, new incidents of concentrated exposure may occur with future development or deterioration of older structures. Exposure can be limited by conducting proper testing within both existing and future developments, and implementing appropriate mitigation measures (PEMA 2013). As part of a 2014 initiative, EPA's "Test, Fix, Save a Life" radon action campaign strives to highlight radon testing and mitigation as a simple and affordable step to significantly reduce risk for lung cancer. Through this initiative, the "Test, Fix, Save a Life" mantra specifies activities and facts for the public regarding radon poisoning, as indicated below:

- Test: All homes with or without basements should be tested for radon. Affordable do-it-yourself radon test kits are available online and at home improvement and hardware stores, or you can hire a qualified radon tester.
- Fix: EPA recommends taking action to fix radon levels at or above 4 pCi/L and contacting a qualified radon-reduction contractor. In most cases, a system with a vent pipe and fan is used to reduce radon. Addressing high radon levels often costs the same as other minor home repairs.
- Save a Life: 21,000 Americans die from radon-related lung cancer each year. By decreasing elevated levels in a home, residents can help prevent lung cancer while creating a healthier home (EPA 2014).

Future occurrences of radon exposure can be considered *likely* as defined by the Risk Factor Methodology probability criteria (further discussed in Section 4.4).

4.3.10.5 Vulnerability Assessment

To understand risk, a community must evaluate assets exposed or vulnerable within the identified hazard area. The following section discusses potential impacts of the radon exposure hazard on Beaver County, including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts on (1) life, health, and safety; (2) general building stock and critical facilities; (3) the economy; (4) the environment; and (5) future growth and development
- Further data collections that will assist in understanding this hazard over time.

Overview of Vulnerability

Radon exposure is of particular concern in Beaver County because of the County's location within a High Potential (Level 1) EPA Radon Zone. While structural factors (such as building construction and engineered mitigation measures) can influence the level of radon exposure, all residents and structures within Beaver County are vulnerable to radon.

Data and Methodology

The 2010 U.S. Census data and the Hazards U.S. – Multi-Hazard (HAZUS-MH) building inventory for Beaver County were referenced to support an evaluation of assets exposed to this hazard and potential impacts associated with this hazard. In accordance with the 2013 Pennsylvania State Hazard Mitigation Plan, an average radon mitigation system cost of $1,200 was applied to 20 percent of the building stock to evaluate economic vulnerability (PEMA 2013).

Impact on Life, Health, and Safety

For the purposes of this plan, the entire population of the County is assumed exposed to radon. Radon is responsible for approximately 21,000 lung cancer deaths every year, approximately 2,900 of which occur among people who have never smoked. Lung cancer is the only known effect on human health from exposure to radon in air, and thus far, no evidence indicates that children are at greater risk of lung cancer than are adults (EPA 2010).

As shown on Figure 4.3.10-3 (included in Section 4.3.10.3), 50 percent of homes in Beaver County have measured radon levels exceeding 4 pCi/L. Excess human cancer risk posed by radon exposure at this elevated level is identified in Table 4.3.10-1.

Impact on General Building Stock and Critical Facilities

While the entire general building stock and critical facility inventory in the County is exposed to radon, radon does not result in direct damage to structures and facilities. Rather, engineering methods installed to mitigate human exposure to radon in structures results in economic costs described in the following subsection. The 2013 Pennsylvania State HMP notes that Beaver County has 158 State critical facilities located in zip codes with average basement or first floor radon readings of over 4 pCi/L. Additionally, it estimated that, of the 121,767 buildings in the County, 24,353 buildings are in locations where occupants would experience a greater exposure (PEMA 2013).

Impact on the Economy

EPA has concluded that an average radon mitigation system costs $1,200. EPA also states that current state surveys indicate one home in five has elevated radon levels. Based on this information, radon loss estimation is factored by assuming that 20 percent of the residential buildings within High Potential (Level 1) counties have elevated radon levels, and each would require a radon mitigation system installed at the EPA-estimated average of $1,200 (PEMA 2013). Therefore, within Beaver County, estimated radon mitigation costs for residential structures could exceed $19 million. However, as shown on Figure 4.3.10-3, 50 percent of households in the County have measured basement-level average radon levels exceeding 4 pCi/L. This information indicates that the estimated cost of radon mitigation may be higher than the EPA estimate, whereby only 20 percent of structures are considered for mitigation.

Impact on the Environment

Radon exposure exerts minimal environmental impacts. Because of the relatively short half-life of radon, it tends to affect only living and breathing organisms such as humans or pets that are routinely within contained areas (basement or house) where the gas is released (PEMA 2013).

Future Growth and Development

Because all of Beaver County has been determined at risk to the radon hazard, any new land development will be exposed to this risk. Measures to reduce human exposure to radon in structures are readily available and can be incorporated during new construction at significantly lower cost and greater effectiveness than retrofitting existing structures to implement these measures.

Additional Data and Next Steps

The assessment above identifies human health and economic losses associated with this hazard of concern; however, these estimates are based on national epidemiological statistics and generalized estimates of costs to mitigate structures in Beaver County. Because specific structural conditions affect human exposure to radon, direct radon measurements within facilities are necessary to properly assess the level of health risk and indicate the need for mitigation measures. Furthermore, EPA recommends consideration of radon exposure risk and installation of mitigation measures as appropriate during all new construction.

4.3.11 Terrorism, Criminal Activity, or Civil Disturbance

Terrorism, criminal activity, and civil disturbance are three types of potential incidents that all relate to malicious human behavior. Beaver County is dedicated to ensuring the continued safety and wellbeing of its residents; to that it end, the County seeks to minimize disruptive and criminal actions under all three of these categories.

Terrorism is defined in the Code of Federal Regulations (CFR) as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (Title 28 CFR §0.85 2015). Terrorism is less about causing physical damage and injuries (and fatalities) as it is about creating and spreading fear. This fear may result in a change in key policy or business operations (such as logging) to cease. Terrorism may include the use of weapons of mass destruction (WMD), including chemical, biological, radiological, nuclear, and high-yield explosive weapons; armed attacks; industrial sabotage; cyber terrorism; and other means. These categories can be further subcategorized or attacks can involve multiple categories, especially when considering the means and purpose behind the event.

Criminal Activity is a very broad hazard category, as defined by the Pennsylvania Standard List of Hazards. It covers all criminality, including enemy attack, disinformation, sabotage, physical or information break of security, work place or school violence, harassment, discrimination, and other crimes (PEMA n.d.). Beaver County is aware of the scope of this hazard and has primarily focused its efforts on mitigating terrorist and civil disturbance-related criminal activities. The County, however, maintains an awareness of the potential for illegal activities outside of those two categories and is prepared to focus mitigation and prevention efforts on new areas, should they also arise.

Beaver County supports the rights of persons to exercise their freedom to speak, dissent, and demonstrate, provided that demonstrations are lawful, do not disrupt normal County or municipal activities, and do not infringe upon the rights of others. Most demonstrations are peaceful. People who are not involved in protests should attempt to carry on business as usual if safe to do so. Incidents that are of most concern to the County are those illegal acts that may arise during demonstration-related activities. Civil disturbances consist of incidents that disrupt County operations and require intervention in order to maintain public safety. Typical situations that can lead to such a disturbance include demonstrations against policies, out-of-control rallies or riots, strikes, public nuisances, and criminal activities. Other common terms for civil disturbance include civil unrest and disorderly conduct.

This section provides a profile and vulnerability assessment of the terrorism, criminal activity, and civil disturbance hazard.

4.3.11.1 Location and Extent

Terrorism, criminal activity, and civil disturbances could occur at any location in Beaver County, depending on the perpetrator's agenda. Any facility is vulnerable to terrorism, as terrorists have historically sent chemical or biological agents through the mail. High-risk targets include local, county, state, or federal government facilities; major venues and gathering places; and sites with historic, cultural, or other significance; and key infrastructure. Specific vulnerable sites to note in Beaver County include the following:

- Military installations, such as the Pennsylvania National Guard and U.S. Army Reserve facilities in Beaver Falls
- County and Municipal Government Facilities

- Beaver County Jail– Hopewell Township
- State/Federal Government Facilities
- Pennsylvania State Police – Beaver Barracks
- U.S. Postal Facilities
- Communications Centers (9-1-1)
- Commercial facilities, particularly multinational or international firms
- Industrial facilities, particularly those storing large quantities of hazardous materials or those involved in military development
- Utility facilities including power generation plants, dams, and water treatment plants
- Law enforcement facilities
- Facilities housing important political or religious figures
- Historical sites
- Transportation infrastructure
- High-profile events attracting large amounts of people or very important persons (VIP)
- Educational facilities, especially colleges and universities
- Major waterways in Beaver County, including the Ohio River, Beaver River

These sites are also the most likely locations for a civil disturbance because of their intrinsic value to the community or potential roles as key economic drivers. Damage to or disruption of operations at government facilities could have a profound impact on Beaver County's population, even if the incident is a relatively small-scale event. Smaller-scale criminal activity can occur anywhere in the County, particularly at retail locations, restaurants, and other facilities where cash is easily accessible.

4.3.11.2 Range of Magnitude

Any acts of terrorism can occur anywhere, at any time of day. The National Terrorism Advisory System (NTAS) communicates information about terrorist threats by providing detailed information to the public, government agencies, first responders, airports and other transportation hubs, and the private sector. When a threat arises, the Secretary of Homeland Security announces an NTAS Alert and shares the news with the public. The alert may include specific information about the nature of the threat, including the geographic region, mode of transportation, or critical infrastructure potentially affected, as well as steps that individuals and communities can take to protect themselves and help prevent, mitigate, or respond to the threat. The alert indicates whether the threat is elevated or imminent. Elevated threats are those that include no specific information about the timing or location. Imminent threats are threats believed to be impending, or occurring very soon. The alerts will be posted on-line on multiple government websites (which websites may vary dependent on the threat) and released to the news media for distribution. U.S. Department of Homeland Security (DHS) will also distribute alerts through its social media channels (DHS 2015).

Terrorism refers to the use of WMDs, including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and "cyber-terrorism." Within these general categories, however, there are many variations. Particularly in the area of biological and chemical weapons, there are a wide variety of agents and ways for them to be disseminated. Terrorist methods can take many forms, including:

- Agri-terrorism
- Arson/incendiary attack
- Armed attack
- Biological agent

- Chemical agent
- Cyber-terrorism
- Conventional bomb or bomb threat
- Hazardous material release (intentional)
- Nuclear bomb
- Radiological agent

In Beaver County, terrorist attacks could vary from a mere threat to an individual facility, to the use of a high-yield explosive or other device in a highly populated area.

Civil disorder can take the form of small gatherings or large groups blocking or impeding access to a building, or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in, to a full-scale riot in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. Generally, two types of large gatherings typically are associated with disorders: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories:

- Casual Crowd: A casual crowd is a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
- Cohesive Crowd: A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.
- Expressive Crowd: An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.
- Aggressive Crowd: An aggressive crowd is comprised of individuals who have assembled and are visibly angry or violent. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They tend to be impulsive and highly emotional, and require only minimal stimulation to arouse them to violence (Blumer 1946).

Terrorism, civil disturbance, and criminal activity events can be minor, such as a peaceful demonstration in Beaver County near the County Courthouse, but they can also significantly disrupt life in the County. A worst-case scenario for a terrorist incident in Beaver County would be if a radioactive or "dirty" bomb would be detonated at the nuclear facility in Shippingport. This would result in a large explosion at the facility itself coupled with long-term nuclear radiation exposure from the power plant's fuel. This type of incident would also cause long-term health issues ranging from cancers to post-traumatic stress disorder, in addition to widespread food supply shortages and power outages.

4.3.11.3 Past Occurrence

Beaver County has never suffered an international terrorist attack. However, Beaver County has experienced domestic terrorism. In 1972, a bomb was detonated in the Beaver County Courthouse, causing considerable structural damage. The Beaver Valley Power Station's location within the County also makes security against terrorist acts increasingly essential.

Beaver County found itself in a heightened level of alertness in the aftermath of the terrorist events occurring on September 11, 2001. Across the County, suspicious activities were reported in multiple locations. The Beaver County Hazardous Materials Team responded to numerous calls, all of which showed negative results for Anthrax (Beaver County 2010). Since 2006, the County has recorded 84 possible instances of terrorism or other suspicious circumstances. Over three-quarters of these were bomb threats; the second most common concern was school safety (Knowledge Center 2015).

The County has not experienced any significant civil disturbance events. In 2013, nearly 40 employees at the Friendship Ridge Nursing Home led a peaceful protest in front of the County Courthouse to protest the sale of the home to a private company (Pittsburgh CBS Local News 2013). Additionally, in 2013, a well site protest was held in Lawrence, North Beaver Township. Over the past 8 years, the County has recorded four other potential civil disturbance events; however, these incidents did not receive noticeable media coverage (Knowledge Center 2015). Ambridge Borough has noted an overall increase in violent crime in the Borough; however, this is not tied to any particular agenda and falls under general criminal activity. Darlington Borough has also recorded an increase in drug-related crimes.

4.3.11.4 Future Occurrence

The probability of terrorism occurring cannot be quantified with as great a level of accuracy as that of many natural hazards. Furthermore, these incidents generally occur at a specific location (such as a government building) rather than encompassing a geographical area such as a floodplain. Thus, planning for the terrorism hazard should be asset-specific, identifying potentially at-risk critical facilities and systems in the community. Although the probability of Beaver County being the target of a direct domestic terrorist attack is greater than being the direct target of an international terrorist attack, the County should be equally prepared for both.

In addition to direct threats within the County, the County's proximity to Pittsburgh, Pennsylvania, may increase the likelihood of secondary effects (for example, a drain on emergency response resources and medical facilities) as a result of an attack on this major metropolitan area.

Minor civil disturbances may occur in Beaver County, but it is not possible to accurately predict the probability of future occurrence for civil disorder events over the long term. However, it may be possible to recognize the potential for an event to occur in the near term. For example, an upcoming significant sporting event at one of the colleges or high schools in the County may result in gathering of large crowds. Local law enforcement should anticipate these types of events and be prepared to handle a crowd so that peaceful gatherings are safeguarded from turning into unruly public disturbances. Overall, it is *possible* that Beaver County will be the target of a major terrorism attack or civil disturbance, as defined by the Risk Factor Methodology probability criteria.

4.3.11.5 Vulnerability Assessment

Beaver County does not have facilities, buildings, or landmarks that are more likely to be targeted than other areas in the country. However, several colleges and universities, a nuclear facility, and major industries within in the County could be considered potential targets for local terrorist activity. These facilities, as well as any of the critical infrastructures in the County, are vulnerable to terrorist attacks. Facility owners and local law enforcement assess the degree of vulnerability at the facility level.

To reduce their vulnerability to terrorism hazards, Beaver County belongs to the Pennsylvania Region 13 Task Force (Region 13), a group of 13 counties that collaborate to prevent, protect against, prepare for, respond to, recover from, and mitigate against terrorism and other hazards on a regional level. Like the other regional task forces in Pennsylvania, Region 13 is funded by the Pennsylvania Emergency Management Agency (PEMA)

using DHS's Homeland Security Grant Program's State Homeland Security Program (SHSP). The counties of Region 13, including Beaver County, use this funding to conduct emergency planning, training, and exercise activities, and to purchase equipment to reduce the region's vulnerability to terrorism.

In general, Beaver County is not particularly vulnerable to civil disorder events. Most civil disorder events, should they occur, would have minimal impact. Sites previously identified in this section are locations where such events are more likely to occur and therefore should be considered more vulnerable. Adequate law enforcement at these locations minimizes the chances of a small assembly of people turning into a significant disturbance.

4.3.12 TORNADOES AND WINDSTORMS

This section provides a profile and vulnerability assessment of the tornado and windstorm hazard. The wind hazard includes various types of wind events, including windstorms and tornados, which are defined below.

Wind is air moving from high to low pressure. It is the rough horizontal movement of air (as opposed to an air current) caused by uneven heating of the Earth's surface. It occurs at all scales, from local breezes generated by heating of land surfaces and lasting tens of minutes, to global winds resulting from solar heating of the Earth (Federal Emergency Management Agency [FEMA] 1997). Types of damaging winds include straight-line winds, downdrafts, downbursts, microbursts, gust fronts, derecho, bow echoes, and hook echoes, described as follows:

- **Straight-line Wind** is any thunderstorm wind not associated with rotation (e.g., tornadic winds). Straight-line winds are movements of air from areas of higher pressure to areas of lower pressure—the greater the difference in pressure, the stronger the winds.
- A **Downdraft** is a small-scale column of air that rapidly sinks toward the ground and usually results in a downburst.
- A **Downburst** is a strong downdraft with horizontal dimensions larger than 2.5 miles, resulting in an outward burst or damaging winds on or near the ground. It is usually associated with thunderstorms, but can occur with rain storms too weak to produce thunder.
- A **Microburst** is a small, concentrated downburst that produces an outward burst of damaging winds near the surface. It is typically short-lived, lasting only 5 to 10 minutes, with maximum wind speeds of up to 168 miles per hour (mph).
- A **Gust Front** is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. It is characterized by a wind shift, temperature drop, and gusty winds ahead of a thunderstorm (National Severe Storms Laboratory [NSSL] Date Unknown).
- A **Derecho** is a widespread and long-lived windstorm associated with thunderstorms that are often curved (Johns and others 2011). The two major influences on the atmospheric circulation are differential heating between the equator and the poles, and rotation of the planet (Federal Emergency Management Agency [FEMA] 1997).
- A **Bow Echo** is a radar echo that is linear but bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo (crest). Bow echoes can be more than 300 kilometers long, last for several hours, and produce extensive swaths of wind damage at the ground (NSSL Date Unknown).
- A **Hook Echo** is a radar echo that is the most recognized and well-known radar signature for a tornadic supercell. This "hook-like" feature occurs when the strong counter-clockwise winds circling the mesocyclone (rotating updraft) are strong enough to wrap precipitation around the rain-free updraft area of the storm (Provic 2013).

High winds other than tornados occur in all parts of the United States. Areas where wind speeds are highest are coastal regions from Texas to Maine and the Alaskan coast; however, speeds of exposed winds in mountain areas can be at least as high as those along the coast (FEMA 1997, Robinson 2013). Wind begins with differences in air pressures. A wind's rough horizontal movement of air is caused by uneven heating of the Earth's surface. Wind occurs at all scales, from local breezes lasting a few minutes to global winds resulting from solar heating of the Earth. Effects from high winds can include downed trees and power lines, and damaged roofs and windows. Table 4.3.12-1 lists wind classifications used by the National Weather Service (NWS).

Table 4.3.12-1. NWS Wind Descriptions

Descriptive Term	Sustained Wind Speed (mph)
Strong, dangerous, or damaging	≥40
Very windy	30-40
Windy	20-30
Breezy, brisk, or blustery	15-25
None	5-15 or 10-20
Light, or light and variable wind	0-5

Source: NWS 2010

Notes:

mph Miles per hour
NWS National Weather Service

Extreme windstorm events are associated with extra-tropical and tropical cyclones, winter cyclones, severe thunderstorms, and accompanying mesoscale offspring such as tornados and downbursts. Winds vary from 0 mph at ground level to 200 mph in the upper atmospheric jet stream at 6 to 8 miles above the Earth's surface (FEMA 1997).

A type of windstorm that occurs often during rapidly-moving thunderstorms is a derecho, a long-lived windstorm associated with a rapidly moving squall line of thunderstorms. It produces straight-line wind gusts of at least 58 mph, and often isolated gusts exceeding 75 mph. As a result, trees generally fall and debris is blown in one direction. To be considered a derecho, these conditions must continue along a path of at least 240 miles. Derechos are more common in the Great Lakes and Midwest regions of the United States, though, on occasion, can persist into the mid-Atlantic and northeast United States (Office of the New Jersey State Climatologist [ONJSC] Rutgers University 2013).

Tornados are nature's most violent storms and can cause fatalities and devastate neighborhoods in seconds. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 250 mph. Damage paths can be greater than 1 mile wide and 50 miles long. Tornados typically develop from either a severe thunderstorm or hurricane as cool air rapidly overrides a layer of warm air. Tornados typically move at speeds between 30 and 125 mph, and can generate internal winds exceeding 300 mph. The lifespan of a tornado rarely is longer than 30 minutes (FEMA 1997). High wind velocity and wind-blown debris, along with lightning or hail, cause the damage from tornados. Destruction from tornados depends on the size, intensity, and duration of the storm. Tornados cause the greatest damage to structures that are light, such as residential and mobile homes, and tend to remain localized during impact (Northern Virginia Regional Commission [NVRC] 2006).

The following sections discuss location and extent, range of magnitude, previous occurrences, future occurrences, and vulnerability assessment associated with the wind and tornado hazard within Beaver County.

4.3.12.1 Location and Extent

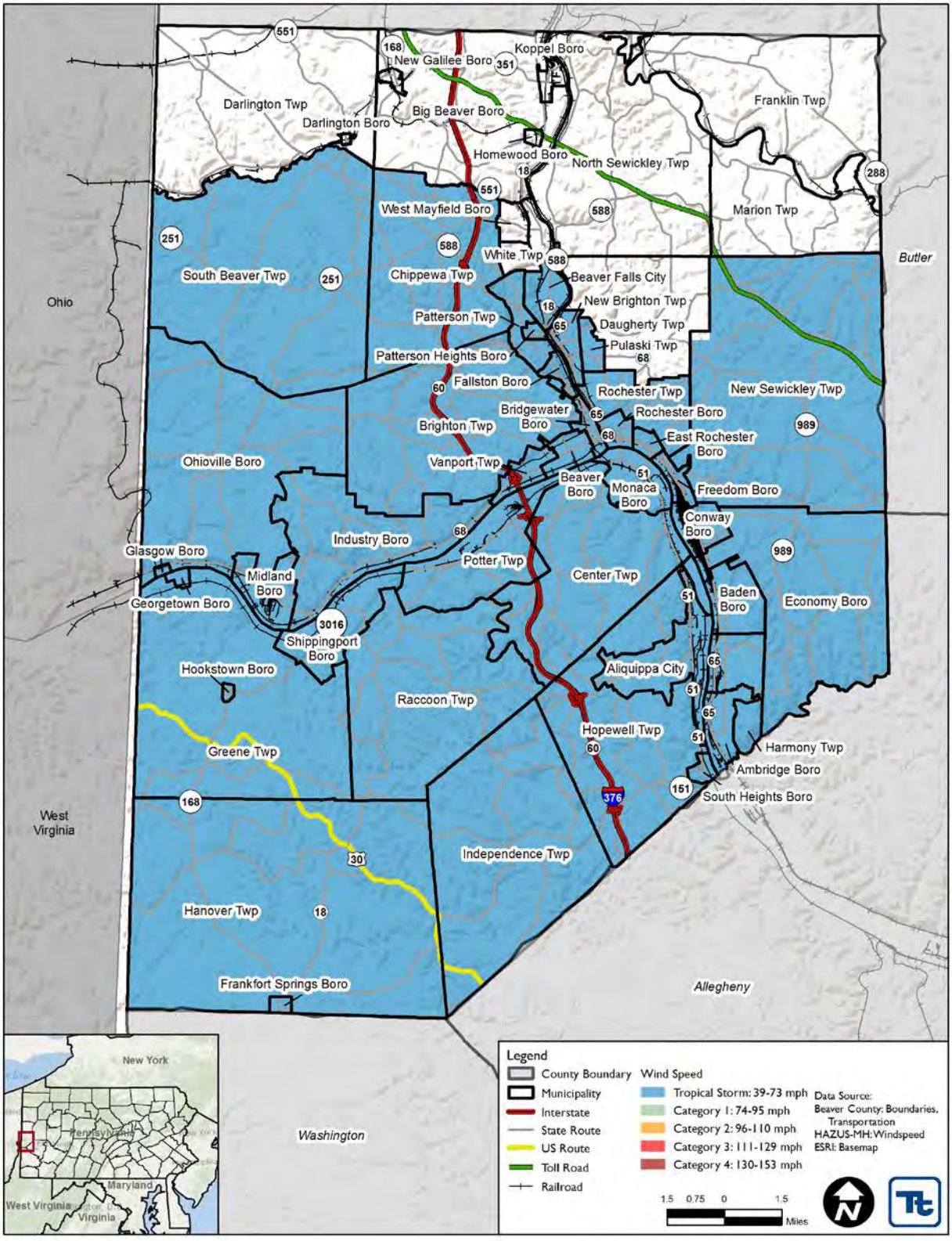
Tornados and windstorms can occur throughout Pennsylvania. Tornados are usually localized; however, severe thunderstorms can result in conditions favorable to formation of numerous or long-lived tornados. Straight-line winds and windstorms occur on a region-wide scale (Pennsylvania Emergency Management Agency [PEMA] 2013).

Mean Return Period

In evaluating potential for hazard events of a given magnitude, a mean return period (MRP) is often used. The MRP provides an estimate of the magnitude of an event that may occur within any given year based on past recorded events. MRP is the average period of time, in years, between occurrences of a particular hazard event, equal to the inverse of the annual frequency of exceedance (Dinicola 2009).

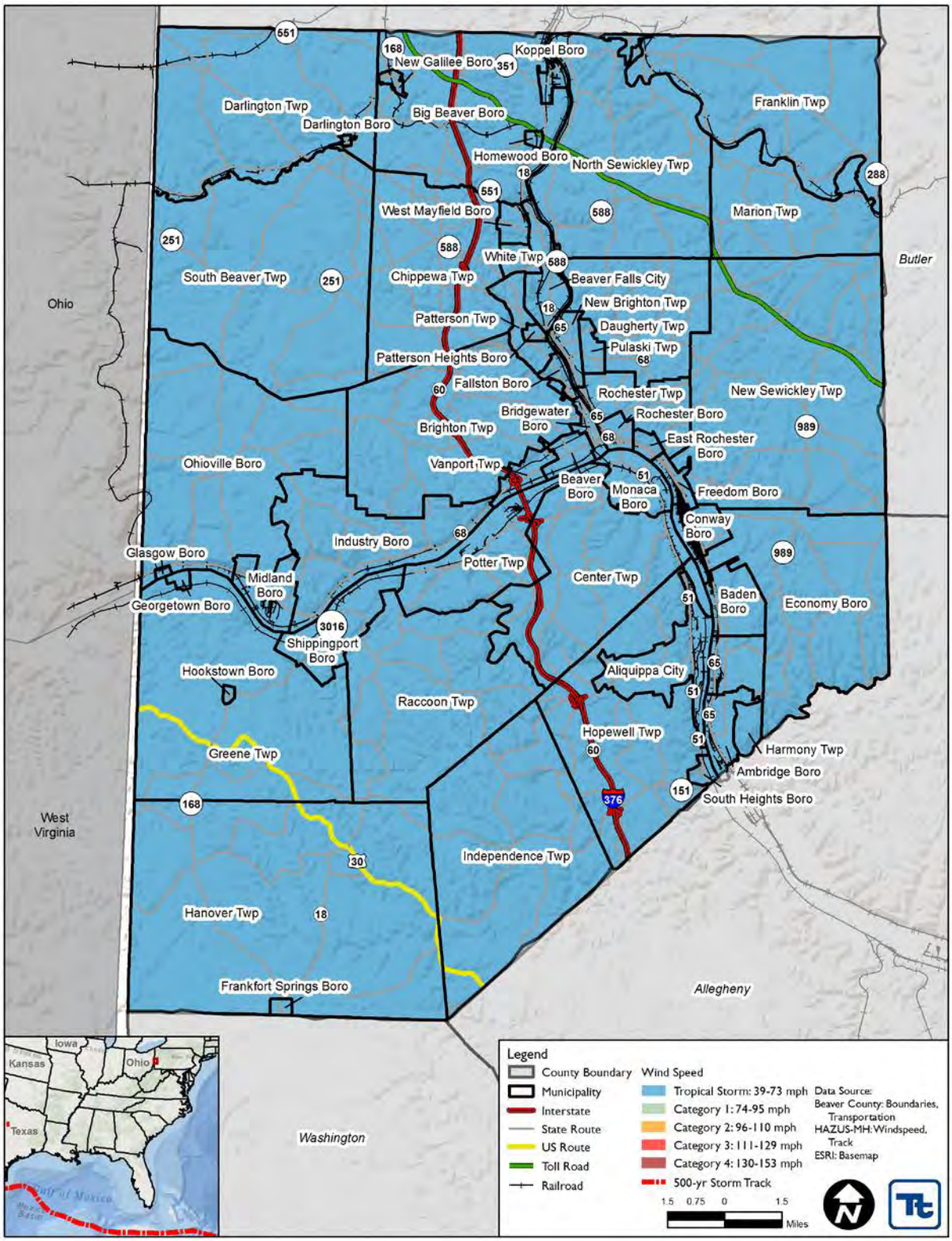
Figure 4.3.12-1 shows estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 100-year MRP event. Figure 4.3.12-2 shows estimated maximum 3-second gust wind speeds that can be anticipated in the study area associated with the 500-year MRP event. These peak wind speed projections were generated by application of the Hazards U.S. – Multi-Hazard (HAZUS-MH) model. The estimated hurricane track assumed for the 500-year event is also shown; the hurricane track for the 100-year event was not displayed in HAZUS-MH 3.0. Maximum 3-second gust wind speeds in Beaver County range from 0 to 48 mph for the 100-year MRP event (Tropical Storm for speeds between 39-48 mph). Maximum 3-second gust wind speeds in Beaver County range from 54 to 60 mph for the 500-year MRP event (Tropical Storm). Associated impacts and losses from the 100-year and 500-year MRP hurricane events are reported in the Vulnerability Assessment.

Figure 4.3.12-1. Wind Speeds during the 100-Year Mean Return Period Event



Source: Hazus-MH 3.0

Figure 4.3.12-2. Wind Speeds during the 500-Year Mean Return Period Event

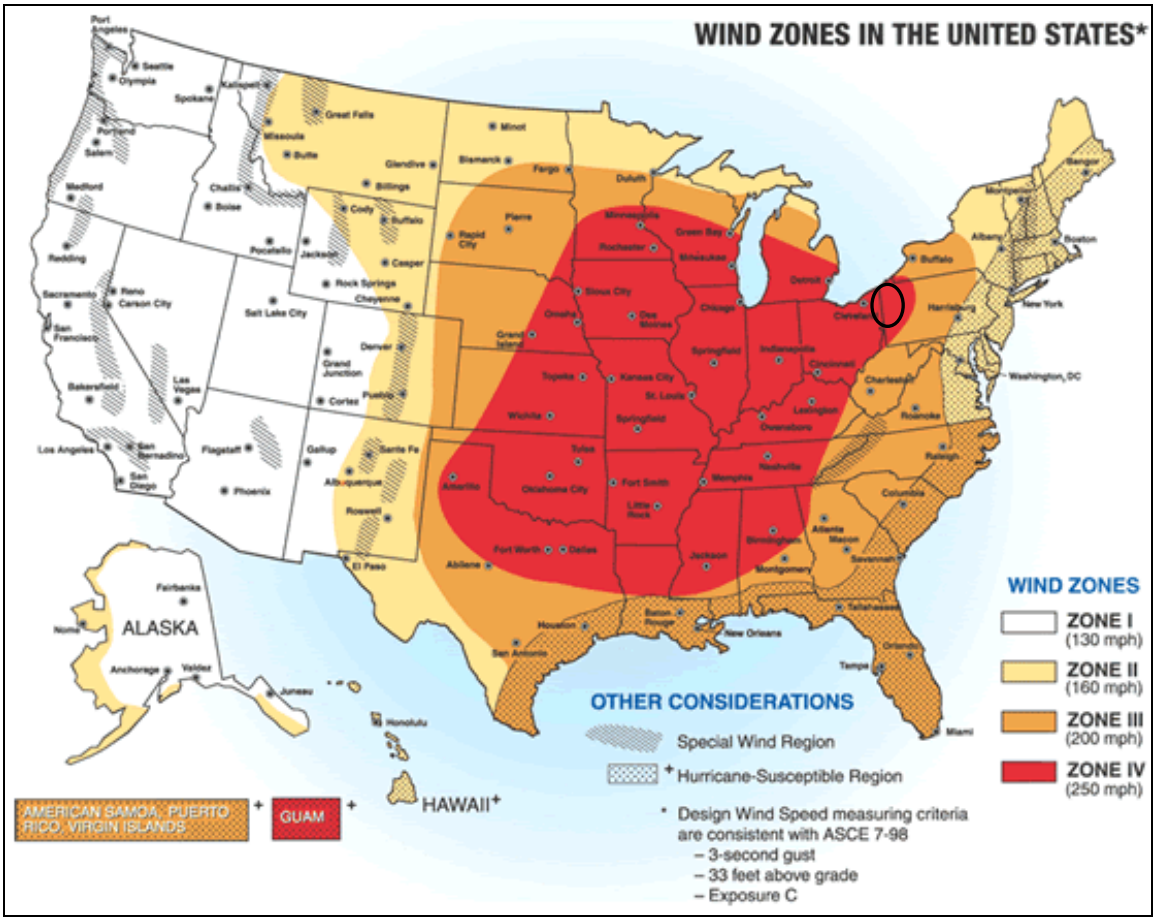


Source: Hazus-MH 3.0

Windstorms

Figure 4.3.12-3 illustrates the ways in which the frequency and strength of windstorms affect the United States, and the general location of the most wind activity. This figure is based on 40 years of tornado history and 100 years of hurricane history collected by FEMA. States located in Wind Zone IV have undergone the greatest number of tornados and the strongest tornados (NVRC 2006). Beaver County is within Wind Zone IV, where wind speeds can be as high as 250 mph. Table 4.3.12-2 describes the areas within the various wind zones of the United States.

Figure 4.3.12-3. Wind Zones in the United States



Source: FEMA 2010

Note: Beaver County is within the black oval..

Table 4.3.12-2. Wind Zones in the United States

Wind Zones	Areas Affected
Zone I (130 mph)	All of Washington, Oregon, California, Idaho, Utah, and Arizona. Western parts of Montana, Wyoming, Colorado, and New Mexico. Most of Alaska, except the east and south coastlines.
Zone II (160 mph)	Eastern parts of Montana, Wyoming, Colorado, and New Mexico. Most of North Dakota. Northern parts of Minnesota, Wisconsin, and Michigan. Western parts of South Dakota, Nebraska, and Texas. All New England States. Eastern parts of New York, Pennsylvania, Maryland, and Virginia. Washington DC.

Wind Zones	Areas Affected
Zone III (200 mph)	Areas of Minnesota, South Dakota, Nebraska, Colorado, Kansas, Oklahoma, Texas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, Kentucky, Pennsylvania, New York, Michigan, and Wisconsin. Most or all of Florida, Georgia, South Carolina, North Carolina, Virginia, and West Virginia. All of American Samoa, Puerto Rico, and Virgin Islands.
Zone IV (250 mph)	Mid United States, including all of Iowa, Missouri, Arkansas, Illinois, Indiana, and Ohio, and parts of adjoining states of Minnesota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Louisiana, Mississippi, Alabama, Georgia, Tennessee, Kentucky, Pennsylvania, Michigan, and Wisconsin. Guam.
Special Wind Region	Isolated areas in the following states: Washington, Oregon, California, Idaho, Utah, Arizona, Montana, Wyoming, Colorado, and New Mexico. The borders between Vermont and New Hampshire; between New York, Massachusetts, and Connecticut; between Tennessee and North Carolina.
Hurricane Susceptible Region	Southern United States coastline from Gulf Coast of Texas eastward to include entire State of Florida. East coastline from Maine to Florida, including all of Massachusetts, Connecticut, Rhode Island, Delaware, and Washington DC. All of Hawaii, Guam, American Samoa, Puerto Rico, and Virgin Islands.

Source: FEMA 2010

Note: mph Miles per hour

Tornados

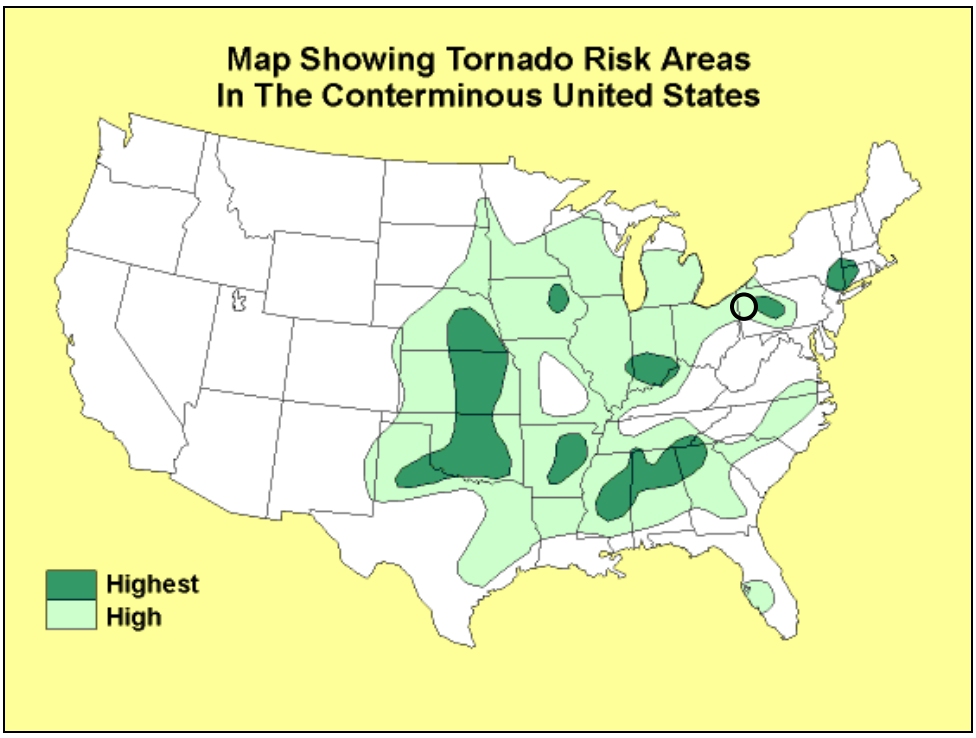
The United States undergoes more tornados than any other country—in a typical year, approximately 1,000. The peak of the U.S. tornado season is April through June, with the highest concentration of tornados in the central United States, although tornados can occur at any time of year (NWS 2011). Tornados tend to strike in the afternoons and evening, the warmest hours of the day, with approximately 80 percent of all tornados striking between noon and 9:00 p.m. (PEMA 2013).

Tornado movement is characterized in two ways: direction and speed of the spinning winds, and forward movement of the tornado and storm track. Rotational wind speeds of the vortex can range from 100 to more than 250 mph. Speed of forward motion can be 0 to 45 or 50 mph. Therefore, some estimates of maximum velocity of tornados (combination of ground speed, wind speed, and upper winds) are about 300 mph. Forward motion of the tornado path can be a few hundred yards or several hundred miles in length. Widths of tornados can vary greatly, but widths generally range from less than 100 feet to more than a mile. Some tornados never touch the ground and are short-lived, while others may touch the ground several times.

While the extent of tornado damage is usually localized, extreme winds of this vortex can be among the most destructive on Earth when they move through populated, developed areas. The Commonwealth of Pennsylvania underwent an average of 15 tornado events annually between 1981 and 2010.

Figure 4.3.12-4 indicates that a large portion of Pennsylvania is at high risk for tornados, with a portion considered at highest risk. According to this graphic, Beaver County has a high risk for tornados. Details regarding historical tornado events are discussed in the Past Occurrences section (Section 4.3.12.3) of this profile.

Figure 4.3.12-4. Tornado Risk in the United States

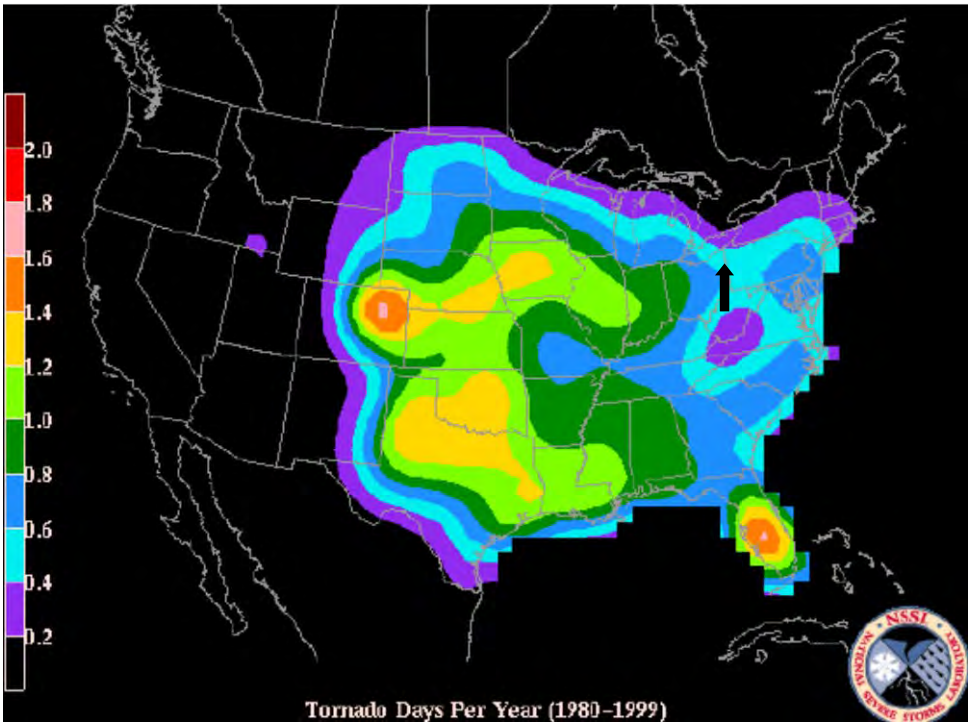


Source: American Red Cross 2010

Note: Beaver County is within the black circle.

A study by the National Oceanic and Atmospheric Administration's (NOAA) NSSL provided estimates of the long-term threat from tornados. NSSL used historical data to estimate the daily probability of tornado occurrences across the United States, no matter the magnitude of the tornado. Figure 4.3.12-5 shows the estimates generated by NSSL. In Pennsylvania, estimated frequency of a tornado occurrence is 0.2 to 0.8 day per year. In Beaver County, estimated frequency of a tornado occurrence is 0.4 to 0.6 day per year (NSSL 2003).

Figure 4.3.12-5. Total Annual Threat of Tornado Events in the United States, 1980-1999



Source: NSSL 2003

Notes:

The mean number of days per year with one or more events within 25 miles of a point is shown here. The fill interval for tornados is 0.2, with the purple starting at 0.2 day. For the non-tornadic threats, the fill interval is 1, with the purple starting at 1. For the significant (violent) threats, it is 5 days per century (millennium).

The tip of the black arrow indicates the general location of Beaver County.

4.3.12.2 Range of Magnitude

Windstorms are generally defined as sustained wind speeds of 40 mph or greater, lasting for 1 hour or longer, or winds of 58 mph or greater for any duration. A tornado's magnitude is classified according to the Enhanced Fujita Scale (EF Scale), further discussed below.

Magnitude or severity of a tornado was originally categorized according to the Fujita Scale (F Scale) or the Pearson Fujita Scale introduced in 1971, based on a relationship between the Beaufort Wind Scales (B-Scales) (measure of wind intensity) and the Mach number scale (measure of relative speed). The F Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure (Tornado Project Date Unknown). The F Scale categorizes each tornado by intensity and area, and is divided into six categories—F0 (Gale) to F5 (Incredible) (Edwards 2013).

Although the F Scale has been in use for more than 30 years, it has limitations. The primary limitations are lack of Damage Indicators (DI), no account of construction quality and variability, and no definitive correlation between damage and wind speed. These limitations have led to inconsistent rating of tornados and, in some cases, overestimates of tornado wind speeds. The limitations encouraged and induced development of the Enhanced Fujita Scale (EF Scale). The Texas Tech University Wind Science and Engineering (WISE) Center, along with a forum of nationally renowned meteorologists and wind engineers from across the country, developed the EF Scale (WISE 2004).

The EF Scale became operational on February 1, 2007. It is used to assign tornados a rating based on estimated wind speeds and related damage. When tornado-related damage is surveyed, it is compared to a list of DIs and Degrees of Damage (DOD), which help better estimate the range of wind speeds produced by the tornado. From that, a rating is assigned, similar to that of the F Scale, with six categories from EF0 to EF5, representing increasing degrees of damage. The EF Scale was revised from the original F Scale to reflect better examinations of tornado damage surveys. This new scale was developed with consideration to the designs of most structures (NWS 2007). Table 4.3.12-3 details each of the six categories of the EF Scale.

Table 4.3.12-3. Enhanced Fujita Damage Scale

EF Scale Number	Intensity Phrase	Wind Speed (mph)	Type of Damage Done
EF0	Light tornado	65–85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	Moderate tornado	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	Significant tornado	111-135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	Severe tornado	136-165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	Devastating tornado	166-200	Devastating damage. Well-constructed houses and whole-frame houses completely leveled; cars thrown, and small missiles generated.
EF5	Incredible tornado	>200	Incredible damage. Strong-frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air over distances exceeding 100 meters (109 yards); high-rise buildings undergo significant structural deformation; incredible phenomena occur.

Source: NWS 2007

Note: mph Miles per hour

The EF Scale takes into account more variables than the original F Scale in assigning a wind speed rating to a tornado. The EF Scale incorporates 28 DIs, such as building type, structures, and trees. There are eight DODs for each DI, ranging from the beginning of visible damage to complete destruction of the DI. Table 4.3.12-4 lists the 28 DIs, with a description of construction typical for each DI. Each DOD in every category is assigned an estimated expected wind speed, a lower boundary of wind speed, and an upper boundary of wind speed.

Table 4.3.12-4. EF Scale Damage Indicators

Number	Damage Indicator	Abbreviation	Number	Damage Indicator	Abbreviation
1	Small barns, farm outbuildings	SBO	15	School – 1-story elementary (interior or exterior halls)	ES
2	One- or two-family residences	FR12	16	School – junior or senior high school	JHSH
3	Single-wide mobile home	MHSW	17	Low-rise (1-4 story) building	LRB
4	Double-wide mobile home	MHDW	18	Mid-rise (5-20 story) building	MRB
5	Apartment, condominium, townhouse (3 stories or less)	ACT	19	High-rise (over 20 stories)	HRB
6	Motel	M	20	Institutional building (hospital, government. or university)	IB
7	Masonry apartment or motel	MAM	21	Metal building system	MBS
8	Small retail building (fast food)	SRB	22	Service station canopy	SSC
9	Small professional (doctor office, branch bank)	SPB	23	Warehouse (tilt-up walls or heavy timber)	WHB
10	Strip mall	SM	24	Transmission line tower	TLT
11	Large shopping mall	LSM	25	Free-standing tower	FST
12	Large, isolated ("big box") retail building	LIRB	26	Free-standing pole (light, flag, luminary)	FSP
13	Automobile showroom	ASR	27	Tree – hardwood	TH
14	Automotive service building	ASB	28	Tree – softwood	TS

Source: Storm Prediction Center (SPC) Date Unknown

Events after February 2007 are classified based on the EF Scale. Previous occurrences and losses associated with historical tornado events, described in the Past Occurrences section of this hazard profile (Section 4.3.12.3), are classified based on the F Scale.

The worst case event in Beaver County occurred in 1985, when an F3 tornado caused $25 million in property damage, injured 40 individuals, and claimed 3 lives. This event, part of a swarm of tornados across Ohio and Pennsylvania, led to a Presidential Declaration of Major Disaster, with both Individual Assistance (IA) and Public Assistance (PubA) available.

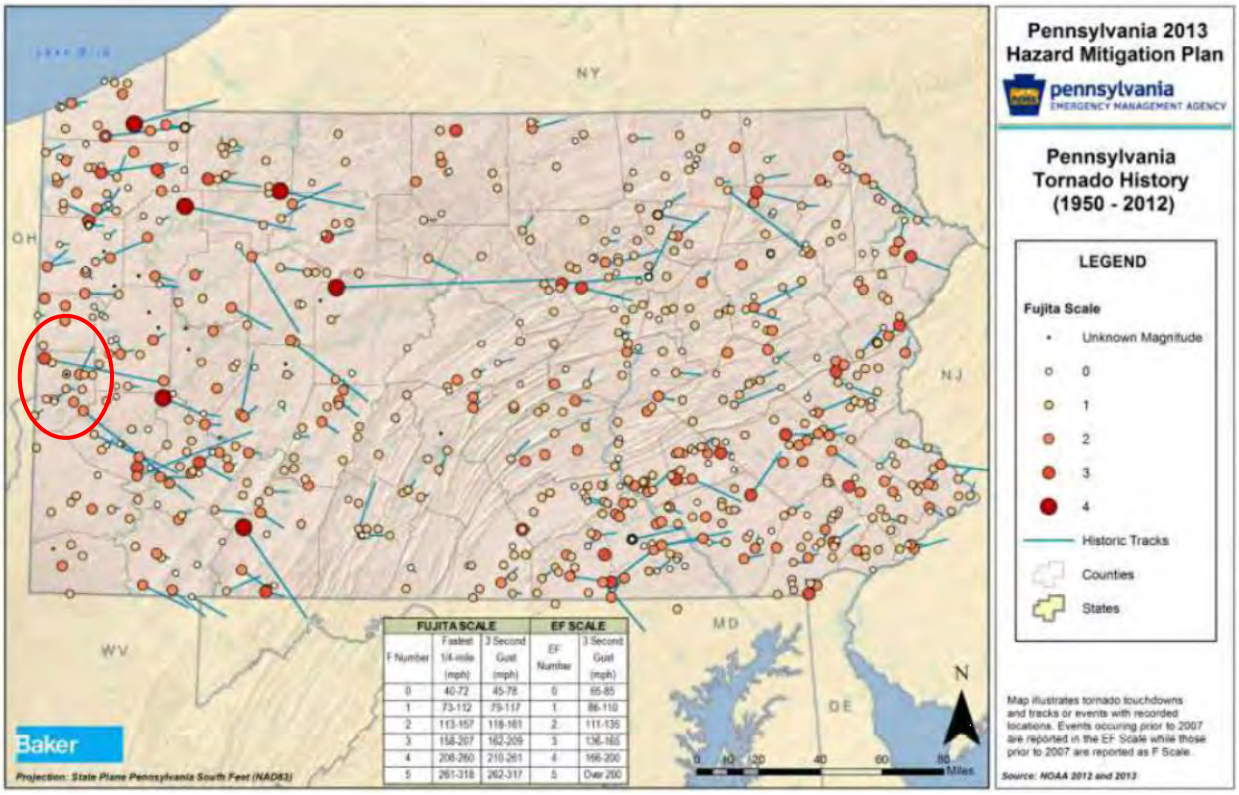
4.3.12.3 Past Occurrence

Many sources provided historical information regarding previous occurrences and losses associated with tornado and windstorm events throughout the Commonwealth of Pennsylvania and Beaver County. With so many sources reviewed for this plan, loss and impact information pertaining to many events could vary depending on the source. Therefore, accuracy of monetary figures discussed is based only on available information identified during research for this Hazard Mitigation Plan (HMP).

According to NOAA's National Climatic Data Center (NCDC) storm events database, Beaver County underwent 331 tornado and windstorm events between August 1, 1950, and August 31, 2015. These events included funnel clouds, high winds, strong winds, thunderstorm winds, and tornados. Total property damages resulting from these tornado and windstorm events were estimated at just over $31.689 million, and total crop damages were estimated at $40 thousand. These totals also include damages within other counties.

Figure 4.3.12-6 shows the tornados that have occurred across Pennsylvania from 1950 to 2012 (PEMA 2013).

Figure 4.3.12-6. Pennsylvania Tornado History



Source: PEMA 2013

Note: Beaver County is within the red oval.

According to NOAA's NCDC, 14 tornados were recorded in Beaver County between 1950 and 2015, ranging in intensity from F0 in June 1998 to F3 in May 1985. As stated above, the most severe tornado to hit Beaver County was an F3 that injured 40 people and killed 3. Additionally, according to NOAA's NCDC, 340 wind events over 216 days were reported in the County from 1950 to 2015 (NCDC 2015).

Between 1954 and 2015, the Commonwealth of Pennsylvania underwent 27 federally-declared windstorm or tornado-related disasters inducing Disaster Declarations (DR) or emergencies (EM). These events were classified as one or a combination of the following disaster types: hurricane, tropical storm, tropical depression, severe storm, flash flooding, flooding, and high winds. Generally, these disasters occurred over a wide region of the State and therefore may have affected many counties. However, not all counties were included in the DRs or EM declarations. Beaver County was included in seven of these declared disasters (FEMA 2014). Additionally, the Pennsylvania Disaster History list, maintained by PEMA, identifies 11 wind events and 11 tornados that have impacted the State, 3 of those 22 affecting Beaver County (PEMA 2013).

Table 4.3.12-6 summarizes the historical record of tornados and associated damage impact statistics (for Beaver County, all tornados use the F Scale for impact statistics due to dates of occurrence). Based on all sources researched, Table 4.3.12-7 lists select significant windstorms (those generating more damage than just utility interruptions and downed trees) and tornado events that affected Beaver County and its municipalities between 1950 and 2015. Because tornado and windstorm documentation pertaining to the Commonwealth of Pennsylvania is so extensive, not all sources have been identified or researched. Therefore, Table 4.3.12-7 may not include all events that have occurred throughout Beaver County.

Table 4.3.12-6. Tornado Data Analysis for Beaver County

Enhanced Fujita Scale	Number of Events	Probability (% annual chance)	Total Length (Miles)	Average Length (Miles)	Total Width (Yards)	Average Width (Yards)	Maximum Length (Miles)*	Maximum Width (Yards)*
0	1	1.6	0.2	0.2	30.0	30.0		
1	11	18.0	13.3	1.2	677.0	61.5		
2	3	4.9	52.7	17.6	50.0	16.7	**45.3**	**300**
3	1	1.6	39.0	39.0	243.0	243.0		
Total	**16**	**26.2**	--	**6.6**	--	**62.5**		

Source: NOAA-SPC, 2015

Notes:

Period of record: 1950-2015 (65 years)

* The maximum length or width of one tornado from any of the Fujita Scale categories.

Table 4.3.12-7. Tornado and Windstorm Events in Beaver County, 1950 to 2015

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
June 10, 1954	Tornado	Beaver County	F2	Property damage estimated at $25,000.
May 12, 1956	Tornado	Beaver County	F2	Property damage estimated at $250,000.
April 19, 1963	Thunderstorm Wind	Beaver County	65 kts	Not listed.
April 23, 1966	Tornado	Beaver County	F1	Property damage estimated at $25,000.
July 24, 1967	Thunderstorm Wind	Beaver County	0 kts	A twister that ripped across Ohio apparently spawned a gust manifested in New Sewickley Township, destroying one Western Pennsylvania home and several garages, sweeping away a nearby barn, and heavily damaging a farmhouse. Trees in the path of the storm were uprooted and strewn about the immediate area. A sawmill at Shelocta was destroyed after a bolt of lightning ignited an extensive fire; losses were

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
				estimated at $20,000. Heavy winds toppled several large trees, lifted a house trailer from its foundation, and sheared off the roof of a barn in the area south of Strongstown.
July 22, 1968	Thunderstorm Wind	Beaver County	0 kts	Lightning caused minor damage to home. Also, a chimney of another home damaged by lightning.
September 3, 1970	Tornado	Beaver County	F1	Property damage estimated at $2,500,000.
June 23, 1972	Pennsylvania Tropical Storm Agnes	Beaver County	NA	DR-340 declared on June 23, 1972.
March 1975	Tornado	Beaver County	NA	NA.
September 22, 1973	Thunderstorm Wind	Beaver County	0 kts	Winds up to 45 mph, downed trees and power and phone lines. Some roof damages and fires from lightning.
April 14, 1974	Thunderstorm Wind	Beaver County	0 kts	Not listed.
March 24, 1975	Tornado	Beaver County	F1	Property damage estimated at $25,000.
June 4, 1975	Tornado	Beaver County	F2	Property damage estimated at $250.
March 7, 1976	Thunderstorm Wind	Beaver County	0 kts	Line of strong thunderstorms moved through Western Pennsylvania, causing considerable damage as reported in following lines…Beaver County…trees and power lines down, causing power outages. Parts of roofs of two large commercial buildings blown away, one cement block and panel wall knocked down. Cars in parking lot damaged by flying debris.
March 27, 1976	Thunderstorm Wind	Beaver County	0 kts	Trees and power lines down, causing power outages. Parts of roofs of two large commercial buildings blown away, one cement block and panel wall knocked down. Cars in parking lot damaged by flying debris.
July 11, 1976	Tornado	Beaver County	NA	Property damage estimated at $2,500.
April 28, 1981	Thunderstorm Wind	Beaver County	65 kts	Wind gust of 77 mph reported at Beaver Airport. Golf ball size hail reported just west of Beaver City.
June 21, 1981	Tornado	Beaver County	F1	Property damage estimated at $25,000.
July 4, 1983	Tornado	Beaver County	F1	Property damage estimated at $250,000.
July 19, 1983	Tornado	Beaver County	F1	Property damage estimated at $25,000. A tornado touched down near Midland, tearing the roof off one building and injuring a woman. There were also uprooted trees and broken roofs. Damage in the area was estimated at $100,000. A tornado touched down near Beaver Falls, damaging several homes and toppling some trees.
March 28, 1985	Thunderstorm Wind	Beaver County	0 kts	One-half inch hail and large trees knocked down, was reported near Monaco.
May 1985	Tornado	Beaver County	NA	President's Declaration Of Major Disaster; Governor Dick Thornburgh – Governor's Proclamation
May 31, 1985	Tornado	Beaver County	F3	Property damage estimated at $25,000,000. 40 injured and 3 killed.

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
May 31, 1985	Tornado	Beaver County	NA	FEMA DR-737 declared on June 8, 1985.
May 31, 1985	Thunderstorm Wind	Beaver County	0 kts	Two deaths.
April 27, 1987	Thunderstorm Wind	Beaver County	0 kts	A 40-foot-high radio tower was downed by thunderstorm wind in Rochester. Large trees and power lines were downed at Monaca.
June 29, 1987	Thunderstorm Wind	Beaver County	0 kts	Trees and power lines were downed in Hopewell. A porch was torn off of a house as well (Hopewell Township). Large trees were downed by winds, and three-quarter inch-diameter hail fell (New Sewickley).
July 9, 1990	Thunderstorm Wind	Beaver County	0 kts	Trees were downed in Raccoon State Park by thunderstorm wind. A funnel cloud was sighted in Raccoon and Center Townships. Windows were blown out in Hookstown and a barn roof off in Green Township. Dissipated over Big Knob. Street and basement flooding occurred in Industry. Four Mile Run flooded. Trees were downed by thunderstorm wind. Thunderstorm wind gusts downed trees and utility lines in Beaver Spring and to the east in Beaver Township between 1345 and 1415 EST.
July 22, 1990	Tornado	Beaver County	F1	Property damage estimated at $25,000. A funnel cloud was sighted in Raccoon and Center Townships. Windows were blown out in Hookstown and a barn roof off in Greene Township. Dissipated over Big Knob.
December 23, 1990	Thunderstorm Wind	Beaver County	0 kts	Connoquenessing Creek continued to flood in Franklin Township. In Marion and Franklin Townships, water was up to the window level; Franklin Township Beauty Shop sustained $4,000 damage. Fifty thousand homes were without power due to thunderstorm winds downing trees and power lines ahead of a fast-moving cold front.
April 8, 1991	Thunderstorm Wind	Beaver County	0 kts	Trees and power lines were downed by winds between Midland and Rochester. A mobile home was overturned in Green Garden (Raccoon Township). Roofs were blown off homes, and 20,000 were without power throughout the County.
April 9, 1991	Thunderstorm Wind	Beaver County	0 kts	Trees and power lines were downed by winds between Midland and Rochester. A mobile home was overturned in Green Garden (Raccoon Township). Roofs were blown off homes, and 20,000 were without power throughout the County.
July 7, 1991	Thunderstorm Wind	Beaver County	0 kts	Lines were downed in Beaver County by thunderstorm winds. Trees were downed all over the County. A funnel cloud was sighted over Industry.
July 23, 1991	Thunderstorm Wind	Beaver County	0 kts	Lines were downed in Beaver County by thunderstorm winds. Trees were downed all over the County. A funnel cloud was sighted over Industry.
May 12, 1993	Thunderstorm Wind	New Brighton	61 kts	One-inch-diameter hail was reported in North Sewickley Township. A wind gust to 70 mph was reported in New Brighton. Trees were downed at Industry.

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
January 4-February 25, 1994	Winter Storm, Severe Storm	Beaver County	NA	FEMA DR-1015 declared on March 10, 1994.
July 5, 1994	Thunderstorm Wind	Midland	0 kts	Widespread wind damage in the form of downed trees were reported in Midland, Homewood, Big Beaver, and Economy. Lightning struck a home in Baden, blasting a hole in the roof.
August 31, 1995	Thunderstorm Wind	Freedom	0 kts	Thunderstorm winds downed large limbs and caused damage to the roof and siding of a house.
March 25, 1996	High Wind	Beaver County	55 kts	Strong gusty winds occurred ahead of a strong cold front that quickly moved east through the Upper Ohio Valley. The winds gusted as high as 63 mph at the Beaver County Airport. Also, a tree was downed by the high winds in Moon Township in Allegheny County.
March 25, 1996	Thunderstorm Wind	Monaca	0 Kts.	Thunderstorm winds uprooted a 60-foot tree in Monaca. A 150-foot radio tower in Center Township was also damaged.
March 25, 1996	Thunderstorm Wind	Economy	0 Kts.	A tree fell onto a house in Economy.
March 25, 1996	Thunderstorm Wind	Ambridge	0 Kts.	Thunderstorm winds knocked over a 73 year-old man in Ambridge. He suffered an injury to his hip.
April 30, 1996	High Wind	Beaver County	51 kts	A tree fell into power lines in Aliquippa.
October 30, 1996	High Wind	Beaver County	55 kts	Trees were downed onto wires in Monaca. Wind gusts to 61 mph at 10:12 a.m. and 63 mph at 11:32 occurred at the Beaver County Airport. A porch in Beaver sustained minor damage when large limbs fell onto it.
September 29, 1997	High Wind	Beaver County	0 kts	A few trees and some large limbs were downed by high winds throughout the County. A power line was also downed along Route 68.
April 9, 1998	Tornado	Unionville	F1	An F1 tornado with maximum winds estimated at around 90 mph briefly touched down and knocked out a 55-foot-wide by 30-foot-high hole at the southeast corner of a cinder block warehouse. Several witnesses reported seeing the tornado lift back into the cloud just after it knocked out the wall. Cinder blocks were blown out roughly 25 to 30 feet east of the building. The cell continued moving southeast with no other damage reported.
May 31-June 2, 1998	Flooding, Severe Storms, Tornado	Beaver County	NA	FEMA DR-1219 declared on June 18, 1998.
June 2, 1998	Tornado	Shippingport	F1	Widespread tree and power line damage occurred as the tornado first touched down in Shippingport, where four houses were damaged and one trailer was destroyed. As the tornado moved east-southeast through Raccoon Township, 19 houses sustained minor to moderate damage, mostly to siding and roofs.
June 2, 1998	Tornado	Shippingport	F0	A weak F0 tornado briefly touched down just south of Shippingport, toppling between 50 and 100 cherry trees and damaging a home.

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
June 1998	Severe Storms/ Tornados	Beaver County	NA	Governor Tom Ridge – Governor's Proclamation; Presidential Major Disaster for IA.
June 19, 1998	Thunderstorm Wind	Beaver Falls	70 kts	A microburst with a width of 350 yards and length of 700 yards occurred in Beaver Falls. Many trees were topped or snapped. One porch was blown off of a house. Maximum wind gust was estimated at 80 mph.
April 16, 1999	High Wind	Beaver County	50 kts	Numerous trees and power lines were blown down by the high winds across western Pennsylvania.
April 22, 1999	Thunderstorm Wind	Independence	50 kts	A large tree was blown down by thunderstorm winds.
July 9, 1999	Thunderstorm Wind	Beaver County	60 kts	Severe thunderstorms formed ahead of a cold front which moved through western Pennsylvania during the evening of the 9th. Although damage was reported in 12 western Pennsylvania counties, the worst damage occurred in Beaver and Allegheny Counties where strong straight-line winds downed numerous trees and left over 26,000 people without power. It took local utility companies over 48 hours to respond to all of the outages. In addition, nearly 500 storm-related calls were logged in the Beaver County Emergency Services Center on the evening of the 9th.
July 28, 1999	Thunderstorm Wind	Beaver County	0 kts	Thunderstorm winds produced widespread damage across the County, downing numerous trees and power lines. One car was crushed by a large tree in Midland. One beef cattle in Daugherty Township was electrocuted when a wire fell on it. Several other reports of minor damage to siding and roofs were received by the area 911.
October 13, 1999	Thunderstorm Wind	Beaver County	0 kts	Thunderstorm winds downed numerous trees and power lines across the entire County. The town of Ambridge was especially hard hit, as part of a metal roof was blown off of a factory, and several other businesses reported minor damage.
June 2, 2000	Thunderstorm Wind	Beaver County	0 kts	Strong thunderstorms downed numerous trees and power lines across the County. In Baden, the strong winds lifted shingles from a roof and blew trees down onto a porch and a parked car. In Industry, a 60-foot tree was blown onto the Volunteer Fire Department hall, damaging the roof and gutters. In Beaver, a large oak tree was downed. At the height of the storm, approximately 2,000 customers across the County were without electricity. Most of the power outages were reported in Beaver, Aliquippa, and Brighton Township.
December 12, 2000	High Wind	Beaver County	0 kts	In general, damage was confined mostly to numerous downed trees and power lines, resulting in loss of power to an estimated 150,000 homes across western Pennsylvania. However, several incidents of property damage were also reported. Several residences and businesses in Beaver County reported property damage. A window was blown in at a fast-food restaurant in Conway. A pavilion at a park

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
				in Monaca was blown over. In Industry, a tree was blown onto a van, crushing it. In South Beaver, the roof was partially ripped off of an industrial supply company. A partially constructed house in the Beaver area was also blown down by the wind.
February 25, 2001	High Wind	Beaver County	52 kts	An intense area of low pressure passing over the region brought a prolonged period of high winds to western Pennsylvania. Although the highest recorded wind was only 60 mph (at the Beaver Falls Airport, Beaver County), wind gusts to over 50 mph continued from late morning into the early evening hours, downing numerous trees, large limbs, and power lines across the entire area.
July 1, 2001	Thunderstorm Wind	Beaver County	0 kts	Thunderstorm winds downed numerous trees at several locations in the County, including Economy, Potter Township, Bookstown, and South Beaver.
December 14, 2001	High Wind	Beaver County	50 kts	High winds associated with a deep area of low pressure passing over the region downed numerous trees and power lines across western Pennsylvania.
February 1, 2002	High Wind	Beaver County	0 kts	High winds associated with a cold frontal passage downed numerous trees and power lines across portions of western Pennsylvania. Most damage across the region was due to downed trees and power lines. In Beaver County, downed power lines left around 1,200 homes and businesses without power at the height of the event, especially in the towns of Big Beaver, Economy, and Industry.
March 9, 2002	Thunderstorm Wind	Beaver County	0 kts	Strong gradient winds and severe thunderstorm winds produced widespread damage across the area, mostly in the form of downed trees and power lines. An estimated 25,000 people were left without electricity in western Pennsylvania in the wake of this wind event.
March 9, 2002	High Wind	Beaver County	0 kts	High winds downed trees and power lines until early morning on March 10, 2002. Approximately 25,000 people were left without electricity in western Pennsylvania in the wake of this wind event.
May 14, 2002	Thunderstorm Wind	Beaver County	0 kts	A microburst passed across Beaver County, producing wind damage countywide, especially in the towns of Economy, Rochester, Beaver Falls, and Ambridge. This microburst downed numerous trees and power lines. Several of these trees were blown down onto houses. One business in Beaver Falls had the brick facade blown from the front of the building.
June 4, 2002	Thunderstorm Wind	New Brighton	0 kts	Thunderstorm winds downed a large tree onto a swimming pool. Several other reports of downed trees were also received by law enforcement officials around the New Brighton area.
February 23, 2003	High Wind	Beaver County	55 kts	Trees and power lines downed in Beaver, leading to $5,000 in property damage.
July 7, 2003	Thunderstorm Wind	Ellwood City	50 kts	Trees down in Big Beaver Borough. 15,000 customers lost power in Beaver Co.

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
October 14, 2003	Thunderstorm Wind	South Heights	60 kts	Trees and power lines down. Four large trees were blown down across Route 51, which had to be closed. Another tree fell on the back porch of a house.
November 13, 2003	Strong Wind	Beaver County	48 kts	An 84-year-old woman died when knocked down on the sidewalk in front of a beauty shop in Patterson Twp by a gust of wind estimated at 55 mph (48 kts).
March 4, 2004	High Wind	Beaver County	50 kts	Numerous trees down countywide. In Lawrence County, trees were reported blown down around Ellwood City and Slippery Rock. In Venango, the trees fell near Franklin. A tree fell across Route 51 near Beaver, striking a pick-up truck on the highway. (0ne person injured)
June 5, 2004	Thunderstorm Wind	Beaver	50 kts	Large trees down over a 4-block area, centered at 5th and Sharon Streets. 1000 customers lost electric power.
August 20, 2004	Thunderstorm Wind	Ohioville	56 kts	Trees down from Hookstown to Ohioville. One house suffered a damaged roof in Hookstown. 10,000 customers lost electric power. Several microbursts hit Hanover and Greene townships, with severe damage where Rte 30 and 151 intersect. Numerous trees toppled or snapped; power lines down. Trees fell on sheds. Siding and roofing shingles blown off. Roof blown off barn on Rte 151. Several swaths of damage, ranging from 80 to 200 yards wide. Path length likely extended for several miles (exact length could not be determined because damage was sporadic). Maximum wind estimated 65 mph (56 kts).
September 8-9, 2004	Severe Storms and Flooding associated with Tropical Depression Francis	Beaver County	NA	FEMA DR-1555 declared on September 19, 2004.
September 17-October 1, 2004	Tropical Depression Ivan	Beaver County	NA	FEMA DR-1557 declared on September 19, 2004.
July 5, 2005	Thunderstorm Wind	Beaver	50 kts	Trees and power lines down in Baden, Beaver Falls, Economy; and in the townships of Chippewa, Crescent, Hopewell, and Independence. Tree fell on car in Beaver. Tree fell on house in New Brighton. 6000 customers lost electricity.
July 26, 2005	Thunderstorm Wind	Ambridge	50 kts	Trees and power lines down from northwest of Ambridge into Ambridge, especially near 8th and 11th Streets. Tree fell on a back porch on Melrose Ave. Trees fell along Rte 65. 3,000 customers lost electricity.
September 9, 2008	High Wind	Beaver County	70 kts	Widespread damage to trees and power lines was reported across the region (eastern Ohio, northern West Virginia, and western Pennsylvania), with power outages and damage to some structures from falling trees. Power was not restored to some rural

Dates of Event	Event Type	Location	Magnitude	Losses / Impacts
				areas for 1 week after the storm. At the peak of the storm, more than 2 million homes were without power. Total damage from the storm across eastern Ohio, western Pennsylvania, and northern West Virginia was around 25 million dollars.
February 12, 2009	High Wind	Beaver County	50 kts	In eastern Ohio, western Pennsylvania, northern West Virginia, and Garrett County, Maryland, over one-half million homes and businesses were without power at some point during the storm.
December 9, 2009	High Wind	Beaver County	50 kts	Trees and power lines were reported down across the region, with more than 50,000 homes without power late afternoon on the 9th at the peak of the winds.
July 26, 2012	Thunderstorm Wind	Fallston	50 kts	The public reported some structural damage to a home and a roof blown off a barn.
October 26-November 8, 2012	Hurricane Sandy	Beaver County	NA	FEMA DR-3356 declared on October 29, 2012. Call center reports of trees down scattered across the County.
May 12, 2014	Thunderstorm Wind	New Brighton	50 kts	Local newspaper reported that a rubber roof was blown off at the Oak Hill car dealership.

Sources: PEMA Disaster History List 2010, FEMA 2015, NOAA-NCDC 2015

Notes:

Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

FEMA Federal Emergency Management Agency
IA Individual Assistance
Kts Knots
mph Miles per hour
NA Not available
NCDC National Climatic Data Center
NOAA National Oceanic and Atmospheric Administration
PEMA Pennsylvania Emergency Management Agency

4.3.12.4 Future Occurrence

In Section 4.4, the hazards of concern identified for Beaver County were ranked according to relative risk. Probability of occurrence, or likelihood of the event, is one parameter used for ranking hazards. Probability of occurrence for severe tornado and windstorm events in Beaver County is considered *highly likely* as defined by the Risk Factor Methodology probability criteria (Section 4.4).

Beaver County undergoes strong winds frequently, and when those winds strike, they can result in significant property damage, downed trees, and utility outages. Assumedly, future tornados will be similar to those that affected Beaver County in the past. Anticipation is that Beaver County will continue to undergo direct and indirect impacts of windstorms and tornados annually that may induce secondary hazards such as infrastructure deterioration or failure, utility failures, power outages, water quality and supply concerns, and transportation delays, accidents, and inconveniences.

4.3.12.5 Vulnerability Assessment

To understand risk, a community must evaluate which assets are exposed or vulnerable in the identified hazard area. The entire County has been identified as the hazard area for tornado and other windstorm events. Therefore, all assets in the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 2), are vulnerable. The following text evaluates and estimates potential impacts of strong winds on the County, including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts on: (1) life, health, and safety of residents; (2) general building stock; (3) critical facilities; (4) economy; (5) environment; and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist in understanding this hazard over time.

Overview of Vulnerability

High winds and air speeds of a severe windstorm event, including winds in a tornado, can result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and need to shelter and care for individuals affected by the events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and in some cases, people. The risk assessment for tornados and windstorms evaluates available data for a range of storms included in this hazard category.

The entire inventory of the County is at risk of damage or loss via impacts of tornados and windstorms. Certain areas, infrastructure, and types of building are at greater risk than others because of their proximities to falling hazards or their manner of construction. Potential losses associated with high-wind events were calculated for the County by application of HAZUS-MH considering two probabilistic wind events: 100-year and 500-year MRP hurricane events. Impacts on population, existing structures, critical facilities, and the economy are presented below, after a summary of data used and methodology applied. Although the estimates are based on a hurricane event, the data can also be used to estimate potential damage from other windstorm events.

Data and Methodology

Data from the HAZUS-MH 3.0 wind model, US Census, NOAA, and Planning Team were used to generate an evaluation of assets exposed to this hazard and potential impacts associated with this hazard.

A probabilistic scenario was run for the County for annualized losses, and the 100- and 500-year MRPs were examined for the wind hazard. These results are shown on Figures 4.3.12-1 and 4.3.12-2 (earlier in this section), which indicate HAZUS-MH maximum peak gust wind speeds that can be anticipated in the study area associated with the 100- and 500-year MRP events. The estimated hurricane storm track for the 100- and 500-year events is also shown.

HAZUS-MH contains data on historical hurricane events and wind speeds. It also includes surface roughness and vegetation (tree coverage) maps for the area. Surface roughness and vegetation data support modeling of wind force across various types of land surfaces. Hurricane and inventory data available in HAZUS-MH were used to evaluate potential losses from the 100- and 500-year MRP events (severe wind impacts). Other than

the updated critical facility inventory, the default data in HAZUS-MH 3.0 were the best available for use in this evaluation.

Impact on Life, Health, and Safety

Impacts of a tornado or windstorm on life, health, and safety depend on several factors, including severity of the event and whether adequate warning time was provided to residents. Assumedly, the entire County's population (U.S. Census 2010 population of 170,539 people) is exposed to this hazard.

Residents may be displaced or require temporary to long-term sheltering. In addition, downed trees, damaged buildings, and debris carried by high winds can lead to injury or loss of life. Socially vulnerable populations are most susceptible, based on a number of factors including their physical and financial ability to react or respond during a hazard and locations and construction quality of their housing. As a result of the 100- and 500-year MRP events, HAZUS-MH estimates that zero people would be displaced and zero people may require temporary shelter.

Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions based on the major economic impact on their family, and may not have funds to evacuate. The population over the age of 65 is also more vulnerable and, physically, they may have more difficulty evacuating. The elderly are considered most vulnerable because they require extra time or outside assistance during evacuations and are more likely to seek or need medical attention that may not be available due to isolation during a storm event. Section 2 presents the statistical information regarding these populations in the County.

Impact on General Building Stock

After consideration of the population exposed to the tornado or windstorm hazard, general building stock replacement value exposed to and damaged by 100- and 500-year MRP events was examined. Wind-only impacts are reported based on probabilistic hurricane runs in HAZUS-MH 3.0. Potential damage is the modeled loss that could occur to the exposed inventory, including damage to structural and content value based on the wind-only impacts associated with a hurricane (applying the methodology described in Section 4.4). Although the estimate is based on a hurricane wind event, the data can also be used to estimate potential damage from other windstorm events.

Presumably, the entire County's general building stock is exposed to the severe storm wind hazard (greater than $19 billion—structure only). Expected building damage was evaluated by HAZUS across the following wind damage categories: no damage/very minor damage, minor damage, moderate damage, severe damage, and total destruction.

Table 4.3.12-8 describes the damage categories.

Table 4.3.12-8. Description of Damage Categories

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
No Damage or Very Minor Damage Little or no visible damage from the outside. No broken windows or failed roof deck. Minimal loss of roof over, with no or very limited water penetration.	≤ 2%	No	No	No	No	No

Qualitative Damage Description	Roof Cover Failure	Window Door Failures	Roof Deck	Missile Impacts on Walls	Roof Structure Failure	Wall Structure Failure
Minor Damage Maximum of one broken window, door, or garage door. Moderate roof cover loss that can be covered to prevent additional water entering the building. Marks or dents on walls requiring painting or patching for repair.	> 2% and ≤ 15%	One window, door, or garage door failure	No	< 5 Impacts	No	No
Moderate Damage Major roof cover damage, moderate window breakage. Minor roof sheathing failure. Some resulting damage to interior of building from water.	> 15% and ≤ 50%	> 1 and ≤ the larger of 20% & 3	1 to 3 Panels	Typically 5 to 10 Impacts	No	No
Severe Damage Major window damage or roof sheathing loss. Major roof cover loss. Extensive damage to interior from water.	> 50%	> the larger of 20% & 3 and ≤ 50%	> 3 and ≤ 25%	Typically 10 to 20 Impacts	No	No
Destruction Complete roof failure or failure of wall frame. Loss of more than 50 percent of roof sheathing.	Typically > 50%	> 50%	> 25%	Typically > 20 Impacts	Yes	Yes

Source: FEMA 2013

As noted earlier in the profile, HAZUS estimates the 100-year MRP peak gust wind speeds for Beaver County between 0 and 48 mph (some areas will undergo Tropical Storm-scale winds). HAZUS-MH 3.0 estimates no structural damages across the County associated with the 100-year MRP event.

HAZUS estimates the 500-year MRP peak gust wind speeds for Beaver County to range from 54 to 60 mph. This wind speed equates to a Tropical Storm that would cause over $992,000 in damages to the general building stock (structure only). This amount is less than 1 percent of the County's building inventory. Residential buildings are expected to undergo most of the damage. Table 4.3.12-9 summarizes building value (structure only) damage estimated for the 100- and 500-year MRP wind-only for all occupancy classes.

Table 4.3.12-9. Estimated Building Replacement Value (Structure Only) Damaged by the 100-Year and 500-Year Mean Return Period Winds for All Occupancy Classes

Municipality	Total RCV (Structure Only)	Estimated Total Damages*			Percent of Total Building Replacement Cost Value		
		Annualized Loss	100-Year	500-Year	Annualized Loss	100-Year	500-Year
City of Aliquippa	$1,046,293,000	<$1000	$0	$23,648	<1%	0%	<1%
Ambridge Borough	$1,119,177,000	<$1000	$0	$8,120	<1%	0%	<1%
Baden Borough	$408,425,000	<$1000	$0	$7,568	<1%	0%	<1%
Beaver Borough	$648,790,000	<$1000	$0	$39,075	<1%	0%	<1%
City of Beaver Falls	$1,153,540,000	<$1000	$0	$77,516	<1%	0%	<1%
Big Beaver Borough	$208,662,000	<$1000	$0	$18,262	<1%	0%	<1%
Bridgewater Borough	$138,376,000	<$1000	$0	$8,186	<1%	0%	<1%
Brighton Township	$982,260,000	<$1000	$0	$67,417	<1%	0%	<1%
Center Township	$1,390,300,000	$1,292	$0	$56,168	<1%	0%	<1%

Municipality	Total RCV (Structure Only)	Estimated Total Damages*			Percent of Total Building Replacement Cost Value		
		Annualized Loss	100-Year	500-Year	Annualized Loss	100-Year	500-Year
Chippewa Township	$1,021,548,000	<$1000	$0	$66,143	<1%	0%	<1%
Conway Borough	$188,707,000	<$1000	$0	$14,555	<1%	0%	<1%
Darlington Borough	$25,195,000	<$1000	$0	$1,835	<1%	0%	<1%
Darlington Township	$188,393,000	<$1000	$0	$15,889	<1%	0%	<1%
Daugherty Township	$302,843,000	<$1000	$0	$31,149	<1%	0%	<1%
East Rochester Borough	$61,337,000	<$1000	$0	$5,127	<1%	0%	<1%
Eastvale Borough	$28,406,000	<$1000	$0	$2,026	<1%	0%	<1%
Economy Borough	$1,000,376,000	$1,005	$0	$62,387	<1%	0%	<1%
Fallston Borough	$50,879,000	<$1000	$0	<$1000	<1%	0%	<1%
Frankfort Springs Borough	$10,029,000	<$1000	$0	<$1000	<1%	0%	<1%
Franklin Township	$402,668,000	<$1000	$0	$46,613	<1%	0%	<1%
Freedom Borough	$134,838,000	<$1000	$0	$9,412	<1%	0%	<1%
Georgetown Borough	$15,456,000	<$1000	$0	<$1000	<1%	0%	<1%
Glasgow Borough	$4,850,000	<$1000	$0	<$1000	<1%	0%	<1%
Greene Township	$199,569,000	<$1000	$0	<$1000	<1%	0%	<1%
Hanover Township	$313,703,000	<$1000	$0	<$1000	<1%	0%	<1%
Harmony Township	$332,791,000	<$1000	$0	$1,247	<1%	0%	<1%
Homewood Borough	$11,384,000	<$1000	$0	<$1000	<1%	0%	<1%
Hookstown Borough	$12,855,000	<$1000	$0	<$1000	<1%	0%	<1%
Hopewell Township	$1,439,039,000	$1,304	$0	$6,205	<1%	0%	<1%
Independence Township	$215,867,000	<$1000	$0	<$1000	<1%	0%	<1%
Industry Borough	$192,443,000	<$1000	$0	$14,948	<1%	0%	<1%
Koppel Borough	$57,874,000	<$1000	$0	$7,728	<1%	0%	<1%
Marion Township	$135,727,000	<$1000	$0	$6,943	<1%	0%	<1%
Midland Borough	$282,009,000	<$1000	$0	$1,247	<1%	0%	<1%
Monaca Borough	$657,385,000	<$1000	$0	$45,629	<1%	0%	<1%
New Brighton Borough	$688,045,000	<$1000	$0	$52,828	<1%	0%	<1%
New Galilee Borough	$81,013,000	<$1000	$0	$3,429	<1%	0%	<1%
New Sewickley Township	$702,882,000	<$1000	$0	$62,234	<1%	0%	<1%
North Sewickley Township	$554,186,000	<$1000	$0	$44,262	<1%	0%	<1%
Ohioville Borough	$287,642,000	<$1000	$0	$24,657	<1%	0%	<1%
Patterson Township	$323,904,000	<$1000	$0	$5,414	<1%	0%	<1%
Patterson Heights Borough	$73,099,000	<$1000	$0	$28,183	<1%	0%	<1%
Potter Township	$76,307,000	<$1000	$0	$2,665	<1%	0%	<1%
Pulaski Township	$126,005,000	<$1000	$0	$10,878	<1%	0%	<1%
Raccoon Township	$301,208,000	<$1000	$0	<$1000	<1%	0%	<1%
Rochester Borough	$415,951,000	<$1000	$0	$22,355	<1%	0%	<1%
Rochester Township	$302,586,000	<$1000	$0	$31,599	<1%	0%	<1%
Shippingport Borough	$30,518,000	<$1000	$0	<$1000	<1%	0%	<1%

Municipality	Total RCV (Structure Only)	Estimated Total Damages*			Percent of Total Building Replacement Cost Value		
		Annualized Loss	100-Year	500-Year	Annualized Loss	100-Year	500-Year
South Beaver Township	$338,004,000	<$1000	$0	$22,904	<1%	0%	<1%
South Heights Borough	$52,720,000	<$1000	$0	<$1000	<1%	0%	<1%
Vanport Township	$162,887,000	<$1000	$0	$10,525	<1%	0%	<1%
West Mayfield Borough	$117,933,000	<$1000	$0	$9,281	<1%	0%	<1%
White Township	$116,680,000	<$1000	$0	$6,660	<1%	0%	<1%
BEAVER COUNTY (TOTAL)	**$19,203,313,000**	**$15,242**	**$0**	**$992,186**	**<1%**	**0%**	**<1%**

Source: HAZUS-MH 3.0

* The Total Damages column represents the sum of damages for all occupancy classes (residential, commercial, industrial, agricultural, educational, religious, and government) based on estimated replacement cost value.

Table 4.3.12-10 summarizes residential and commercial building values (structure only) damage estimated for the 100- and 500-year MRP hurricane-related winds.

Table 4.3.12-10. Estimated Residential and Commercial Building Values (Structure Only) Damaged by the 100-Year and 500-Year MRP Hurricane-Related Winds

Municipality	Total RCV (Structure Only)	Estimated Residential Damage		Estimated Commercial Damage	
		100-Year	500-Year	100-Year	500-Year
City of Aliquippa	$1,046,293,000	$0	$23,648	$0	$0
Ambridge Borough	$1,119,177,000	$0	$8,120	$0	$0
Baden Borough	$408,425,000	$0	$7,568	$0	$0
Beaver Borough	$648,790,000	$0	$39,075	$0	$0
City of Beaver Falls	$1,153,540,000	$0	$77,516	$0	$0
Big Beaver Borough	$208,662,000	$0	$18,262	$0	$0
Bridgewater Borough	$138,376,000	$0	$8,186	$0	$0
Brighton Township	$982,260,000	$0	$67,417	$0	$0
Center Township	$1,390,300,000	$0	$56,168	$0	$0
Chippewa Township	$1,021,548,000	$0	$66,143	$0	$0
Conway Borough	$188,707,000	$0	$14,555	$0	$0
Darlington Borough	$25,195,000	$0	$1,835	$0	$0
Darlington Township	$188,393,000	$0	$15,855	$0	<$100
Daugherty Township	$302,843,000	$0	$31,149	$0	$0
East Rochester Borough	$61,337,000	$0	$5,127	$0	$0
Eastvale Borough	$28,406,000	$0	$2,026	$0	$0
Economy Borough	$1,000,376,000	$0	$62,387	$0	$0
Fallston Borough	$50,879,000	$0	$832	$0	$0
Frankfort Springs Borough	$10,029,000	$0	$20	$0	$0
Franklin Township	$402,668,000	$0	$46,453	$0	<$100
Freedom Borough	$134,838,000	$0	$9,412	$0	$0
Georgetown Borough	$15,456,000	$0	$35	$0	$0

Municipality	Total RCV (Structure Only)	Estimated Residential Damage		Estimated Commercial Damage	
		100-Year	500-Year	100-Year	500-Year
Glasgow Borough	$4,850,000	$0	$485	$0	$0
Greene Township	$199,569,000	$0	$358	$0	$0
Hanover Township	$313,703,000	$0	$46	$0	$0
Harmony Township	$332,791,000	$0	$1,247	$0	$0
Homewood Borough	$11,384,000	$0	$840	$0	$0
Hookstown Borough	$12,855,000	$0	$40	$0	$0
Hopewell Township	$1,439,039,000	$0	$6,205	$0	$0
Independence Township	$215,867,000	$0	$40	$0	$0
Industry Borough	$192,443,000	$0	$14,948	$0	$0
Koppel Borough	$57,874,000	$0	$7,728	$0	$0
Marion Township	$135,727,000	$0	$6,943	$0	$0
Midland Borough	$282,009,000	$0	$1,247	$0	$0
Monaca Borough	$657,385,000	$0	$45,629	$0	$0
New Brighton Borough	$688,045,000	$0	$52,828	$0	$0
New Galilee Borough	$81,013,000	$0	$3,429	$0	$0
New Sewickley Township	$702,882,000	$0	$62,234	$0	$0
North Sewickley Township	$554,186,000	$0	$44,198	$0	$0
Ohioville Borough	$287,642,000	$0	$24,657	$0	$0
Patterson Township	$323,904,000	$0	$5,414	$0	$0
Patterson Heights Borough	$73,099,000	$0	$28,183	$0	$0
Potter Township	$76,307,000	$0	$2,665	$0	$0
Pulaski Township	$126,005,000	$0	$10,878	$0	$0
Raccoon Township	$301,208,000	$0	$30	$0	$0
Rochester Borough	$415,951,000	$0	$22,355	$0	$0
Rochester Township	$302,586,000	$0	$31,599	$0	$0
Shippingport Borough	$30,518,000	$0	$10	$0	$0
South Beaver Township	$338,004,000	$0	$22,904	$0	$0
South Heights Borough	$52,720,000	$0	$10	$0	$0
Vanport Township	$162,887,000	$0	$10,525	$0	$0
West Mayfield Borough	$117,933,000	$0	$9,281	$0	$0
White Township	$116,680,000	$0	$6,660	$0	$0
BEAVER COUNTY (TOTAL)	**$19,203,313,000**	**$0**	**$991,928**	**$0**	**<$100**

Source: HAZUS-MH 3.0

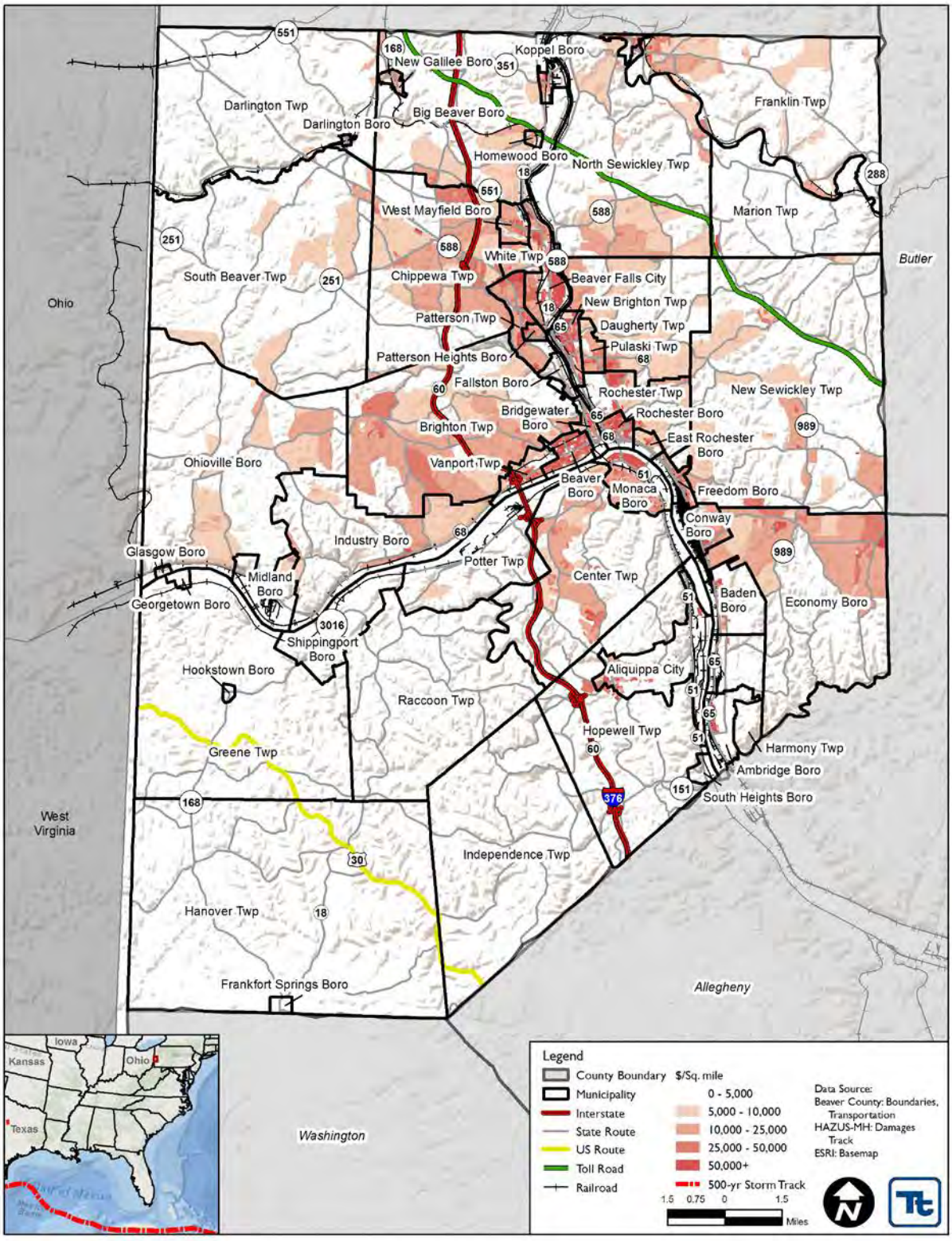
Because of differences in building construction, residential structures are generally more susceptible to wind damage than are commercial and industrial structures. Wood and masonry buildings in general, regardless of their occupancy class, tend to undergo more damage than concrete or steel buildings. Damage counts include buildings damaged at all severity levels from minor damage to total destruction. Total dollar damage reflects the overall impact on buildings at an aggregate level.

Of the greater than $14 billion in total residential replacement value (structure only) for the entire County, an estimated $992,000 in residential building damage can be anticipated from the 500-year event. Residential building damage accounts for nearly 100 percent of total damages from the 500-year wind-only event, reflecting the greater vulnerability of residential structures to the wind hazard in the County.

Annualized losses were also examined for Beaver County. A total of $15,242 is estimated as the annualized loss countywide. Notably, annualized loss does not predict losses in any particular year.

Figure 4.3.12-7 shows density of losses of structures (all occupancies) from the County 500-Year MRP hurricane (wind-only) event.

Figure 4.3.12-7. Density of Losses ($) for Structures (All Occupancies) for the County 500-Year MRP Hurricane (Wind-Only) Event



Source: HAZUS-MH 3.0

Impact on Critical Facilities

HAZUS-MH estimates the probability that critical facilities (medical facilities, fire/Emergency Medical Services [EMS], police, emergency operation centers, schools, and user-defined facilities such as shelters and municipal buildings) may sustain damage as a result of 100-year and 500-year MRP wind-only events. Additionally, HAZUS-MH estimates loss of use for each facility in number of days. HAZUS-MH estimates no structural losses to critical facilities in Beaver County, and continuity of operations (COOP) at these facilities would not be interrupted (loss of use estimated at 0 days) as a result of both the 100- and 500-year MRP events.

At this time, HAZUS-MH 3.0 does not estimate losses to transportation lifelines and utilities as part of the hurricane model. Transportation lifelines are not considered particularly vulnerable to the wind hazard; they are more vulnerable to cascading effects such as flooding, and falling debris. Impacts on transportation lifelines affect both short-term (evacuation activities) and long-term (day-to-day commuting) transportation needs.

Utility structures could sustain damage associated with falling tree limbs or other debris. These impacts can result in loss of power, which can impair business operations and affect provision of heating or cooling to citizens (including the young and elderly, who are particularly vulnerable to temperature-related health impacts).

Impact on Economy

Tornados and windstorms also impact the economy, including loss of business function (e.g., tourism, recreation), damage to inventory, relocation costs, and wage loss and rental loss due to repair/replacement of buildings. HAZUS-MH estimates total economic loss associated with each storm scenario (direct building losses and business interruption losses). Direct building losses are estimated costs to repair or replace damage to buildings. This is reported in the "Impact on General Building Stock" subsection above. Business interruption losses are associated with inability to operate a business because of wind damage sustained during a storm or temporary living expenses for those displaced from their home because of the event.

For the 100-year MRP wind event, HAZUS-MH estimates zero business interruption costs (income loss, relocation costs, rental costs, and lost wages) and inventory losses. For the 500-year MRP wind event, HAZUS-MH estimates less than $1,000 in business interruption losses for the County, which includes loss of income, relocation costs, rental costs, and lost wages.

Impacts on transportation lifelines affect both short-term (e.g., evacuation activities) and long-term (e.g., day-to-day commuting and goods transport) transportation needs. Utility infrastructure (power lines, gas lines, electrical systems) could sustain damage, and impacts could result in loss of power, which can affect business operations and provision of heating or cooling to the population.

HAZUS-MH 3.0 also estimates the amount of debris that may be produced a result of the 100- and 500-year MRP wind events. Table 4.3.12-11 estimates the debris produced. HAZUS-MH estimates that no brick and wood or concrete and steel debris would be generated as a result of both the 100- and 500-year MRP wind events—only tree debris. Because estimated debris production does not include flooding, this is likely a conservative estimate and may be higher if multiple impacts occur.

According to the HAZUS-MH Hurricane User Manual:

"The Eligible Tree Debris columns provide estimates of the weight and volume of downed trees that would likely be collected and disposed at public expense. As discussed in Chapter 12 of the HAZUS-MH Hurricane Model Technical Manual, the eligible tree debris estimates produced by the Hurricane Model tend to underestimate reported volumes of debris brought to landfills for a number of events that have occurred over the past several years. This indicates that that there may be other sources of vegetative and non-vegetative debris that are not currently being modeled in HAZUS. For landfill estimation purposes, it is recommended that the HAZUS debris volume estimate be treated as an approximate lower bound. Based on actual reported debris volumes, it is recommended that the HAZUS results be multiplied by three to obtain an approximate upper bound estimate. It is also important to note that the Hurricane Model assumes a bulking factor of 10 cubic yards per ton of tree debris. If the debris is chipped prior to transport or disposal, a bulking factor of 4 is recommended. Thus, for chipped debris, the eligible tree debris volume should be multiplied by 0.4."

Table 4.3.12-11. Debris Production from 100- and 500-Year Mean Return Period Hurricane-Related Winds

Municipality	Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year
City of Aliquippa	0	0	0	0
Ambridge Borough	0	0	0	0
Baden Borough	0	0	0	0
Beaver Borough	0	0	0	0
City of Beaver Falls	0	4	0	39
Big Beaver Borough	0	11	0	42
Bridgewater Borough	0	0	0	0
Brighton Township	0	0	0	0
Center Township	0	10	0	25
Chippewa Township	0	0	0	4
Conway Borough	0	2	0	23
Darlington Borough	0	0	0	0
Darlington Township	0	11	0	32
Daugherty Township	0	0	0	0
East Rochester Borough	0	0	0	0
Eastvale Borough	0	0	0	0
Economy Borough	0	0	0	0
Fallston Borough	0	0	0	0
Frankfort Springs Borough	0	0	0	0
Franklin Township	0	1	0	2
Freedom Borough	0	0	0	0
Georgetown Borough	0	0	0	0
Glasgow Borough	0	0	0	0
Greene Township	0	0	0	0
Hanover Township	0	0	0	0
Harmony Township	0	0	0	0
Homewood Borough	0	0	0	0

Municipality	Tree (tons)		Eligible Tree Volume (cubic yards)	
	100-Year	500-Year	100-Year	500-Year
Hookstown Borough	0	0	0	0
Hopewell Township	0	0	0	0
Independence Township	0	0	0	0
Industry Borough	0	0	0	0
Koppel Borough	0	0	0	0
Marion Township	0	11	0	7
Midland Borough	0	0	0	0
Monaca Borough	0	13	0	47
New Brighton Borough	0	0	0	0
New Galilee Borough	0	0	0	0
New Sewickley Township	0	0	0	1
North Sewickley Township	0	0	0	0
Ohioville Borough	0	0	0	0
Patterson Township	0	0	0	0
Patterson Heights Borough	0	0	0	0
Potter Township	0	15	0	12
Pulaski Township	0	0	0	0
Raccoon Township	0	0	0	0
Rochester Borough	0	0	0	0
Rochester Township	0	0	0	0
Shippingport Borough	0	0	0	0
South Beaver Township	0	0	0	6
South Heights Borough	0	0	0	0
Vanport Township	0	0	0	0
West Mayfield Borough	0	0	0	0
White Township	0	0	0	0
BEAVER COUNTY (TOTAL)	**0**	**78**	**0**	**237**

Source: HAZUS-MH 3.0

Impact on the Environment

Tornado events are typically localized; therefore, environmental impacts are rarely widespread. Impacts of windstorms on the environment usually occur over a larger area. Severe damage to plant species is likely from both tornado and windstorm events. This includes uprooting or total destruction of trees, and increased threat to wildfire in areas of tree debris.

Future Growth and Development

As discussed and illustrated in Section 2.4, areas targeted for future growth and development have been identified across Beaver County. Any areas of growth could be affected by the tornado and windstorm hazard because the entire County is exposed and vulnerable to the wind hazard, particularly when associated with severe storms.

Effect of Climate Change on Vulnerability

Climate is defined not just as average temperature and precipitation but also by type, frequency, and intensity of weather events. Both globally and at the local scale, climate change could alter prevalence and severity of events such as hurricanes. While predicting changes in prevalence or intensity of hurricanes and in effects of events under a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating impacts of future climate change on human health, society, and the environment (U.S. Environmental Protection Agency [EPA], 2006).

Additional Data and Next Steps

Over time, the County will obtain additional data to support the analysis of this hazard. Data that will support the analysis would include additional detail on past hazard events and impacts and specific building information such as details on protective features (for example, hurricane straps).

4.3.13 Transportation Accident

Transportation hazards include hazardous materials (HazMat) in transit, vehicular accidents, aviation accidents, at-grade railroad crossings, and roadways vulnerable to floods. In 2012, the National Transportation Safety Board (NTSB) reported 35,531 transportation-related fatalities across the U.S. Of those 35,531 fatalities, 33,561 were highway incidents, 803 were rail incidents, 449 were aviation incidents, 12 were pipeline incidents, and 706 were marine incidents (NTSB 2012).

A transportation hazard may be defined as a condition created by movement of anything by common carrier. Transportation hazards can be divided into two categories: hazards created by the material being transported, and hazards created by the transportation medium. Transportation systems available in Beaver County include roadways, rail lines, and airports. Major road accidents in the County are probable, and major rail and aviation accidents are possible. All County systems and supporting transportation resources provide services locally, regionally, and nationally. Vehicular, aviation, HazMat, railway, and waterway accidents are defined below:

- Vehicular Accidents: A vehicular accident is a road traffic incident that usually involves one vehicle colliding with another vehicle or other road user, such as an animal or a stationary roadside object. A vehicular accident may result in injury, property damage, or possible fatalities. Many factors contribute to vehicular accidents, including equipment failure, poor road conditions, weather, traffic volume, and driver behavior.
- Aviation Accidents: According to the International Civil Aviation Organization, an aviation accident occurs during operation of an aircraft between the time a person boards the aircraft with intent to fly to a destination, to the time the person has disembarked the aircraft. Three different situations qualify as an aviation accident: (1) a person is fatally or seriously injured; (2) the aircraft sustains damage or structural failure; or (3) the aircraft is missing or inaccessible. An aviation incident is an occurrence, other than an accident, associated with operation of an aircraft that affects or could affect the safety of operation (International Civil Aviation Organization 1994). Airport accidents and incidents have the potential to occur while the plane is over County airspace; not only directly on airport property.
- Hazardous Materials (HazMat) in Transit: A HazMat is defined as a substance or material determined capable of posing an unreasonable risk to health, safety, or property when transported. "Unreasonable risk" covers a broad range of health, fire, and environmental considerations. HazMat come in various forms that can cause death; serious injury; long-lasting health effects; and damage to buildings, homes, and other property. HazMat substances include explosives, flammable solids, substances that become dangerous when wet, oxidizing substances, and toxic liquids. An accident involving a vehicle carrying HazMat becomes a HazMat incident if the HazMat leaks; is involved in a fire; or if potential for release, fire, or other hazard exists. Hazards can occur during production, storage, transportation, use, or disposal of HazMat (Illinois Emergency Management Agency 2012; Federal Emergency Management Agency [FEMA] 2015).
- Railway Accidents: Railway accidents involve one or more trains. They can involve a train derailment or one train impacting another train, vehicle, or pedestrian.
- Waterway Accidents: Waterway accidents associated with the transportation accident hazard typically involve loose barges or boats, as well as water rescues. Rarely do they involve significant collisions with other watercraft.

Transportation accidents described here include incidents involving road, air, and rail travel. Because of the low number of waterway accidents in the County, these accidents are only briefly mentioned under the Previous Occurrences section of this plan. HazMat transportation is an additional transportation threat to Beaver County. Volatility of products transported, along with potential impact on a local community, may increase risk of intentional acts against a transport vehicle. Release of certain products considered HazMat could cause immediate and adverse impacts on the general population, ranging from the inconvenience of

evacuations to personal injury and even death. Additional effects of a release of HazMat from transportation accidents are addressed in the Environmental Hazard profile (Section 4.3.4).

This section provides a profile and vulnerability assessment of the transportation accident hazard for Beaver County.

4.3.13.1 Location and Extent

Vehicular Accidents

Major roadways in Beaver County include the Pennsylvania Turnpike – Interstate (I)-76 and I-376 (Beaver Valley Expressway); U.S. Route-30; and Pennsylvania (PA)-65, 68, 18, and 51. Beaver County has almost 1,690 miles of roadways, divided as listed in Table 4.3.13-1, and illustrated on Figure 4.3.13-1 on the following page.

Table 4.3.13-1. Beaver County Transportation Network

Category	Miles
Interstate Highway	40.7
Freeways/Expressways	0.0
Principal Arterials	66.9
Minor Arterials	150.7
Major Collectors	168.0
Minor Collectors	66.8
Local Roads	1,196.6
Total	**1,689.7**

Source: Pennsylvania Department of Transportation (PennDOT) 2013

Transportation accidents can occur at any point along these roadways, with many occurring at the intersection of two or more roadways.

As of July 2015, 6,151 structurally deficient bridges were present throughout Pennsylvania (PennDOT 2015). Table 4.3.13-2 lists the total number of bridges in Beaver County, as well as the number of those that are structurally deficient (in parentheses). Each structurally deficient bridge poses a risk for transportation accidents.

Table 4.3.13-2. Bridges in Beaver County

On State Roads	On Local Roads
334 (65)	60 (16)

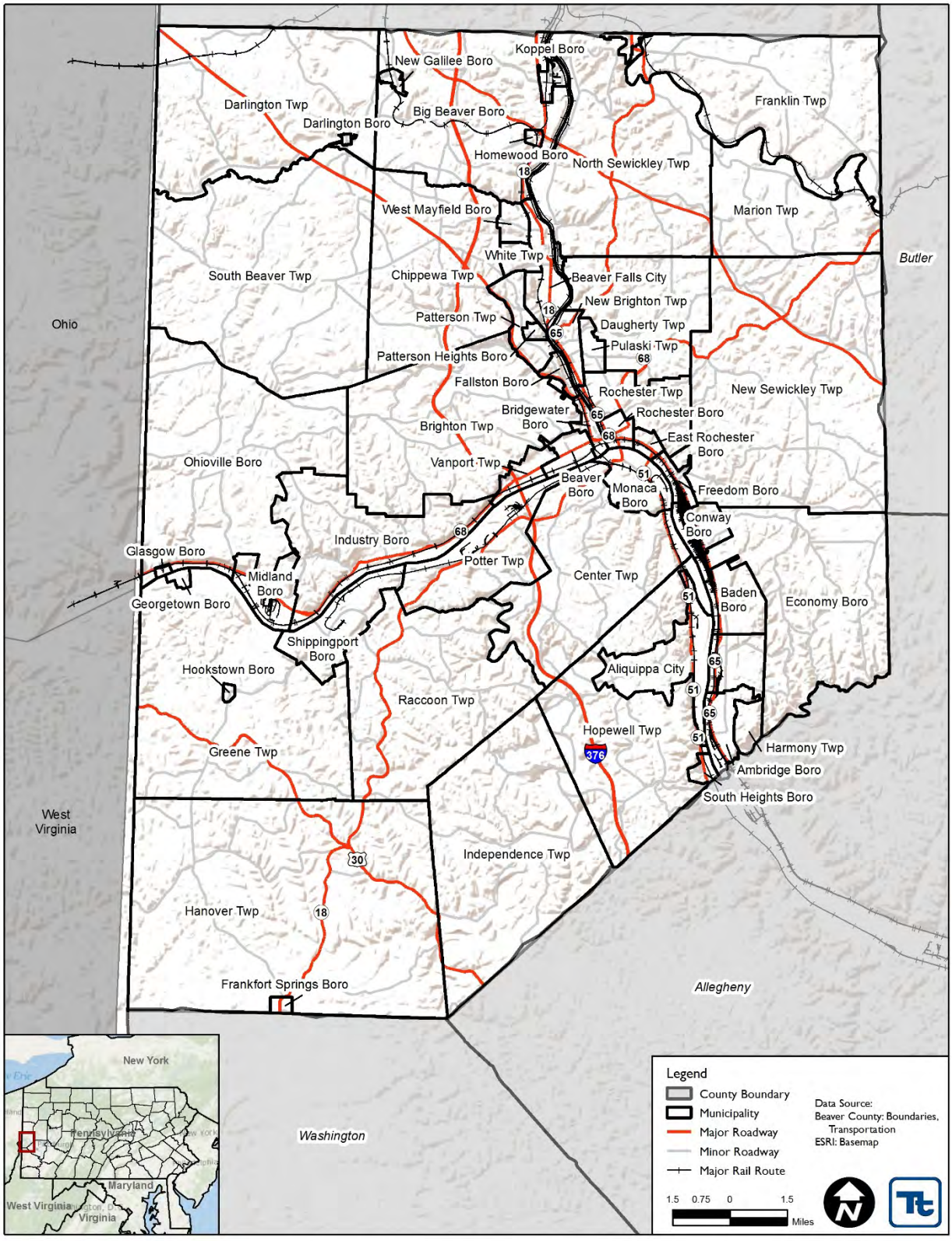
Source: PennDOT 2015

PennDOT has plans in place to rebuild some of these bridges during and beyond 2016. In the past 5 years, PennDOT has invested approximately $670 million to preserve more than 2,200 bridges. No data regarding the schedule to repair or rebuild Beaver County's structurally deficient bridges were available.

There is no warning time for vehicular accidents. Factors contributing to these accidents are typically associated with the driver, vehicle, and environment. Factors associated with the driver include error, speeding, experience, and blood-alcohol level. Factors associated with the vehicle include type, condition, and center of gravity. Environmental factors include quality of the infrastructure, weather, and obstacles. The majority of vehicular accidents are attributed to the driver. Vehicular accidents can severely affect those

directly involved, as well as others not directly involved. Other effects of vehicular accidents may include severe traffic delays, lost sales to businesses, delayed commodity shipments, and increased insurance costs (Cova and Conger 2003).

Figure 4.3.13-1. Major Roadways in Beaver County



Source: Beaver County 2015

Railway Accidents

Pennsylvania hosts freight, passenger, and commuter rail systems. The Pennsylvania Bureau of Rail Freight, Ports, and Waterways (BRFPW) cites in its 2035 Intercity Passenger and Freight Rail Plan that the freight rail network totals 5,095 miles of track with over 60 railroads, making Pennsylvania the fifth-largest rail network in the nation and the State with the greatest number of railroads. Three railroad systems offer Pennsylvania passenger service: (1) Southeastern Pennsylvania Transportation Authority (SEPTA) – Rapid Transit, Trolley and Light Rail, and Commuter Rail; (2) the Port Authority of Allegheny County (PAAC) – Light Rail); and (3) Amtrak (Intercity Passenger Rail). Amtrak is the only rail service that crosses the entire State (Pennsylvania BRFPW 2010).

Railways in Beaver County are typically located along the valleys of major waterways, including the Ohio River, Beaver River, and Connoquenessing Creek. Additionally, railways serve large industrial areas in Koppel, Midland, Aliquippa, Port Ambridge, and Shippingport. The Conway Yard is a major rail hub located in Conway Borough and is operated by Norfolk Southern (NS) Corporation. In addition to transporting goods and materials, the railways also transport people. Amtrak operates along a NS line. Specifically, there are five main railway operators in Beaver County:

- Amtrak
- Buffalo and Pittsburgh Railroad (BPRR)
- CSX Transportation (CSXT)
- Norfolk Southern Corporation (NS)
- A&S Genesee Wyoming Railroad

Rail accidents generally fit into one of three categories (Pennsylvania Emergency Management Agency [PEMA] 2013):

- Derailment – the train leaves the rails
- Collision – a train strikes another train or a vehicle
- Other – including striking objects on the rails, fires, or explosions

Aviation Accidents

Beaver County has 12 airports within its limits, including 10 private and two public airports. The Beaver County Airport in Beaver Falls, and the Zelienople Municipal Airport in Franklin Township, are more critical to mitigation planning because they are public airports and more susceptible to larger-scale aviation incidents. Additionally, Beaver County is near the Pittsburgh International Airport, a notable major public airport located 3 miles southeast of Beaver County. This airport has associated air traffic patterns in the skies above Beaver County that could lead to problems in flight and could result in a crash within the County (as occurred in 1994, described further in this section).

Approximately 80 percent of all aviation accidents occur shortly before or during take off and landing. Reportedly, most of these accidents are caused by human error. Mid-flight accidents are rare but not unheard of. A survey of 1,843 plane crashes between 1950 and 2006 showed that 53 percent were the result of pilot (human) error, 21 percent were caused by mechanical failure, 11 percent were caused by weather, 8 percent were attributed to other human error (lack of communication or improper maintenance), 6 percent were caused by sabotage and terrorism, and 1 percent resulted from other causes (Krasner 2009).

Aviation accidents are often devastating incidents that may result in serious injuries or fatalities. The Federal Aviation Administration (FAA) and the NTSB are the agencies responsible for monitoring air travel and investigating accidents. Some of the most common causes of aviation accidents occur as a result of violations of FAA and NTSB regulations. Some other causes of accidents include, but are not limited to:

- Pilot or flight crew errors – Pilot error is the number-one cause of aviation accidents and accounts for the highest number of fatalities. Pilots have the responsibility to transport passengers safely from one place to another and follow the FAA and NTSB regulations to better ensure passenger safety. If a pilot or flight crew makes an error, an accident may occur.

- Faulty equipment – Faulty aircraft equipment or mechanical features is another common cause of aviation accidents.

- Aircraft design flaws – The manufacturer of an aircraft is responsible for an aviation accident if the structural design is flawed and results in an accident.

- Failure to properly fuel or maintain the aircraft – If any regulations and safety standards set by the FAA or NTSB are violated, an accident may occur.

- Negligence of Federal Air Traffic Controllers – Failure of air traffic controllers to properly monitor the airways is another cause of aviation accidents (Aviation Law News Date Unknown).

4.3.13.2 Range of Magnitude

Roadway accidents in Beaver County range from minor crashes to more serious incidents that involve injuries or fatalities, or result in release of HazMat (see Section 4.3.4). Information for this plan regarding fatalities associated with automobile crashes (Table 4.3.13-3), fatalities of pedestrians involved in transportation incidents (Table 4.3.13-4), and fatalities by person/crash type in Beaver County (Table 4.3.13-5) was drawn from the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) 2015 data.

Table 4.3.13-1. Fatalities from Automobile Crashes

Timeline	Pennsylvania	Beaver County
2009	1,256	13
2010	1,324	10
2011	1,286	24
2012	1,310	19
2013	1,208	13
2014	1,195	10
Total:	**6,384**	**80**

Source: NHTSA 2015

Table 4.3.13-2. Fatalities of Pedestrians

Timeline	Pennsylvania	Beaver County
2009	134	0
2010	145	0
2011	147	2
2012	163	3
2013	147	1
2014	161	0
Total:	**897**	**6**

Source: NHTSA 2015

Table 4.3.13-5. Fatalities by Person/Crash Type in Beaver County

Fatality Type	2009	2010	2011	2012	2013	2014
Total Fatalities (All Crashes):	**13**	**10**	**24**	**19**	**13**	**10**
Alcohol-Impaired Driving Fatalities	3	3	8	7	4	3
Single Vehicle Crash Fatalities	5	6	13	14	6	8
Large Truck-Involved Crash Fatalities	0	1	5	2	1	0
Speeding-Involved Crash Fatalities	4	8	7	8	3	4
Rollover-Involved Crash Fatalities	1	4	6	4	6	4
Roadway Departure-Involved Crash Fatalities	5	7	14	13	7	6
Intersection (or Intersection-Related) Crash Fatalities	7	2	3	4	3	1
Passenger Car Occupant Fatalities	7	5	8	4	5	2
Light Truck Occupant Fatalities	2	2	9	7	4	2
Motorcyclist Fatalities	4	3	4	4	2	5

Source: NHTSA 2015
Note: A fatality can be listed in more than one category; therefore, the sum of the individual cells will not equal the total (due to double-counting).

Rail accidents can vary widely in terms of injuries, fatalities, property damage, and interruption of service, depending on the nature and severity of the accident. Local residents may also be involved in rail accidents while traveling outside the County.

Aircraft accidents can vary from a single-engine aircraft having a "hard landing" and causing damage to the aircraft, to a crash of a small turboprop or jet aircraft, to a crash of a large jet aircraft (such as a Boeing 727). Other aircraft accidents could include helicopter or experimental aircraft crashes. Aviation accidents also can involve radio-controlled or drone aircraft devices, many of which are experimental and not subject to defined regulatory oversight, potentially complicating issues with and for the public that could arise if one of these devices crashes.

The worst-case scenario for a roadway transportation accident within the County would be the overturning of a tractor trailer carrying an extremely hazardous substance (further described in Section 4.3.4), resulting in a massive release of its cargo on a major roadway. This incident would block traffic on Beaver County's major

transportation routes, and could threaten the health and safety of individuals on the roadways and in surrounding neighborhoods. In addition, a release could necessitate closure of critical facilities in the County. The worst-case scenario for a railroad accident would be similar to that described for a roadway accident (i.e., a train carrying a hazardous substance crashing in the Conway Yard). The worst-case scenario for an aviation accident would be a major plane crash into a residential or industrial area, causing mass fatalities and property destruction. The most likely transportation accident in the County would involve a single vehicle hitting an object and sustaining minimal damage.

4.3.13.3 Past Occurrence

Beaver County reports major accidents (such as multi-vehicle accidents, those that close roads or bridges, or those involving school buses) to PennDOT. Table 4.3.13-6 summarizes these accidents from 1999 to 2014. While this table lists accidents reported to the counties and Commonwealth, a significantly higher number of minor accidents are not reported.

Table 4.3.13-6. Summary of Major Vehicle Accidents in Beaver County, 1999 to 2014

Year	Vehicle Accidents	Year	Vehicle Accidents
1999	1,653	2007	9,235
2000	1,612	2008	7,589
2001	1,586	2009	6,620
2002	1,556	2010	1,524
2003	9,068	2011	1,408
2004	9,598	2012	1,458
2005	9,795	2013	1,459
2006	8,386	2014	1,404

Source: Beaver County Emergency Services 2010; PennDOT 2014

Because of the number and proximity of rail lines and airports, Beaver County has also experienced both rail and aviation accidents. In October 2006, an 86-car train derailed in New Brighton, spilling HazMat. Recent rail accidents, however, are more frequently the result of a person or car being hit at a train crossing rather than because of a train derailment. As recently as July 2014, a 14-year-old boy was hit and injured by a train in Homewood Borough (Schaarsmith 2014). In September 2013, a 29-year-old man was struck and killed by a train while crossing tracks located in Beaver Falls (Pittsburgh CBS Local 2013). One month later, a 73-year-old woman was also struck and killed by a train in Beaver Falls (WPXI 2013). In 2011, a train struck a car when it was crossing tracks in Big Beaver Borough, causing one fatality and one injury to the occupants in the vehicle (Pittsburgh CBS Local 2011). In total, 17 train-related accidents have been reported to Knowledge Center since 2006; four of these events were derailments and the rest involved a train collision with either a vehicle or pedestrian (Knowledge Center 2015).

Aircraft and aviation accidents are less frequent than railroad-related incidents. In 1998, a single-engine aircraft crashed upon take off from the Beaver County Airport, killing two passengers. Based on anecdotal history, the Zelienople Municipal Airport has experienced five aircraft-related deaths in the past 20 years (Beaver County 2011). In 2003, a helicopter crash occurred at the airport; however, no injuries were reported. Additionally, as mentioned earlier, aviation accidents can occur over County airspace. In 1994, a Boeing 737 en route to Pittsburgh International Airport crashed in Hopewell Township. All 132 people on board were killed. Since 2006, Beaver County has recorded 12 aircraft-related incidents, although not all of these involved injuries or fatalities (Knowledge Center 2015).

Recently, Beaver County has been witness to only minor aviation accidents that do not result in severe injuries or loss of life. In 2012, a small plane crashed in Chippewa Township after hitting a power line. Neither of the two people on the plane were seriously injured (WPXI 2012). In 2013, another small plane crash-landed in Chippewa Township after engine difficulty. Neither occupant was injured (Pittsburgh CBS Local 2013b).

Although not as major a concern to County transportation accident mitigation due to the more limited occurrences, Beaver County has also experienced waterway transportation accidents. According to the Pennsylvania Fish and Boat Commission, nine deaths in Beaver County have been attributed to waterway transportation accidents since 1993. Three other drowning fatalities have occurred since 2012, although these are not necessarily related to water transportation accidents. The most significant water transportation accident occurred in 2005, when coal barges traveling the Ohio River crashed over the Montgomery Lock and Dam in Industry Borough. Four of the seven crew members of the barges were killed. Another accident occurred at the Montgomery Lock and Dam in 2006 when a recreational boat crashed into one of the gates, killing the two people on board. Knowledge Center reports indicate that the County has performed two water rescues, managed one boat fire, and assisted six barge-related incidents since 2006 (Knowledge Center 2015).

4.3.13.4 Future Occurrence

Transportation hazards are impossible to predict accurately; however, areas prone to these hazards can be located, quantified through analysis of historical records, and plotted on Countywide and municipality base maps. Certain characteristics that contribute to the occurrence or increase vulnerability to these hazards can be identified, in particular, areas that may be prone.

Assuming that transportation accidents are as likely to occur in the future as they have occurred in the past, and based on the available data, Beaver County can expect the following each year:

- Approximately 1,450 major vehicle accidents (The actual number of vehicle accidents in Beaver County may be much higher; however, this figure is based on the 5-year average of vehicle accidents captured from PennDOT.)
- 0 to 1 aircraft incidents
- 1 railroad incident, most likely involving a pedestrian or car being struck by a train

Additionally, the County has noted an increase in crude oil rail traffic and a pipeline expansion; New Sewickley Township has also noted that overall traffic has increased, thus creating a greater likelihood for future accidents. Based on the Risk Factor Methodology Probability Criteria, the probability of a transportation accident in the categories listed above is considered to be *highly likely* (described further in Table 4.4-1).

4.3.13.5 Vulnerability Assessment

The entire County has been identified as the hazard area for transportation accidents. The following subsections evaluate and provide estimates for the potential impacts of transportation hazards on Beaver County, including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts, including those on life, safety, and health; and on general building stock, critical facilities, the economy, and future growth and development
- Further data collections that will assist in understanding this hazard over time

Overview of Vulnerability

Transportation systems available in the County rely on use of its roadways. Hazards associated with transportation can be natural hazards that affect the roadway, the material being transported, or hazards pertaining to the transportation medium itself.

Multiple major roadways (interstates and other major highways) within the County are used by residents and commuters, as well as by businesses for transporting all types of materials, including HazMat. A major accident on any of these major roadways is possible and could affect the County minimally to severely.

Data and Methodology

Regarding this hazard, data were obtained from the County, local officials, and federal data sources. In addition, the Planning Committee has identified roadways within the County that are vulnerable to other natural hazards (flood).

Impact on Life, Health, and Safety

Transportation hazards could lead to potential losses in categories of human health and life, property, and natural resources. Vehicular accidents, flooded roadways, and other roadway impairments may result in injury or death to drivers and passengers on the road, the public in the immediate vicinity, and emergency services personnel. The number of people exposed depends on population density, time of exposure (day or night), and proportions of the population located indoors and outdoors.

The County and its municipalities are prepared to manage and respond to transportation hazards.

Impact on General Building Stock, Critical Facilities, Economy, and Future Development

Because of insufficient data, a full loss estimate was not completed for the transportation hazard. Loss of roadway use and public transportation services would affect thousands of commuters, employment, day-to-day operations within the County, and delivery of critical municipal and emergency services. Disruption of one or more of the modes of transportation in use in Beaver County can lead to congestion of another, and affect both the County and the region as a whole. As discussed in Section 2.4, areas targeted for future growth and development have been identified across the County. Increased development in the County and region will lead to increased road traffic.

Additional Data and Next Steps

Based on limited data regarding the probability and potential impact of this hazard, a quantitative loss estimate was not completed for this HMP. Over time, the County can work with appropriate agencies to collect additional data to support mitigation planning, consider potential risks, and prioritize mitigation measures for this hazard.

It is recognized that the County must compile and maintain data regarding specific concerns and past losses from this hazard. These data should include specific information regarding damage or loss of life, property, or infrastructure; and any data pertaining to potential or actual cost and logistics of responding to an event caused by this hazard (locations of road closures, map detours, traffic counts, durations of closures and detours; and costs to respond). These data will be included in future revisions of the HMP, and can be used to support future mitigation grant efforts (benefit cost analysis).

Studying traffic and potential transportation accident patterns could provide information on vulnerability of specific road segments and nearby populations. Increased understanding of the types of HazMat transported through the County will also support mitigation efforts. Maintaining a record of these frequently transported

materials can facilitate development of preparatory measures to respond to a release. Predicting costs to respond to a release, remediate the environment, or repair damaged infrastructure would be useful for developing mitigation options.

4.3.14 Urban Fire and Explosions

This section provides a hazard profile and vulnerability assessment of the urban fire and explosions hazard for Beaver County.

4.3.14.1 Location and Extent

Structural and urban fires within Beaver County have had a detrimental impact on life, property, and the local economy over the past decade. The age of many residential structures within the region combined with changes in building construction and materials has increased the threat of fire loss that is occurring on a regular basis.

As defined by the National Fire Protection Agency (NFPA) in the *NFPA 901: Standard Classifications for Incident Reporting and Fire Protection Data*, a structure fire is defined as "Any fire inside, on, under, or touching a structure." This definition includes any mobile residential structure such as a mobile or modular home, but does not include roadworthy vehicles such as recreation vehicles (NFPA 2011). Significant urban fires are limited to densely populated areas of the County that contain large and/or multiple buildings. Urban fires may start in single structure, but spread to nearby buildings or throughout a large building if adequate fire control measures are not in place.

Significant explosions are most common in densely populated areas and at industrial facilities that utilize combustible hazardous materials. Explosions can also occur in conjunction with automobile, boat, and rail accidents. All such explosions can turn into fires, spreading to nearby structures.

4.3.14.2 Range of Magnitude

The severity of urban fires is measured according to the losses associated with the incident. The impact to the local economy is minimal with the loss of a residential structure, but effects of the loss of a large manufacturing facility that employs a large number of people can be extensive. Likewise, the impact to the local environment from a single residential fire is minimal, while the impact from an industrial or commercial fire can take years to measure. Finally, the loss of life caused by urban fires appears to be opposite of the previous two impacts. The loss of life is more likely to be associated with a residential fire than an industrial or commercial building fire. Building compositions combined with the time of day of the incident are risk factors that can increase the chance for the loss of life during a residential-type fire.

The effects of a major (industrial) explosion include minor to serious property damage, loss of life, environmental damage, and residential or industry displacement. Severe explosions result in extensive damage to residential, commercial, and/or pubic property. Lives may be lost and people are often displaced. Additionally, major explosions may result in hazardous materials mitigation issues.

The urban fires within Beaver County are usually small and generally affect residential structures. These fires are limited in duration and are generally contained within the local jurisdiction. While the average fire is small, the threat from a large or even catastrophic fire is always present. Many operations within larger industrial and commercial sites within Beaver County are prone to and have experienced small fires that if improperly contained can (and do) lead to catastrophic fire losses. Combined with the presence of volatile materials, threats of fire and explosions are ever changing and increasing within the region. Vacant buildings (both residential and commercial) pose a particular threat concerning urban fires. Ambridge Borough in particular noted a larger number of vacant buildings, increasing its potential vulnerability to this hazard.

The worst year on record in Beaver County for fire hazards was 2000, when 11 people lost their lives due to fires. A worst-case scenario for fire would be a large urban fire destroying residential and industrial buildings, which would potentially cause additional environmental hazard effects. A worst-case scenario for explosions would be a massive explosion causing numerous fatalities in the facility as well as the surrounding area, and leading to a secondary urban fire(s).

4.3.14.3 Past Occurrence

Within Beaver County from 1999 to October 2015, 12,046 structural fires were reported to the Pennsylvania Emergency Management Agency (PEMA). While not an all-encompassing listing, these fires represent incidents that met the threshold set forth by the State to be a reportable incident. Table 4.3.14-1 shows an annual fire report for Beaver County from 1999 to 2015. The 2015 data listed below does not include events after October 13, 2015. No federally declared disasters have been reported as a result of structural fires in Pennsylvania.

Table 4.3.14-1: Reported Structural Fires 1999-2015

Year	Structural Fires	Brush Fires	Fatalities
1999	952	575	6
2000	841	380	11
2001	752	307	2
2002	601	360	2
2003	1,275	488	1
2004	1,315	226	5
2005	1,224	524	2
2006	1,324	647	0
2007	1,557	372	0
2008	796	289	0
2009	594	361	2
2010	472	251	0
2011	48	2	2
2012	74	6	1
2013	71	2	0
2014	72	5	1
2015	78	3	0
Total	**12,046**	**4,798**	**35**

Source: Pennsylvania Emergency Incident Response System (PEIRS) 2011; Beaver County Emergency Services 2011; Knowledge Center 2015

Note: (1) The statistics for fires from 1999 to 2010 originate from PEIRS, and those for fires from 2011 to 2015 are from Knowledge Center. Differences in reporting programs or procedures may account for the significant drop in reported fires.

(2) One fire event in 2013 was listed as both a structural and brush fire. This event was recorded under both categories; however, the total number of reported fires in 2013 is 72.

(3) The number of fires for 2015 includes January 1, 2015, through October 12, 2015, based on when reports were run.

Data from the Department of Conservation and Natural Resources (DCNR) indicates that four wildfires (14.5 acres burned) occurred between 2002 and 2013 in Beaver County. While these are not urban fires, they have the potential to spread to urbanized areas and cause similar issues. These fires may or may not be represented under the incidents indicated in the table above.

Several explosions have occurred in Beaver County during the past decade. These incidents were primarily industrial in nature and resulted in one or more the following: extensive use of resources, loss of jobs, or impact to the community. In 1984, an explosion at the Valvoline Plant in Freedom caused multiple fatalities. In addition, heavy smoke conditions caused road closures and forced evacuations of surrounding buildings. In July 2010, an explosion at the Horsehead Corporation zinc smelting plant in Monaca killed two people (Chemical Safety Board [CSB] 2015). In February 2011, an explosion at a Marcellus Shale natural gas well site in Independence Township led to minimal environmental damage, a large fire, and injuries to three employees (WTAE 2011). Most recently, in July 2014, a home in South Beaver exploded and resulted in the death of two residents. The explosion was heard from several miles away. Investigators identified both a basement stove and outside propane tank as possible causes for the explosion (Pittsburgh CBS Local News 2014).

4.3.14.4 Future Occurrence

Based on the Risk Factor Methodology Probability Criteria, urban fires are categorized as *highly likely*. According to the NFPA report *A Few Facts at the Household Level,* based on historical data collected, an average household is expected to experience a fire within a structure every 15 years, based on an average expectance of the household to be 78 years (NFPA 2009). While most of these fires will be considered small and may not cause any significant damage, the possibility of a catastrophic loss caused by fire is present.

NFPA reports a decreasing trend in structural fires within the United States over the past 30 years. Based on public outreach campaigns to promote fire safety awareness and smoke detector use, NFPA has reported a decrease of more than 7,000 deaths per year in the 1970s to about 3,200 deaths in 2014 (NFPA 2015). Despite the decrease reported in fire fatalities, Beaver County remains consistent with the number of fires reported over the previous several years. This number has dropped, however, from the number of incidents reported in 2010 or earlier. The quantity of residential and industrial structures within Beaver County, combined with a varying range of fire code enforcement, equates to a potential for significant loss in the future. In addition, the influx of commercial and industrial sites within Beaver County also increases the possibility of future commercial or industrial fires.

While a number of explosion-related events have occurred in Beaver County in the past, explosion incidents are generally considered difficult to predict. An occurrence is largely dependent upon the accidental actions of a person or group and/or oversights in industrial processes. However, past occurrences of explosions indicate that they will continue into the future. The concentration of industrial activity located in aging facilities increases the potential for an accident. Therefore, the probability for industrial accidents is considered *possible,* as defined by the Risk Factor Methodology probability criteria.

4.3.14.5 Vulnerability Assessment

The potential for fire damage is not limited to any one area of the County. However, human error can play an important role in creating the potential for a major urban or forest fire. The vulnerability of the citizens and property of Beaver County to fire and related incidents depends on many factors. A positive factor helping to mitigate the risk is the advanced fire services provided within the County. On the negative side, many homes and business within the County have not been updated to current fire safety codes. The risk of loss caused by fire increases each year that these structures go without safety updates. In Pennsylvania, the most vulnerable

population groups are the elderly, age 65 and over, and the low-income earners. The elderly had the highest number of deaths resulting from fire and all population groups. The elderly in the County represent a large portion of the population spectrum.

Although newer buildings are constructed with higher safety standards and with more fire-resistant material, large numbers of older, highly vulnerable buildings remain throughout the County. Until these buildings are upgraded or replaced, the risk will continue.

Similarly, the potential for explosions is not limited to any one area of the County. However, human error can play an important role in creating the potential for a major explosion. The vulnerability of the citizens and property of Beaver County to explosions and industrial accidents depends on many factors. A positive factor helping to mitigate the risk is the advanced emergency services provided within the County. On the negative side, many industries within the County inhabit buildings that have not been updated to current fire and safety standards. Additionally, despite regulations and standards enforced by the Occupational Safety and Health Administration (OSHA), preventable malfunctions in industrial activities persist.

4.3.15 Utility Interruptions

A utility interruption, or power failure, is defined as any interruption or loss of electrical service from disruption of power transmission caused by accident, sabotage, natural hazards, or equipment failure (also referred to as a loss of power or power outage). A significant power failure is defined as any incident of a long duration that would require the involvement of the local or State emergency management organizations to coordinate provision of food, water, heating, cooling, and shelter.

This section provides a profile and vulnerability assessment of the utility interruption hazard for Beaver County.

4.3.15.1 Location and Extent

Utility interruptions occur throughout Beaver County, but are usually of small scale and short duration. Utility interruptions in Beaver County focus primarily on power failures that are often a secondary impact of another hazard event. For example, severe thunderstorms or winter storms could bring down power lines and cause widespread disruptions in electricity service. Strong heat waves may result in rolling blackouts where power may not be available for an extended period. Local outages may be caused by traffic accidents or wind damage.

Local companies—such as Penn Power, a FirstEnergy Company that provides electricity to Beaver County—are capable of handling minor interruptions (Section 2 of this plan describes other utilities in the County). Interruptions are possible anywhere utility service has been installed. Some utility facilities are especially vulnerable. For instance, because water intakes and many water control facilities lie in the 1-percent annual chance floodplain, a flood of this magnitude may seriously impair water service. Section 4.3.5 provides more detail on possible flood impacts.

Interruptions in basic utilities (such as power, data/telecommunications, water, or sewer) can have a detrimental impact on Beaver County. Utilities that employ aboveground wiring (power and data/telecommunications) are vulnerable to the effects of other hazards such as high wind, heavy snow, ice, rain, and vehicular accidents.

4.3.15.2 Range of Magnitude

Generally speaking, the most severe utility interruptions are regional power outages. Regional loss of power affects lighting; heating, ventilation, and air conditioning (HVAC) and other support equipment; communications; fire and security systems; and refrigerators, which can in turn cause loss of water and sewer service, and food spoilage. These effects are especially severe for individuals with functional needs and the elderly.

At a minimum, power outages can cause short-term disruption in the orderly functioning of businesses, government operations, and private citizen functions and activities. Examples of everyday functions that would be affected by power outages include traffic signals, elevators, and retail sales. A worst-case scenario for utility interruption in Beaver County would be a County-wide power outage during winter months, forcing the evacuation of vulnerable populations.

Sabotage also plays a role in some utility outages. Sabotage may be the direct result of a malicious attack against utilities, or may be the secondary effect of the theft of copper wiring. In report published in October 2010 titled “An Updated Assessment of Copper Wire Theft from Electric Utilities,” the U.S. Department of

Energy's (DOE) Office of Electricity Delivery and Energy Reliability reported that United States-based utilities suffer several million dollars' worth of copper thefts annually (DOE 2010). The estimated minutes of outages experienced by utilities nationwide as a result of copper theft were 456,000 or about 7,600 hours (American Public Power Association [APPA] 2012).

4.3.15.3 Past Occurrence

The nationwide oil embargo of 1973 through 1974, the severe winter of 1976 through 1978, and the national gasoline shortage of 1979 emphasized the vulnerability of all residents in Beaver County to energy emergencies. Minor power outages occur annually. Beaver County has not endured any localized energy emergencies. However, some County residents have experienced individual household emergencies, likely due to aging utility infrastructure. No comprehensive list of utility interruptions exists for the County.

Every year, Beaver County is susceptible to minor utility interruptions either through technological failure or as the result of inclement weather. Table 4.3.15-1 below shows the number of utility interruptions reported to the State for Beaver County (by type) between 2007 and 2015. The 2015 data reflects incidents reported through October 2015 only.

Table 4.3.15-1: Utility Interruptions from 2007-2015

	9-1-1 Issue	Gas	Phone	Power	Sewer	Water	Electrical	Other	Total
2006	2	NR	NR	NR	NR	1	NR	NR	**3**
2007	NR	1	4	2	NR	2	NR	1	**10**
2008	NR	1	1	8	NR	2	NR	2	**14**
2009	2	1	2	NR	NR	1	1	2	**9**
2010	NR	1	1	2	NR	3	NR	NR	**7**
2011	NR	1	NR	3	NR	5	NR	NR	**9**
2012	NR	3	1	7	NR	3	1	1	**16**
2013	NR	1	1	2	NR	3	NR	1	**8**
2014	NR	1	1	6	NR	5	NR	2	**15**
2015	NR	3	NR	1	NR	2	NR	1	**7**

Source: Knowledge Center 2015

Notes:
NR: None reported

4.3.15.4 Future Occurrence

Minor power failure (i.e., short outage events) may occur several times a year for any given area in the County, while major (i.e., widespread, long outage) events take place once every few years. Power failures often occur during severe weather; therefore, they should be expected during those events. Based on the assumption that the County will experience severe weather annually, in addition to outages from other causes, the future occurrence of utility interruptions in Beaver County should be considered *highly likely* as defined by the Risk Factor Methodology probability criteria.

4.3.15.5 Vulnerability Assessment

Utility interruptions most severely affect individuals with access and functional needs (e.g., children, the elderly, and individuals with special medical needs). Special medical equipment will not function without power. Likewise, a loss of air conditioning during periods of extreme heat or the loss of heating during extreme cold can be especially detrimental to those with medical needs, children, and the elderly. A lack of clean, potable water has health implications for all people, and a lack of water supply may also affect the sewer system and the availability of sewer service. Ambridge Borough, in particular, noted its concern with ensuring the safety of its vulnerable populations during a utility interruption.

All facility infrastructure considered critical are vulnerable to utility interruptions, especially the loss of power. The establishment of reliable backup power at these facilities is extremely important to continue to provide for the health, safety, and well-being of Beaver County's population. The City of Beaver Falls has identified that Providence Health Care would require special patient care in the event that their diesel backup generators run low on fuel. The current estimated run time, per maintenance staff, is 5 days on a 200-gallon tank. Additionally, if Beaver Falls Plaza experiences water loss caused by power failures, the Plaza could require the evacuation of up to 150 residences. This emphasizes how strong an impact even a relatively small utility failure can have.

No data regarding economic impacts from utility interruptions in Beaver County are available. However, utility interruptions can cause economic impacts stemming from lost income, spoiled food and other goods, costs to the owners or operators of the utility facilities, and costs to government and community service groups.

4.3.16 Winter Storm

This section provides a profile and vulnerability assessment of the winter storm hazard in Beaver County. Winter storms occur, on average, approximately five times each year in Pennsylvania. From November through March, the State is exposed to winter storms that move up the Atlantic coast or sweep in from the west. Every county in the Commonwealth is subject to severe winter storms; however, the northern tier, western counties, and mountainous regions tend to undergo winter weather more frequently and with greater severity.

Winter storms can produce more damage than any other severe weather event, including tornados. Complications caused by winter storms can lead to road closures, especially of secondary and farm roads; business losses to commercial centers built in outlying areas because of supply interruption and loss of customers; property losses and roof damages from snow and ice loading and fallen trees; utility interruptions; and loss of water supplies. Flooding can result from winter storm events as well.

Most severe winter storm hazards include heavy snow (snowstorms), blizzards, sleet or freezing rain, ice storms, and Nor'easters. Because most extra-tropical cyclones (mid-Atlantic cyclones locally known as Northeasters or Nor'easters) generally occur during winter weather months, these hazards have also been grouped as a type of severe winter weather storm. Types of severe winter weather events or conditions are further defined as follows:

- Heavy Snow: According to the National Weather Service (NWS), heavy snow is generally considered snowfall accumulating to depths of 4 inches or more within 12 hours or less; or snowfall accumulating to depths of 6 inches or more within 24 hours or less. A snow squall is an intense but limited-duration period of moderate to heavy snowfall, also known as a snowstorm, accompanied by strong, gusty surface winds and possibly lightning (generally moderate to heavy snow showers) (NWS 2009). Snowstorms are complex phenomena involving heavy snow and winds, whose impact can be affected by a great many factors, including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, and occurrence during the course of the day, weekday versus weekend, and time of season (Kocin and Uccellini 2013).

- Blizzard: Blizzards are characterized by low temperatures, wind gusts of 35 miles per hour (mph) or more, and falling and/or blowing snow that reduces visibility to 0.25 mile or less for an extended period of time (3 or more hours) (NWS 2009). A severe blizzard is defined as an event with wind velocity of 45 mph, temperatures of 10 degrees Fahrenheit (°F) or lower, and a high density of blowing snow with visibility frequently measured in feet over an extended period of time.

- Sleet or Freezing Rain: Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen, partially-melted snowflakes. These pellets of ice usually bounce after hitting the ground or other hard surfaces. Freezing rain is rain that falls as a liquid but freezes into glaze upon contact with the ground. Both types of precipitation, even in small accumulations, can cause significant hazards to a community (NWS 2009).

- Ice storm: An ice storm is described as an occasion when damaging volumes of ice are expected to accumulate during freezing rain situations. Significant accumulations of ice pull down trees and utility lines, resulting in loss of power and means of communication. These accumulations of ice make walking and driving extremely dangerous, and can create extreme hazards to motorists and pedestrians (NWS 2009).

- Nor'easter (abbreviation for Northeaster): Nor'easters are named for the strong northeasterly winds that blow in from the Atlantic Ocean ahead of the storm and over coastal areas. They are also referred to as a type of extra-tropical cyclone (mid-latitude storms, or Great Lake storms). A Nor'easter is a macro-scale, extra-tropical storm whose winds come from the northeast, especially in the coastal areas of the northeastern United States and Atlantic Canada. Wind gusts associated with Nor'easters can exceed hurricane forces in intensity. Unlike tropical cyclones that form in the tropics and have warm cores (including tropical depressions, tropical storms, and hurricanes), Nor'easters contain a cold core of low barometric pressure that forms in the mid-latitudes. Their strongest winds are close to the earth's surface and often measure several hundred miles across. Nor'easters may occur at any time of the year but are more common during fall and winter months (September through April) (New York City Office of Emergency Management [NYCOEM] Date Unknown).

Nor'easters can include heavy snow, rain, gale-force winds, and oversized waves (storm surge) that can cause beach erosion, coastal flooding, structural damage, power outages, and unsafe human conditions. If a Nor'easter cyclone stays just offshore, the results are much more devastating than if the cyclone travels up the coast on an inland track. Nor'easters that stay inland are generally weaker and usually cause strong winds and rain. Those that stay offshore can bring heavy snow, blizzards, ice, strong winds, high waves, and severe beach erosion. In these storms, the warmer air is aloft. Precipitation falling from this warm air moves into the colder air at the surface, causing crippling sleet or freezing rain (McNoldy Multi-Community Environmental Storm Observatory [MESO] Date Unknown). While some of the most devastating effects of Nor'easters occur in coastal areas (e.g., beach erosion, coastal flooding), effects on inland areas, like Beaver County, may include heavy snow, strong winds, and blizzards.

4.3. 16.1 Location and Extent

Winter storms are regional events, with most events impacting a large area or the entire Commonwealth. In many cases, surrounding states and even the northeast region of the United States are affected by a single winter storm event.

The magnitude or severity of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts, snowfall rates, wind speeds, temperatures, visibility, storm duration, topography, time of occurrence during the day (e.g., weekday versus weekend), and time of season.

The extent of a severe winter storm can be classified by meteorological measurements and by evaluating its societal impacts. National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) currently produces the Regional Snowfall Index (RSI) for significant snowstorms that affect the eastern two-thirds of the United States. The RSI ranks snowstorm impacts on a scale from 1 to 5. The index is based on spatial extent of the storm, amount of snowfall, and interaction of extent and snowfall totals with population (based on the 2000 U.S. Census). NCDC has analyzed and assigned RSI values to over 500 storms since 1900 (NOAA-NCDC 2011). Table 4.3.16-1 describes the five RSI ranking categories.

All of Beaver County is susceptible to winter storms. Based on annual snowfall averages according to the 2013 State Hazard Mitigation Plan (HMP) (Figure 4.3.16-1), Beaver County expectedly would receive an average of 30-40 inches of snowfall accumulation during the winter season.

Table 4.3.16-1. RSI Ranking Categories

Category	Description	RSI Value
1	Notable	1-3
2	Significant	3-6
3	Major	6-10
4	Crippling	10-18
5	Extreme	18.0+

Source: NOAA-NCDC 2011

Notes: RSI Regional Snowfall Index

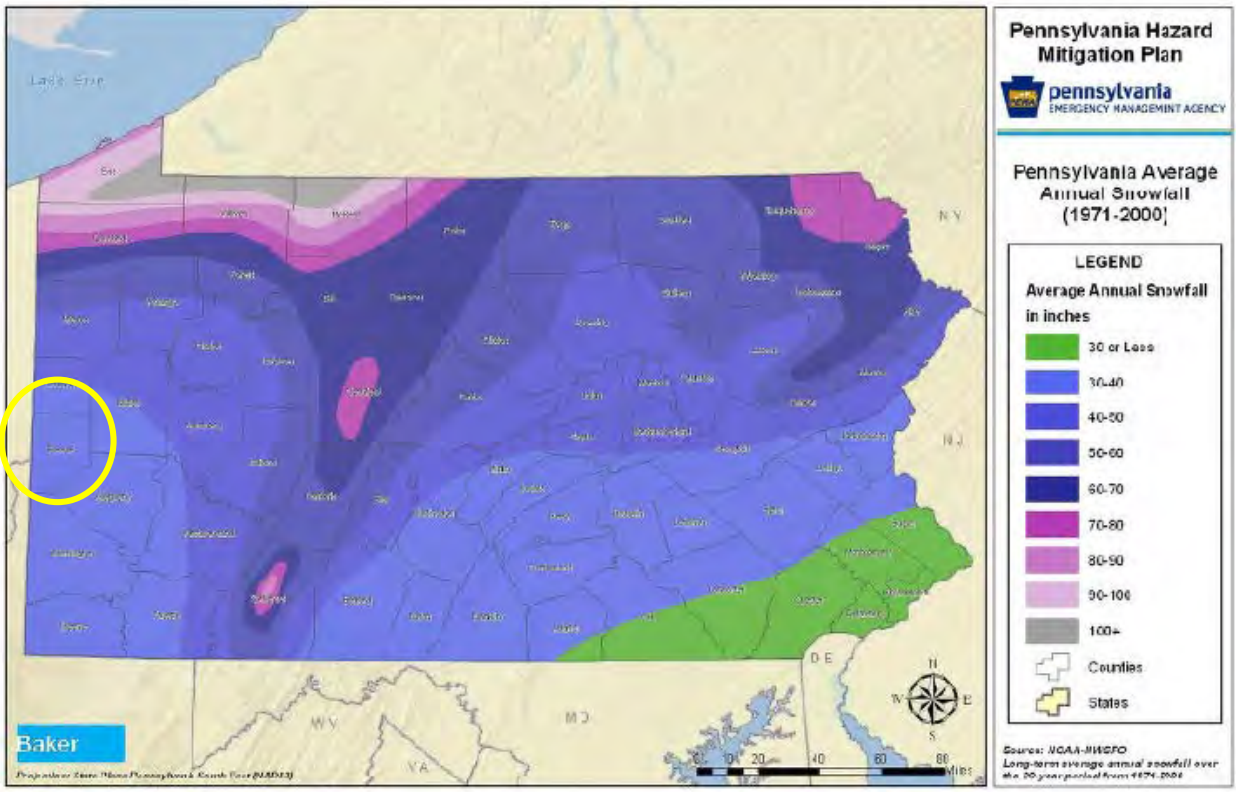
4.3. 16.2 Range of Magnitude

A winter storm can adversely affect roadways, utilities, and businesses, and can cause loss of life, frostbite, and freezing conditions. These storms typically fall into one of the following categories, which have been defined in the previous section:

- Heavy snow
- Sleet or freezing rain
- Ice storm
- Blizzard
- Nor'easter.

Beaver County typically receives 30-40 inches of snow each year, as shown on Figure 4.3.16-1. The worst winter storm to strike Beaver County occurred in January 1994. Specific snowfall totals during that storm were not available, but snowfall in the southwest portions of Pennsylvania exceeded 30 inches within 1 day. The Pennsylvania Turnpike (I-76), as well as I-70 (a major north-south highway in the County), were closed or shut down because of the snow. The storm brought with it strong winds and sleet/freezing rains. Numerous storm-related power outages were reported, and as many as 600,000 residents throughout Pennsylvania were without electricity, in some cases for several days at a time. The storm caused 185 injuries and approximately $5 million in damages across the State. South Beaver Township notes that most winter storm hazards in the region are minimal, and the most common concern is persons venturing outside too soon or at unsafe speeds on roadways. Primary impacts are from travel, not from damage to structures.

Figure 4.3.16-1. Annual Snowfall



Source: Pennsylvania Emergency Management Agency (PEMA) 2013

Note: Beaver County is within the yellow oval.

4.3. 16.3 Past Occurrence

Many sources provided historical information regarding previous occurrences and losses associated with winter storm events throughout the Commonwealth of Pennsylvania and Beaver County. With so many sources reviewed for the purpose of this Plan, loss and impact information for many events could vary depending on the source. Therefore, accuracy of monetary figures discussed is based only on available information identified during research for this Plan. Monetary figures may also have been calculated for the region as a whole, based on entire storm damage, and include damage from other counties.

According to the NOAA-NCDC storm events database, Beaver County underwent 12 winter storm events between 1950 and August 31, 2015. No property damage, injuries, or fatalities were reported during any of these events.

The Federal Emergency Management Agency (FEMA) reported that between 1954 and 2015, the Commonwealth of Pennsylvania underwent events inducing seven winter storm-related disaster declarations (DR) or emergency declarations (EM), these events classified as one or a combination of the following disaster types: severe winter storm, snowstorm, blizzard, winter storm, severe storm, and snowfall. Generally, these disasters covered a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations. PEMA and other sources indicate that Beaver County was declared a disaster area during two of those seven winter storm events that induced DRs or EMs (FEMA 2012). Additionally, the Pennsylvania disaster history list maintained by PEMA indicates that Beaver County was impacted by 3 of the 14 winter incidents included on that list.

Based on all sources researched, known winter storm events that have affected Beaver County (and resulted in injuries, fatalities, and/or damages) are identified in Table 4.3.16-2. Because winter storm documentation for the State of Pennsylvania is so extensive, not all sources have been identified or researched. Therefore, Table 4.3.16-2 may not include all events that have occurred throughout the County.

Table 4.3.16-1. Winter Storm Events in Beaver County between 1950 and 2015

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
1960	Winter Storm	N/A	N/A	Four storms occurred this year.
1961	Winter Storm	N/A	N/A	Two storms occurred this year.
1962	Winter Storm	N/A	N/A	Three storms occurred this year.
1964	Heavy Snow/Ice	N/A	N/A	No data available.
1966	Winter Storm	N/A	N/A	No data available.
1968	Winter Storm	N/A	N/A	Two storms with heavy wind.
1971	Ice and Snow	N/A	N/A	Four storms with heavy wind.
1972	Heavy Snow/Blizzard	N/A	N/A	Heavy wind
1974	Heavy Snow and Ice	N/A	N/A	Major Power Outages
January 1977	Gas Shortage/Severe Winter Weather	N/A	Yes	President's Declaration of Emergency; Governor Milton J. Shapp – Governor's Proclamation
January 29, 1977	Snowstorms	EM-3026	Yes	Beaver County is eligible for PubA.
1978	Ice Storm	N/A	N/A	Two major storms with heavy wind and snow.
1984	Winter Storm	N/A	N/A	No data available.
1992	Winter Storm	N/A	N/A	Heavy snow
1993	Winter Storm	N/A	N/A	Blizzard
1994	Winter Storm/Blizzard	N/A	N/A	Five Storms, including one with a Presidential declaration.
March 10, 1994	Winter Storm, Severe Storm	DR-1015	Yes	Beaver County is eligible for PubA.
1995	Winter Storm	N/A	N/A	Two storms with wind and ice
1996	Heavy Snow/Ice	N/A	N/A	Beaver County used half of budget for winter operations on single storm, snow followed by extreme flooding.
January 1996	Severe Winter Storms	N/A	Yes	Governor Tom Ridge – Governor's Proclamation and President's Declaration Of Major Disaster.
1997	Ice Storm	N/A	N/A	Multiple power lines down.
1999	Winter Storm	N/A	N/A	Heavy wind, power lines down.
January 2, 1999	Winter Storm	N/A	N/A	A strong winter storm approached the region from the south central U.S., bringing a mix of snow, sleet, and freezing rain to western Pennsylvania. Across southwest Pennsylvania, between 1 and 3 inches of snow fell before the precipitation turned to freezing rain. Ice accumulations of between 0.25 and 0.5 inch were reported across most of the area. Farther north, across northwest Pennsylvania (generally north of Interstate 80), snowfall amounts of between 3 and 6 inches were common before the precipitation turned to freezing rain. In addition to the snowfall, these areas also picked up between 0.25 and 0.5 inch of ice accumulation. This combination of ice and snow produced numerous accidents on roads across western Pennsylvania.

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
January 8, 1999	Winter Storm	N/A	N/A	A winter storm spread a mix of snow and freezing rain across all of western Pennsylvania. By the afternoon of the 8th, snowfall amounts ranged from 2 to 4 inches across the west central Pennsylvania counties of Mercer, Venango, Clarion, Forest, and Jefferson. These snowfall totals increased to 4 to 7 inches across the remainder of southwest Pennsylvania. By the evening of the 8th, the snow had turned to freezing rain across the entire region, which continued into the early morning hours of the 9th. Most areas across western Pennsylvania reported ice accumulations of between 0.25 and 0.5 inch.
January 13, 1999	Winter Storm	N/A	N/A	A powerful winter storm brought another combination of snow and freezing rain to all of western Pennsylvania. The precipitation remained mostly snow across the west central Pennsylvania counties of Mercer, Forest, and Venango where between 10 and 12 inches of snow were reported. Across southwest Pennsylvania, the snow mixed with freezing rain and snowfall totals dropped off quickly from north to south. Clarion, Lawrence, Butler, Armstrong, and Beaver counties all reported between 3 and 6 inches of accumulation, while the extreme southwest corner of Pennsylvania received mostly freezing rain. The freezing rain continued through the overnight hours of the 14th, with the majority of counties across western Pennsylvania reporting between 0.25 and 0.5 inch of ice accumulation.
December 13, 2000	Winter Storm	N/A	N/A	A mix of sleet, freezing rain, and snow spread across western Pennsylvania during the day on the 13th. By late afternoon on the 13th, the snow had turned to sleet in many areas, with several counties reporting sleet accumulations of up to 1 inch. Finally, by the evening hours of the 13th, the precipitation had turned to freezing rain across all of western Pennsylvania. Every county across the area reported ice accumulations of one-quarter to one-half inch by the late evening hours on the 13th. Numerous accidents were reported on area highways as the freezing rain coated roadways. Overnight, the freezing precipitation gradually turned to rain. However, even by the early morning hours of the 14th, a few pockets of freezing drizzle were still reported, as cold air remained trapped in some of the valleys.
2002	Heavy Snow/Ice	N/A	N/A	No data available.
2005	Ice Storms	N/A	N/A	No data available.
March 2005	Heavy Rainfall, Snowstorm, Embankment Failures	No	Yes	Governor Edward G. Rendell Disaster Proclamation, noted for Beaver, Greene, Washington, and Westmoreland Counties
February 12, 2008	Winter Storm	N/A	N/A	A heavy mixture of winter precipitation fell across western Pennsylvania, southeast Ohio, and the northern panhandle of West Virginia on February 12th as an area of low pressure moved across the upper Ohio Valley just south of Pittsburgh. Snowfall of 4-6 inches was common, with ice accumulation of more than 0.1 inch from freezing rain, as well as light sleet accumulations. Travel was extremely hazardous, with disruptions plaguing schools and some businesses.

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
March 7, 2008	Winter Storm	N/A	N/A	A large late winter storm moved slowly across the Ohio valley and produced heavy snow that mixed at times with sleet and freezing rain. The heaviest snow accumulations were across eastern Ohio where more than a foot of snow fell, and across northern Pennsylvania where amounts ranged from 6 to 8 inches. Ice accumulation from freezing rain also ranged from 0.1 to more than 0.25 inch in combination with the snow and sleet.
2009	Heavy Snow and Ice Storms	N/A	N/A	No data available.
December 13, 2009	Winter Weather	N/A	N/A	As warm air headed north ahead of low pressure moving into the Ohio Valley, freezing rain quickly developed across much of eastern Ohio, western Pennsylvania, northern West Virginia, and Garrett County, Maryland. Untreated roadways quickly accumulated up to 0.1 inch of ice, making travel nearly impossible between 6 and 10 a.m. Major interstates in and around Pittsburgh, including the Pennsylvania Turnpike, were closed for more than 2 hours until roads could be treated and surface temperatures warmed above freezing. 911 centers across the area received thousands of calls due to minor accidents. Two more serious accidents resulted in two deaths—one in Beaver County and one in Westmoreland County. Icy roads played a role in a traffic accident in Beaver Falls after 7 a.m. that resulted in the death of a 77 year old male driver.
April 16, 2010	Severe Winter Storms and Snowstorms	DR-1898	Yes	Beaver County is eligible for PubA.
December 9, 2010	Winter Storm	N/A	N/A	Only 3 days after an historic snow storm hit the region, another major storm blasted portions of western Pennsylvania; northern West Virginia; Garrett County, Maryland; and eastern Ohio from the afternoon of February 9th to the early morning of February 11th. In western Pennsylvania, snowfall was from 8 to 12 inches generally in and north of Pittsburgh to north of I-80. In the remainder of eastern Ohio, western Pennsylvania, and northern West Virginia, 3 to 5 inches of snow fell.
December 16, 2010	Winter Weather	N/A	N/A	Low-level moisture in cold northwest flow produced a mix of light snow and freezing drizzle across much of western Pennsylvania and eastern Ohio from the afternoon of the 16th to the late night of the 17th. This produced some icing on roadways and numerous accidents. The most serious accident was on the Pennsylvania Turnpike between 10 and 11 p.m. on the 17th, when three people were injured in a 13-car pileup on the eastbound lanes in Beaver County, in Sewickley Twp. The turnpike was closed for over 7 hours to remove the wreckage and replace a broken median.
February 4, 2014	Winter Storm	N/A	N/A	A complex and fast moving storm system swept across eastern Ohio, western Pennsylvania, northern West Virginia, and Garrett County, Maryland from late evening of the 4th into late morning of the 5th. Snowfall from 4 to 10 inches fell along and north of a line from Zanesville in Ohio, to Wheeling in West Virginia, and from Pittsburgh to Latrobe in Pennsylvania. The snow then changed to sleet and freezing rain in the early morning hours of the 5th, with sleet accumulations of an inch or more, and freezing rain accretion from 0.25 to 0.5 inch.

Date of Event	Event Type	FEMA Declaration Number	County Designated?	Losses / Impacts
November 22, 2014	Winter Weather	N/A	N/A	An upper level shortwave crossing the upper Ohio Valley brought light freezing rain through the morning hours of the 22nd. While strong warm advection was ongoing ahead of the system aloft, a strong inversion at the surface did not allow for temperatures to warm above freezing at onset of precipitation. This allowed accumulation of a light glazing of ice on untreated surfaces over portions of eastern Ohio, the northern West Virginia panhandle, and counties north of I-70 in Pennsylvania. Several accidents were reported across the advisory area, including a head-on collision between a car and a school bus in Columbiana County, Ohio.
December 2, 2014	Winter Weather	N/A	N/A	Warmer air aloft moving over cold low levels produced a mix of sleet and freezing rain from the evening of the 1st into the early morning hours of the 3rd. A light coating of ice was reported, with some accidents on untreated roads due to slick conditions across Garrett County, Maryland; eastern Ohio; western Pennsylvania; and northern West Virginia.

Sources: Hazards & Vulnerability Research Institute, SHELDUS 2011, NOAA 2015, PEMA 2015, FEMA 2015

Notes:

Monetary figures within this table were U.S. Dollar (USD) figures calculated during or within the approximate time of the event. If such an event would occur in the present day, monetary losses would be considerably higher in USDs as a result of increased U.S. Inflation Rates.

DR	Federal Disaster Declaration
FEMA	Federal Emergency Management Agency
IA	Individual Assistance
N/A	Not applicable/available
NCDC	National Climate Data Center
NOAA	National Oceanic Atmospheric Administration
PubA	Public Assistance
PEMA	Pennsylvania Emergency Management Agency
SBA	Small Business Administration
SHELDUS	Spatial Hazard Events and Loss Database for the U.S.

4.3. 16.4 Future Occurrence

Given the history of winter storm events that have impacted Beaver County, it is apparent that future winter storm events of varying degrees will continue to occur. Because the elements required for winter storms exist, and major events have occurred throughout Beaver County in the past, evidence suggests that many people and properties will be at risk from the winter storm hazard in the future.

Based on available historical data, future occurrence of winter storm events can be considered *likely* as defined by the Risk Factor Methodology probability criteria (further discussed in Section 4.4).

4.3. 16.5 Vulnerability Assessment

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For winter storm events, all of Beaver County has been identified as the hazard area. Therefore, all assets (population, structures, critical facilities and lifelines), as described in the County Profile (Section 2), are vulnerable. This section includes an evaluation and estimation of potential impacts of winter storm events on the County, including:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts on (1) life, health, and safety; (2) general building stock; (3) critical facilities; (4) economy; (5) environment; and (6) future growth and development
- Effect of climate change on vulnerability
- Further data collections that will assist understanding this hazard over time.

Overview of Vulnerability

Winter storms are a concern based on the frequency of winter storm effects on Beaver County. Additionally, winter storms are of significant concern because of direct and indirect costs associated with these events, delays caused by the storms, and impacts on people and facilities of the region.

Data and Methodology

National weather databases, the 2013 Pennsylvania HMP, and local resources were referenced to collect and analyze information about severe winter storm impacts on Beaver County. The 2010 U.S. Census data and the Hazards U.S. – Multi-Hazard (HAZUS-MH) building inventory for Beaver County were referenced to support an evaluation of assets exposed to this hazard and potential impacts associated with this hazard.

Impact on Life, Health, and Safety

According to the NOAA National Severe Storms Laboratory (NSSL), winter weather indirectly kills hundreds of people in the United States every year, primarily from automobile accidents, overexertion, and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow, extreme cold temperatures, and dangerous wind chill. Winter storms are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storms. People can die in traffic accidents on icy roads, of heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold.

Heavy snow can immobilize a region and paralyze a city, shutting down air and rail transportation, stopping flow of supplies, and disrupting medical and emergency services. Accumulations of snow can collapse

buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches (NSSL 2006).

Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL 2006).

For the purposes of this Plan, the entire population of Beaver County is considered exposed to winter storm events (U.S. Census 2010). The elderly are considered most susceptible to this hazard because of their increased risk of injuries and death from falls and overexertion and/or hypothermia from exposure while attempting to clear snow and ice. In addition, winter storm events can reduce ability of these populations to access emergency services. Residents with low incomes may not have access to housing, or their housing may be less able to withstand cold temperatures (e.g., homes with poor insulation and heating supply). The County Profile (Section 2) of this Plan provides population statistics for each participating municipality and a summary of the more vulnerable populations (over the age of 65 and individuals living below the U.S. Census poverty threshold).

Impact on General Building Stock

The entire general building stock inventory in Beaver County is exposed and vulnerable to the winter storm hazard. In general, structural impacts include damage to roofs and building frames, rather than to building content. Current modeling tools are not available to estimate specific losses from this hazard. As an alternate approach, this Plan considers percentage damages that could result from winter storm conditions. Table 4.3.16-3 below summarizes percent damages to Beaver County's total general building stock (structure only) that could result from winter storm conditions. Considering professional knowledge and currently available information, potential losses from this hazard are considered overestimated; hence, values in Table 4.3.16-3 are conservative estimates of losses associated with severe winter storm events.

Table 4.3.16-1. General Building Stock Exposure (Structure Only) and Estimated Losses from Winter Storm Events in Beaver County

Municipality	Total GBS (Structure Only)	1% of Total	5% of Total	10% of Total
City of Aliquippa	$1,046,293,000	$10,462,930.00	$52,314,650.00	$104,629,300.0
Ambridge Borough	$1,119,177,000	$11,191,770.00	$55,958,850.00	$111,917,700.0
Baden Borough	$408,425,000	$4,084,250.00	$20,421,250.00	$40,842,500.0
Beaver Borough	$648,790,000	$6,487,900.00	$32,439,500.00	$64,879,000.0
City of Beaver Falls	$1,153,540,000	$11,535,400.00	$57,677,000.00	$115,354,000.0
Big Beaver Borough	$208,662,000	$2,086,620.00	$10,433,100.00	$20,866,200.0
Bridgewater Borough	$138,376,000	$1,383,760.00	$6,918,800.00	$13,837,600.0
Brighton Township	$982,260,000	$9,822,600.00	$49,113,000.00	$98,226,000.0
Center Township	$1,390,300,000	$13,903,000.00	$69,515,000.00	$139,030,000.0
Chippewa Township	$1,021,548,000	$10,215,480.00	$51,077,400.00	$102,154,800.0
Conway Borough	$188,707,000	$1,887,070.00	$9,435,350.00	$18,870,700.0
Darlington Borough	$25,195,000	$251,950.00	$1,259,750.00	$2,519,500.0
Darlington Township	$188,393,000	$1,883,930.00	$9,419,650.00	$18,839,300.0

Municipality	Total GBS (Structure Only)	1% of Total	5% of Total	10% of Total
Daugherty Township	$302,843,000	$3,028,430.00	$15,142,150.00	$30,284,300.0
East Rochester Borough	$61,337,000	$613,370.00	$3,066,850.00	$6,133,700.0
Eastvale Borough	$28,406,000	$284,060.00	$1,420,300.00	$2,840,600.0
Economy Borough	$1,000,376,000	$10,003,760.00	$50,018,800.00	$100,037,600.0
Fallston Borough	$50,879,000	$508,790.00	$2,543,950.00	$5,087,900.0
Frankfort Springs Borough	$10,029,000	$100,290.00	$501,450.00	$1,002,900.0
Franklin Township	$402,668,000	$4,026,680.00	$20,133,400.00	$40,266,800.0
Freedom Borough	$134,838,000	$1,348,380.00	$6,741,900.00	$13,483,800.0
Georgetown Borough	$15,456,000	$154,560.00	$772,800.00	$1,545,600.0
Glasgow Borough	$4,850,000	$48,500.00	$242,500.00	$485,000.0
Greene Township	$199,569,000	$1,995,690.00	$9,978,450.00	$19,956,900.0
Hanover Township	$313,703,000	$3,137,030.00	$15,685,150.00	$31,370,300.0
Harmony Township	$332,791,000	$3,327,910.00	$16,639,550.00	$33,279,100.0
Homewood Borough	$11,384,000	$113,840.00	$569,200.00	$1,138,400.0
Hookstown Borough	$12,855,000	$128,550.00	$642,750.00	$1,285,500.0
Hopewell Township	$1,439,039,000	$14,390,390.00	$71,951,950.00	$143,903,900.0
Independence Township	$215,867,000	$2,158,670.00	$10,793,350.00	$21,586,700.0
Industry Borough	$192,443,000	$1,924,430.00	$9,622,150.00	$19,244,300.0
Koppel Borough	$57,874,000	$578,740.00	$2,893,700.00	$5,787,400.0
Marion Township	$135,727,000	$1,357,270.00	$6,786,350.00	$13,572,700.0
Midland Borough	$282,009,000	$2,820,090.00	$14,100,450.00	$28,200,900.0
Monaca Borough	$657,385,000	$6,573,850.00	$32,869,250.00	$65,738,500.0
New Brighton Borough	$688,045,000	$6,880,450.00	$34,402,250.00	$68,804,500.0
New Galilee Borough	$81,013,000	$810,130.00	$4,050,650.00	$8,101,300.0
New Sewickley Township	$702,882,000	$7,028,820.00	$35,144,100.00	$70,288,200.0
North Sewickley Township	$554,186,000	$5,541,860.00	$27,709,300.00	$55,418,600.0
Ohioville Borough	$287,642,000	$2,876,420.00	$14,382,100.00	$28,764,200.0
Patterson Township	$323,904,000	$3,239,040.00	$16,195,200.00	$32,390,400.0
Patterson Heights Borough	$73,099,000	$730,990.00	$3,654,950.00	$7,309,900.0
Potter Township	$76,307,000	$763,070.00	$3,815,350.00	$7,630,700.0
Pulaski Township	$126,005,000	$1,260,050.00	$6,300,250.00	$12,600,500.0
Raccoon Township	$301,208,000	$3,012,080.00	$15,060,400.00	$30,120,800.0
Rochester Borough	$415,951,000	$4,159,510.00	$20,797,550.00	$41,595,100.0
Rochester Township	$302,586,000	$3,025,860.00	$15,129,300.00	$30,258,600.0
Shippingport Borough	$30,518,000	$305,180.00	$1,525,900.00	$3,051,800.0
South Beaver Township	$338,004,000	$3,380,040.00	$16,900,200.00	$33,800,400.0
South Heights Borough	$52,720,000	$527,200.00	$2,636,000.00	$5,272,000.0
Vanport Township	$162,887,000	$1,628,870.00	$8,144,350.00	$16,288,700.0
West Mayfield Borough	$117,933,000	$1,179,330.00	$5,896,650.00	$11,793,300.0

Municipality	Total GBS (Structure Only)	1% of Total	5% of Total	10% of Total
White Township	$116,680,000	$1,166,800.00	$5,834,000.00	$11,668,000.0
BEAVER COUNTY (TOTAL)	**$19,203,313,000**	**$192,033,130.00**	**$960,165,650.00**	**$1,920,331,300.0**

Source: HAZUS-MH 2.1

Note: GBS General building stock

An area especially vulnerable to the winter storm hazard is the floodplain. At-risk building stock and infrastructure in floodplains are addressed in the flood hazard profile (Section 4.3.5). Generally, losses from flooding associated with winter storms should be less than those associated with a 1-percent or 0.2-percent flood. In summary, snow and ice melt can cause both riverine and urban flooding. Estimated losses from riverine flooding in the County are discussed in Section 4.3.5.

Impact on Critical Facilities

Full functionality of critical facilities such as police, fire, and medical services is essential for response during and after a winter storm event. These critical facility structures are largely constructed of concrete and masonry; therefore, they should undergo only minimal structural damage from severe winter storm events. Because power interruption can occur, backup power is recommended for critical facilities and infrastructure.

Impact on the Economy

Infrastructure at risk from the winter storm hazard includes roadways that could be damaged by application of salt, and intermittent freezing and warming conditions that can damage roads over time. Costs of snow and ice removal and repair of roads damaged by the freeze/thaw cycle can drain local financial resources. Potential secondary impacts from winter storms also affect the local economy, including loss of utilities, interruption of transportation corridors, and loss of business function.

Impact on the Environment

Environmental impacts often include damage to trees and shrubs caused by heavy snow loading, ice buildup, and/or high winds, which can break limbs and down large trees. An indirect effect of winter storms is impairment of surface and groundwater adjacent to roadway surfaces treated with salt, chemicals, and other de-icing materials (PEMA 2013).

Winter storms have a positive environmental impact: gradual melting of snow and ice provides groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause accelerated snowmelt, rapid surface water runoff, and severe flooding (PEMA 2013).

Future Growth and Development

Areas targeted for potential future growth and development within the next 5 to 10 years have been identified across the County at the municipal level, and are further discussed in Section 2.4 of this Plan. For the winter storm hazard, Beaver County in its entirety has been identified as the hazard area. Therefore, any new development will be exposed to such risks.

Effect of Climate Change on Vulnerability

Climate is defined not just as average temperature and precipitation, but also by type, frequency, and intensity of weather events. Both globally and at the local level, climate change can alter prevalence and severity of

weather extremes such as winter storms. While predicting changes in winter storm events under conditions of a changing climate is difficult, understanding vulnerabilities to potential changes is a critical part of estimating future impacts of climate change on human health, society, and the environment (U.S. Environmental Protection Agency [EPA] 2006).

The climate of Pennsylvania has changed in several ways. Over the past 100 years, annual average temperatures have been rising across the State. Warmer winters have led to decrease in snow cover and earlier arrival of spring. Recent analyses based on the Intergovernmental Panel on Climate Change models suggest a decrease in frequency and an increase in intensity of extra-tropical winter cyclones. However, based on the methodology applied, some models show no significant change in the storm track whereas others indicate a northward displacement of the storm track in the North Atlantic. For the mid-Atlantic region, there is little indication of a change in storm activity or track over Pennsylvania. An overall increase in winter precipitation is anticipated, with a decrease in snow and increase in rain during winter months. Projections of future occurrences of extra-tropical cyclones in Pennsylvania are uncertain. Based on available information and projections, winter storms are anticipated to continue to affect Pennsylvania in the future. Future improvements in modeling smaller-scale climatic processes can be expected, and will lead to improved understanding of the ways the changing climate will alter temperature, precipitation, and storm events in Pennsylvania (Shortle and others 2009).

Additional Data and Next Steps

The assessment above identifies vulnerable populations and economic losses associated with the winter storm hazard. Historical data on structural losses to general building stock are not adequate to predict specific losses to this inventory; therefore, the percent of damage assumption methodology was applied. This methodology is based on FEMA How-to Series (FEMA 386-2), Understanding Your Risks, Identifying and Estimating Losses (FEMA 2001), and FEMA's Using HAZUS-MH for Risk Assessment (FEMA 433) (FEMA 2004). Acquisition of additional/actual data regarding (1) valuations of general building stock and (2) critical infrastructure losses would further support future estimates of potential exposure of and damage to the general building stock inventory.

4.4 Hazard Risk Ranking

As discussed in Section 4.2, Hazard Identification, a comprehensive range of natural and non-natural hazards that pose significant risk to Beaver County were selected and considered in this plan. However, the communities in Beaver County have differing levels of exposure and vulnerability to each of these hazards. It is important for each community participating in this plan to recognize those hazards that pose the greatest risk to their community and direct their attention and resources accordingly to most effectively and efficiently manage risk.

To this end, a relative hazard risk ranking process was conducted for the County using the Risk Factor (RF) methodology identified in Section 5 and Appendix 9 of Pennsylvania Emergency Management Agency's (PEMA) All-Hazard Planning Standard Operating Guide (PEMA October 2013). The guidance states:

> "The RF approach produces numerical values that allow identified hazards to be ranked against one another (the higher the RF value, the greater the hazard risk). RF values are obtained by assigning varying degrees of risk to five categories for each hazard: *probability, impact, spatial extent, warning time,* and *duration*.
>
> To calculate the RF value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the example equation below:

Example Equation

RF Value = [(Probability x .30) + (Impact x .30) +
(Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

> Hazards identified as high risk have RFs greater than or equal to 2.5. RFs ranging from 2.0 to 2.4 are considered moderate risk hazards. Hazards with RFs less than 2.0 are considered low risk."

Table 4.4-1 identifies the five risk assessment categories, the criteria and associated risk level indices used to quantify their risk, and the suggested weighting factor (weight value) applied to each risk assessment category. Table 4.4-2 shows the five risk assessment categories' values for each of Beaver County's hazards, and each hazard's RF.

Table 4.4-1. Summary of Risk Factor (RF) Approach

Summary of Risk Factor (RF) Approach				
Risk Assessment Category	Degree of Risk Level	Criteria	Index	Weight Value
PROBABILITY *What is the likelihood of a hazard event occurring in a given year?*	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1% & 49.9% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 50% & 90% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	GREATER THAN 90% ANNUAL PROBABILTY	4	
IMPACT *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	4	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED	1	20%
	SMALL	BETWEEN 1 & 10.9% OF AREA AFFECTED	2	
	MODERATE	BETWEEN 11 & 25% OF AREA AFFECTED	3	
	LARGE	GREATER THAN 25% OF AREA AFFECTED	4	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	**MORE THAN 24 HRS**	SELF-DEFINED	1	10%
	12 TO 24 HRS	SELF-DEFINED	2	
	6 TO 12 HRS	SELF-DEFINED	3	
	LESS THAN 6 HRS	SELF-DEFINED	4	
DURATION *How long does the hazard event usually last?*	**LESS THAN 6 HRS**	SELF-DEFINED	1	10%
	LESS THAN 24 HRS	SELF-DEFINED	2	
	LESS THAN 1 WEEK	SELF-DEFINED	3	
	MORE THAN 1 WEEK	SELF-DEFINED	4	

(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)

(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)

Source: PEMA All-Hazard Mitigation Planning Standard Operating Guide, October 2013

Table 4.4-2. Risk Ranking for Beaver County

HAZARD RISK	NATURAL HAZARDS	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Flood	4	3	4	3	4	3.6
	Winter Storm	4	3	4	1	4	3.4
	Tornadoes and Windstorms	4	2	4	3	3	3.2
	Environmental Hazards	4	3	2	4	3	3.0
	Nuclear Incident	1	4	4	3	4	3.0
	Transportation Accident	4	2	2	4	2	2.8
	Drought	3	1	3	1	4	2.5
	Pandemic	2	2	4	1	4	2.5
	Utility Interruption	4	1	2	3	3	2.5
MODERATE	Dam Failure	1	3	2	4	3	2.3
	Urban Fire and Explosions	4	1	1	4	2	2.3
	Radon Exposure	3	1	1	3	4	2.1
	Landslide	3	1	1	4	3	2.1
	Levee Failure	1	2	2	4	3	2.0
LOW	Terrorism, Criminal Activity, or Civil Disturbance	2	2	1	3	1	1.8
	Earthquake	1	1	3	4	1	1.7

SECTION 5 CAPABILITY ASSESSMENT

The capability assessment evaluates Beaver County's capabilities and resources already in place at the municipal, County, State, and federal levels to reduce hazard risks. The assessment also identifies where improvements can be made to increase disaster resistance in the community.

The first step in organizing hazard mitigation capabilities or resources for the Beaver County Hazard Mitigation Plan (HMP) update is to describe the basic approaches available to reduce hazard risks. According to the 2013 Pennsylvania Emergency Management Agency (PEMA) All-Hazard Mitigation Planning Standard Operating Guide (SOG), the following four general approaches may reduce hazard risks:

- **Local Plans and Regulations** – These actions include government authorities, policies, or codes that influence the ways land is developed and buildings are constructed.
- **Structure and Infrastructure** – These actions involve modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability.
- **Natural Systems Protection** – These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.
- **Education and Awareness** – These are actions taken to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Education and awareness actions may also include participation in national programs (PEMA SOG 2013).

Capability assessments document the existing resources available to local communities to reduce hazard risks. Resources can be divided into the following five categories (according to the PEMA All-Hazard Mitigation Planning SOG). For each basic capability or approach, one or more of the five resources described below may be available:

- **Human resources** include local police, fire, ambulance, and emergency management and response personnel; local government services; and electric, gas, and other utility providers that are critical during disasters.
- **Physical resources** include the equipment and vehicles (such as emergency response and recovery equipment and vehicles), public lands, facilities, and buildings available to the community.
- **Technical/technological resources** include early warning systems, weather alert radios, stream-level monitoring gauges, and 9-1-1 communications systems. They also include technical requirements established by law, regulation, or ordinance.
- **Informational resources** include materials about disasters, and actions related to hazard mitigation and planning. Informational resources are available from a wide variety of sources such as applicable websites, libraries, and state and federal agencies.
- **Financial resources** identify the sources of funding available for hazard mitigation. Most state and federal grant programs require local communities to provide at least part of the necessary project funding in real dollars or through in-kind services. Local communities need to assess their financial capability and resources to implement hazard mitigation action plans.

During this plan update process, Beaver County and all participating municipalities were surveyed to provide an updated assessment of their mitigation planning capabilities. Each municipality was provided with a Capability Assessment Survey, based on the capability assessment survey provided in Appendix 3 of the October 2013 edition of the PEMA All-Hazard Mitigation Planning SOG (PEMA SOG 2013). The survey was

provided to each of the municipal planning points of contact prior to the municipal kick-off meetings, during the kick-off meetings, and throughout the planning process as needed. Completed capability assessment surveys provided by the municipalities may be found in Appendix D.

This section describes and summarizes the federal, State, County, and local capabilities to address hazard risk in Beaver County.

5.1 EMERGENCY MANAGEMENT

This section describes emergency management capabilities at the County (Section 5.1.1) and local levels (Section 5.1.2).

5.1.1 County Capabilities

Beaver County Emergency Services coordinates countywide emergency management efforts. Each municipality has a designated local emergency management coordinator who possesses a unique knowledge of the impact that hazard events have on their community. A significant amount of information used to develop this plan was obtained from the emergency management coordinators, and is described in the sections below.

9-1-1 Center

9-1-1 is the telephone number used to report emergencies. Citizens use the service in the event of the presence or potential for an immediate threat to life or property, and to request response from police, fire, or emergency medical service (EMS) agencies. Examples include a crime that has just occurred or is in progress, odor or presence of fire, and a sick or injured person who requires treatment and possibly transportation to a hospital emergency department. The 9-1-1 system is capable of accepting calls from hearing- and speech-impaired callers using a Telecommunications Device for the Deaf (TDD). Each county in Pennsylvania operates a 9-1-1 Public Safety Answering Point (PSAP). These PSAPs would need to coordinate their efforts in a regional hazard event. Computerized mapping of streets with address information is critical for emergency response purposes. Opportunities exist to streamline the regional 9-1-1 coordination through development of fully integrated, consistent mapping and databases. Beaver County maintains its own 9-1-1 Center, located in Ambridge, PA. New Galilee Borough emphasized the importance of this center in ensuring transportation-related (rail and highway) safety.

Emergency Operations Center (EOC)

In the event of an impending emergency or disaster, Beaver County would activate its EOC. The purpose of the EOC is to manage an emergency response and coordinate the distribution of resources to a disaster incident. When the EOC is activated and becomes operational, it is staffed with highly trained, experienced personnel that have the authority, flexibility, imagination, and initiative needed to make command and coordination decisions relative to their field of expertise. EOC staffing utilizes recommendations from the National Response Framework (NRF), Emergency Support Functions (ESF), and the State EOP, and staffing is organized by general position names and skillsets. Major staffing positions are indicated in the list below; however, this staffing may be adjusted/expanded to meet event scope as appropriate:

- Transportation (ESF 1)
- Communications (ESF 2)
- Public Works and Pennsylvania Department of Transportation (PennDOT) (ESF 3)
- Firefighting/Search and Rescue (ESFs 4 and 9)
- Emergency Management (ESF 5)
- Schools, Mass Care, and Human Services (ESF 6)
- Logistics/Resource Supervisor (ESF 7)
- Coroner, Health, and Medical (ESF 8)
- Radiological Officer and Hazardous Materials (HazMat) (ESF 10)

- Agriculture (ESF 11)
- Energy (ESF 12)
- Police Services, Pennsylvania State Police (PSP), and Military (ESF 13)
- Disaster Recovery (ESF 14)
- Public Information Officer (PIO) (ESF 15)

When activated, the EOCs are in constant communication with the 9-1-1 centers to ensure coordination of activities.

The Beaver County emergency management/9-1-1 capabilities fall under two categories: emergency service measures and public information programs. These capabilities are described below.

Emergency Service Measures

Emergency service measures protect people during and immediately following a disaster. The County monitors several systems that will disseminate emergency information and warnings. These monitoring systems are described below.

- The **Satellite Emergency Voice Alerting Network (SEVAN)** is the voice component of the satellite warning system. SEVAN allows PEMA and Pennsylvania counties, regional offices, and cities to communicate directly in real time regardless of the status of the telephone system. Warning messages are routinely broadcast by PEMA using the system.

- **Knowledge Center** is a web-based interactive incident management tool that provides emergency managers with the ability to gather large quantities of information related to incidents, and then coordinate that information with the proper agencies. For small-scale events, one or two responder agencies would be contacted. For large-scale events that involve complex, multi-jurisdictional responses, hundreds of agencies from the local, state, federal, non-governmental, and private sector organizations may be contacted. The system allows for seamless communication with neighboring jurisdictions, counties, and the State regarding the types of incidents and emergencies occurring.

- The **Pennsylvania Statewide Telecommunication Alerting and Reporting (PaSTAR) Network** is a computer network that uses satellite-based technology and the latest computer server and client systems. The system allows data sharing and reporting, and textual and graphic communications to flow unimpaired between users connected to the system. The core of PaSTAR consists of a commercially available computer server and e-mail software packages.

- The **Radio Amateur Civil Emergency Services (RACES)** is a group of amateur radio operators who donate their services in times of natural disaster or emergency. They provide communication to fire, police, and other agencies that need assistance. Amateur Radio is a newer resource for Beaver County, and is still in the process of being implemented.

- **NOAA Weather Radio All Hazards (NWR)** is a nationwide network of radio stations broadcasting continuous weather information directly from a nearby National Weather System (NWS) office. NWR broadcasts NWS warnings, watches, forecasts, and other hazard information 24 hours a day. NWR also broadcasts warning and post-event information for all types of hazards, including natural and manmade (such as chemical releases or oil spills) and public safety (such as Amber alerts or 9-1-1 telephone outages).

- The **800-MHz radio system** provides two-way voice and data communications for all Beaver County and State agencies. The primary function of this system is to provide redundant communications between the County and partner agency facilities in the event that the primary means of communication becomes interrupted.

Emergency Response Planning

Emergency Operations Plan

The Beaver County Emergency Operations Plan (EOP) documents the County's emergency preparedness planning. An EOP is an all-hazard plan developed for use by county government departments and agencies to ensure a coordinated and effective response to natural, technological, or manmade disasters that may impact the County. Municipalities in Beaver County adopt the County EOP by resolution.

The EOP also includes County-specific emergency response procedures. Beaver County reviews and continually updates the EOP as needed. The County's EOP was last updated and adopted in February 2010. Because EOPs are required to be updated every 2 years, the County will update this plan as part of a unique or combined mitigation action (see Section 6 of this Plan for proposed mitigation actions).

Mutual Aid Agreements

Beaver County has mutual aid agreements (formal agreements) with the contiguous Pennsylvania counties as a result of the Pennsylvania Intrastate Mutual Assistance Program. Every county in the State participates in this program. Beaver County is also part of a larger county consortium, the PA Region 13 Counterterrorism Task Force (PA Region 13 Task Force), which works together and shares resources during times of emergency. Originally formed in response to the increasing threat of weapons of mass destruction (WMD) and other terroristic activity, the Task Force also provides all-hazards preparedness, mitigation, prevention, response, and recovery services to citizens in its purview. This unprecedented intergovernmental agreement is between the following counties:

- Allegheny County (including the City of Pittsburgh)
- Armstrong County
- Beaver County
- Butler County
- Cambria County
- Fayette County
- Greene County
- Indiana County
- Lawrence County
- Mercer County
- Somerset County
- Washington County
- Westmoreland County

Regional Planning Initiatives

Beaver County also assists in either County or regional planning and preparation for the following:

- Local (Municipal) EOPs

- Medical facilities
- Dams
- Airports
- Pandemic
- Mass casualty/fatality incidents
- Counterterrorism preparedness
- Special events, such as concerts, parades, etc.
- School emergency planning
- Day care, group home, and special needs facilities
- Evacuation and Detour Plan
- Superfund Amendments and Reauthorization Act of 1986 (SARA) – The Local Emergency Planning Committee program is based on SARA, Title III. This legislation requires local planning by businesses and response agencies (such as fire departments and HazMat teams) whenever HazMat is involved. SARA also requires the establishment of a system in each community that informs the citizens of chemicals used, manufactured, and stored locally.
- In cooperation with the American Red Cross, the County has set up designated shelters that may be used during emergencies and disasters.

Public Information Programs

Flood Maps

Flood maps and flood data are accessible to the County through the Planning Commission. Tax maps and records are available at the Assessment/Tax Claim office, and deeds are available through the Recorder of Deeds. Municipal maps are available through municipal offices.

Library Education Tools

Libraries have educational materials available upon request that are used at public speaking events or County meetings, when appropriate. The available educational materials include (but are not limited to) the following resources:

- Various types of training videos
- Pennsylvania Emergency Preparedness Guides
- American Red Cross Packets for Flash Flooding, Hurricane, Thunder and Lightning, Tornado, and Winter Storms
- Family Disaster Planning Guides
- Homeland Security Information for Businesses, Family, Individuals, Neighborhoods and Schools
- Pandemic brochures

PA Region 13 Task Force

Information about the activities of the PA Region 13 Task Force is provided on the Task Force website (http://www.pa-region13.org/). The PA Region 13 Task Force is an intergovernmental agreement between 13 counties in southwest Pennsylvania and the City of Pittsburgh. Its capabilities were tested in Beaver County during a Hepatitis A outbreak, numerous natural disasters, and large-scale planned events, such as the Major League Baseball All-Stars Game and Pittsburgh G-20 summit. The Task Force has identified the following goals and activities through its mission statement:

- Formalized mutual aid and intergovernmental agreements
- Interoperable regional communications system
- Specialized equipment resource pool specific to WMD responses
- Specialized WMD and terrorism response training to all emergency services and support personnel
- Grant funding applications for special acquisitions and projects
- Increased regional cooperation and coordination
- Regional Response and Intelligence Protocol and procedures
- WMD preparedness and response capacity enhancement that can also be used to mitigate and respond to other manmade and natural disasters

Outreach Projects

Several organizations (both public and private sector) have developed outreach projects, educational tools, and training programs. The County promotes both online and traditional in-person programs to appeal to as wide an audience as possible. Beaver County outreach tools are listed below:

- Utility Public Awareness Campaign - The following utility agencies provide safety information accessible to the public:
    - Penn Power: https://www.firstenergycorp.com/help/safety.html
    - Columbia Gas of Pennsylvania: https://www.columbiagaspa.com/stay-safe
    - Duquesne Light: https://www.duquesnelight.com/forYourHome/customerService/neighborhoodProjects.cfm
        - Duquesne Light's webpage is focused on infrastructure projects that may lead to power outages rather than hazard safety information.
- ReadyPA Campaign – Established by the Commonwealth of Pennsylvania, www.readypa.org is a website that aims to prepare the public for times of disaster by providing education on the risks within Pennsylvania, template emergency plans and kits, and information on ways to get involved with community organizations to help others.
- Community Emergency Response Teams (CERT) – CERT provides training to educate citizens about disaster preparedness and instruction in basic disaster response skills, such as fire suppression, medical operations during disasters, light search and rescue, team organization, disaster psychology, and terrorism awareness. The goal of this program is for emergency personnel to train members of neighborhoods, community organizations, or workplaces in basic response skills. If a disastrous event overwhelms or delays the community's professional response, CERT members can assist others by applying the basic response and organizational skills that they learned during training. These skills can

help save and sustain lives following a disaster until help arrives. The County currently has an active CERT.

- Citizen Corps Council – The mission of the Citizen Corps is to harness the power of every individual through education, training, and volunteer service to make communities safer, stronger, and better prepared to respond to the threats of terrorism, crime, public health issues, and disasters of all kinds. The County currently has an active Citizen Corps Council.

- Emergency management courses are provided through Emergency Services to local coordinators and elected officials. The County provides all classes necessary for certification at both local and county levels. The following courses are examples of the types of classes the County may provide:

    - Duties and Responsibilities of the Local Emergency Management Coordinator (LEMC)
    - Elected Officials Seminar
    - Initial Damage Assessment
    - Safe Schools Training
    - National Incident Management System (NIMS)
    - Work Environment of the LEMC
    - Numerous Federal Emergency Management Agency (FEMA) Independent Study Courses

Local Emergency Planning Committee (LEPC)

The Local Emergency Planning Committee (LEPC) works closely with the business community to form a safety net around the chemical industry to protect the general population from the possible outcome of HazMat incidents. The following features of the LEPC demonstrate the capability of the LEPC to support County emergency management and preparedness initiatives:

- Beaver County's LEPC has 31 members. The LEPC shall have a minimum of seven members with at least one representative from each of the following groups:

    - Group 1 – Elected Official representing local government within the County

    - Group 2 – Local law enforcement, first aid, health, environmental, hospital, and transportation personnel

    - Group 3 – Firefighting personnel

    - Group 4 – Civil defense and emergency management personnel

    - Group 5 – Broadcast and print media

    - Group 6 – Community groups not affiliated with emergency service groups

    - Group 7 – Owners and operators of facilities subject to the requirements of SARA Title III

- Reporting Facilities – The minimum reporting threshold for which facilities are required to have or prepared a Material Safety Data Sheet is 10,000 pounds of hazardous chemicals. This document provides workers and emergency personnel with procedures for handling or working with HazMat in a safe manner. It includes information on the chemicals' physical properties, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.

- Planning Facilities – The reporting threshold for Extremely Hazardous Substances (as designated under Section 302 of Title III) is 500 pounds or the threshold planning quantity, whichever is lower. Qualifying facilities are subject to additional reports and accident-prevention regulations.

- Community Awareness Program – Beaver County provides the following awareness information about LEPC via the County website: http://www.beavercountypa.gov/emergency-services/emergency-services-beaver-county-local-emergency-planning-committee

Technical Assistance

The County Office of Emergency Services can support local, public, and private entities as needed through coordination and provision of information and equipment resources. These include both existing County capabilities and predetermined private and public resources.

Geographic Information Systems

Beaver County Planning Commission, which includes Geographic Information Systems (GIS) functions, has enabled Emergency Services to multiply its force through interactive mapping technologies, and high-resolution aerial photography. Emergency Services also has its own in-house GIS expert. Mapping and other GIS resources allow decision makers and stakeholders to identify, mitigate, respond to, and recover from disasters. These systems act as the common operating picture combining together general approaches that may reduce hazard risks, should a disaster of significant magnitude occur and photography of an affected area is warranted. Additionally, the County is in the process of updating its building layer system. This layer has been updated for about 2/3 of the County and will enhance risk analysis once complete.

Beaver County Conservation District

The Beaver County Conservation District is a local agency that provides conservation-based programs and services to County residents. Specifically, it provides services related to natural resource information, community conservation concerns, and local environmental efforts to residents. The Conservation District maintains a guiding philosophy that local conservation issues should be managed at a local level and by residents who understand the local environment. The County Conservation District has a Board of Directors, which consists of three farmers, four public representatives, and one County Commissioner.

The Beaver County Conservation District promotes four major program areas:

- Agricultural conservation
- Environmental conservation
- Erosion and sediment pollution control
- Watershed conservation

The County Conservation District owns and maintains an environmental center and 18 acres of wetlands in Independence Township. Other programs and services include the Annual Maple Syrup Festival, school programs (Beaver County Envirothon, Conservation Camp, etc.), manure management workshops, and more. Many of these programs tie into or promote the County's overall preparedness and mitigation goals by seeking to inspire better informed and engaged residents. The Beaver County Conservation District also supports the municipalities in the County by providing education in understanding floodplain ordinance regulations, reviewing ordinances to ensure compliance with NFIP standards, and assisting municipalities in the enforcement of ordinance regulations, when needed. The Conservation District promotes community preparedness and ultimately hopes to reduce the potential impact of hazard events through outreach and resource management. Additional information on the Beaver County Conservation District is available at http://www.beavercountyconservationdistrict.org/index.asp.

5.1.2 Local Capabilities

According to Pennsylvania Title 35 (Emergency Management Services Code), Chapter 7500, the following stipulations apply:

- Each political subdivision of Pennsylvania is directed and authorized to establish a local emergency management organization in accordance with the plan and program of PEMA. Each local organization shall have responsibility for emergency response and recovery within the territorial limits of the political subdivision within which it is organized, and shall conduct such services outside of its jurisdictional limits as may be required under this part.

- The governing body of a political subdivision may declare a local disaster emergency upon finding a disaster has occurred or is imminent. The effect of a declaration of a local disaster emergency is to activate the response and recovery aspects of any and all applicable local emergency management plans and to authorize the furnishing of aid and assistance.

- Each local organization of emergency management shall have a coordinator who shall be responsible for the planning, administration, and operation of the local organization.

- Each political subdivision shall adopt an Intergovernmental Cooperation agreement with other political subdivisions to accomplish the following:

    - Prepare, maintain, and keep current a disaster emergency management plan for (1) the prevention and minimization of injury and damage caused by disaster, (2) prompt and effective response to disaster, and (3) disaster emergency relief and recovery consistent with the Pennsylvania Emergency Management Plan.

    - Establish, equip, and staff an EOC (integrated with warning and communication systems) to support government operations in emergencies, and provide other essential facilities and equipment for agencies and activities assigned emergency functions.

    - Provide individual and organizational training programs to ensure prompt, efficient, and effective disaster emergency services.

    - Organize, prepare, and coordinate all locally available manpower, materials, supplies, equipment, facilities, and services necessary for disaster emergency readiness, response, and recovery.

    - Adopt and implement precautionary measures to mitigate the anticipated effects of a disaster. Execute and enforce such rules and orders as the agency shall adopt and promulgate under the authority of this part.

    - Cooperate and coordinate with any public and private agency or entity in achieving any purpose of this part.

    - Have available for inspection at its EOC all emergency management plans, rules, and orders of the Governor and the agency.

    - Provide prompt and accurate information regarding local disaster emergencies to appropriate Commonwealth and local officials and agencies and the general public.

    - Participate in all tests, drills, and exercises—including remedial drills and exercises—scheduled by the agency or by the federal government.

- Participate in the program of integrated flood warning systems under Section 7313 (6) (relating to powers and duties).

- Direction of disaster emergency management services is the responsibility of the lowest level of government affected. When two or more political subdivisions within a county are affected, the county organization shall exercise responsibility for coordination and support to the area of operations. When two or more counties are involved, coordination shall be provided by PEMA or by area organizations established by PEMA.

- When all appropriate locally available forces and resources are fully committed by the affected political subdivision, assistance from a higher level of government shall be provided.

- Local coordinators of emergency management shall develop mutual aid agreements with adjacent political subdivisions for reciprocal emergency assistance. The agreements shall be consistent with the plans and programs of PEMA.

Municipal capabilities often vary by local jurisdiction as many municipalities have different access to funding, staffing, and other resources, which can impact their overall capacity to manage disasters. The local municipalities in Beaver County have the following capabilities:

Mutual Aid Agreements

Beaver County has formal mutual aid agreements with its municipalities. Mutual aid is covered under Act 93.

Emergency Operations Centers (EOC)

In the event of an impending emergency or disaster, the local EOC may be activated. The purpose of the EOC is to manage the emergency response and coordinate distribution of resources to a disaster incident at the local level.

Emergency Response

Each municipality is responsible for providing emergency response to their municipality consisting of EMS, fire, and police. If a municipality does not have one of these providers in their community, they have mutual aid agreements with an adjacent political subdivision to provide such.

Monitoring Systems

Municipalities may also be equipped with several systems to monitor emergency information and warnings, including RACES, NWS, and Knowledge Center, which have been described previously in Section 5.

Emergency Response Planning

The municipalities may also assist with planning for:

- Municipal EOPs
- Medical facilities
- Dams
- Counterterrorism preparedness
- Special events
- School emergency planning
- Day care, group homes, and special needs facilities
- Evacuation

A summary of existing federal, State, regional, and County programs (regulatory and otherwise) to manage specific hazard risks may be found in the hazard profiles in Section 4 of this plan update. While the risk of certain hazards can be addressed at least partially through mitigation, the risks of other hazards (particularly certain non-natural hazards) are primarily managed through the preparedness and response elements of emergency management, or through other regulatory programs at the federal and State levels.

5.2 PARTICIPATION IN THE NATIONAL FLOOD INSURANCE PROGRAM

According to FEMA's 2002 National Flood Insurance Program (NFIP) program description, the U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA 2002). The NFIP is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages.

Participation in the NFIP is based on an agreement between communities and the federal government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction and substantial improvements in floodplains, the federal government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods (FEMA 2002).

NFIP-participating communities in Beaver County are required to adopt a Flood Damage Prevention Ordinance (also sometimes called a Floodplain Ordinance), and update this ordinance whenever the regulatory NFIP Flood Insurance Rate Maps (FIRM) are officially updated. The Beaver County Planning Commission, Beaver County Conservation District, and the Pennsylvania Department of Community and Economic Development (PA DCED) (State coordinating agency for the NFIP) provide support to municipalities. One such way this support has been provided is through the development of a model flood ordinance, which was then disseminated to all municipalities in the County. During the recent FEMA Digitized Flood Insurance Rate Maps (DFIRM) updates in August 2015, the majority of municipalities updated their ordinance with the model ordinance. The County model ordinance is based on the State model ordinance and contains the same higher standards and recommendations as the State model ordinance.

Currently, 52 of the 53 municipalities in Beaver County participate in the NFIP, and one municipality (Georgetown Borough) was suspended from the NFIP in August 2015. Georgetown Borough does not have any repetitive loss or severe repetitive loss properties within its boundaries. Additionally, it only has land in the 1-percent annual chance flood zone (northern part of the Borough) and not in the 0.2-percent annual chance floodplain (refer to the flood map in Section 4.3.5). The flood profile hazard profile vulnerability analysis also states that Georgetown Borough does not have any population exposed to flood events. Although the risk of Georgetown Borough having a severe flooding event that would impact its residents is low, Beaver County still encourages all its jurisdictions to remain compliant with the NFIP.

All participating municipalities have adopted a Floodplain Ordinance, and some have adopted a Stormwater Management Ordinance. The municipalities' floodplain administrators enforce the Floodplain Ordinances locally.

NFIP-participating communities in Beaver County are required to make current NFIP FIRMs available to their residents for review, and may provide mapping assistance through their floodplain administrators. Typically this mapping is available at the municipal offices in each community. At the time of this plan update, the Beaver County FEMA DFIRM (dated August 2015) were used to evaluate exposure and determine potential future losses.

Municipal participation in and compliance with the NFIP is supported at the federal level by FEMA Region III and the Insurance Services Organization (ISO), and at the State level by the Pennsylvania Department of Environmental Protection (PA DEP), PA DCED, and PEMA. Both the County's Emergency Services and

Planning Commission support flood mitigation efforts as well as associated training and public education and awareness programs.

Flood hazard risk management in Beaver County is further supported by the County's Phase I Act 167 Countywide Stormwater Management Plan. The Phase 2 Act 167 Stormwater Management Plan, which will include stormwater runoff modeling for major watersheds, has not yet been started. The County intends to develop this plan eventually, and once this plan is drafted, it will hopefully reduce the effects of flooding in certain areas of the County. Additional information regarding this project is found in Section 5.4.2 of this document.

Additional information on the NFIP program and its implementation within the County may be found in the flood hazard profile in Section 4.3.5.

5.3 COMMUNITY RATING SYSTEM (CRS)

In the 1990s, the Flood Insurance Administration (FIA) established the Community Rating System (CRS) to encourage local governments to increase their standards for floodplain development. The goal of the program is to encourage communities—through flood insurance rate adjustments—to implement standards above and beyond the minimum required in order to:

- Reduce losses from floods
- Facilitate accurate insurance ratings
- Promote public awareness of the availability of flood insurance

CRS is a voluntary program designed to reward participating jurisdictions for their efforts to create more disaster-resistant communities using the principles of sustainable development and management. By enrolling in CRS, municipalities can leverage greater flood protection while receiving flood insurance discounts.

Currently, no municipalities in Beaver County participate in the CRS. Increased participation will be supported by the County, and will be promoted through the local emergency management coordinators as identified in the updated mitigation strategies.

5.4 PLANNING AND REGULATORY CAPABILITY

While municipalities in Pennsylvania must comply with the minimum regulatory requirements established under the Pennsylvania Municipal Planning Code, they otherwise have considerable latitude in adopting ordinances, policies, and programs that can support their ability to manage natural and non-natural hazard risk. Specifically, municipalities can manage these risks through comprehensive land use planning, hazard-specific ordinances (for example, flood damage prevention, sinkholes, and steep slopes), zoning, site-plan approval, and building codes. Specific plans guiding hazard mitigation under the planning and regulatory capability in Beaver County are described in the sections below.

5.4.1 Beaver County Comprehensive Plan

The Beaver County Comprehensive Plan, last updated in 2010, grew out of a need to analyze and consolidate the numerous detailed and well-developed plans for an overall picture of Beaver County. This plan is a guidance document for future growth and development in Beaver County. It analyzes the trends, changes, and conditions of the population, economics, housing, environment, infrastructure, and other areas. It then assesses the strengths, weaknesses, opportunities, and threats, and establishes a vision for future growth and formulates goals and strategies to implement that vision.

The purpose of the plan is to guide development and growth in Beaver County while promoting the conservation of farmland and natural resources including streams and floodplains, riparian buffers, wetlands, important natural areas, steep slopes, and woodlands. The plan recommends that new industrial or residential

growth should not locate in areas recommended for natural resource or farmland protection. Higher-density residential growth, and industrial and business expansion should take place in the recommended urban areas. The plan identifies goals, policies, and a number of implementation strategies for a variety of topics including land use, housing, natural resources, farmland preservation, economic development, transportation, community utilities (water, wastewater, and stormwater), parks and recreation, and historic preservation.

Although the Pennsylvania Municipalities Planning Code requires that municipal plans be in accord with the County plan, the code provides no measures for ensuring that this occurs. Most municipalities have adopted their own comprehensive plan.

5.4.2 Stormwater Management Planning

In 1978, the Pennsylvania General Assembly passed the Stormwater Management Act (Act 167) of 1978. Act 167 requires counties to prepare stormwater management plans on a watershed-by-watershed basis. The plans must be developed in consultation with the affected municipalities. Standards for control of runoff from new development are a required component of each plan and are based on a detailed hydrologic assessment. A key objective of each plan is to coordinate the stormwater management decisions of the watershed municipalities. Implementation of each plan is through mandatory municipal adoption of ordinance provisions consistent with the plan.

Plans prepared under Act 167 will not resolve all drainage issues. A key goal of the planning process is to maintain existing peak runoff rates throughout a watershed as land development continues to take place. While the planning process does not solve existing flooding problems, it aims to prevent these problems from getting worse. Each municipality is responsible for correcting existing flooding problems.

In 2010, Beaver County published its first Countywide Stormwater Management Plan. This plan was developed to reflect requirements and recommendations from the PA DEP-preferred planning approach. The County identified several goals and benefits with this Stormwater Management Plan, including:

- Consistency in stormwater management planning, regulation, and implementation
- Integrated Stormwater Management Plan
- Usable technical information in GIS format
- Technical information for future hydrologic and hydraulic analysis and regulatory activities

The County has not yet developed its Phase II Act 167 Countywide Stormwater Management Plan. Once this plan has been developed, it will seek to address the full range of hydrologic and hydraulic impacts from cumulative land development within a watershed.

5.4.3 Natural Resource Planning

Beaver County is mindful of the importance of natural resource planning. To that end, the Beaver County Greenways and Trails Plan serves as a companion document and additional resource to the County Comprehensive Plan. Written in 2007, the Plan provides recommendation and information relevant to initiatives and issues related to the region's land-use, parks, recreation, environmentally sensitive areas, and open-space planning efforts.

5.4.4 Open-Space Planning

According to the County Comprehensive Plan, almost 8 percent of the County is devoted to parkland or other open space dedicated for recreational use. To continue to preserve open space for both recreation and environmental purposes, Beaver County has prepared several plans. These plans include chapters and strategies in the Beaver County Comprehensive Plan (2010), the Beaver County Comprehensive Recreation and Parks Plan (2003), and the Beaver County Greenways and Trails Plan (2007). A greenway is a corridor of

open space. These plans (1) identify regional conservation and cultural, recreational, conservation, and scenic greenways and (2) evaluate ways local ordinances may protect greenways.

The Planning Committee will comment on open-space issues identified in these plans during project reviews.

5.4.5 Informational Resources

Beaver County has a variety of informational resources available to the public. Many of the publications discussed previously are available for review by the public on the Beaver County website (http://www.beavercountypa.gov/). Beaver County also responds to floodplain information requests from the public. The County has sponsored seminars related to stormwater management, floodplain issues, model environmental ordinances, and basic courses in subdivision review and zoning.

Beaver County—along with many of the municipalities—has identified specific mitigation initiatives in this plan update to help build and enhance mitigation-related planning and regulatory capabilities in Beaver County.

5.4.6 Municipal Capabilities

Participating municipalities in this planning effort were provided a capabilities survey. Table 5-1 summarizes the responses of the municipalities based on the planning and regulatory capability. Copies of the individual municipal responses are provided in Appendix D.

Table 5-1. Planning and Regulatory Capability

Municipality	Hazard Mitigation Plan	EOP	Disaster Recovery Plan	Evacuation Plan	COOP Plan	NFIP	NFIP – CRS	Floodplain Regulations	Floodplain Mgmt. Plan	Zoning Regulations	Subdivision Regulations	Comprehensive Land Use Plan (or General, Master, or Growth Mgmt. Plan)	Open Space Mgmt. Plan	Stormwater Mgmt. Plan/Ordinance	Natural Resource Protection Plan	Capital Improvements Plan	Economic Dev. Plan	Historic Preservation Plan	Farmland Preservation	Building Code	Fire Code	Firewise	Storm Ready	Other
Beaver County	X	X	-	-	-	-	-	-	-	-	-	X	X	UD	-	-	-	-	X	-	-	-	-	-
Aliquippa, City of	X	X	-	X	X	X	X	X	-	X	X	-	-	-	-	-	-	-	-	X	X	-	-	-
Ambridge, Borough of	X	X	-	-	-	X	-	X	X	X	X	X	-	X	-	-	-	X	-	X	X	-	-	-
Baden, Borough of	X	X	X	X	X	X	-	X	X	X	X	-	-	X	-	-	-	-	-	X	X	-	X	-
Beaver Falls, City of	X	-	-	-	-	X	-	X	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-	-
Beaver, Borough of	X	X	X	X	-	X	-	X	X	X	X	X	X	X	X	X	X	X	-	X	X	-	-	-
Big Beaver, Borough of	X	X	-	X	-	X	X	X	X	X	X	X	X	X	-	-	-	-	-	X	X	-	-	-
Bridgewater, Borough of	X	X	-	X	-	X	X	X	X	X	-	-	-	X	X	-	-	-	-	X	X	-	-	-
Brighton, Township of	X	X	-	-	-	X	-	X	-	X	X	X	UD	X	-	-	-	-	X	X	-	-	-	-
Center, Township of	X	-	X	X	-	X	-	X	X	X	X	X	-	X	-	-	-	-	X	X	-	-	-	-
Chippewa, Township of	-	X	-	X	-	X	-	X	-	X	X	X	X	X	-	X	-	-	X	X	X	-	-	-
Conway, Borough of	X	X	X	X	-	X	-	X	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-	-
Darlington, Borough of	X	X	-	X	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Darlington, Township of	X	X	X	X	-	X	-	X	X	X	X	X	X	X	-	-	-	-	X	X	-	-	-	-
Daugherty, Township of	X	X	-	-	X	X	-	X	-	-	-	X	-	X	-	-	-	-	X	X	X	-	-	-
East Rochester, Borough of	X	X	X	X	X	X	-	X	X	X	X	X	X	X	-	X	-	-	-	X	-	-	X	-
Eastvale, Borough of	X	X	-	X/ UD	-	X	-	X	X	X	X	-	-	-	-	-	-	-	-	X	-	-	-	-

Municipality	Hazard Mitigation Plan	EOP	Disaster Recovery Plan	Evacuation Plan	COOP Plan	NFIP	NFIP – CRS	Floodplain Regulations	Floodplain Mgmt. Plan	Zoning Regulations	Subdivision Regulations	Comprehensive Land Use Plan (or General, Master, or Growth Mgmt. Plan)	Open Space Mgmt. Plan	Stormwater Mgmt. Plan/Ordinance	Natural Resource Protection Plan	Capital Improvements Plan	Economic Dev. Plan	Historic Preservation Plan	Farmland Preservation	Building Code	Fire Code	Firewise	Storm Ready	Other
Economy, Borough of	X	X	-	-	-	X	-	X	-	X	X	X	X	X	-	-	-	-	X	X	X	-	-	-
Fallston, Borough of	X	-	-	X	-	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	UD	-	-	-
Frankfort Springs, Borough of	X	X	X	X	-	X	-	X	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-
Franklin, Township of	X	X	-	X	-	X	-	X	-	X	X	X	-	X	-	-	-	-	X	X	-	-	-	-
Freedom, Borough of	X	X	X	X	-	X	-	X	X	X	X	-	-	X	-	-	-	-	-	X	X	-	-	-
Georgetown, Borough of																								
Glasgow, Borough of																								
Greene, Township of	X	X	X	X	-	X	-	X	X	X	X	X	-	-	-	-	-	-	X	-	-	-	-	-
Hanover, Township of	X	X	-	-	-	X	X	X	X	X	X	X	-	X	X	-	-	X	X	X	X	-	-	-
Harmony, Township of	X	X	-	-	-	X	-	X	-	X	X	X	-	X	-	-	-	-	X	X	-	-	-	-
Homewood, Borough of																								
Hookstown, Borough of																								
Hopewell, Township of	X	X	-	X	X	X	X	X	X	X	X	-	X	X	-	-	-	-	-	X	X	-	-	-
Independence, Township of	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	X	X	X	-	-	-
Industry, Borough of	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	-	-	X	X	-	-	-	-
Koppel, Borough of	X	X	UD	X	UD	X	UD	X	UD	UD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marion, Township of	X	X	-	-	-	X	-	X	-	X	X	X	-	X	-	-	-	-	-	X	-	-	-	-
Midland, Borough of	X	-	-	X	-	X	-	X	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-	-

Municipality	Hazard Mitigation Plan	EOP	Disaster Recovery Plan	Evacuation Plan	COOP Plan	NFIP	NFIP – CRS	Floodplain Regulations	Floodplain Mgmt. Plan	Zoning Regulations	Subdivision Regulations	Comprehensive Land Use Plan (or General, Master, or Growth Mgmt. Plan)	Open Space Mgmt. Plan	Stormwater Mgmt. Plan/Ordinance	Natural Resource Protection Plan	Capital Improvements Plan	Economic Dev. Plan	Historic Preservation Plan	Farmland Preservation	Building Code	Fire Code	Firewise	Storm Ready	Other
Monaca, Borough of	X	X	UD	X	UD	X	X	X	X	X	X	X	X	X	-	-	-	-	-	X	X	UD	X	-
New Brighton, Borough of	X	X	-	-	-	X	-	X	-	X	X	X	-	X	-	-	-	-	-	X	X	-	-	-
New Galilee, Borough of	X	X	-	-	X	X	-	X		-	-	-	-			-	-	-	-			-	-	-
New Sewickley, Township of	X	X	-	-	-	X	-	X	X	X	X	X	-	-	-	-	-	-	-	X	-	-	-	-
North Sewickley, Township of																								
Ohioville, Borough of																								
Patterson Heights, Borough of	X	X	X	X	-	X	-	X	X	X	-	-	-	-	X	X	-	-	-	X	X	-	-	X
Patterson, Township of	X	X	X	X	-	X	-	X	X	X	X	X	-	X	-	-	-	-	-	X	X	-	-	-
Potter, Township of	X	X	-	X	-	X	X	X	X	X	X	X	X	X	X	-	-	X	X	X	-	-	-	-
Pulaski, Township of	X	X	-	-	-	X	-	X	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Raccoon, Township of																								
Rochester, Borough of	X	X	X	X	-	X	X	X	X	X	-	X	-	X	-	-	-	-	-	X	X	-	-	-
Rochester, Township of	X	X	X	X	-	X	-	X	X	X	X	X	-	X	-	X	X	-	-	X	X	-	X	-
Shippingport, Borough of	X	X	X	X	X	X	-	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-	-	-
South Beaver, Township of	X	X	-	X	-	X	-	X	X	X	X	X	-	X	-	-	-	-	X	X	X	-	-	-
South Heights, Borough of	X	X	X	X	-	X	-	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-
Vanport, Township of	X	X	X	X	-	X	-	X	X	X	X	-	-	X	-	-	-	-	-	X	X	-	-	-

Municipality	Hazard Mitigation Plan	EOP	Disaster Recovery Plan	Evacuation Plan	COOP Plan	NFIP	NFIP – CRS	Floodplain Regulations	Floodplain Mgmt. Plan	Zoning Regulations	Subdivision Regulations	Comprehensive Land Use Plan (or General, Master, or Growth Mgmt. Plan)	Open Space Mgmt. Plan	Stormwater Mgmt. Plan/Ordinance	Natural Resource Protection Plan	Capital Improvements Plan	Economic Dev. Plan	Historic Preservation Plan	Farmland Preservation	Building Code	Fire Code	Firewise	Storm Ready	Other
West Mayfield, Borough of	X	X	-	X/ UD	-	X	-	X	X	X	X	-	-	X	-	-	-	-	-	X	-	-	-	-
White, Township of																								

Notes:
"X" indicates that the municipality currently has this capability in place.
"UD" indicates this capability is under development.
"-" indicates no capability is currently in place.
Blank space indicates no response was received from the municipality.

COOP = Concept of Operations
EOP = Emergency Operations Plan
CRS = Community Rating System
NFIP = National Flood Insurance Program

Detailed information regarding Beaver County municipalities' planning and regulatory capabilities can be found in the municipal survey responses provided in Appendix D.

5.5 ADMINISTRATIVE AND TECHNICAL CAPABILITY

Municipalities are further supported by County, regional, State, and federal administrative and technical capabilities. For this HMP, the majority of support agencies and resources have been identified and referenced throughout this plan update.

The County and many of its municipalities have identified specific mitigation initiatives described in this plan update, which will help build and enhance mitigation-related administrative and technical capabilities in Beaver County.

5.5.1 Municipal Capabilities

Participating municipalities in this planning effort were provided with a capabilities survey. Table 5-2 summarizes the responses of the municipalities based on administrative and technical capability. Copies of the individual municipal responses are found in Appendix D.

Table 5-2. Administrative and Technical Capability

Municipality	Planners (with land use/land development knowledge)	Planners or engineers (with natural and/or human caused hazards knowledge)	Engineers or professionals trained in building and/or infrastructure construction practices	Emergency Manager	NFIP Floodplain Administrator	Land surveyors	Scientists or staff familiar with the hazards of the community	Personnel skilled in GIS and/or FEMA's HAZUS program	Grant writers or fiscal staff to handle large/complex grants	Staff with expertise or training in benefit-cost analysis	Other
Beaver County	X	X	-	-	-	-	X	X	X	-	-
Aliquippa, City of	X	X	X	X	-	-	-	-	-	-	-
Ambridge, Borough of	-	-	X	X	X	-	-	-	X	-	-
Baden, Borough of	X	X	X	X	X	-	-	X	-	X	-
Beaver Falls, City of	X	X	X	X	X	X	-	-	-	-	-
Beaver, Borough of	X	X	X	X	X	X	X	X	X	X	-
Big Beaver, Borough of	X	X	X	X	X	X	X	X	X	X	-
Bridgewater, Borough of	X	X	X	X	-	-	-	-	-	-	-
Brighton, Township of	-	-	-	X	X	-	-	-	X	-	-
Center, Township of	X	X	X	X	X	-	-	X	X	-	-
Chippewa, Township of	X	X	X	X	X	X	X	X	X	X	-
Conway, Borough of	-	-	X	X	X	-	-	-	-	-	-
Darlington, Borough of	-	-	-	-	-	-	-	-	-	-	-
Darlington, Township of	X	X	X	X	X	X	X	X	X	X	-
Daugherty, Township of	X	X	X	X	X	X	-	X	X	X	-
East Rochester, Borough of	X	X	X	X	X	X	-	-	-		-
Eastvale, Borough of	-	-	X	X	X	-	-	-	-	-	-

Municipality	Planners (with land use/land development knowledge)	Planners or engineers (with natural and/or human caused hazards knowledge)	Engineers or professionals trained in building and/or infrastructure construction practices	Emergency Manager	NFIP Floodplain Administrator	Land surveyors	Scientists or staff familiar with the hazards of the community	Personnel skilled in GIS and/or FEMA's HAZUS program	Grant writers or fiscal staff to handle large/complex grants	Staff with expertise or training in benefit-cost analysis	Other
Economy, Borough of	X	-	X	X	X	X	-	X	X	X	-
Fallston, Borough of	X	X	X	-	-	-	-	DK	-	-	-
Frankfort Springs, Borough of	-	-	-	X	-	-	-	-	-	-	-
Franklin, Township of	X	X	X	X	X	-	-	-	X	-	-
Freedom, Borough of	X	X	X	X	X	X	X	X	X	X	-
Georgetown, Borough of											
Glasgow, Borough of											
Greene, Township of	X	X	X	X	X	X	X	X	X	X	-
Hanover, Township of	X	X	X	X	X	X	X	-	X	X	-
Harmony, Township of	X	X	X	X	X	-	X	X	X	X	-
Homewood, Borough of											
Hookstown, Borough of											
Hopewell, Township of	X	X	X	X	X	X	X	X	X	X	-
Independence, Township of	X	X	X	X	X	X	X	X	X	X	-
Industry, Borough of	X	X	X	X	X	X	X	X	X	X	-
Koppel, Borough of	X	X	X	-	-	-	-	-	-	-	-
Marion, Township of	-	-	X	-	X	X	-	-	-	-	-
Midland, Borough of	X	X	X	X	X	X	X	X	X	X	-

Municipality	Planners (with land use/land development knowledge)	Planners or engineers (with natural and/or human caused hazards knowledge)	Engineers or professionals trained in building and/or infrastructure construction practices	Emergency Manager	NFIP Floodplain Administrator	Land surveyors	Scientists or staff familiar with the hazards of the community	Personnel skilled in GIS and/or FEMA's HAZUS program	Grant writers or fiscal staff to handle large/complex grants	Staff with expertise or training in benefit-cost analysis	Other
Monaca, Borough of	X	-	X	X	X	-	-	X	X	-	-
New Brighton, Borough of	X	-	X	X	X	X	X	X	X	X	-
New Galilee, Borough of	-	-		X	-	-	-	-	-	-	-
New Sewickley, Township of	-	-	X	X	-	-	-	-	-	-	-
North Sewickley, Township of											
Ohioville, Borough of											
Patterson Heights, Borough of	-	-	X	X	X	X	-	X	-	-	-
Patterson, Township of	X	X	X	X	X	X	X	X	X	X	-
Potter, Township of	-	-	X	X	X	-	-	-	-	-	-
Pulaski, Township of											
Raccoon, Township of											
Rochester, Borough of	-	-	-	X	X	-	-	-	-	-	-
Rochester, Township of	X	X	X	X	X	X	X	X	X	X	-
Shippingport, Borough of	-	X	X	X	-	X	-	-	X	-	-
South Beaver, Township of	-	-	-	-	X	-	-	-	-	-	-
South Heights, Borough of	X	-	X	X	-	-	X	-	X	-	-
Vanport, Township of	X	X	X	X	X	X	X	X	X	X	-

Municipality	Planners (with land use/land development knowledge)	Planners or engineers (with natural and/or human caused hazards knowledge)	Engineers or professionals trained in building and/or infrastructure construction practices	Emergency Manager	NFIP Floodplain Administrator	Land surveyors	Scientists or staff familiar with the hazards of the community	Personnel skilled in GIS and/or FEMA's HAZUS program	Grant writers or fiscal staff to handle large/complex grants	Staff with expertise or training in benefit-cost analysis	Other
West Mayfield, Borough of	-	-	X	X	X	-	-	-	-	-	-
White, Township of											

Notes:
"X" indicates that the municipality currently has this capability in place.
"-" indicates no capability is currently in place.
DK indicates "don't know."
Blank space indicates no response was received from the municipality.
FEMA = Federal Emergency Management Agency GIS = Geographic Information System
HAZUS = Hazards U.S. NFIP = National Flood Insurance Program

Detailed information regarding Beaver County municipalities' administration and technical capabilities can be found in the municipal survey responses provided in Appendix D.

5.6 FISCAL CAPABILITY

Mitigation projects and initiatives are largely or entirely dependent on available funding. As such, it is critical to identify all available sources of funding at the local, county, regional, state, and federal level to support implementation of the mitigation strategies identified in this plan update.

Jurisdictions fund mitigation projects though existing local budgets, local appropriations (including referendums and bonding), and through myriad federal and state loan and grant programs.

Federal mitigation grant funding (Stafford Act 404 and 406) is available to all communities with a current HMP (this plan); however, most of these grants require a "local share" in the range of 10 to 25 percent of the total grant amount. This section describes the funding sources and programs available to Beaver County in support of their mitigation efforts.

5.6.1 Capital Improvement Planning

Capital improvement plans are often recommended by counties to their municipalities, as these plans help identify specific capital projects to be funded and completed according to a defined schedule. Some of these projects involve improvements to facilities and infrastructure that provide hazard mitigation benefits. As such, during this update process, the County and its municipalities have been encouraged to consider the mitigation benefits associated with their known or anticipated capital projects as a way to help prioritize their execution and to develop awareness that mitigation grants may be available to help fund such projects.

5.6.2 Federal Hazard Mitigation Funding Opportunities

Hazard Mitigation Grant Program (HMGP)

HMGP (Stafford Act 404 and 406) is a post-disaster mitigation program made available to states by FEMA after each federal disaster declaration. The HMGP can provide up to 75 percent funding for hazard mitigation measures and can be used to fund cost-effective projects that will protect public or private property in an area covered by a federal disaster declaration or that will reduce the likely damage from future disasters. Examples of projects include acquisition and demolition of structures in hazard-prone areas, flood proofing or elevation to reduce future damage, minor structural improvements, and development of state or local standards.

Projects must fit into an overall mitigation strategy for the area identified as part of a local planning effort. All applicants must have a FEMA-approved HMP. Applicants who are eligible for the HMGP include state and local governments, certain nonprofit organizations or institutions that perform essential government services, and Indian tribes and authorized tribal organizations. Individuals or homeowners cannot apply directly for the HMGP; a local government must apply on their behalf. Applications are submitted to PEMA and placed in rank order for available funding and submitted to FEMA for final approval. Eligible projects not selected for funding are placed in an inactive status and may be considered as additional HMGP funding becomes available.

FEMA Stafford Act Sections 404 and 406 are two distinct criteria associated with mitigation funding. Participation in FEMA 404 HMGP may cover mitigation activities including raising, removing, relocating, or replacing structures within flood hazard areas. FEMA 406 HMGP is applied to parts of a facility that were actually damaged by a disaster, and the mitigation measures that provide protection from subsequent events.

Flood Mitigation Assistance (FMA) Program

FMA provides funding to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. FMA is funded annually; no federal disaster declaration is required. Only NFIP-insured homes and businesses are eligible for mitigation in this program. Funding for FMA is very limited and, as with the

HMGP, individuals cannot apply directly for the program. Applications must come from local governments or other eligible organizations.

The federal government cost share for an FMA project is 75 percent. At least 25 percent of the total eligible costs must be provided by a non-federal source, and of this 25 percent, no more than half can be provided as in-kind contributions from third parties. At a minimum, a FEMA-approved local HMP is required before a project can be approved. FMA funds are distributed from FEMA to the State. PEMA serves as the grantee and program administrator for FMA.

As of fiscal year 2013, the Severe Repetitive Loss and Repetitive Flood Claims Programs were dismantled and incorporated into the FMA Program. As a result, residential and non-residential properties currently insured with NFIP are eligible to receive FMA funds as long as they meet either the Repetitive Loss Properties (RLP) or Severe Repetitive Loss (SRL) property definitions as described in Section 4.3.5 of this plan.

Pre-Disaster Mitigation (PDM) Program

The PDM program is an annually funded, nationwide, competitive grant program. No disaster declaration is required. Federal funds will cover 75 percent of a project's cost up to $3 million. As with the HMGP and FMA, a FEMA-approved local HMP is required to be approved for funding under the PDM program.

5.6.3 Federal Disaster Assistance Programs

Following a disaster, various types of assistance may be made available by local, state, and federal governments. The types and levels of disaster assistance depend on the severity of the damage and the declarations that result from the disaster event. Should the President of the United States declare the event a major disaster, the following general types of assistance are offered:

- Individual Assistance – provides help for homeowners, renters, businesses, and some nonprofit entities after disasters occur. This program is largely funded by the U.S. Small Business Administration largely funds this program. For homeowners and renters, those who suffered uninsured or underinsured losses may be eligible for a Home Disaster Loan to repair or replace damaged real estate or personal property. Renters are eligible for loans to cover personal property losses. Individuals may borrow up to $200,000 to repair or replace real estate, $40,000 to cover losses to personal property and an additional 20 percent for mitigation. For businesses, loans may be made to repair or replace disaster damages to property owned by the business, including real estate, machinery and equipment, inventory and supplies. Businesses of any size are eligible. Non-profit organizations such as charities, churches, private universities, etc. are also eligible. An Economic Injury Disaster Loan provides necessary working capital until normal operations resume after a physical disaster. These loans are restricted (by law) to small businesses only.

- Public Assistance – provides cost reimbursement aid to local governments (state, county, local, municipal authorities, and school districts) and certain nonprofit agencies that were involved in disaster response and recovery programs or that suffered loss or damage to facilities, or property used to deliver government-like services. This program is largely funded by FEMA with both local and state matching contributions required.

5.6.4 Other Potential Funding Sources

Community Development Block Grants (CDBG)

CDBGs are federal funds intended to provide low- and moderate-income households with decent housing, a suitable living environment, and expanded economic opportunities. Eligible activities include community facilities and improvements, roads and infrastructure, housing rehabilitation and preservation, development

activities, public services, economic development, planning, and administration. Public improvements may include flood and drainage improvements. In limited instances and during times of "urgent need" (for example, post-disaster) as defined by the CDBG National Objectives, CDBG funding may be used to acquire a property located in a floodplain that was severely damaged by a recent flood, demolish a structure severely damaged by an earthquake, or repair a public facility severely damaged by a hazard event. Beaver County and several of its municipalities have utilized CDBG funding for infrastructure and other necessary improvements to increase County resiliency.

Marcellus Shale Legacy Fund - Act 13 of 2012

Watershed Restoration and Protection Program (WRPP) - Act 13 of 2012 establishes the Marcellus Legacy Fund and allocates funds to the Commonwealth Financing Authority for watershed restoration and protection projects. The overall goal of this program is to restore and maintain restored stream reaches impaired by the uncontrolled discharge of nonpoint source polluted runoff, and ultimately to remove these streams from the PA DEP's Impaired Waters list.

Greenways, Trails and Recreation Program (GTRP) - In addition, Act 13 of 2012 allocates funds to the Commonwealth Financing Authority (the "Authority") for planning, acquisition, development, rehabilitation and repair of greenways, recreational trails, open space, parks and beautification projects. Projects can involve development, rehabilitation and improvements to public parks, recreation areas, greenways, trails, and river conservation.

Flood Mitigation Projects – Finally, Act 13 of 2012 allocates funds to the Commonwealth Financing Authority (the "Authority") for funding Statewide initiatives to assist with flood mitigation projects.

While most of the identified fiscal capabilities are available to all of the municipalities in Beaver County, the extent to which communities have leveraged these funding sources varies widely. It is expected that communities familiar with accessing grant programs will continue to pursue those grant sources, as appropriate.

5.6.5 Municipal Capabilities

Municipalities participating in this planning effort were provided with a capabilities survey. Table 5-3 summarizes the responses of the municipalities based on fiscal capabilities. Copies of the individual municipal responses are found in Appendix D.

Table 5-3. Fiscal Capability

Municipality	Capital Improvements Program	Community Development Block Grants (CDBG)	Special Purpose Taxes	Gas/Electric Utility Fees	Water/Sewer Fees	Stormwater Utility Fees	Development Impact Fees	General Obligation, Revenue, and/or Special Tax Bonds	Partnering Arrangements or Intergovernmental Agreements	Other
Beaver County	-	X		-	-	-	X		X	-
Aliquippa, City of	-	X	-	-	-	-	-	-	-	-
Ambridge, Borough of	-	X	-	-	-	-	-	-	-	X
Baden, Borough of	X	X	-	-	X	-	-	-	X	-
Beaver Falls, City of	-	X	-	-	X	-	-	-	-	-
Beaver, Borough of	X	X	X	-	X	X	X	X	X	-
Big Beaver, Borough of	-	-	-	-	-	-	-	-	-	-
Bridgewater, Borough of	-	X	-	-	-	-	-	X	X	-
Brighton, Township of	X	-	-	-	X	-	X	X	X	-
Center, Township of	-	-	-	-	-	-	-	-	-	-
Chippewa, Township of										
Conway, Borough of	X	X	X	-	X	X	X	X	X	-
Darlington, Borough of	-	-	-	-	-	-	-	-	-	-
Darlington, Township of	X	X	X	-	X	X	X	X	X	-
Daugherty, Township of	-	X	-	-	-	-	-	-	X	-
East Rochester, Borough of	-	X	X	-	X	-	-	-	-	-
Eastvale, Borough of	-	-	-	-	-	-	-	-	-	-
Economy, Borough of	-	X	-	-	-	-	-	X	X	-
Fallston, Borough of	DK	-	DK	-	-	-	DK	DK	DK	DK
Frankfort Springs, Borough of	-	-	-	-	-	-	-	-	-	-
Franklin, Township of	-	X	X	-	-	-	-	-	X	-
Freedom, Borough of	X	X	X	-	X	X	X	X	X	-
Georgetown, Borough of										
Glasgow, Borough of										
Greene, Township of	X	X	X	-	-	X	X	X	X	-
Hanover, Township of	X	X	-	-	-	-	-	-	X	-
Harmony, Township of	X	X	-	X	X	-	X	X	X	X

Municipality	Capital Improvements Program	Community Development Block Grants (CDBG)	Special Purpose Taxes	Gas/Electric Utility Fees	Water/Sewer Fees	Stormwater Utility Fees	Development Impact Fees	General Obligation, Revenue, and/or Special Tax Bonds	Partnering Arrangements or Intergovernmental Agreements	Other
Homewood, Borough of										
Hookstown, Borough of										
Hopewell, Township of	-	X	X	-	-	-	X	X	-	-
Independence, Township of	X	X	X	-	-	X	X	X	X	X
Industry, Borough of	X	X	X	-	X	X	X	X	X	-
Koppel, Borough of	-	-	-	-	-	-	-	DK	-	-
Marion, Township of										
Midland, Borough of	X	X	X	-	X	X	X	X	X	-
Monaca, Borough of		X	-		X	-	-	X	X	
New Brighton, Borough of	X	X	-	-	X	-	-	-	X	-
New Galilee, Borough of	-	-	-	-	-	-	-	-	-	-
New Sewickley, Township of	-	-	-	-	-	-	-	-	-	-
North Sewickley, Township of										
Ohioville, Borough of										
Patterson Heights, Borough of	X	X	X	-	X	X	X	X	X	-
Patterson, Township of	X	X	X	-	X	X	X	X	X	-
Potter, Township of	X	X	-	-	-	-	-	-	X	-
Pulaski, Township of										
Raccoon, Township of										
Rochester, Borough of	X	X	-	-	-	-	-	-	-	-
Rochester, Township of	X	X	X	-	X	X	-	X	X	-
Shippingport, Borough of	-	-	-	-	X	-	-	-	-	-
South Beaver, Township of	-	X	-	-	-	-	-	-	X	-
South Heights, Borough of	-	X	-	-	-	-	-	-	-	-
Vanport, Township of	X	X	X	-	X	X	X	X	X	-
West Mayfield, Borough of	-	-	-	-	-	-	-	-	-	-
White, Township of										

Notes:
"X" indicates that the municipality currently has this capability in place.
"-" indicates no capability is currently in place.
DK indicates "don't know."
Blank space indicates no response was received from the municipality.

Detailed information regarding municipalities' fiscal capabilities can be found in the municipal survey responses provided in Appendix D.

5.7 POLITICAL CAPABILITY

For a hazard mitigation project, political capability speaks to a jurisdiction's ability, will, and commitment to supporting risk management activities and programs within all aspects of their community's governance. This commitment may be evidenced through the adoption and appropriate enforcement of mitigation-related ordinances and plans (zoning, comprehensive planning, site-plan review, building code, higher regulatory standards), appropriate and critical mitigation-related outreach to vulnerable property owners and the public in general, an appropriate dedication of resources (administrative, technical, fiscal) to implement identified priority mitigation projects/actions, and the integration and coordination of the findings and recommendations of this plan update within other complementary and supportive plans and programs.

Strong political capabilities are built over time; they are not necessarily transferred from one elected official to the next. Communities that have had to repeatedly face hazard events and their impacts tend to be those that build and maintain greater mitigation capabilities, and this is certainly the case with political (including public) will. Through this mitigation planning, update, and implementation process, FEMA and the State are promoting efforts to build political and popular support to improve the management of hazard risk at the local level.

The capability assessment surveys provided to each jurisdiction included an assessment of local political capability, where the respondent was asked to rate their community's political capability to effect and support hazard mitigation on a scale ranging from "5 – Very Willing" to "0 – Unwilling to Adopt Policies/Programs." Completed capability assessment worksheets returned from communities are provided in Appendix D. By its very nature, an assessment of political capabilities tends to be highly subjective, and any such local assessment provided by a community should not necessarily be considered statistically valid or reflective of the opinions of others in the community.

5.7.1 Municipal Capabilities

Participating municipalities in this planning effort were provided with a capabilities survey. Table 5-4 summarizes the responses of the municipalities based on political capability.

Table 5-4. Political Capability

Municipality	Very Willing	Moderate to Very Willing	Moderately Willing	Unwilling to Moderately Willing	Unwilling
Beaver County					
Aliquippa, City of		X	X		
Ambridge, Borough of			X		
Baden, Borough of		X			
Beaver Falls, City of		X			

Municipality	Very Willing	Moderate to Very Willing	Moderately Willing	Unwilling to Moderately Willing	Unwilling
Beaver, Borough of	X				
Big Beaver, Borough of			X		
Bridgewater, Borough of			X		
Brighton, Township of		X			
Center, Township of			X		
Chippewa, Township of					
Conway, Borough of			X		
Darlington, Borough of					X
Darlington, Township of	X				
Daugherty, Township of		X			
East Rochester, Borough of			X		
Eastvale, Borough of			X		
Economy, Borough of	X	X			
Fallston, Borough of			X		
Frankfort Springs, Borough of			X		
Franklin, Township of		X			
Freedom, Borough of	X				
Georgetown, Borough of					
Glasgow, Borough of					
Greene, Township of	X				
Hanover, Township of	X				
Harmony, Township of			X		
Homewood, Borough of					
Hookstown, Borough of					
Hopewell, Township of		X			
Independence, Township of	X				
Industry, Borough of	X				
Koppel, Borough of			X		

Municipality	Very Willing	Moderate to Very Willing	Moderately Willing	Unwilling to Moderately Willing	Unwilling
Marion, Township of			X		
Midland, Borough of			X		
Monaca, Borough of		X			
New Brighton, Borough of		X			
New Galilee, Borough of			X		
New Sewickley, Township of			X		
North Sewickley, Township of					
Ohioville, Borough of					
Patterson Heights, Borough of		X			
Patterson, Township of	X				
Potter, Township of			X		
Pulaski, Township of					
Raccoon, Township of					
Rochester, Borough of	X				
Rochester, Township of	X				
Shippingport, Borough of			X		
South Beaver, Township of			X		
South Heights, Borough of					
Vanport, Township of	X				
West Mayfield, Borough of			X		
White, Township of					

Notes:
"X" indicates the identified municipal political effort currently in place.
Blank space indicates no response was received from the municipality.

Detailed information regarding municipalities' political capabilities can be found in the municipal survey responses provided in Appendix D.

5.8 SELF-ASSESSMENT

Through the capability assessment surveys, all participating jurisdictions were further asked to provide a self-assessment of their jurisdiction's capability in the areas of planning and regulatory, administrative and technical, fiscal, community/political, and community resilience. Respondents evaluated their degree of

capability in these areas as "Limited", "Moderate," or "High." Table 5-5 summarizes the results from municipalities within Beaver County that completed capability self-assessment worksheets.

Table 5-5. Capability Self-Assessment Matrix

Municipality	Capability Category				
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability	Community Resiliency Capability
Beaver County	L				
Aliquippa, City of	L	L	L	L	L
Ambridge, Borough of	H	M	L	L	M
Baden, Borough of	H	H	H	H	H
Beaver Falls, City of	L	M	L	M	L
Beaver, Borough of	H	H	H	H	H
Big Beaver, Borough of	L	M	M	L	L
Bridgewater, Borough of	M	M	M	M	M
Brighton, Township of	M	H	H	H	M
Center, Township of					
Chippewa, Township of					
Conway, Borough of	M	H	H	M	M
Darlington, Borough of	L	L	L	L	L
Darlington, Township of	H	H	H	H	H
Daugherty, Township of	M	M	M	M	M
East Rochester, Borough of	L	L	L	L	L
Eastvale, Borough of	L	L	L	L	L
Economy, Borough of	H	H	H	M	M
Fallston, Borough of	M	M	M	M	M
Frankfort Springs, Borough of	L	L	L	L	L
Franklin, Township of	M	M	M	M	M
Freedom, Borough of	H	H	H	H	H
Georgetown, Borough of					
Glasgow, Borough of					
Greene, Township of	H	H	M	H	H

Municipality	Capability Category				
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability	Community Resiliency Capability
Hanover, Township of	H	H	M	L	L
Harmony, Township of	M	H	H	M	M
Homewood, Borough of					
Hookstown, Borough of					
Hopewell, Township of	H	H	L	M	M
Independence, Township of	H	H	H	H	H
Industry, Borough of	H	H	H	H	H
Koppel, Borough of	M	M	H	L	M
Marion, Township of	M	L	L	M	M
Midland, Borough of	H	H	L	M	M
Monaca, Borough of	M	M	M	M	M
New Brighton, Borough of	H	H	L	H	M
New Galilee, Borough of	M	M	L	M	M
New Sewickley, Township of	M	L	L	L	L
North Sewickley, Township of					
Ohioville, Borough of					
Patterson Heights, Borough of	M	L	L	M	L
Patterson, Township of	H	H	H	H	H
Potter, Township of	M	M	M	M	M
Pulaski, Township of					
Raccoon, Township of					
Rochester, Borough of	M	M	L	M	M
Rochester, Township of	H	H	H	H	H
Shippingport, Borough of	M	M	M	M	M
South Beaver, Township of	M	M	M	M	M
South Heights, Borough of	L	L	L	L	L
Vanport, Township of	H	H	H	H	H

Municipality	Capability Category				
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability	Community Resiliency Capability
West Mayfield, Borough of	L	L	L	L	L
White, Township of					

Notes:
"-" indicates no capability is currently in place.
Blank space indicates no response was received from the municipality.

Detailed information regarding the municipalities' capabilities self-assessments can be found in the municipal survey responses provided in Appendix D.

5.9 CAPABILITY ASSESSMENT CONCLUSIONS

A jurisdiction's ability to effectively manage natural hazard risk is directly related to their level of hazard mitigation capabilities. As such, mitigation strategies developed in coordination with Beaver County's municipalities have a direct effect on establishing new capability functions in the community or strengthening existing capabilities.

SECTION 6 MITIGATION STRATEGY

This section describes the process by which the Beaver County Planning Team (Planning Team) will reduce or eliminate potential losses from the natural and non-natural hazards identified in Section 4.2 of this hazard mitigation plan (HMP). The mitigation strategy focuses on existing and potential future mitigation actions to alleviate the effects of hazards on Beaver County's population, economy, and general building stock.

This section provides a summary of the 2016 HMP update process, outlines the mitigation goals and objectives set forth in the 2016 HMP Update, describes the process for identifying and analyzing mitigation techniques, and provides the mitigation action plan.

6.1 UPDATE PROCESS SUMMARY

The goals and objectives listed in the Beaver County HMP were first examined through the dispersal of the Mitigation Strategy 5-Year Plan Review Worksheet (Mitigation Review Worksheet). During the 5-year review, the Planning Team members and general public were afforded the opportunity to comment on the goals, objectives, and actions that were listed in the existing HMP. In addition, the HMP was posted on the County's project website (http://beavercountyhmp.com/) throughout the course of the plan update process. Correspondence distributed to the municipalities referenced the website and welcomed comments on the HMP to the Planning Team or to Tetra Tech, Inc. (Tetra Tech).

The general mitigation planning approach used to develop this plan is based on (1) the Federal Emergency Management Agency (FEMA) publication, "Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies," as well as (2) the Pennsylvania All-Hazard Mitigation Planning Standard Operating Guide (SOG). The SOG document includes the following four steps, which were used to support mitigation planning for this HMP:

1. **Review of Mitigation Goals and Objectives:** Existing mitigation goals and objectives were examined during the 2016 HMP Mitigation Solutions Workshop and the Mitigation Strategy Meeting, both of which were open to members of the public and County stakeholders. The Planning Team and members of the general public were afforded the opportunity to comment on the goals and objectives that were listed in the existing 2011 HMP through both the Mitigation Solutions Workshop and the Mitigation Review Worksheet. Mitigation goals and objectives were updated using the latest information gathered through the hazard profiles, vulnerability assessments, and the risk assessment; they were also compared to the State HMP goals and objectives.
2. **Develop and Update Mitigation Strategies:** Mitigation actions were identified based on the risk assessment, mitigation goals and objectives, existing policies, and input from the Planning Team and municipal planning partners.
3. **Mitigation Strategy Prioritization and Implementation:** The potential mitigation actions were qualitatively evaluated using the Political, Administrative, Social, Technical, Economic, Environmental, and Legal (PA-STEEL) method, described in more detail in Section 6.4 of this HMP. Mitigation actions were prioritized into three categories: high, medium, and low. High-priority and medium-priority mitigation actions are recommended for implementation before low-priority actions; however, based on County and community-specific needs, cost estimation, and available funding, some low-priority mitigation actions may be addressed first.
4. **Document the Mitigation Planning Process:** The entire mitigation planning process is documented throughout this HMP, particularly in Section 3.

This section summarizes past mitigation goals, past mitigation action status and update of mitigation strategies, and additional past mitigation accomplishments.

6.1.1 Review of the Past Mitigation Goals

The mitigation goals identified in the 2011 version of the HMP are listed below:

1. **Goal 1:** Protect lives, property, environmental quality, and natural resources of the County.
2. **Goal 2:** Enhance consistent coordination, collaboration, and communication among stakeholders.
3. **Goal 3:** Provide a framework for active hazard mitigation planning and implementation.
4. **Goal 4:** Build political support and secure funding for mitigation efforts.
5. **Goal 5:** Increase awareness, understanding, and preparedness.

6.1.2 Past Mitigation Action Status and Update of Mitigation Strategies

In the 2011 HMP, Beaver County identified 64 actions and initiatives to support an improved understanding of hazard risk and vulnerability and to enhance mitigation capabilities. Progress on the 2011 County-level mitigation actions was evaluated during the 2016 update process.

Beaver County, via various representatives on the Planning Team, was provided with a Mitigation Review Worksheet identifying all of the County and municipal actions and initiatives from the 2011 plan. The respondents were asked to indicate the status of each action ("No Progress/Unknown," "In Progress/Not Yet Complete," "Continuous," "Completed," or "Discontinued"), and provide review comments on each.

The completed Mitigation Action Plan Review Worksheet is provided in Table 6-1. Projects and initiatives identified as "Complete" and "Discontinued" have been removed from this plan update. The actions that the County has identified as "No Progress/Unknown," "In Progress/Not Yet Complete," or "Continuous" have been carried forward in the updated mitigation strategies identified in Table 6-3 (unless otherwise determined by the County to be a discontinued project). The language in some actions being carried over has been adjusted to reflect changes to County needs and capabilities. Some actions were also merged to reduce redundant efforts on behalf of the County and its municipalities.

Table 6-1. Past Mitigation Action Status

Description	Jurisdiction	Status	Review Comments
Action 1.1.1: Beaver County Conservation District and Planning Commission will work with Pennsylvania Emergency Management Agency (PEMA), Federal Emergency Management Agency (FEMA), and/or Pennsylvania Department of Community and Economic Development (DCED) to hold training sessions with the County and the municipalities on National Flood Insurance Program (NFIP) requirements.	County and all municipalities	Continuous	• Brighton Township noted that continuous training on proper implementation of the NFIP requirements is still needed. • Unless otherwise noted, municipalities marked this action as Continuous. • Marion Township, Bog Beaver, Hanover Township, and Midland Borough marked this action as Complete. Big Beaver completed this on 09/24/15. • Economy Borough marked this action as In Progress/Not Yet Complete and noted that the County Conservation District is providing training. • A few municipalities marked the status of this action as Unknown, but that may be because the action is primarily organized through the County.
Action 1.1.2: Beaver County Conservation District and Planning Commission will work with PEMA/FEMA/DCED to hold training sessions with the County and the municipalities on the Community Rating System (CRS).	County and all municipalities	Continuous	• Unless otherwise noted, municipalities marked this action as Continuous. • Marion Township, Darlington Borough, Fallston Borough, Franklin Township, Midland Borough, New Galilee Borough, Bridgewater Borough, Eastvale, West Mayfield, Aliquippa, and Potter Township marked this action as No Progress/Unknown. • Hanover Township marked this action as Completed. • Economy Borough marked this action as In Progress/Not Yet Complete. • Midland Borough noted that its consulting engineer has also provided information on CRS.
Action 1.1.3: Beaver County will work with municipalities to collect updated information on the number and location of all repetitive loss properties throughout the County and municipalities to plan future mitigation actions.	County and all municipalities	In Progress/ Not Yet Complete	• Beaver County, Aliquippa, West Mayfield, Eastvale, Patterson, and Bridgewater Borough marked this action as In Progress/Not Yet Complete. • Beaver Borough, Industry Borough, Rochester Township, Daugherty, Freedom, East Rochester, Independence, Ambridge, Greene, Darlington Township, Frankfort Springs, City of Beaver Falls, Vanport, Patterson Heights, Conway, and New Brighton marked this action as Continuous. • Darlington Borough and Hanover Township marked this action as Completed. • Marion Township, Fallston Borough, Economy Borough, New Galilee Borough, and Potter Township marked this action as No Progress/Unknown. New Galilee also noted that nobody has contacted the Borough in relation to this action.

Description	Jurisdiction	Status	Review Comments
Action 1.1.4: Maximize the use of FEMA Hazard Mitigation Assistance (HMA) grant funding and other programs to support all-hazard mitigation. Specific mitigation efforts include acquisition/demolition, elevation, and relocation of flood-prone residences; and flood proofing of non-residential structures.	County and all municipalities	Continuous	• Unless otherwise noted, municipalities marked this action as Continuous. • Eastvale and West Mayfield marked this action as In Progress/Not Yet Complete. New Brighton, New Galilee Borough, Economy Borough, Frankfort Springs, City of Beaver Falls, Fallston Borough, and Midland Borough marked this action as No Progress/Unknown. New Galilee also noted that relocation/acquisition and destruction of properties will cause a considerable net loss in housing stock for the Borough. • Big Beaver marked this action as completed (floodplain ordinance) on 06/06/15.
Action 1.1.5: Municipalities will review, create, and/or adopt a floodplain ordinance to ensure full compliance with the NFIP.	County and all municipalities	Completed	• Beaver County Conservation District and Brighton Township noted that this action was required to be completed by 08/17/15. • Beaver County marked this action as In Progress/Not Yet Complete AND Continuous. • Unless otherwise noted, municipalities marked this action as Completed. Shippingport completed this on 09/04/15. West Mayfield adopted this in October 2015. The City of Beaver Falls adopted Ordinance No. 2072 on June 23, 2015. Beaver Falls also has a Code Enforcement Officer who is a Certified Floodplain Manager (CFM). • New Brighton and Industry Borough marked this action as Continuous. Bridgewater Borough and Frankfort Springs marked this action as No Progress/Unknown. Koppel marked this as both No Progress and Continuous.
Action 1.1.6: Municipalities will review building codes and subdivision and land development ordinances to improve construction and hazard mitigation within designated flood zones.	County and all municipalities	Completed	• Monaca, Potter Township, Daugherty, Hanover Township, Franklin Township, City of Beaver Falls, and Ambridge marked this action as Completed. • Brighton Township notes that model zoning regulations for floodplain restrictions/regulations that comply with PA MPC would be helpful. • Many municipalities consider this an integrated, ongoing action. • New Galilee Borough noted that they do not have any places left to build. • Eastvale and West Mayfield use the universal Building Code and Code System to monitor. • Bridgewater Borough, Big Beaver, and Aliquippa marked this as In Progress. Bridgewater noted that Zoning Ordinances are under review this year. • Fallston Borough and Frankfort Springs marked this as No Progress/Unknown. Koppel marked this as both No Progress and Continuous.

Description	Jurisdiction	Status	Review Comments
Action 1.2.1: Create and continually monitor a list of critical facilities (as guided by PEMA) that could be affected by each identified hazard.	County and all municipalities	Completed	• This action is maintained through the HMP update process. • Potter Township, Industry Borough, and Hanover Township marked this action as Completed. • Marion Township, Frankfort Springs, Eastvale, West Mayfield, Fallston Borough, and Franklin Township marked this action as No Progress/Unknown. Big Beaver marked this as In Progress. • Other municipalities marked this as Continuous. • New Galilee Borough noted that no critical facilities are within their jurisdiction.
Action 1.2.2: Continue to use and improve geographic information system (GIS) capability to identify and prioritize hazards and critical infrastructure for mitigation. As funding becomes available, collect and/or support the collection of first-floor elevations for all severe repetitive loss properties in Beaver County.	County and all municipalities	In Progress/ Not Yet Complete	• Most municipalities considered this project as In Progress/Not Yet Complete, Continuous, or No Progress/Unknown. • West Mayfield updates some addresses as the issues arise. • New Brighton supports itself for all GIS information. New Galilee Borough has nothing at the Borough level.
Action 1.2.3: Identify insurable County and municipal-owned, flood-prone buildings and infrastructure, and take appropriate mitigation methods if located in a Special Flood Hazard Area (SFHA). Continually monitor and update, as necessary.	County and all municipalities	In Progress/ Not Yet Complete	• Potter Township, Big Beaver Borough, and Aliquippa marked this action as In Progress/Not Yet Complete. • Darlington Borough noted it is not in the floodplain. • Midland Borough marked this action as both Continuous and Completed. Bridgewater Borough and West Mayfield marked this action as Complete. Conway, City of Beaver Falls, and Daugherty Township marked this action Continuous. • West Mayfield's action plan is to buy out properties identified as funding is available. • Fallston Borough, Eastvale, and Economy Borough marked this as No Progress/Unknown. • New Galilee Borough has no government-owned structures involved in its jurisdiction.
Action 1.2.4: Implement a building-hardening program for critical facilities and infrastructure to protect against terrorism.	County and all municipalities	No Progress/ Unknown	• Most municipalities marked this as No Progress/Unknown. • Economy Borough marked this action as Continuous. • New Galilee Borough noted this action as Not Applicable (N/A).

Description	Jurisdiction	Status	Review Comments
Action 1.2.5: Upgrade the fire protection system to meet National Fire Protection Association (NFPA) standards. Projects may include purchase of mobile booster pumps to increase pressure for fire protection.	County and all municipalities	In Progress/ Not Yet Complete	• Many municipalities marked this action as In Progress/Not Yet Complete. Fallston and South Heights Boroughs marked this as In Progress/Not Yet Complete and Continuous. Koppel marked this as both No Progress and Continuous. • Midland, Daugherty, Darlington Township, Greene, Big Beaver, Aliquippa, Conway, Patterson Heights, and New Brighton marked this action as Continuous. • Marion Township, City of Beaver Falls, Economy Borough, Hanover Township, Franklin Township, Frankfort Springs, Eastvale, Bridgewater Borough, and Ambridge marked this action as No Progress/Unknown. • Patterson Heights noted this is maintained by its volunteer fire department. • New Brighton noted that the fire protection system is inspected by the fire department and dedicated service company once a year. • New Galilee Borough does not have water service or hydrants. • Darlington Borough contracts fire protection.
Action 1.3.1: Promote reverse notification systems in high-hazard areas.	County and all municipalities	In Progress/ Not Yet Complete	• Beaver Borough, Conway, Industry Borough, Greene, and Monaca marked this action as Complete. • New Brighton, Freedom, East Rochester, South Heights, Bridgewater Borough, Rochester Township, Darlington Township, Patterson, Patterson Heights, Independence, Midland, and Potter Township marked this action as In Progress/Not Yet Complete. Vanport selected both In Progress and Continuous. • Marion Township, West Mayfield, Eastvale, Aliquippa, Economy Borough, Frankfort Springs, Hanover Township, Fallston Borough, and Franklin Township marked this action as No Progress/Unknown. • Ambridge, Big Beaver, City of Beaver Falls, and Daugherty marked this action as Continuous. • New Brighton noted "Implication of Swift 9-1-1." • Monaca noted "Swift 9-1-1 Beaver County." • Darlington Borough stated it has no high hazard areas. • New Galilee Borough noted this action as N/A.
Action 1.3.2: Investigate opportunities to expand siren notification system.	County and all municipalities	In Progress/ Not Yet Complete	• The majority of municipalities marked this action as No Progress, In Progress, or Continuous. • New Brighton and Aliquippa marked this action as Discontinued. • Ambridge noted that the siren system is not heard in the Borough. Darlington Borough Fire Department retrieved siren from Borough building. New Galilee Borough has no sirens in the Borough and would appreciate grant opportunities for this.

Description	Jurisdiction	Status	Review Comments
Action 1.4.1: Review all emergency action plans (EAP) for dams.	County and all municipalities	Continuous	• Depending on municipal vulnerability to dam location, responses varied between No Progress/Unknown, In Progress/Not Yet Complete, and Continuous. • Koppel marked this as both No Progress and Completed.
Action 1.4.2: Continue to participate in radiological emergency plans to improve response planning for nuclear incidents.	County and all municipalities	In Progress/ Not Yet Completed	• Marion Township, West Mayfield, Eastvale, Big Beaver, Economy Borough, and Franklin Township marked this action as No Progress/Unknown. • Daugherty Township marked this as Complete. • Some municipalities consider this an integrated action, while others consider it In Progress.
Action 1.4.4: As funding is available, continue to conduct commodity flow studies on a regular basis.	County and all municipalities	No Progress/ Unknown	• Many municipalities marked this project as No Progress/Unknown. • Freedom Borough marked this action as In Progress. Industry Borough, Rochester Township, Greene, South Heights, Aliquippa, Darlington Township, Vanport, and Daugherty Township marked this as Continuous. • Koppel marked this as both No Progress and Continuous. • Some communities had confusion on this action.
Action 1.4.5: Municipalities will aggressively enforce building and safety codes for all buildings, including industrial uses.	County and all municipalities	Continuous	• South Heights Borough works with Labor and Industry. • Frankfort Springs marked this as No Progress. Koppel marked this as both No Progress and Continuous.
Action 1.4.6: Identify and monitor transportation routes of hazardous materials. Train municipal police and fire departments on placard identification.	County and all municipalities	In Progress/ Not Yet Complete	• Brighton Township, Franklin Township, Hanover Township, New Galilee Borough, Aliquippa, and Marion Township marked this action as No Progress/Unknown. Koppel marked this as both No Progress and Continuous. • Fallston Borough, East Rochester, Freedom Borough, Rochester Township, Daugherty, Industry Borough, Greene, Bridgewater Borough, Conway, South Heights, Big Beaver, Independence, Darlington Township, Patterson, City of Beaver Falls, Patterson Heights, Vanport, Frankfort Springs, and Economy Borough marked this action as Continuous. • Eastvale and West Mayfield marked this action as Complete and noted it has one set of train tracks that pass through Borough borders. • New Brighton noted Pennsylvania Department of Transportation (PennDOT). • Darlington Borough stated they contact fire and police protection. • New Galilee Borough has highway and rail exposure to hazardous materials (HazMat).

Description	Jurisdiction	Status	Review Comments
Action 1.4.7: Improve the design, routing, and traffic control functions on high-risk roadways.	County and all municipalities	In Progress/ Not Yet Complete	• Marion Township, Aliquippa, Hanover Township, Franklin Township, Economy Borough, Eastvale, Ambridge, Bridgewater Borough, West Mayfield, and Monaca marked this action as No Progress/Unknown. • Fallston Borough, Daugherty Township, East Rochester, Rochester Township, Freedom, Greene, South Heights, Big Beaver, Independence, Frankfort Springs, Patterson, Patterson Heights, Conway, City of Beaver Falls, Vanport, and Industry Borough marked this action as Continuous. • Darlington Borough has no high-risk roadways. • Patterson Township noted PA DOT – SR 51, New Galilee noted 351-168, and Conway noted PA-65-PennDOT. • South Heights and Patterson Heights work with PennDOT to complete this.
Action 1.4.8: Reduce risk of structure fires by acquiring and/or demolishing high-risk properties.	County and all municipalities	In Progress/ Not Yet Complete	• Brighton Township notes that more funding needed for building demolition within Beaver County. • New Brighton noted, "Increase funding from the local and state level." • Ambridge noted the municipality needs help with this action. • Ambridge Borough, Potter Township, Economy Borough, Hanover Township, Bridgewater Borough, and Marion Township marked this action as No Progress/Unknown. • Fallston Borough marked this action as In Progress/Not Yet Complete and Continuous. Daugherty Township, Aliquippa, Freedom, Big Beaver, Patterson, Eastvale, Conway, Greene, City of Beaver Falls, and Rochester Township marked this as Continuous. • Patterson Heights marked this action as In Progress/Not Yet Complete. • Eastvale and West Mayfield will implement this as money is available or will contact owners to eliminate issue. • New Galilee considers this action not applicable.
Action 1.5.1: Track floodplain management ordinance information, including adopting building code and other relevant ordinances and incorporating more restrictive requirements. Update on a regular basis.	County and all municipalities	Continuous	• Potter Township, Daugherty Township, City of Beaver Falls, and Economy Borough marked this action as Completed. • Hanover Township marked this as both Completed and Continuous. • Fallston Borough, Bridgewater Borough, and Industry Borough marked this action as No Progress/Unknown. Eastvale and West Mayfield marked this action as In Progress. • New Galilee considers this action not applicable. • All other municipalities marked this action as Continuous.

Description	Jurisdiction	Status	Review Comments
Action 1.5.2: Conduct effective outreach with municipalities to explain the value of floodplain ordinances and adopting more restrictive requirements.	County and all municipalities	Continuous	• Brighton Township noted that continued emphasis of this action is needed. • Potter Township, City of Beaver Falls, New Galilee Borough, and Hanover Township marked this action as Completed. • Marion Township, Bridgewater Borough, Fallston Borough, Franklin Township, and Midland Borough marked this action as No Progress/Unknown. Eastvale and West Mayfield marked this action as In Progress. • All other municipalities marked this as Continuous.
Action 1.5.3: Improve and/or install structural and non-structural stormwater systems to reduce flooding.	County and all municipalities	Continuous	• Marion Township, Aliquippa, City of Beaver Falls, Potter Township, New Galilee, and Ambridge marked this action as No Progress/Unknown. Bridgewater Borough marked this action as Complete. • All other municipalities marked this action as Continuous or In Progress. • Eastvale and West Mayfield note they make constant repairs to stormwater lines. • Ambridge noted that they need help and money for this action. • Fallston Borough notes that Beaver Street is complete but Main Street needs implementation of the stormwater system (which is dependent on funding).
Action 1.5.4: Where feasible, separate combined stormwater and sanitary sewer systems to reduce flooding and the negative impacts of overflows.	County and all municipalities	In Progress/ Not Yet Complete	• Marion Township, Aliquippa, Hanover Township, Franklin Township, Potter, New Galilee, and Monaca marked this action as No Progress/Unknown. Economy Borough marked this action as Completed. Almost all other municipalities marked this as Continuous or In Progress. Patterson Heights, Industry Borough, Conway, and Rochester Township marked this action as N/A. • Eastvale and West Mayfield note they make repairs to old sewer lines and puts liners in, as funding permits. • Ambridge noted that it needs funding for this action. • Darlington Borough and Fallston Borough note “septic systems only.” • Midland Borough is discontinuing this project because such separation is not a recommendation of Midland’s Long-Term Control Plan.

Description	Jurisdiction	Status	Review Comments
Action 1.6.1: Fully utilize resources available to help identify impacts and consequences of Marcellus Shale natural gas extraction operations.	County, Daugherty Township, Franklin Township, Independence Township, Frankfort Springs, Freedom, Marion Township, Big Beaver, South Beaver Township	In Progress/ Not Yet Complete	• Ambridge notes that it has concern with tank trains. • Darlington Borough, West Mayfield, Eastvale, and New Galilee Borough note that they have no drilling. Conway and City of Beaver Falls noted this as Not Applicable. • Daugherty and Big Beaver marked this action as Continuous
Action 1.6.2: Identify mitigation options for identified impacts and consequences.	County and all municipalities	Discontinued	• This action is covered under the HMP. • Midland Borough, Big Beaver, City of Beaver Falls, and Daugherty Township are the only respondents to mark this action as Continuous. Others marked it as No Progress. • New Galilee, West Mayfield, and Eastvale consider this action not applicable.
Action 1.6.3: Provide training to enable municipalities to mitigate the negative impacts of Marcellus Shale natural gas extraction.	County and all municipalities	In Progress/ Not Yet Complete	• Monaca marked this action as Discontinued. Economy Borough, Eastvale, West Mayfield, City of Beaver Falls, and Aliquippa marked this as No Progress/Unknown. City of Beaver Falls considers this action Not Applicable. • Ambridge, Bridgewater Borough, Freedom, and Industry marked this action as In Progress/Not Yet Complete. Daugherty and Big Beaver marked this action as Continuous. • New Galilee notes that this would benefit the fire departments and emergency management agency staff.
Action 1.6.4: Map potential natural gas and petroleum transmission lines.	County and all municipalities	In Progress/ Not Yet Complete	• Brighton Township noted that this action is needed for lines and storage facilities. Annual training is needed for gas line response. • Aliquippa marked this as No Progress/Unknown and noted that it needs to be completed. Eastvale, City of Beaver Falls, and West Mayfield marked this action as Complete. • Monaca marked this action as Discontinued. Economy Borough and Patterson marked this as No Progress/Unknown. • New Galilee does not have any in the Borough. It only has Columbia Gas. • All other municipalities marked this as Continuous or In Progress.

Description	Jurisdiction	Status	Review Comments
Action 1.6.5: Hold public outreach sessions about the potential impacts of Marcellus Shale natural gas extraction and surface mining.	County and all municipalities	In Progress/ Not Yet Complete	• Eastvale, Midland, Big Beaver, Monaca, Franklin Township, Aliquippa, Bridgewater Borough, West Mayfield, Economy Borough, Fallston Borough, City of Beaver Falls, and Potter marked this action as No Progress/Unknown. City of Beaver Falls considers it Not Applicable. • Daugherty and Independence marked this action as Continuous. • New Galilee Borough marked this action as Completed.
Action 1.7.1: Regularly report the successes of flood-related projects on the Planning Commission website.	County and all municipalities	Discontinued	• Status marked as No Progress/Unknown. City of Beaver Falls noted this as Continuous. This action will be included in the public education/outreach action. • Chippewa noted it does not have any flood-related projects.
Action 1.7.2: Annually review severe repetitive loss and repetitive loss properties to identify candidates for mitigation through FEMA Repetitive Flood Claims (RFC), Severe Repetitive Loss (SRL) properties strategy, and other HMA funding programs.	County and all municipalities	In Progress/ Not Yet Complete	• West Mayfield, Eastvale, Potter, Monaca, Aliquippa, Bridgewater, Franklin Township, Fallston Borough, Economy Borough, and Ambridge marked this action as No Progress/Unknown. • Hanover, City of Beaver Falls, Big Beaver, and Daugherty Townships marked this action as Continuous. • All other municipalities marked this action as In Progress. • Darlington Borough has limited floodplain. • This action will be incorporated into the flood mitigation action.
Action 1.7.3: Ensure that the geographic coordinates (latitude and longitude) of each property is confirmed.	County and all municipalities	In Progress/ Not Yet Complete	• New Brighton noted the Borough GIS program. • Monaca marked this action as Completed. Economy Borough, Bridgewater Borough, West Mayfield, Eastvale, and Fallston Borough marked this action as No Progress/Unknown. City of Beaver Falls marked this as Complete. • All other municipalities marked this action as In Progress or Continuous. • Darlington Borough believes the emergency management person should have this
Action 1.7.4: Contact municipalities with severe repetitive loss properties to confirm the number and type of mitigated properties and source of funding.	County, Bridgewater Borough, Franklin Township, Marion Township	No Progress/ Unknown	• This action will be incorporated into the other GIS action.

Description	Jurisdiction	Status	Review Comments
Action 1.8.1: Planning Commission and municipal offices will review existing zoning ordinances and subdivision and land development ordinances to ensure new buildings and infrastructure are discouraged or prohibited in high-hazard areas in their jurisdiction.	County and all municipalities	In Progress/ Not Yet Complete	• Beaver County and Bridgewater Borough marked this action as In Progress/Not Yet Complete. • Many municipalities marked this action as Continuous. • Potter Township, City of Beaver Falls, and Hanover Township marked this action as Completed. Aliquippa, West Mayfield, and Eastvale marked this as No Progress/Unknown. • Midland Borough marked this as both Continuous/Completed. • Brighton Township comments, "Is the County providing a map of these areas for use by each municipality in the preparation of their ordinances? With limits (setbacks) required for each identified risk?" • Darlington Borough and New Galilee Borough do not have any zoning.
Action 1.8.2: Planning Commission and applicable municipal offices will review their comprehensive plans to ensure that designated growth areas are not within high-hazard areas identified in this plan.	County and all municipalities	Completed	• Beaver County, Aliquippa, Vanport, Bridgewater Borough, and Hanover Township marked this action as In Progress/Not Yet Complete. • Many municipalities marked this action as Continuous. • Potter Township and City of Beaver Falls marked this action as Completed. Eastvale and West Mayfield marked it as No Progress. • Brighton Township comments, "Is the County providing a map of these areas for use by each municipality in the preparation of their ordinances? With limits (setbacks) required for each identified risk?" • Economy Borough is due to renew their Comprehensive Plan in 2016. • Patterson Heights noted "County Plan" in the comment area. Conway Borough also does not have a Comprehensive Plan and uses the County Plan instead. • Darlington Borough and New Galilee Borough do not have any growth areas.
Action 1.9.1: Implement debris-flow projects, including slope stabilization, energy dissipation, or vegetative plantings.	County and all municipalities	No Progress/ Unknown	• Economy Borough is not aware of any municipal debris-flow projects. • Daugherty, Big Beaver, and Freedom marked this action as Continuous.
Action 1.9.2: Implement a brush clearing, bank stabilization, and debris control program for flood-prone waterways. Remove structures that impede natural flow of waterways.	County and all municipalities	No Progress/ Unknown	• Darlington Borough notes this action is Not Applicable. • New Galilee Borough marks this action as Complete "to the maximum extent possible." • Economy Borough is not aware of any local projects under this description. • Daugherty, East Rochester, West Mayfield, Big Beaver, and South Heights marked this action as Continuous. • This action will be combined with another flood mitigation action.
Action 2.1.1: Encourage all critical government facilities to have Continuity of Operations (COOP) and Continuity of Government (COG) plans and to begin implementing appropriate backup systems.	County and all municipalities	No Progress/ Unknown	• New Galilee considers this action not applicable. • Daugherty and Big Beaver marked this action as Continuous.

Description	Jurisdiction	Status	Review Comments
Action 2.1.2: Conduct outreach to privately owned businesses and infrastructure that provide critical services in post-disaster situations to encourage them to develop COOP/Business Recovery Plans.	Monaca Borough, Big Beaver Borough, Daugherty Township	In Progress/ Not Yet Complete	• Monaca marked this action as In Progress. Daugherty and Big Beaver marked it as Continuous. • All other municipalities marked this as No Progress/Unknown. • This action will be included with the outreach/education action.
Action 2.2.1: Assess and update emergency operations center equipment to improve communication.	Monaca Borough, City of Beaver Falls, Big Beaver, Ambridge, Economy Borough, Freedom, Daugherty, West Mayfield, Shippingport, Patterson Heights, Potter Township	Continuous	• Monaca, Big Beaver, Potter, Industry Borough, City of Beaver Falls, Eastvale, Freedom, Daugherty, Hanover Township, West Mayfield, Economy Borough, Patterson Heights, and Shippingport marked this action as Continuous. • Ambridge marked this action as In Progress/Not Yet Complete. • Darlington Borough notes this action is Not Applicable. • New Galilee Borough does not have an Emergency Operations Center (EOC) within its jurisdiction. • Patterson Heights has an intergovernmental EOC with Patterson Township. • All other municipalities marked this action as No Progress/Unknown.
Action 2.2.2: Review and update winter preparedness plans and evacuation signage plans.	County and all municipalities	Continuous	• Most municipalities marked this action as Continuous. Ambridge and Aliquippa marked this action as In Progress/Not Yet Complete. • Darlington Borough contracts its snow removal. It also does not have signage. • New Galilee considers this action not applicable. • A few municipalities marked this as No Progress/Unknown. • This mitigation action will be incorporated into a broader action.
Action 2.3.1: Review County and municipal planning mechanisms, and make recommendations to incorporate hazard mitigation planning techniques.	County and all municipalities	In Progress/ Not Yet Complete	• Darlington Borough notes this action is Not Applicable. Bridgewater Borough, West Mayfield, Eastvale, and Aliquippa marked this as No Progress/Unknown. • Hanover, Big Beaver, City of Beaver Falls, and Daugherty Townships marked this action as Continuous. • Other municipalities marked this action as In Progress.
Action 2.4.1: Identify a hazard mitigation point of contact empowered to participate in the hazard mitigation planning process and implement mitigation activities.	County and all municipalities	Complete	• Franklin Township, Big Beaver, and Daugherty Township are the only respondents to mark this as Continuous. Fallston Borough and Economy Borough marked this action as In Progress/Not Yet Complete. Many municipalities marked this as Complete. • Big Beaver specifically noted its Emergency Management Coordinator (EMC) and Engineer as the HMP point of contact. Frankfort Springs noted Dale Bonner as its point of contact. • This action has been completed with the HMP update.

Description	Jurisdiction	Status	Review Comments
Action 2.4.2: Involve identified hazard mitigation team members in implementation and outreach activities.	Ambridge Borough, Darlington Borough, City of Beaver Falls, Fallston Borough, Big Beaver, Midland Borough, Rochester Township, Daugherty Township	Discontinued	• Midland Borough and Rochester Township marked this action as Completed. Daugherty, City of Beaver Falls, and Big Beaver marked it as Continuous. Big Beaver specifically noted its EMC and Engineer. • Darlington, Fallston Borough, and Midland marked this action as In Progress. • All other municipalities marked this as No Progress/Unknown. • This action will be marked as Discontinued, as project specifics will too greatly impact team member composition.
Action 2.5.1: Hold annual meetings to ensure that mitigation, planning, preparedness, and response personnel are (1) cross-trained in each other's area of expertise, (2) aware of ongoing activities, and (3) fostering increased communication.	New Brighton, Aliquippa, City of Beaver Falls, Monaca Borough, Fallston Borough, Industry Borough, Hanover Township, Daugherty Township, Big Beaver	Continuous	• New Brighton performs this action through the local EMA. • Fallston Borough marked this action as In Progress/Not Yet Complete. Aliquippa, City of Beaver Falls, and Big Beaver marked this as Continuous. • Ambridge marked this action as No Progress/Unknown; however, it also put a question mark under the In Progress option. • All other municipalities marked this as No Progress/Unknown.
Action 2.5.2: Reach out to agencies that were invited but did not participate in the HMP update process.	County and all municipalities	Completed	• No other comments noted. • This action is a standard aspect of the HMP update process.
Action 2.5.3: Reinstate the Beaver County Community Emergency Response Team (CERT) program to recruit and train interested citizens to assist first responders at specified emergencies throughout the County.	Daugherty Township, New Brighton, City of Beaver Falls, Big Beaver Borough, Potter Township, Hanover Township	In Progress/ Not Yet Complete	• Ambridge noted "Good idea." Aliquippa also noted "Important." • Daugherty, City of Beaver Falls, and Big Beaver marked this as Continuous. • Darlington Borough noted that its Emergency Management person has no control regarding this issue. • All non-listed municipalities marked this as No Progress/Unknown.

Description	Jurisdiction	Status	Review Comments
Action 2.5.4: Beaver County Emergency Service Center will provide information about local, regional, State, and federal training opportunities to municipalities, fire departments, emergency medical services (EMS), ambulance services, and other emergency responders. Create a Training Resource Center on the Emergency Services website.	New Brighton, Big Beaver Borough, West Mayfield Borough, Eastvale Borough, Daugherty Township, City of Beaver Falls, Monaca Borough, Fallston Borough, Bridgewater Borough, Shippingport	Continuous	• Brighton Township noted that a county burn building would be a nice asset to assist training of volunteer departments. • New Brighton noted it uses mass distribution e-mails and is creating a training facility. • Ambridge noted "Good idea." • Fallston Borough marked this action as In Progress/Not Yet Complete. Bridgewater Borough, West Mayfield, Eastvale, City of Beaver Falls, and Daugherty Township marked this action as Continuous. Darlington Borough does not consider this applicable. All non-listed municipalities marked this as No Progress/Unknown.
Action 2.6.1: Provide briefings to planning and code associations and municipal officials on damage assessment expectations following a disaster.	Monaca Borough, Big Beaver Borough, Daugherty Township, Darlington Borough, Midland Borough, Industry Borough, Bridgewater Borough, Hanover Township	Continuous	• Hanover Township also marked this action as Completed.

Description	Jurisdiction	Status	Review Comments
Action 3.1.1: Develop and maintain a comprehensive list of relevant regional agencies, including Council of Governments, River Basin Commissions, and Metropolitan Planning Organizations (MPO).	Beaver Borough, Vanport, Frankfort Springs, Darlington Township, Conway, Greene Township, Patterson, Independence, East Rochester Borough, Midland Borough, Industry Borough, South Heights, Freedom, Daugherty Township, Patterson Heights, Big Beaver, Rochester Township, Hanover Township	Continuous	• Hanover Township marked this action as Completed. • All other listed municipalities marked this action as Continuous. • All non-listed municipalities marked this as No Progress/Unknown.
Action 3.2.1: Assess and identify locations where regional coordination between local projects would be beneficial to achieving efficiencies in mitigation efforts.	Midland Borough, Big Beaver, City of Beaver Falls, Rochester Township, Daugherty Township	Continuous	• Midland Borough listed this as Completed. • All non-listed municipalities marked this as No Progress/Unknown.
Action 3.2.2: Facilitate hands-on training regarding planning and project tools offered by PEMA, as well as FEMA eGrants training.	County and all municipalities	In Progress/ Not Yet Complete	• Brighton, Daugherty, Eastvale, Rochester Township, City of Beaver Falls, Big Beaver, and Hanover Township marked this action as Continuous. Bridgewater, West Mayfield, and Aliquippa marked this action as No Progress/Unknown. • This action will be incorporated into a general training action.
Action 3.2.3: Planning Committee will notify municipalities when funds become available for hazard mitigation projects.	County and all municipalities	Discontinued	• All municipalities marked this as No progress/Unknown. • Action will be marked as Discontinued, as it is a standard operational technique.
Action 4.1.1: Develop and disseminate relevant information on hazard mitigation programs to municipal officials.	Darlington Borough, Daugherty Township, Big Beaver, Hanover Township	Continuous	• All non-listed municipalities marked this as No Progress/Unknown. • This action will be incorporated into the general training action.
Action 4.1.2: Document and share success stories and best practices.	County and all municipalities	Completed	• Ambridge noted the kickoff meeting.

Description	Jurisdiction	Status	Review Comments
Action 4.2.1: Invite identified agencies and organizations to be part of the Hazard Mitigation Planning Team.	Monaca Borough, Big Beaver, City of Beaver Falls, Daugherty Township, Hanover Township	Completed	• This action was completed during the 2016 HMP update. • Monaca marked this action as In Progress. • Hanover and City of Beaver Falls marked it as Completed. • Daugherty and Big Beaver marked it as Continuous. • All non-listed municipalities marked this as No Progress/Unknown.
Action 4.3.1: Secure funding for hazard mitigation projects.	Midland Borough, Big Beaver, City of Beaver Falls, Franklin Township, Eastvale, Daugherty Township	Discontinued	• All non-listed municipalities marked this as No Progress/Unknown. Midland marked this action as In Progress, and Franklin, Big Beaver, Eastvale, City of Beaver Falls, and Daugherty as Continuous. • This action is being removed, as it is a standard operating action.
Action 5.1.1: Continue to utilize media outlets for the distribution and publication of hazard information by sending news releases and public service series to local newspapers, radio, and television stations. News releases should contain pre-disaster information and be designed to reach all areas of Beaver County.	Midland Borough, Hanover Township, Big Beaver, West Mayfield, Daugherty Township	Continuous	• All non-listed municipalities marked this as No Progress/Unknown. • This action will be incorporated with the public outreach/education action.
Action 5.1.2: Continue to work with non-governmental organizations (NGO) to promote mitigation education and awareness by presenting to interested groups on hazard-related topics, such as types of disasters and risks, how to develop a family disaster plan and disaster supply kit, sheltering in place, how to develop a business continuity plan, and simple types of mitigation projects for homeowners and businesses.	Monaca Borough, Daugherty Township, City of Beaver Falls, Big Beaver Borough	Continuous	• Monaca Borough uses its municipal website and Facebook page to post information. • Big Beaver listed this as No Progress/Unknown but noted "Special Needs List." • This action will be incorporated with the public outreach/education action.
Action 5.1.3: Ensure that the American Red Cross (ARC) Citizen's Disaster course is held on a frequent basis. ARC will hold a variety of courses—including Adult and Child Cardiopulmonary Resuscitation (CPR), Basic First Aid, Introduction to Disaster Services, Mass Care, Shelter Operations, and others—at the ARC Office and at other locations throughout the County.	Hanover Township, West Mayfield, Industry Borough, Daugherty Township, City of Beaver Falls, Eastvale Borough, Economy Borough	Continuous	• City of Beaver Falls marked this action as Complete while other listed municipalities marked it as Continuous. • All non-listed municipalities marked this as No Progress/Unknown.
Action 5.1.4: Update the County website to provide hazard-related information that is easily accessible. The County Emergency Services website will provide information about disaster preparedness and related activities. The plan is to expand and update the website as needed and as appropriate in a timely manner to benefit all County residents.	Monaca Borough, Midland Borough, Economy Borough, Big Beaver Borough, Daugherty Township, Hanover Township	Continuous	• All non-listed municipalities marked this as No Progress/Unknown.

Description	Jurisdiction	Status	Review Comments
Action 5.2.1: Install emergency generators for all critical facilities.	County and all municipalities	In Progress/ Not Yet Complete	• Beaver Borough and South Heights Borough both need help with securing grant funding. • Fallston Borough purchased a generator. The generator's installation has been halted due to a wiring issue. • Monaca Borough, Big Beaver, Conway, Greene, West Mayfield, and Daugherty Township marked this action as Continuous. Beaver Borough, East Rochester Borough, Darlington Township, and Rochester Township marked it as In Progress. Hanover Township, Vanport, Frankfort Springs, Industry Borough, Patterson, Patterson Heights, and Economy Borough marked it as Complete. Patterson Heights noted "intergovernmental with Patterson Heights (assumed Township)." • New Galilee Borough notes that its fire hall would benefit from a generator.
Action 5.3.1: Establish all-hazard resource centers located in the County Courthouse, Chamber of Commerce, municipalities, local libraries, and senior centers. Centers will serve as repositories for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders. Centers would display literature about the NFIP; Flood Insurance Rate Maps (FIRM); books about mitigation for homeowners; and copies of "Are You Ready Guide," "Protecting Building Utilities from Flood Damage," and "Seeking Shelter from the Storm."	Monaca Borough, Big Beaver Borough, Daugherty Township, Economy Borough	Continuous	• All non-listed municipalities marked this as No Progress/Unknown.
Action 5.3.2: Applicable municipalities will communicate with property owners or renters within the 100-year floodplain regarding potential flood hazards. Letters may include the following information: local flood hazard, flood safety, flood insurance information, property protection measures, natural and beneficial functions of the local floodplain, a map of the local flood hazard area, information about hazard notification systems, floodplain development permit requirements, and substantial improvement/damage requirements.	Monaca Borough, Midland Borough, Conway Borough, Daugherty Township, Industry Borough, Big Beaver, Rochester Township, Hanover Township	In Progress/Not Yet Complete	• Monaca Borough marked this action as In Progress/Not Yet Complete. • Midland Borough, Big Beaver, and Hanover Township marked this action as Completed. Big Beaver also noted its website. • Industry Borough, Conway, Rochester Township, and Daugherty Township marked this action as Continuous.

On January 5, 2016, the Planning Team hosted a Mitigation Solutions Workshop that was attended by several County and municipal representatives. The purpose of this workshop was to provide another opportunity to review the current goals, objectives, and actions listed in the HMP, and to determine possible revised HMP's goals, objectives, and actions. The goals, objectives, and mitigation techniques to be considered in the document were identified. Meeting minutes are provided in Appendix C. The Planning Team then used the outcomes from the workshop to help identify and prioritize the final mitigation actions included further in this section.

The Planning Team determined that most of the actions listed in the 2011 version of the HMP would be continued (i.e., deferred) to the current version of the plan; however, to reflect revised objectives, County capabilities, and long-term needs, the exact wording of the mitigation actions may have changed.

6.1.3 Additional Past Mitigation Accomplishments

Beaver County and its municipalities are dedicated to mitigation activities and comprehensive all-hazards planning. To that end, the County has engaged in mitigation activities beyond those identified in its 2011 HMP. The County and its municipalities have demonstrated a proactive approach, commitment to resiliency, and desire to protect both physical assets and citizens against hazard losses through the following additional accomplishments:

- Beaver County currently is working on a stormwater runoff rehabilitation project, as much of the local stormwater infrastructure is very old and no longer adequate to meet current drainage needs. All municipalities must meet Pennsylvania Department of Environmental Protection (PADEP) requirements to separate stormwater and sewer infrastructure.
- Chippewa Township is working on enhancing communication tools to share information with residents, and it conducts and annual building and facility inspection to ensure adherence to safety measures.
- Economy Borough participates in multi-jurisdictional HazMat training at Conway Yards and has more training planned for 2016.
- Franklin Township acquired multiple properties on McKim Way between 2015 and 2016.
- Harmony Township removed and replaced Valley Road Bridge to reduce hazard vulnerability.
- Hopewell Township has been very proactive in reducing hazard loss through regulations designed to protect lives, property, and the environment. The Township has completed mitigation projects to reduce hazard risk at critical operations buildings; adopted aggressive stormwater, flood, and water pollution control regulations; and installed a reverse 9-1-1 phone alert system (Swift 9-1-1).
- New Brighton Borough completed a property acquisition about 10 years ago and has cross-trained code enforcement and fire personnel, along with council members.
- Many municipalities have begun using mass notification services (Swift 9-1-1).

6.2 MITIGATION GOALS AND OBJECTIVES

This section describes the mitigation goals and objectives set forth in the 2016 HMP Update.

6.2.1 2016 Mitigation Goals

The Planning Team reviewed the 2011 HMP goals during the January 2016 Mitigation Solutions Workshop to determine their continuing applicability to County mitigation needs. After careful and deliberate discussion, the Planning Team determined that the goals would be carried over to the 2016 update without change in phrasing. The 2016 County HMP goals are in line with State mitigation goals,

embody the overarching needs and concerns of the County and participating municipalities, and address both natural and non-natural hazard risk reduction. The 2016 County HMP goals are listed below:

1. **Goal 1:** Protect lives, property, environmental quality, and natural resources of the County.
2. **Goal 2:** Enhance consistent coordination, collaboration, and communication among stakeholders.
3. **Goal 3:** Provide a framework for active hazard mitigation planning and implementation.
4. **Goal 4:** Build political support and secure funding for mitigation efforts.
5. **Goal 5:** Increase awareness, understanding, and preparedness.

6.2.2 2016 Mitigation Objectives

The goals listed above were used to develop relevant objectives. The objectives address the results of the vulnerability assessment in more specific terms and reflect the possible effects that can be mitigated for the identified hazards, as well as existing limitations in available data and information. The objectives were originally identified during the 2011 HMP update process but were reviewed by the Planning Team during the Mitigation Solutions Workshop in January 2016. After detailed discussion, the Planning Team determined some objectives to still be relevant to County needs and concerns; other objectives were adjusted to reflect changes in County priorities and capabilities since the last update. Objectives related to each of the goals are listed below:

1. **Goal 1**
    a. **Objective 1.1:** Encourage homeowners, renters, and businesses to insure their properties against all hazards, including flood coverage under the National Flood Insurance Program (NFIP).
    b. **Objective 1.2:** Acquire, relocate, elevate, and/or retrofit existing structures located in hazard areas.
    c. **Objective 1.3:** Acquire, relocate, elevate, and/or retrofit repetitive loss properties from flood-prone areas.
    d. **Objective 1.4:** Identify transportation routes with high-hazard vulnerability—especially for potential HazMat events, flooding, or steep slopes—and in regards to possible injury, death, or property damage.
    e. **Objective 1.5:** Improve the county's stormwater management systems.
    f. **Objective 1.6:** Address hazard issues from Marcellus Shale natural gas extraction operations and surface mining, and explore mitigation options including pipelines, compressor stations, Shell petrochemical plant, and multi-modal transportation of oil and gas.
2. **Goal 2**
    a. **Objective 2.1:** Develop and maintain partnerships with external federal, State, municipal, and stakeholder agencies that have a role in hazard mitigation.
    b. **Objective 2.2:** Coordinate, promote, and sponsor local events where hazard mitigation, risk reduction, and emergency management is emphasized.
    c. **Objective 2.3:** Promote strong and supportive inter-jurisdictional and inter-municipal relationships that encourage resource sharing and strengthen municipalities with limited resources.
3. **Goal 3**
    a. **Objective 3.1:** Support mitigation action implementation, inclusion of mitigation planning and actions in local documents, and regular mitigation meetings.

b. **Objective 3.2:** Encourage local participation in the Community Rating System (CRS) Program.

4. **Goal 4**

   a. **Objective 4.1:** Track and/or recommend local, County, State, and federal legislation and regulations related to hazard mitigation.

   b. **Objective 4.2:** Develop and maintain local regulations that reduce vulnerability to hazards.

   c. **Objective 4.3:** Track and promote mitigation and emergency management funding opportunities to local jurisdictions and relevant stakeholders.

5. **Goal 5**

   a. **Objective 5.1:** Encourage homeowners, renters, and businesses to insure their properties against all hazards—including flood coverage under NFIP—and with emphasis on repetitive loss properties.

   b. **Objective 5.2:** Improve public alert, warning, and communications systems by promoting redundant and multi-faceted communication methods.

   c. **Objective 5.3:** Conduct a coordinated public information program related to hazards and their impacts throughout the County.

   d. **Objective 5.4:** Encourage residents to implement hazard mitigation and preparedness measures on their properties.

   e. **Objective 5.5:** Improve training and cross-training opportunities for emergency management, response, and local government personnel.

6.3 IDENTIFICATION AND ANALYSIS OF MITIGATION TECHNIQUES

Concerted efforts were made to ensure that the County and its municipalities developed updated mitigation strategies. Updated strategies included activities and initiatives covering the range of mitigation action types described in recent FEMA planning guidance, "Local Mitigation Planning Handbook." Mitigation action types listed in the FEMA guidance include the following:

1. **Local Plans and Regulations:** These actions include government authorities, policies, or codes that influence the way land and buildings are being developed and built.
2. **Structure and Infrastructure Projects:** These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. These project types could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct man-made structures to reduce the impact of hazards.
3. **Natural Systems Protection:** These are actions that minimize damage and losses, and also preserve or restore the functions of natural systems.
4. **Education and Awareness Programs:** These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as NFIP and CRS, StormReady (NOAA) and Firewise (National Fire Protection Association [NFPA]) Communities (FEMA 2013).

The participants of the Mitigation Solutions Workshop and the Planning Team identified actions that relate to the techniques listed above. Table 6-2 identifies which mitigation techniques are applicable for the hazards included in the 2016 HMP.

Table 6-2. Mitigation Technique Matrix

Hazard	Local Plans and Regulations	Structure and Infrastructure Projects	Natural Systems Protection	Education and Awareness Programs
Dam Failure	X	X		X
Drought	X	X		X
Earthquake	X	X	X	X
Environmental Hazards	X	X	X	X
Flood, Flash Flood, and Ice Jam	X	X	X	X
Landslide	X	X	X	X
Levee Failure	X	X		X
Nuclear Incident	X	X		X
Pandemic	X	X		X
Radon Exposure	X	X		X
Terrorism, Criminal Activity, or Civil Disturbance	X	X		X
Tornadoes and Windstorms	X	X		X
Transportation Accidents	X	X		X
Urban Fire and Explosions	X	X		X
Utility Interruption	X	X		X
Winter Storm	X	X		X

6.4 MITIGATION ACTION PLAN

Representatives from the County and all participating municipalities selected mitigation strategies and initiatives to pursue until the next plan update. These actions also include some actions identified during the 2011 update that are still relevant or in progress. This section describes 2016 mitigation initiatives, mitigation strategy prioritization and implementation, and prioritization of mitigation actions.

6.4.1 2016 Mitigation Initiatives

Table 6-3 summarizes the updated mitigation strategies identified by the County and all participating municipalities, including the following information:

- Mitigation actions for individual and multiple hazards
- Mitigation action type
- Department or agency primarily responsible for project initiation and/or implementation
- Estimated cost for the mitigation action, and identification of known or potential sources of funding
- Implementation schedule
- Implementation priority

Specific mitigation actions were identified to prevent future losses; however, current funding is not identified for all of these actions at present. The County and participating municipalities have limited resources to take on new responsibilities or projects. The implementation of these mitigation actions is dependent on the approval of the local elected governing body and the ability of the jurisdiction to obtain funding from local or outside sources.

In general, mitigation actions ranked as highest priorities will be addressed first. However, medium- or low-priority mitigation actions will be considered for concurrent implementation. Therefore, the ranking levels should be considered as a preliminary ranking, which will evolve based on prevailing priorities and discretion of local governments, the public, the Pennsylvania Emergency Management Agency (PEMA), and FEMA as the plan update is implemented.

Table 6-3. Hazard Mitigation Strategy

Note: Some of the identified mitigation initiatives in Table 6-3 are dependent upon available funding (grants and local match availability) and may be modified or omitted at any time based on the occurrence of new hazard events and changes in County or municipal priorities. Actions that have been carried over from the 2011 version of the HMP may have been reworded and given a new initiative designation to conform to current needs and procedures.

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC001	Support the mitigation of vulnerable structures via retrofit (e.g. elevation, flood-proofing) or acquisition/relocation to protect them from future damage; repetitive loss and severe repetitive loss properties should be a priority, when applicable. Phase 1: Identify appropriate candidates and determine most cost-effective mitigation option (in progress). Phase 2: Work with the property owners to implement selected action based on available funding from FEMA and local match availability. Specifically identified are properties in the following areas: • Water Street, Railroad Street, and Beaver River Boulevard (Rochester Borough) • 1400 Block of Riverside Drive and 600 Block of Mulberry Street (Bridgewater Borough) (The 600 block is lower priority as property flooding has been minimal over previous decade) • 8th Street residences and businesses, Third Avenue, George Warner Building, J&J Catering, Fox's Pizza, SOI, U.S. Postal Office, Sewage Pump Station (Freedom Borough) • 4th Street Creek, Crawford Street Creek, Route 51 at corner of North Street, CHJA, and Hill Road at Economy Street (South Heights Borough)										
	See above.	Existing	Flood	1, 3, 5	Township/Borough Engineering via NFIP FPA with PEMA and FEMA support	High	High	FEMA mitigation grant programs and local budget (or property owner) for cost share	Ongoing (outreach and specific project identification); Long-term DOF (specific project application and implementation)	High	SIP
BC002	Develop and implement an enhanced all-hazards, public outreach / education / mitigation information program on natural hazard risks, and outline the ways in which the program(s) can strengthen community mitigation and preparedness efforts. This program may include: • Develop/maintain a natural hazard risk management webpage on the municipal website where information and mapping can be posted. • Provide general natural hazard risk preparedness and mitigation, and related NFIP information in regular newsletter and mailings. • Provide natural hazard risk and risk reduction information through social media channels and e-mail blast systems. • Post flyers and other readily available NFIP informational materials at municipal hall, or distribute at regular civic meetings. • Enhance public outreach to residents in NFIP floodplain areas to inform them of annual grant opportunities, which may include distributing periodic articles and including handouts in the annual newsletter. • D.E.G. (Freedom Borough)										

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
	See above.	N/A	All Hazards	All	Township/Borough Manager, Beaver County Emergency Services	Medium	Low	Municipal budget; HMA programs with local or County match	Short	Low	EAP
BC003	Develop and implement an enhanced municipal training program, with specific focuses on the NFIP, CRS, flood mitigation projects, hazard mitigation, damage assessments, PEMA planning and project tools, FEMA eGrants program, and Marcellus Shale natural gas extraction. Information on trainings will be posted on the Emergency Services website.	N/A	All Hazards	1, 2, 4, 5	County, Municipality, PEMA, FEMA	Medium	Low	Municipal budget; HMA programs with local or County match	Short	High	EAP
BC004	Maintain compliance with and good standing in the NFIP, including adoption and enforcement of floodplain management requirements (e.g., regulating all new and substantially improved construction in special-hazard flood areas), floodplain identification and mapping, and flood insurance outreach to the community. Further meet and/or exceed the minimum NFIP standards and criteria through the following NFIP-related continued compliance actions identified in subsequent initiatives.										
	See above.	New and Existing	Flood	All	NFIP Floodplain Administrator (FPA); with support from PEMA, ISO, FEMA	Medium - High	Low-Medium	Municipal budget	Ongoing	Medium	LPR

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC005	Promote or adopt higher regulatory and zoning standards to manage flood hazard risk; specifically, through updates to the building codes, flood ordinances, and subdivision and land development ordinances. Goals of increased standards are to ensure new buildings and infrastructure are discouraged or prohibited in high-hazard areas in their jurisdiction.	New and Existing	Flood	1, 3, 4, 5	Township/Borough NFIP FPA and Board, with support of PEMA, Beaver County, Conservation District, and DCED for model ordinance	Medium	Low	Municipal budget	Short	Low	LPR
BC006	The County will work with DCED, Beaver County Conservation District, other State agencies, and the municipalities to provide model zoning regulations for floodplain restrictions that comply with the PA MPC.	New and Existing	Flood	All	Township/Borough NFIP FPA and Board, with support of PEMA, Conservation District, and DCED for model ordinance	Medium	Low	Municipal budget	Short	Low	LPR
BC007	Support participation in the NFIP CRS program by attending CRS workshop(s) if offered within the County. Join the CRS program if adequate resources to support long-term participation can be dedicated. See following related CAV initiative.	N/A	Flood	2, 3, 4, 5	Township/Borough NFIP FPA, as fully supported by local government officials	Medium - High	Low	Municipal budget	Short (year 1)	High	LPR

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC008	Assess and update emergency operations center equipment to improve communication. Targeted needs include repeaters to strengthening radio signals, providing base ration station and replacement portable radio batteries, and installing PEMARS radio antennae, as well as generators/ backup power in municipal buildings, police stations, and public works garages.	Existing	All	1, 5	County, PEMA	Medium	Medium	County budget, FEMA HMGP and PDM	Short	Low	EAP, SIP
BC009	Install back-up power at the following critical facilities in the Township/Borough: • Bridgewater Borough Municipal Building, Police Station, and Public Works Garage • Freedom Borough Municipal Building (includes Fire and Police) • Monaca Borough Fire Stations and Community Center (EOC and shelter) • Rochester Borough Fire Station and Public Works Garage • South Heights Borough EOC/Municipal Building/Police Department										
	See above.	Existing	Tornado and Windstorm, Winter Storm	1, 2, 4	Engineering and DPW	High (reduced interruption of critical facilities and services; life safety)	Medium - High	Local budget; Emergency Management grants as available	Short (DOF)	Low	SIP
BC010	Work with County and power companies to identify roads within the Township/Borough considered "critical;" these would be the first priority for clearing after an event involving downed power lines.	Existing	Tornado and Windstorm, Winter Storm, Flood, Utility Interruption	1, 2, 3	County, Municipal Public Works Departments; Local Power Companies	Medium	Medium	Local budget	Short	Medium	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC011	Upgrade the fire protection system to meet NFPA standards. Projects may include purchase of mobile booster pumps to increase pressure for fire protection.	Existing	Urban Fire	1, 4	Local Fire Departments, Municipality	Medium	Medium	Local budget; Emergency Management grants as available	Short	High	SIP
BC012	Promote reverse notification systems in high-hazard areas.	Existing	All	1, 2, 5	County and Municipality	Medium	Medium	Local budget; Emergency Management grants as available	Ongoing	Low	EAP
BC013	Identify and monitor transportation routes of hazardous materials. Implement safety projects where applicable. Targeted areas include: • Countywide: State Routes 18, 51, and 65 • Freedom Borough: State Route 65 ramps and East Rochester Overpass • Monaca Borough: Emergency Boat Dock access to Ohio River • Rochester Borough: Water Street next to train tracks, Railroad Street, and Beaver River Blvd.										
	See above.	Existing	Environmental Hazards	1, 3, 5	County, Municipality, PennDOT	High	High	Local budget; Emergency Management grants as available	Short	Low	SIP
BC014	Work with County to implement transportation upgrades to roads with high flooding vulnerability. Projects could include culvert enhancement, culvert replacement, and road elevation. Targeted roads include: • Countywide: State Routes 18 and 65 • City of Aliquippa: Baker Street, Franklin Avenue, and Prince Street retention ponds • Ambridge Borough: Route 65, 4th Street, and the intersection of 19th Street and Duss Avenue • Freedom Borough: 8th Street • Harmony Township: Duss Avenue, Legionville Road, 8th Street Extension, and Valley Road • South Beaver Township: Swamp Poodle Bridge Site, Township Recreation Park, and McClain Road area • South Heights: Route 51 through South Heights										
	See above.	Existing	Flood	`1	County, Municipality, PennDOT	High	High	Local budget; Emergency Management grants as available	Short	Low	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC015	Improve the design, routing, and traffic control functions on high-risk roadways. Targeted roads include: • State Route 68 • 9th Street • Harvey Run • Crawford Street	Existing	Flood, Environmental Hazards, Landslide, Transportation Accidents	1	County, Municipality, PennDOT	High	High	Local budget; Emergency Management grants as available	Short	Low	SIP
BC016	Implement debris-flow projects, including slope stabilization, energy dissipation, or vegetative plantings. Targeted roads include: • State Route 68 • North Street Storm Sewer Drainage • Hill Road • Route 151 at Route 51	Existing	Landslide, Earthquake	1	County, Municipality, PennDOT	High	High	Local budget; Emergency Management grants as available	Short	Low	SIP, NSP
BC017	Implement stormwater management projects to facilitate stormwater flow during severe storms. Targeted needs include: • Countywide stormwater runoff survey • Mitigate the storm drain on Route 51 before the Bridge Street Exit in Bridgewater Borough (this drain clogs frequently, causing at least one lane northbound to be under at least 1 foot of water). • Rehabilitate Dutch Men's Run (Freedom Borough) • Mitigate the downtown area of South Heights Borough, including Crawford Street, Hill Road, and Fourth Street Creek.										
	See above.	Existing	Flood	1, 3	County, Municipality, PennDOT	High	High	Local budget; Emergency Management grants as available	Short	Low	SIP, NSP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC018	Beaver County will work with municipalities to collect or update information on the number and location of all repetitive loss properties to plan future mitigation actions.	Existing	Flood	1, 2, 3	County, Municipality, PEMA	Medium	Low	Local budget	Ongoing	Low	EAP
BC019	Continue to use and improve GIS capability to identify and prioritize hazards and critical infrastructure for mitigation. This action has two focuses: • As funding becomes available, collect and/or support the collection of first-floor elevations for all severe repetitive loss properties in Beaver County. Additionally, ensure that the geographic coordinates (latitude and longitude) of each property is confirmed. • Create a new development mapping layer so that the County can run mapping contrasts of targeted growth areas and hazard areas.										
	See above.	New and Existing	All	1, 3, 5	County Planning, County Emergency Services	High	Medium	Local budget; Emergency Management grants as available	Ongoing	Medium	EAP
BC020	Identify insurable County and municipal-owned, flood-prone buildings and infrastructure, and take appropriate mitigation methods if located in a SFHA. Continually monitor and update, as necessary.	Existing	Flood	1, 3, 5	County, Municipality	Low	Medium	Local budget; Emergency Management grants as available	Ongoing	Medium	LPR
BC021	Implement a building-hardening program for critical facilities and infrastructure to protect against terrorism.	New and Existing	Terrorism	1	County Sheriff's Office, Municipal Police Departments	Low	Medium	Federal Homeland Security Grants	Short	Low	SIP
BC022	Participate in emergency planning for applicable hazard and emergency response events. Specific types of planning relevant to the County and its municipalities include EAPs for dams, radiological emergency plans for nuclear incidents, winter preparedness plans, evacuation signage plans, Phase II Act 167 Stormwater Management Plan, and commodity flow studies. Additionally, other plans should be reviewed to ensure coordination with hazard mitigation planning techniques.										
	See above.	N/A	All	All	County Planning and OES, Municipalities	Medium	Low	County or local budget	Ongoing	Low	LPR
BC023	Municipalities will aggressively enforce building and safety codes for all buildings, including industrial uses.	New and Existing	All	1, 5	Municipal Code Enforcement	High	Low	County or local budget	Ongoing	Medium	LPR

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC024	Continue to map potential natural gas and petroleum transmission lines.	Existing	Environmental Hazard, Utility Interruption	1	County GIS, Utility Providers (Gas and Petroleum)	Medium	Medium	County, PEMA, FEMA	Short	Low	LPR
BC025	Planning Commission and applicable municipal offices will review their comprehensive plans to ensure that designated growth areas are not within high-hazard areas identified in this plan.	Existing	All	1, 2	County Planning, County OES, Municipal Managers	Medium	Low	Staff time, local budget	Ongoing	Low	LPR
BC026	Encourage all critical government facilities to have COOP and COG plans and to begin implementing appropriate backup systems.	Existing	All	1, 3	County Planning and OES, Municipal Emergency Managements	High	Low	Staff time, local budget	Ongoing	Low	LPR
BC027	Hold annual meetings to ensure that mitigation, planning, preparedness, and response personnel are (1) cross-trained in each other's area of expertise, (2) aware of ongoing activities, and (3) fostering increased communication.	N/A	All	All	County Planning and OES, Municipality	Medium	Low	Staff time, local budget	Ongoing	High	LPR
BC028	Reinstate the Beaver County CERT program to recruit and train interested citizens in Beaver County to assist first responders at specified emergencies throughout the County.	N/A	All	1	County Planning and OES, Municipality, Fire Departments	Medium	Medium	Local budget, PEMA, FEMA	Short	Low	EAP
BC029	Investigate the possibility of a county burn building to assist the training of volunteer fire departments.	New	Urban Fire and Explosions	1	County OES, Local Fire Departments	Medium	Medium	PEMA, FEMA, Assistance to Firefighters Grant	Short	Low	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC030	Develop and maintain a comprehensive list of relevant regional agencies, including Council of Governments, River Basin Commissions, and MPOs.	N/A	All	2, 3, 4	County Planning and OES	Medium	Low	Local budget, staff time	Ongoing	Low	LPR
BC031	Establish all-hazard resource centers located in the County Courthouse, Chamber of Commerce, municipalities, local libraries, and senior centers. Centers will serve as repositories for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders. Centers would display literature about the NFIP; FIRMs; books about mitigation for homeowners; and copies of "Are You Ready Guide," "Protecting Building Utilities from Flood Damage," and "Seeking Shelter from the Storm."										
	See above.	New	All	1, 5	County OES and Planning, Municipality	Medium	Medium	County budget, PEMA, FEMA emergency management grants	Short	Low	EAP
BC032	Applicable municipalities will communicate with property owners or renters within the 100-year floodplain regarding potential flood hazards. Letters may include the following information: local flood hazard, flood safety, flood insurance information, property protection measures, natural and beneficial functions of the local floodplain, a map of the local flood hazard area, information about hazard notification systems, floodplain development permit requirements, and substantial improvement/damage requirements.										
	See above.	New and Existing	Flood	1, 2, 5	Municipal FPA, County OES, County Planning	Medium	Low	Staff Time, Local budget	Ongoing	Medium	EAP
BC033	Remove blight/abandoned buildings, especially in Ambridge Borough and South Heights Borough.	Existing	Urban Fire, Environmental Hazards	1	County OES, Ambridge Borough, Fire Departments	Medium	High	Local budget, PEMA, FEMA	Short	Medium	SIP, NSP
BC034	Support equipment needs for local public works departments to ensure readiness for sudden onset hazard events.	N/A	Tornado and Windstorm, Flood, Winter Storm	1	County OES, Municipal Highway/Public Works	Medium	Medium	Local budget, PEMA, FEMA	Short	Low	SIP
BC035	Support residents and local businesses in testing properties for radon exposure.	Existing	Radon Exposure	1, 5	County OES, Municipality	Medium	Low	Staff Time	Ongoing	Low	LPR

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
BC036	Where feasible, separate combined stormwater and sanitary sewer systems to reduce flooding and the negative impacts of overflows. For instance, 75% of Rochester Borough has combined sewers or no storm sewers at all, making this project highly needed.	New and Existing	Flood	1	County OES, Municipality	High	High	FEMA PDM, HMGP, and FMA funds; other federal funding as available; PEMA; County	Long, DOF	High	SIP
BC037	Follow up with any reported concerns on drinking water contamination, especially when associated with fracking and environmental hazards.	Existing	Environmental Hazards	1, 3	County OES, Municipality	High	Low / Medium	FEMA PDM, HMGP, and FMA funds; EPA grants; other federal funding as available; PEMA; County	Ongoing	High	LPR, NSP
AC001	Implement flood control measures on Green Street, such as purchasing and removing structures.	Existing	Flood	1, 5	City of Aliquippa, Codes Enforcement	High	High	FEMA HMGP, PDM, and FMA funds, and other federal and State grants	Ongoing	High	SIP
AC002	Implement flood control measures on Baker Street, such as purchasing and removing structures.	Existing	Flood	1, 5	City of Aliquippa	High	High	FEMA HMGP, PDM, and FMA funds, and other federal and State grants	DOF	High	SIP
AC003	Implement flood control measures on Franklin Avenue, such as purchasing and removing structures.	Existing	Flood	1, 5	City of Aliquippa	High	High	FEMA HMGP, PDM, and FMA funds, and other federal and State grants	Long, DOF	High	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
AC004	Implement flood control measures on Spring Street, such as purchasing and removing structures.	Existing	Flood	1, 5	City of Aliquippa	High	High	FEMA HMGP, PDM, and FMA funds, and other federal and State grants	DOF	High	SIP
BBB001	Update stormwater ordinance.	N/A	Flood	All	Big Beaver Borough Planning Commission, Engineers	High	Low	Municipal budget, staff time	Ongoing	High	LPR
BB001	Investigate opportunities, such as the CRS program, to reduce NFIP needs and costs.	New and Existing	Flood	All	Bridgewater Borough, Beaver County	Medium	Low/ Medium	FEMA HMA, other federal or State grants, local cost share	Short, DOF	Medium	LPR
BT001	Mudlick Run, which runs parallel to Mudlick Hollow Road, is eroding the creek bank and causing damage to Mudlick Hollow Road, creating a potential hazard. Installation of gabion baskets or large riprap stone to protect the roadway is needed.	Existing	Flood	1, 3	Brighton Township, Public Works Department	Medium	Medium ($18,500)	FEMA HMA, other federal or State grants, local cost share	Short	Medium	SIP
BT002	Two Mile Run Creek is creating significant erosion in the area of two bridges that cross the Creek within Two Mile Run Park. Bridge approaches need to be secured with gabion baskets or similar protection. Bridge footings are being eroded underneath the creek.	Existing	Flood	1, 3	Brighton Township, Public Works Department	Medium	Medium ($20,000)	FEMA HMA, other federal or State grants, local cost share	Short	Medium	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
DarlT001	Secure an emergency generator for redundant power to the Township Municipal Building.	Existing	All	1, 3	Darlington Township	High	Medium	Federal (FEMA HMGP, PDM, or FMA; HUD CDBG; etc.), State, County, Local	Short	High	SIP
DarlT002	Secure heavy equipment to assist in hazard preparedness and response efficiency.	N/A	All	1, 3	Darlington Township	Medium	Medium	Federal (FEMA HMGP, PDM, or FMA; HUD CDBG; etc.), State, County, Local	Short	High	SIP
DarlT003	Conduct industrial park water system upgrades.	Existing	Flood, Utility Interruption	1, 3	Darlington Township	High	High	Federal (FEMA HMGP, PDM, or FMA; HUD CDBG; etc.), State, County, Local	Short	High	SIP
DT001	Secure and install a backup generator for municipal building.	Existing	All	1, 2, 4	Daugherty Township, New Brighton Borough, Pulaski Township	High	Medium	FEMA HMA, other federal or State grants, local cost share	Short, DOF	High	SIP
EB001	Tear down the old fire department building, which is built over a stream that empties into the Beaver River.	Existing	Building Collapse, All (Emergency Response Impacted)	1, 3	Firemen's Club, Eastvale Borough	High	Medium	FEMA PDM, HMGP, and FMA funds; other federal funding as available; PEMA; County	DOF	Medium	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
ER001	Update and promote information on the floodplain management ordinance to remain compliant with the NFIP.	Existing and New	Flood	1, 2, 3, 5	East Rochester Borough	Medium	Low	Municipal budget, FEMA PDM grant	DOF	Low	LPR
ER002	Monitor land subsidence and structural deficiencies to prepare and eliminate mine subsidence.	Existing	Subsidence	1, 3	East Rochester Borough	Medium	High	FEMA PDM, HMGP, and other federal or State grants	Ongoing	Low	LPR
FB001	Dredge and clean banks of Brady's Run Creek. Install riprap to prevent additional erosion and flooding.	New	Flood, Transportation Accident	1	Fallston Borough	High	High	FEMA PDM, HMGP, and FMA funds; other federal funding as available; PEMA; County	Short, DOF	Medium	NSP
FB002	Add storm drains to Main Street to prevent flooding.	New	Flood, Tornadoes and Windstorms	1	Fallston Borough	High	High	FEMA PDM, HMGP, and FMA funds; HUD CDBG; other federal funding as available; PEMA; County	Long, DOF	Medium	SIP
FreeB001	Remove streambed debris from 3rd Avenue to 8th Street, past the Borough Garage.	Existing	Flood	1	Freedom Borough, Beaver County	Medium	Medium	FEMA PDM, HMGP, and FMA funds; HUD CDBG; other federal funding as available; PEMA; County	Short	Medium	SIP, NSP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
GT001	Mitigate the existing pipe erosion at the stream crossing at Sharon Drive.	Existing	Flood, Utility Interruption	1	Greene Township	High	High	FEMA PDM, HMGP, and FMA funds; HUD CDBG; PEMA; other federal and state funding as available; County, Local	Short	High	SIP
HT001	Purchase repetitive loss properties, especially those along Raccoon Creek, as funding becomes available. Acquired properties will be turned into open space. This initiative will complement the Township's other flood management programs, including enforcing the newly adopted and updated flood ordinance.	Existing	Flood	All	Hopewell Township Emergency Management Coordinator, Public Works, and Volunteer Fire Department; Beaver County Emergency Services	High	High	FEMA HMGP, PDM, and FMA, and other federal and State grants	Short, DOF	Medium	SIP, NSP
HT002	Mitigate slip-slide prone areas through hillside stabilization projects and stormwater retention sites. These areas are vulnerable to hazard events at all times but vulnerability may be worse during flood events.	Existing	Landslide	1, 3	Hopewell Township Emergency Management Coordinator, Public Works, and Private Contractors	High	High	FEMA HMGP, PDM, and FMA, and other federal and State grants	Short, DOF	High	SIP
HT003	Provide stormwater controls in areas of the Township where they do not exist (i.e., areas of Township that do not have stormwater lines).	Existing	Flood, Tornados and Windstorms	1, 3, 5	Hopewell Township Emergency Management Coordinator, Public Works, and Private Contractors	High	High	FEMA HMGP, PDM, and FMA, and other federal and State grants	Ongoing	High	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
	Maintain, update, and enhance Township wastewater separation program. The Township has actively been involved in meeting PADEP thresholds for wastewater separation for about 10-15 years. The priority goal is eliminating wastewater/stormwater from Raccoon Creek Water Pollution Control Plant, although the Township also implements other measures, including enforcing regulations and public education.										
HT004	See above.	Existing	Flood, Pandemic	All	Hopewell Township Emergency Management Coordinator and Engineer, PADEP	High	High	FEMA HMGP, PDM, and FMA, and other federal and State grants	Ongoing, Long	High	SIP
KB001	Secure alternate electrical supply (i.e., generator) for Borough.	Existing	Utility Interruption	1, 3, 5	Koppel Emergency Management Agency, Koppel Volunteer Fire Company	Medium	Low	Federal and State Grants	Short	Medium	SIP, LPR
MB001	Install a stormwater conveyance system and/or maintain/rehabilitate existing drainage ways to address roadway flooding during rain events.	New and Existing	Flood	1, 3, 5	Midland Borough	High	TBD (Probably High)	Local funds, State or federal infrastructure funding	DOF	Low	SIP
MB002	Adopt stormwater management ordinance.	N/A	Flood	All	Midland Borough	Medium	Low	Local funds	TBD	High	LPR
NB001	Stream Bed Debris Removal ~ Removal of objects and debris from Blockhouse Run that may increase flooding potential.	N/A	Flood	1	New Brighton Borough, PADEP	Medium	Medium	FEMA PDM and HMGP	DOF	Medium	NSP
NB002	Retaining Wall Replacement / Elimination ~ Repair or replace existing stove retaining walls along hillsides in town or eliminate the walls and grade the land where appropriate.	Existing	Landslide	1	New Brighton Borough, Engineering Department	High	High	FEMA PDM and HMGP	DOF	High	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
NB003	Penn Avenue Hillside Stabilization ~ Construct structure to prevent debris and land movement onto the 800 block of Penn Avenue.	Existing	Landslide	1	New Brighton Borough, Engineering Department	Low	High	FEMA PDM and HMGP	DOF	Low	SIP
NB004	Pave Run Flood Wall ~ Construct flood wall / barrier along Rave Run to prevent flooding of Damascus Steel.	New	Flood	1	New Brighton Borough, PADEP	High	High	FEMA PDM and HMGP	DOF	Medium	SIP
NB005	Sewer Interceptor Upgrade ~ Increase capacity of Allegheny Street and Pave Run sewer interceptors to prevent repetitive flooding of adjacent structures.	Existing	Flood	1, 4	New Brighton Borough, Engineering Department	High	High	FEMA PDM and HMGP	Long	Medium	SIP
NB006	Stream Bank Stabilization ~ Prevent continued washout of the Blockhouse Run and Pave Run stream banks.	Existing	Flood	1	New Brighton Borough, PADEP	Medium	Medium	FEMA PDM and HMGP	DOF	Medium	NSP
NB007	Joint Emergency Operations Center Generator ~ Provide the Daugherty Township Municipal Building with a standby generator for use as a joint EOC between New Brighton Borough, Pulaski Township, and Daugherty Township.	N/A	All Hazards	1, 2, 3	New Brighton Borough, Daugherty Township, Pulaski Township	High	Medium	FEMA PDM and HMGP	Short	Medium	SIP
NB008	Update Zoning and Land Development Ordinances	Both	All Hazards	1, 2, 3, 4	New Brighton Borough, Planning Department	Medium	Medium	FEMA PDM and HMGP	DOF	High	LPR
NB009	Installation of Warning Siren System	N/A	All Hazards	1, 2, 5	New Brighton Borough	Medium	Medium	FEMA PDM and HMGP	DOF	Medium	EAP
NB010	Demolition of High Risk Structures	Existing	Fire	1	New Brighton Borough	Medium	Medium	FEMA PDM and HMGP	OG	High	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
NG001	Install an emergency notification siren to alert residents when hazardous conditions exist. This will also be used to alert the Fire Department.	Existing	All	1, 2, 3, 5	New Galilee EMA, Fire Department	High	Medium	Grants, government equipment programs, low-cost Loans	Short	High	SIP
NG002	Install reserve power generator in VFC Community Hall (for sheltering).	Existing	All, especially those requiring shelter activation	1, 2, 4, 5	New Galilee EMA, Fire Department	High	High	Grants, government equipment programs, low-cost Loans	Short	High	SIP
NG003	Clean and widen Little Jordan Creek and construct berms to contain floodwaters.	Existing	Flood	1	New Galilee Borough, DCNR, USACE, PennDOT	High	High	State and federal grants (HMGP, FMA, or PDM)	Long	High	SIP, NSP
PT001	Mitigate potential landslide occurrences.	Existing	Landslide	1, 3	Patterson Township	High	High	Federal, State, County, Local	DOF	High	SIP
PT002	Identify and implement mine subsidence mitigation measures.	Existing	Mine Subsidence	1, 3	Patterson Township	High	Medium	Federal, State, County, Local	DOF	Medium	NSP
PT003	Mitigate the flooding and erosion problems at Bradys Run Creek.	Existing	Flood, Erosion	1, 3	Patterson Township	High	Medium	Federal, State, County, Local	DOF	Medium	SIP
RB001	Work with County and stakeholders to secure funding to install some type of above ground barrier and containment facilities to prevent/reduce hazardous material incidents on vulnerable roadways.	Existing	Environmental Hazards	1, 2, 4	Rochester Borough, Beaver County OES	High	High	FEMA PDM, HMGP, and FMA funds; other federal funding as available; PEMA; County	Long, DOF	Low	SIP

Initiative*	Mitigation Initiative	Applies to New and/or Existing Structures**	Hazard(s) Mitigated	Goals Met	Lead and Support Agencies	Estimated Benefits	Estimated Cost	Sources of Funding	Timeline	Priority***	Mitigation Category
RT001	Upgrade Grant Street sewer trunk and increase capacity for the larger flows.	Existing	Flood	1	Rochester Township	High	High	Federal, State, County, Local	DOF	High	SIP
RT002	Install permanent or mobile generator for the municipal building.	Existing	Utility Interruption	1, 5	Rochester Township	High	Medium	Federal, State, County, local	Short	Medium	SIP
SHB001	Route 51, Jordan Street, Emergency Route is a landslide-prone area and a route for evacuation. Shore up hillside to prevent landslides, and prune trees to prevent blocking of Route 51.	Existing	Landslide	1, 3	South Heights Borough, PennDOT	High	High	Federal, State, and County	Ongoing	Medium	SIP
SHB002	Route 51, Jordan Streets, and South Heights (State Route) area sewers need to be repaired to be able to take the runoff from the hillside through the main route in the Borough. There is a lot of flooding, and the sewers will not hold the runoff. There is no map of the sewer system; the Borough also needs a study and map of these sewers.	Existing	Flood, Pandemic	1, 2, 3	South Heights Borough, Beaver County	High	High	Federal, State, and County	Ongoing	High	SIP
SHB003	Fourth Street Creek – This creek runs off of the hill at the Fourth Street extension, leading to floods. The Borough needs a bigger pipe put in to take the water to the river during heavy rains.	Existing	Flood, Severe Storms	1, 3	South Heights Borough	Medium	Medium	Federal, State, and County	Ongoing	Medium	SIP

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SHB004	Crawford Street Creek – The Borough has repaired the sewers, but the runoff is still great. The sewers need to be made bigger and better (expanded capacity) to keep water flowing and to prevent flooding.	Existing	Flood, Severe Storms, Pandemic	1, 3	South Heights Borough	High	High	Federal, State, and County	Ongoing	Medium	SIP
SHB005	Railroad Street – The Creswell Heights Joint Authority has buildings in this area. If the dam were to break, this could possibly flood the area. There are also buildings near railroad tracks. The Borough needs to install a safety net in the area to protect the water supply for three areas.	Existing	Flood, Dam Failure	1, 3	South Heights Borough, Creswell Heights Joint Authority	High	High	Federal, State, and County	Ongoing	High	SIP
SHB006	Two blighted properties are falling down and in danger of collapse. This has created a public hazard in the area of North Jordan Street and Hill Road in the Borough.	Existing	Urban Fire, Environmental Hazards	1, 3	South Heights Borough	Medium	Medium	Federal, State, and County	Ongoing	Medium	SIP, NSP
VT001	Conduct stormwater upgrades at Division Lane.	Existing	Flood	1, 3	Vanport Township, Beaver County Emergency Services and Planning, Beaver County Conservation District	Medium	Medium	Federal (FEMA HMGP, PDM, or FMA; HUD CDBG; etc.), State, County, Local	Short	High	SIP

Notes:
* The letters associated with the initiative number indicate the lead agency (i.e., County or municipality
** Does this mitigation initiative reduce the effects of hazards on new and/or existing buildings and/or infrastructure? Not applicable (N/A) is inserted if this does not apply.
*** Priority indicates the prioritization identified by the lead agency. This may differ from the County prioritization on municipal actions because the municipal priority may be of higher ranking than the PA-STEEL/County priority. Further explanations are provided at the end of this section.

CAV = Community Assistance Visit
CDBG = Community Development Block Grant
CERT = Community Emergency Response Team
COG = Continuity of Government
COOP = Continuity of Operations
CRS = Community Rating System
DCED = Pennsylvania Department of Community and Economic Development
EAP = Emergency Action Plan
EOC = Emergency Operations Center
FEMA = Federal Emergency Management Agency
FIRM = Flood Insurance Rate Map
FPA = Floodplain Administrator
GIS = Geographic information system
HMA = Hazard Mitigation Assistance
HUD = U.S. Housing Urban Development
ISO = Insurance Services Office
MPC = Pennsylvania Municipalities Planning Code
MPO = Metropolitan Planning Organizations
NFIP = National Flood Insurance Program
NFPA = National Fire Protection Association
OES = Office of Emergency Services
PADEP = Pennsylvania Department of Environmental Protection
PDM = Pre-Disaster Mitigation Program
PEMA = Pennsylvania Emergency Management Agency
PEMARS = Pennsylvania Emergency Management Agency Radio System
SFHA = Special Flood Hazard Area
TBD = To Be Determined
VFC = Volunteer Fire Company

Costs:
These rough estimates should be used where actual project costs cannot reasonably be established at this time:
Low = < $10,000
Medium = $10,000 to $100,000
High = > $100,000

Potential FEMA HMA Funding Sources:
DOF = Depending on funding
FMA = Flood Mitigation Assistance Grant Program
HMGP = Hazard Mitigation Grant Program
PDM = Pre-Disaster Mitigation Grant Program
RFC = Repetitive Flood Claims Grant Program
SRL = Severe Repetitive Loss Grant Program

Timeline:
Short Term = 1 to 5 years. Long Term = 5 years or greater. OG = Ongoing program.

Priority:
H = High
M = Medium
L = Low

Mitigation Category:
Education and Awareness Programs (EAP) = These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady and Firewise Communities.
Local Plans and Regulations (LPR) = These actions include government authorities, policies or codes that influence the way land and buildings are being developed and built.
Natural Systems Protection (NSP) = These are actions that minimize damage and losses, and also preserve or restore the functions of natural systems.
Structure and Infrastructure Project (SIP) = These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.

6.4.2 Mitigation Strategy Prioritization and Implementation

Section 201.6(c) (3) (iii) of Title 44 Code of Federal Regulations (44 CFR) requires the prioritization of the action plan to emphasize the extent to which benefits are maximized according to a cost-benefit review of the proposed projects and their associated costs. This allows the jurisdictions to select the most cost-effective actions for implementation first, not only to use resources efficiently, but also to make a realistic start toward mitigating risks.

Mitigation benefits are defined as future damages and losses that would be eliminated and/or reduced by implementing the proposed mitigation project, and include physical damage to structures and infrastructure, loss of service or function, and emergency management costs. Particularly for physical ("shovel-in-the-ground") mitigation projects, jurisdictions were encouraged to estimate project costs as well as to identify the anticipated benefits. Where exact project costs and potential benefits were not available, ranges were identified (high, medium, low) for each, allowing a qualitative evaluation of project cost-effectiveness.

The PA-STEEL methodology is defined in Pennsylvania's All-Hazard Planning SOG (October 2013), pages 36-37 and Appendix 12, "Mitigation Strategy Action Evaluation," as the Political, Administrative, Social, Technical, Economic, Environmental, and Legal (PA-STEEL) opportunities and constraints of implementing a particular mitigation action in a jurisdiction. The PA-STEEL method provides a uniform approach for counties and jurisdictions to use to consider, in a systematic way, the best mitigation strategies for their communities. The following provides a brief discussion of each of the PA-STEEL evaluation criteria, excerpted from the FEMA 386 mitigation planning guidance:

- **Political:** Understanding current opinions of community and state political leadership regarding issues related to the environment, economic development, safety, and emergency management will provide valuable insight into the level of political support offered for mitigation activities and programs. Proposed mitigation objectives sometimes fail because of a lack of political acceptability.
- **Administrative:** Under this part of the evaluation criteria, the Hazard Mitigation Working Group examines the anticipated staffing, funding, and maintenance requirements for the mitigation action to determine whether the jurisdiction has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.
- **Social:** The public must support the overall implementation strategy and specific mitigation actions. Therefore, the projects have to be evaluated in terms of community acceptance.
- **Technical:** It is important to determine whether the proposed action is technically feasible, will help to reduce losses in the long term, and has minimal secondary impacts. Here, the Hazard Mitigation Working Group determines whether the alternative action is a whole or partial solution, or not a solution at all.
- **Economic:** Every local, state, and tribal government experiences budget constraints at one time or another. Cost-effective mitigation actions that can be funded in current or upcoming budget cycles are much more likely to be implemented than mitigation actions requiring general obligation bonds or other instruments that would incur long-term debt to a community. States and local communities with tight budgets or budget shortfalls may be more willing to undertake a mitigation initiative if it can be funded, at least in part, by outside sources. "Big ticket" mitigation actions, such as large-scale acquisition and relocation, are often considered for implementation in a post-disaster scenario when additional federal and state funding for mitigation is available. Economic considerations must include the present economic base and projected growth.
- **Environmental:** Impact on the environment is an important consideration because of public desire for sustainable and environmentally healthy communities. In addition, many statutory considerations, such as the National Environmental Policy Act (NEPA), should be counted when using federal funds. Jurisdictions need to evaluate whether, when implementing mitigation actions, the potential negative

consequences to environmental assets such as threatened and endangered species, wetlands, and other protected natural resources.

- **Legal:** Without the appropriate legal authority, the action cannot lawfully be undertaken. When considering this criterion, the Hazard Mitigation Working Group determines whether a jurisdiction has the legal authority at the state, tribal, or local level to implement the action, or whether the jurisdiction must pass new laws or regulations. Each level of government operates under a specific source of delegated authority. As a general rule, most local governments operate under enabling legislation that gives them the power to engage in different activities. Jurisdictions should identify the unit of government undertaking the mitigation action, and include an analysis of the inter-relationships between local, regional, state, and federal governments. Legal authority is likely to have a significant role later in the process when the state, tribe, or community determines the ways in which mitigation activities can best be carried out, and the extent to which mitigation policies and programs can be enforced (PEMA 2013).

Municipal and County-level mitigation actions were evaluated and prioritized primarily using the PA-STEEL methodology. Table 6-4 contains the completed PA-STEEL action evaluation table for the updated mitigation strategies (listed in Table 6-3).

In accordance with the PEMA Standard Operating Guidance (SOG), the mitigation strategy evaluation through the PA-STEEL methodology also summarizes the feasibility factors for each action and summarizes the factors with benefits and costs weighed more heavily and, therefore given greater priority. Using cost-benefit weighted prioritization, mitigation actions were ranked as high, medium, or low-priority actions.

Other factors beyond the PA-STEEL numeric rankings may have to be considered during project prioritization. For example, a project might be designated medium priority because of the uncertainty of a funding source. This priority could be changed to “high” once a funding source has been identified such as a grant.

Table 6-4. Analysis of Mitigation Actions

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
BC001	Support the mitigation of vulnerable structures via retrofit (e.g. elevation, flood-proofing) or acquisition/relocation to protect them from future damage; repetitive loss and severe repetitive loss properties should be a priority, when applicable.	+	-	+	+	-	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	N	+	+	19 (+) 3 (-) 1 (N)	23 (+) 3 (-) 1 (N)
BC002	Develop and implement an enhanced all-hazards, public outreach / education / mitigation information program on natural hazard risks, and outline the ways in which the program(s) can strengthen community mitigation and preparedness efforts.	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	N	+	+	+	12 (+) 6 (-) 5 (N)	14 (+) 8 (-) 5 (N)
BC003	Develop and implement an enhanced municipal training program, with specific focuses on the NFIP, CRS, flood mitigation projects, hazard mitigation, damage assessments, PEMA planning and project tools, FEMA eGrants program, and Marcellus Shale natural gas extraction. Information on trainings will be posted on the Emergency Services website.	+	+	-	+	-	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	N	+	+	18 (+) 4 (-) 1 (N)	22 (+) 4 (-) 1 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																					Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
BC004	Maintain compliance with and good standing in the NFIP, including adoption and enforcement of floodplain management requirements (e.g., regulating all new and substantially improved construction in special-hazard flood areas), floodplain identification and mapping, and flood insurance outreach to the community. Further meet and/or exceed the minimum NFIP standards and criteria through the following NFIP-related continued compliance actions identified in subsequent initiatives.	+	-	+	-	-	+	+	+	+	+	+	+	-	N	-	N	N	+	+	+	N	+	+	14 (+) 5 (-) 4 (N)	16 (+) 7 (-) 4 (N)
BC005	Promote or adopt higher regulatory and zoning standards to manage flood hazard risk; specifically, through updates to the building codes, flood ordinances, and subdivision and land development ordinances. Goals of increased standards are to ensure new buildings and infrastructure are discouraged or prohibited in high-hazard areas in their jurisdiction.	+	-	-	+	+	-	-	+	+	+	+	+	-	+	-	N	N	+	N	+	+	+	+	14 (+) 6 (-) 3 (N)	16 (+) 8 (-) 3 (N)
BC006	The County will work with DCED, Beaver County Conservation District, other State agencies, and the municipalities to provide model zoning	+	-	+	-	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	N	+	+	+	13 (+) 5 (-) 5 (N)	15 (+) 7 (-) 5 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																					Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
	regulations for floodplain restrictions that comply with the PA MPC.																									
BC007	Support participation in the NFIP CRS program by attending CRS workshop(s) if offered within the County. Join the CRS program if adequate resources to support long-term participation can be dedicated. See following related CAV initiative.	+	-	+	+	-	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	N	+	+	18 (+) 4 (-) 1 (N)	22 (+) 4 (-) 1 (N)
BC008	Assess and update emergency operations center equipment to improve communication. Targeted needs include repeaters to strengthen radio signals and installing PEMARS radio antennae, as well as generators/backup power in municipal buildings, police stations, and public works garages.	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-	N	N	+	N	N	+	+	+	13 (+) 6 (-) 4 (N)	15 (+) 8 (-) 4 (N)
BC009	Install back-up power at the following critical facilities in the Township/Borough: • Monaca Borough Fire Stations and Community Center (EOC and shelter) • Rochester Borough Fire Station and Public Works Garage	+	+	+	+	-	-	+	+	+	-	+	+	-	N	-	N	N	N	N	N	+	+	+	12 (+) 5 (-) 6 (N)	14 (+) 7 (-) 6 (N)
BC010	Work with County and power companies	+	-	+	-	-	-	+	+	+	-	+	+	+	N	-	+	+	+	+	+	+	+	+	16 (+) 6 (-)	20 (+) 6 (-)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental						L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
	to identify roads within the Township/Borough considered "critical;" these would be the first priority for clearing after an event involving downed power lines.																							1 (N)	1 (N)
BC011	Upgrade the fire protection system to meet NFPA standards. Projects may include purchase of mobile booster pumps to increase pressure for fire protection.	+	+	+	-	-	+	+	+	+	+	+	+	+	+	-	+	N	+	N	+	+	+	+	18 (+) 3 (-) 2 (N)	22 (+) 3 (-) 2 (N)
BC012	Promote reverse notification systems in high-hazard areas.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	N	N	+	N	+	+	+	+	16 (+) 4 (-) 3 (N)	18 (+) 6 (-) 3 (N)
BC013	Identify and monitor transportation routes of hazardous materials. Implement safety projects where applicable.	+	+	+	-	-	+	+	+	+	-	+	+	-	+	-	N	N	+	N	+	N	+	+	14 (+) 5 (-) 4 (N)	16 (+) 7 (-) 4 (N)
BC014	Work with County to implement transportation upgrades to roads with high flooding vulnerability. Projects could include culvert enhancement, culvert replacement, and road elevation.	+	+	+	-	-	+	+	+	+	-	+	+	-	+	-	N	N	+	N	+	N	+	+	14 (+) 5 (-) 4 (N)	16 (+) 7 (-) 4 (N)
BC015	Improve the design, routing, and traffic control functions on high-risk roadways.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	+	N	+	+	+	+	16 (+) 5 (-) 2 (N)	18 (+) 7 (-) 2 (N)
BC016	Implement debris-flow projects, including slope stabilization, energy dissipation, or vegetative plantings.	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	17 (+) 6 (-) 0 (N)	19 (+) 8 (-) 0 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
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BC017	Implement stormwater management projects to facilitate stormwater flow during severe storms.	+	-	+	-	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	N	+	+	+	13 (+) 5 (-) 5 (N)	15 (+) 7 (-) 5 (N)
BC018	Beaver County will work with municipalities to collect or update information on the number and location of all repetitive loss properties to plan future mitigation actions.	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	N	+	+	+	12 (+) 6 (-) 5 (N)	14 (+) 8 (-) 5 (N)
BC019	Continue to use and improve GIS capability to identify and prioritize hazards and critical infrastructure for mitigation.	+	-	+	-	-	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	18 (+) 5 (-) 0 (N)	20 (+) 7 (-) 0 (N)
BC020	Identify insurable County and municipal-owned, flood-prone buildings and infrastructure, and take appropriate mitigation methods if located in a SFHA. Continually monitor and update, as necessary.	+	-	+	-	-	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	18 (+) 5 (-) 0 (N)	20 (+) 7 (-) 0 (N)
BC021	Implement a building-hardening program for critical facilities and infrastructure to protect against terrorism.	+	+	+	-	-	+	+	+	+	+	+	+	-	+	-	N	N	+	N	+	+	+	+	16 (+) 4 (-) 3 (N)	18 (+) 6 (-) 3 (N)
BC022	Participate in emergency planning for applicable hazard and emergency response events. Specific types of planning relevant to the County and its municipalities include EAPs for dams,	+	+	+	-	-	+	+	+	+	-	+	+	-	+	-	N	N	+	N	+	+	+	+	15 (+) 5 (-) 3 (N)	17 (+) 7 (-) 3 (N)

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	radiological emergency plans for nuclear incidents, winter preparedness plans, evacuation signage plans, Phase II Act 167 Stormwater Management Plan, and commodity flow studies. Additionally, other plans should be reviewed to ensure coordination with hazard mitigation planning techniques.																								
BC023	Municipalities will aggressively enforce building and safety codes for all buildings, including industrial uses.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	N	N	+	N	+	N	+	+	16 (+) 3 (-) 4 (N)	18 (+) 5 (-) 4 (N)
BC024	Continue to map potential natural gas and petroleum transmission lines.	+	-	+	-	-	-	+	+	+	+	+	+	-	N	-	+	+	+	+	+	N	+	+	15 (+) 6 (-) 2 (N)	17 (+) 8 (-) 2 (N)
BC025	Planning Commission and applicable municipal offices will review their comprehensive plans to ensure that designated growth areas are not within high-hazard areas identified in this plan.	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	17 (+) 6 (-) 0 (N)	19 (+) 8 (-) 0 (N)
BC026	Encourage all critical government facilities to have COOP and COG plans and to begin implementing appropriate backup systems.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	N	N	+	N	N	+	+	+	14 (+) 5 (-) 4 (N)	16 (+) 7 (-) 4 (N)
BC027	Hold annual meetings to ensure that mitigation, planning, preparedness, and response personnel are (1) cross-trained in each other's area of expertise, (2)	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	+	N	+	+	+	18 (+) 5 (-) 4 (N)	22 (+) 5 (-) 4 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
	aware of ongoing activities, and (3) fostering increased communication.																								
BC028	Reinstate the Beaver County CERT program to recruit and train interested citizens in Beaver County to assist first responders at specified emergencies throughout the County.	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-	N	N	+	N	N	+	+	+	12 (+) 6 (-) 4 (N)	14 (+) 8 (-) 4 (N)
BC029	Investigate the possibility of a county burn building to assist the training of volunteer fire departments.	-	+	-	-	-	-	+	+	+	+	N	+	-	-	-	+	N	+	+	+	+	+	+	13 (+) 8 (-) 2 (N)	15 (+) 9 (-) 2 (N)
BC030	Develop and maintain a comprehensive list of relevant regional agencies, including Council of Governments, River Basin Commissions, and MPOs.	+	-	+	-	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	N	+	+	+	12 (+) 6 (-) 5 (N)	14 (+) 8 (-) 5 (N)
BC031	Establish all-hazard resource centers located in the County Courthouse, Chamber of Commerce, municipalities, local libraries, and senior centers. Centers will serve as repositories for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders. Centers would display literature about the NFIP; FIRMs; books about mitigation for homeowners; and copies of "Are You Ready Guide," "Protecting Building Utilities from Flood Damage," and	+	-	+	+	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	N	+	+	+	13 (+) 5 (-) 5 (N)	15 (+) 7 (-) 5 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
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	"Seeking Shelter from the Storm."																								
BC032	Applicable municipalities will communicate with property owners or renters within the 100-year floodplain regarding potential flood hazards. Letters may include the following information: local flood hazard, flood safety, flood insurance information, property protection measures, natural and beneficial functions of the local floodplain, a map of the local flood hazard area, information about hazard notification systems, floodplain development permit requirements, and substantial improvement/damage requirements.	+	-	+	+	-	-	+	+	+	+	+	+	+	+	-	N	N	N	N	N	+	+	+	14 (+) 4 (-) 5 (N)	18 (+) 4 (-) 5 (N)
BC033	Remove blight/abandoned buildings, especially in Ambridge Borough.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	18 (+) 5 (-) 0 (N)	20 (+) 7 (-) 0 (N)
BC034	Support equipment needs for local public works departments to ensure readiness for sudden onset hazard events.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	15 (+) 4 (-) 4 (N)	17 (+) 6 (-) 4 (N)
BC035	Support residents and local businesses in testing properties for radon exposure.	+	-	-	-	-	-	+	+	+	+	-	+	+	-	+	N	N	N	+	+	+	+	+	13 (+) 7 (-) 3 (N)	17 (+) 7 (-) 3 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																					Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
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BC036	Where feasible, separate combined stormwater and sanitary sewer systems to reduce flooding and the negative impacts of overflows. For instance, 75% of Rochester Borough has combined sewers or no storm sewers at all, making this project highly needed.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	20 (+) 3 (-) 0 (N)	22 (+) 5 (-) 0 (N)
BC037	Follow up with any reported concerns on drinking water contamination, especially when associated with fracking and environmental hazards.	+	+	+	+	-	-	+	+	+	+	+	+	N	+	+	+	+	+	+	+	+	+	+	20 (+) 2 (-) 1 (N)	22 (+) 4 (-) 1 (N)
AC001	Implement flood control measures on Green Street, such as purchasing and removing structures.	+	+	+	+	-	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	N	+	+	20 (+) 2 (-) 1 (N)	22 (+) 4 (-) 2 (N)
AC002	Implement flood control measures on Baker Street, such as purchasing and removing structures.	+	+	+	+	-	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	N	+	+	20 (+) 2 (-) 1 (N)	22 (+) 4 (-) 2 (N)
AC003	Implement flood control measures on Franklin Avenue, such as purchasing and removing structures.	+	+	+	+	-	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	N	+	+	20 (+) 2 (-) 1 (N)	22 (+) 4 (-) 2 (N)
AC004	Implement flood control measures on Spring Street, such as purchasing and removing structures.	+	+	+	+	-	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	N	+	+	20 (+) 2 (-) 1 (N)	22 (+) 4 (-) 2 (N)
BBB001	Update stormwater ordinance.	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	N	+	+	+	+	+	+	21 (+) 1 (-) 1 (N)	25 (+) 1 (-) 1 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
BB001	Investigate opportunities, such as the CRS program, to reduce NFIP needs and costs.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	+	+	N	+	+	+	+	+	18 (+) 4 (-) 1 (N)	20 (+) 6 (-) 1 (N)
BT001	Mudlick Run, which runs parallel to Mudlick Hollow Road, is eroding the creek bank and causing damage to Mudlick Hollow Road, creating a potential hazard. Installation of gabion baskets or large riprap stone to protect the roadway is needed.	+	+	+	-	-	+	+	+	+	+	+	+	-	N	-	+	+	N	+	+	+	+	+	17 (+) 4 (-) 2 (N)	19 (+) 6 (-) 2 (N)
BT002	Two Mile Run Creek is creating significant erosion in the area of two bridges that cross the Creek within Two Mile Run Park. Bridge approaches need to be secured with gabion baskets or similar protection. Bridge footings are being eroded underneath the creek.	+	+	+	-	-	+	+	+	+	+	+	+	-	N	-	+	+	N	+	+	+	+	+	17 (+) 4 (-) 2 (N)	19 (+) 6 (-) 2 (N)
DarlT001	Secure an emergency generator for redundant power to the Township Municipal Building.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	16 (+) 3 (-) 4 (N)	18 (+) 5 (-) 4 (N)
DarlT002	Secure heavy equipment to assist in hazard preparedness and response efficiency.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	+	N	N	N	N	+	+	+	+	17 (+) 2 (-) 4 (N)	19 (+) 4 (-) 4 (N)
DarlT003	Conduct industrial park water system upgrades.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	+	N	+	+	+	+	+	+	18 (+) 4 (-) 1 (N)	20 (+) 6 (-) 1 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental						L Legal			
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
DT001	Secure and install a backup generator for municipal building.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	16 (+) 3 (-) 4 (N)	18 (+) 5 (-) 4 (N)
EB001	Tear down the old Fire Department building, which is built over a stream that empties into the Beaver River.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	+	N	N	+	+	+	+	+	18 (+) 3 (-) 2 (N)	20 (+) 5 (-) 2 (N)
ER001	Update and promote information on the floodplain management ordinance to remain compliant with the NFIP.	+	+	+	-	-	+	+	+	+	+	+	+	-	N	-	N	N	+	+	+	+	+	+	16 (+) 4 (-) 3 (N)	18 (+) 6 (-) 3 (N)
ER002	Monitor land subsidence and structural deficiencies to prepare and eliminate mine subsidence.	+	+	+	-	-	-	+	+	+	+	+	+	-	N	-	+	N	+	+	+	+	+	+	16 (+) 5 (-) 2 (N)	18 (+) 7 (-) 2 (N)
FB001	Dredge and clean banks of Brady's Run Creek. Install riprap to prevent additional erosion and flooding.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	+	+	N	+	+	+	+	+	18 (+) 4 (-) 1 (N)	20 (+) 6 (-) 1 (N)
FB002	Add storm drains to Main Street to prevent flooding.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	15 (+) 4 (-) 4 (N)	17 (+) 6 (-) 4 (N)
FreeB001	Remove streambed debris from 3rd Avenue to 8th Street, past the Borough Garage.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	18 (+) 5 (-) 0 (N)	20 (+) 7 (-) 0 (N)
GT001	Mitigate the existing pipe erosion at the stream crossing at Sharon Drive.	+	+	+	+	-	+	+	+	+	+	+	+	-	N	-	+	+	+	+	+	+	+	+	19 (+) 3 (-) 1 (N)	21 (+) 5 (-) 1 (N)
HT001	Purchase repetitive loss properties, especially those along Raccoon Creek, as funding becomes available. Acquired properties will be turned into open space.	+	+	+	+	-	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	N	+	+	20 (+) 2 (-) 1 (N)	22 (+) 4 (-) 2 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																					Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
	This initiative will complement the Township's other flood management programs, including enforcing the newly adopted and updated flood ordinance.																								
HT002	Mitigate slip-slide prone areas through hillside stabilization projects and stormwater retention sites. These areas are vulnerable to hazard events at all times but vulnerability may be worse during flood events.	+	+	+	-	-	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+	18 (+) 5 (-) 0 (N)	20 (+) 7 (-) 0 (N)
HT003	Provide stormwater controls in areas of the Township where they do not exist (i.e., areas of Township that do not have stormwater lines).	+	+	+	+	+	-	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	20 (+) 3 (-) 0 (N)	22 (+) 5 (-) 0 (N)
HT004	Maintain, update, and enhance Township wastewater separation program. The Township has actively been involved in meeting PADEP thresholds for wastewater separation for about 10-15 years. The priority goal is eliminating wastewater/stormwater from Raccoon Creek Water Pollution Control Plant, although the Township also implements other measures, including enforcing regulations and public education.	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	21 (+) 2 (-) 0 (N)	23 (+) 4 (-) 0 (N)
KB001	Secure alternate electrical supply (i.e., generator) for Borough.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	16 (+) 3 (-) 4 (N)	18 (+) 5 (-) 4 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental						L Legal			
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MB001	Install a stormwater conveyance system and/or maintain/rehabilitate existing drainage ways to address roadway flooding during rain events.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	N	+	+	+	+	+	16 (+) 5 (-) 2 (N)	18 (+) 7 (-) 2 (N)
MB002	Adopt Stormwater Management Ordinance	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	+	21 (+) 0 (-) 2 (N)	25 (+) 0 (-) 2 (N)
NB001	Stream Bed Debris Removal ~ Removal of objects and debris from Blockhouse Run that may increase flooding potential.	+	+	+	+	-	-	+	+	+	+	+	+	-	N	-	+	+	N	+	+	+	+	+	17 (+) 4 (-) 2 (N)	19 (+) 6 (-) 2 (N)
NB002	Retaining Wall Replacement / Elimination ~ Repair or replace existing stove retaining walls along hillsides in town or eliminate the walls and grade the land where appropriate.	+	+	+	+	-	-	+	+	+	+	+	+	-	N	-	+	N	N	+	+	+	+	+	16 (+) 3 (-) 5 (N)	18 (+) 5 (-) 5 (N)
NB003	Penn Avenue Hillside Stabilization ~ Construct structure to prevent debris and land movement onto the 800 block of Penn Avenue.	+	+	-	+	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	13 (+) 6 (-) 5 (N)	15 (+) 8 (-) 5 (N)
NB004	Pave Run Flood Wall ~ Construct flood wall / barrier along Rave Run to prevent flooding of Damascus Steel.	+	+	+	+	-	-	+	+	+	+	+	+	-	-	-	+	N	N	+	+	+	+	+	20 (+) 5 (-) 2 (N)	22 (+) 7 (-) 2 (N)
NB005	Sewer Interceptor Upgrade ~ Increase capacity of Allegheny Street and Pave Run sewer interceptors to prevent repetitive flooding of adjacent structures.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	19 (+) 4 (-) 0 (N)	21 (+) 6 (-) 0 (N)
NB006	Stream Bank Stabilization ~ Prevent continued washout of the Blockhouse	+	+	+	+	-	-	+	+	+	+	+	+	-	N	-	+	+	N	+	+	+	+	+	17 (+) 4 (-) 2 (N)	19 (+) 6 (-) 2 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental						L Legal			
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
	Run and Pave Run stream banks.																									
NB007	Joint Emergency Operations Center Generator ~ Provide the Daugherty Township Municipal Building with a standby generator for use as a joint EOC between New Brighton Borough, Pulaski Township, and Daugherty Township.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	15 (+) 4 (-) 4 (N)	17 (+) 6 (-) 4 (N)
NB008	Update Zoning and Land Development Ordinances	+	+	+	+	+	-	+	+	+	+	N	+	+	+	-	N	N	N	N	+	+	+	+	16 (+) 2 (-) 5 (N)	20 (+) 2 (-) 5 (N)
NB009	Installation of Warning Siren System	+	+	+	+	-	-	+	+	+	+	N	+	-	+	-	N	N	N	N	+	+	+	+	14 (+) 3 (-) 6 (N)	16 (+) 5 (-) 6 (N)
NB010	Demolition of High Risk Structures	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	20 (+) 5 (-) 0 (N)	22 (+) 5 (-) 0 (N)
NG001	Install an emergency notification siren to alert residents when hazardous conditions exist. This will also be used to alert the Fire Department.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	16 (+) 3 (-) 4 (N)	18 (+) 7 (-) 4 (N)
NG002	Install reserve power generator in VFC Community Hall (for sheltering).	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	16 (+) 3 (-) 4 (N)	18 (+) 7 (-) 4 (N)
NG003	Clean and widen Little Jordan Creek and construct berms to contain floodwaters.	+	+	+	-	-	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+	18 (+) 5 (-) 0 (N)	20 (+) 7 (-) 0 (N)
PT001	Mitigate potential landslide occurrences.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	N	+	+	+	+	+	16 (+) 5 (-) 2 (N)	18 (+) 7 (-) 2 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental						L Legal			
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
PT002	Identify and implement mine subsidence mitigation measures.	+	+	+	-	-	-	+	+	+	+	+	+	-	N	-	+	N	+	+	+	+	+	+	16 (+) 5 (-) 2 (N)	18 (+) 7 (-) 2 (N)
PT003	Mitigate the flooding and erosion problems at Bradys Run Creek.	+	+	+	+	-	+	+	+	+	+	+	+	-	N	-	+	+	+	+	+	+	+	+	19 (+) 3 (-) 1 (N)	21 (+) 5 (-) 1 (N)
RB001	Work with County and stakeholders to secure funding to install some type of above ground barrier and containment facilities to prevent/reduce hazardous material incidents on vulnerable roadways.	+	+	+	-	-	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+	18 (+) 5 (-) 0 (N)	20 (+) 7 (-) 0 (N)
RT001	Upgrade Grant Street sewer trunk and increase capacity for the larger flows.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	+	N	N	+	+	+	+	+	17 (+) 3 (-) 2 (N)	19 (+) 5 (-) 2 (N)
RT002	Install permanent or mobile generator for the municipal building.	+	+	+	+	-	+	+	+	+	+	+	+	-	+	-	N	N	N	N	+	+	+	+	16 (+) 3 (-) 4 (N)	18 (+) 7 (-) 4 (N)
SHB001	Route 51, Jordan Street, Emergency Route is a landslide-prone area and a route for evacuation. Shore up hillside to prevent landslides, and prune trees to prevent blocking of Route 51.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	N	+	+	+	+	+	16 (+) 5 (-) 2 (N)	18 (+) 7 (-) 2 (N)
SHB002	Route 51, Jordan Streets, and South Heights (State Route) area sewers need to be repaired to be able to take the runoff from the hillside through the main route in the Borough. There is a lot of flooding, and the sewers will not hold the runoff.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	+	+	+	+	+	+	17 (+) 5 (-) 1 (N)	19 (+) 7 (-) 1 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental					L Legal				
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
	There is no map of the sewer system; the Borough also needs a study and map of these sewers.																								
SHB003	Fourth Street Creek – This creek runs off of the hill at the Fourth Street extension, leading to floods. The Borough needs a bigger pipe put in to take the water to the river during heavy rains.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	N	+	+	+	+	+	16 (+) 5 (-) 2 (N)	18 (+) 7 (-) 2 (N)
SHB004	Crawford Street Creek – The Borough has repaired the sewers, but the runoff is still great. The sewers need to be made bigger and better (expanded capacity) to keep water flowing and to prevent flooding.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	+	+	+	+	+	+	17 (+) 5 (-) 1 (N)	19 (+) 7 (-) 1 (N)
SHB005	Railroad Street – The Creswell Heights Joint Authority has buildings in this area. If the dam were to break, this could possibly flood the area. There are also buildings near railroad tracks. The Borough needs to install a safety net in the area to protect the water supply for three areas.	+	+	+	-	-	-	+	+	+	+	+	+	-	+	-	+	N	+	+	+	+	+	+	17 (+) 5 (-) 1 (N)	19 (+) 7 (-) 1 (N)
SHB006	Two blighted properties are falling down and in danger of collapse. This has created a public hazard in the area of North Jordan Street and Hill Road in the Borough.	+	+	+	-	-	+	+	+	+	+	+	+	-	N	-	+	N	+	+	+	+	+	+	17 (+) 4 (-) 2 (N)	19 (+) 6 (-) 2 (N)

Mitigation Action		PA-STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less favorable (N) Not Applicable																						Results	
		P Political			A Admin-istrative			S Social		T Technical			E Economic				E Environmental						L Legal			
No.	Name	Political Support	Local Champion	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action (x3)	Cost of Action (x3)	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HazMat / Waste Site	Consistent with Community Environmental Goals	Consistent with Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	Summary (Equal Weighing)	Summary (Priority Ranking)
VT001	Conduct stormwater improvements at Division Lane.	+	+	+	+	-	-	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	19 (+) 4 (-) 0 (N)	21 (+) 6 (-) 0 (N)

Notes:
CAV = Community Assistance Visit
CDBG = Community Development Block Grant
CERT = Community Emergency Response Team
COG = Continuity of Government
COOP = Continuity of Operations
CRS = Community Rating System
DCED = Pennsylvania Department of Community and Economic Development
EAP = Emergency Action Plan
EOC = Emergency Operations Center
FEMA = Federal Emergency Management Agency
FIRM = Flood Insurance Rate Map
FPA = Floodplain Administrator
GIS = Geographic information system
HMA = Hazard Mitigation Assistance
HUD = U.S. Housing Urban Development
ISO = Insurance Services Office
MPC = Pennsylvania Municipalities Planning Code
MPO = Metropolitan Planning Organizations
NFIP = National Flood Insurance Program
NFPA = National Fire Protection Association
OES = Office of Emergency Services
PADEP = Pennsylvania Department of Environmental Protection
PDM = Pre-Disaster Mitigation Program
PEMA = Pennsylvania Emergency Management Agency
PEMARS = Pennsylvania Emergency Management Agency Radio System
SFHA = Special Flood Hazard Area
TBD = To Be Determined
VFC = Volunteer Fire Company

6.4.3 Prioritization of Mitigation Actions

Once the mitigation actions were evaluated, the Planning Team set about prioritizing them to create an implementation strategy. FEMA mitigation planning requirements indicate that any prioritization system used shall include a special emphasis on the extent to which benefits are maximized according to a cost-benefit review of the proposed projects. Though the PA-STEEL values for each action are somewhat qualitative, all of the actions listed as having an economic impact indicated that that impact would be beneficial to the community. Whether the actions had associated costs or not, those mitigation actions could not be ruled out based on the benefit or cost values in the PA-STEEL evaluation. Implementation of any project will be based on a benefit-cost analysis as described in FEMA 386-5: Using Benefit Cost Review in Mitigation Planning (FEMA 2007). The specific economic benefits and costs will be determined prior to application for funding of the mitigation project.

Participants in the 2016 HMP update process provided comments that allowed for the prioritization of the mitigation actions listed in Table 6-4 using the seven PA-STEEL criteria. To evaluate and prioritize the mitigation actions, the County identified *favorable* and *less favorable* factors for each action. Table 6-4 summarizes the evaluation methodology and provides the results of this evaluation for all 89 mitigation actions (37 County actions and 52 municipal actions) in two columns. The first results column includes a summary of the feasibility factors, placing equal weight on all factors. The second results column reflects feasibility scores with benefits and costs weighted more heavily; and therefore, given greater priority. A weighting factor of 3 was used for each benefit and cost element. Therefore, a "+" benefit factor rating equals three pluses, and a "-" benefit factor rating equals three minuses in the total prioritization score.

The results of the weighted PA-STEEL matrix were examined to prioritize the mitigation actions. The number of unfavorable ratings was subtracted from the number of favorable ratings to determine each action's score. The average score was 13, with a standard deviation of 4. Actions that received more than 17 points (one standard deviation above the average) were assigned high priority. Actions that received scores of 13 to 17, inclusive, were assigned medium priority. Other actions were assigned low priority.

The actions identified in Table 6-5 are listed in order of priority, with the high-priority actions first. This list of actions is the result of the planning effort led by the Planning Team and represents what the County and municipalities consider most important. Any actions, including projects, to be implemented will have benefits outweighing their associated costs (i.e., the benefit-cost ratio would be greater than 1).

Table 6-5. Prioritized Mitigation Actions

Mitigation Action	Score
High Priority	
MB002: Adopt stormwater management ordinance.	25
BBB001: Update stormwater ordinance.	24
BC001: Support the mitigation of vulnerable structures via retrofit (e.g. elevation, flood-proofing) or acquisition/relocation to protect them from future damage; repetitive loss and severe repetitive loss properties should be a priority, when applicable.	21
BC011: Upgrade the fire protection system to meet NFPA standards. Projects may include purchase of mobile booster pumps to increase pressure for fire protection.	19
HT004: Maintain, update, and enhance Township wastewater separation program. The Township has actively been involved in meeting PADEP thresholds for wastewater separation for about 10-15 years. The priority goal is eliminating wastewater/stormwater from Raccoon Creek Water Pollution Control Plant, although the Township also implements other measures, including enforcing regulations and public education.	19
HT001: Purchase repetitive loss properties, especially those along Raccoon Creek, as funding becomes available. Acquired properties will be turned into open space. This initiative will complement the Township's other flood management programs, including enforcing the newly adopted and updated flood ordinance.	18
BC003: Develop and implement an enhanced municipal training program, with specific focuses on the NFIP, CRS, flood mitigation projects, hazard mitigation, damage assessments, PEMA planning and project tools, FEMA eGrants program, and Marcellus Shale natural gas extraction. Information on trainings will be posted on the Emergency Services website.	18
BC007: Support participation in the NFIP CRS program by attending CRS workshop(s) if offered within the County. Join the CRS program if adequate resources to support long-term participation can be dedicated. See following related CAV initiative.	18
BC027: Hold annual meetings to ensure that mitigation, planning, preparedness, and response personnel are (1) cross-trained in each other's area of expertise, (2) aware of ongoing activities, and (3) fostering increased communication.	18
BC037: Follow up with any reported concerns on drinking water contamination, especially when associated with fracking and environmental hazards.	18
AC001: Implement flood control measures on Green Street, such as purchasing and removing structures.	18
AC002: Implement flood control measures on Baker Street, such as purchasing and removing structures.	18
AC003: Implement flood control measures on Franklin Avenue, such as purchasing and removing structures.	18
AC004: Implement flood control measures on Spring Street, such as purchasing and removing structures.	18
NB008: Update zoning and land development ordinances.	18
Medium Priority	
NB010: Demolish high-risk structures.	17
BC036: Where feasible, separate combined stormwater and sanitary sewer systems to reduce flooding and the negative impacts of overflows. For instance, 75% of Rochester Borough has combined sewers or no storm sewers at all, making this project highly needed.	17
GT001: Mitigate the existing pipe erosion at the stream crossing at Sharon Drive.	16
PT003: Mitigate the flooding and erosion problems at Bradys Run Creek.	16
NB004: Maintain compliance with and good-standing in the NFIP including adoption and enforcement of floodplain management requirements (e.g. regulating all new and substantially improved construction in special-hazard flood areas), floodplain identification and mapping, and flood insurance outreach to the community. Further meet and/or exceed the minimum NFIP standards and criteria through the following NFIP-related continued compliance actions identified in subsequent initiatives.	15
NB005: Promote or adopt higher regulatory and zoning standards to manage flood hazard risk; specifically through updates to the building codes, flood ordinances, and subdivision and land development ordinances. Goals of increased standards are to ensure new buildings and infrastructure are discouraged or prohibited in high-hazard areas in their jurisdiction.	15
EB001: Tear down the old fire department building which is built over a stream that empties into the Beaver River.	15
HT003: Provide stormwater controls in areas of the Township where they do not exist (i.e., areas of Township that do not have stormwater lines).	15

Mitigation Action	Score
DarlT002: Secure heavy equipment to assist in hazard preparedness and response efficiency.	15
VT001: Conduct stormwater improvements at Division Lane.	15
RT001: Upgrade Grant Street sewer trunk and increase capacity for the larger flows.	14
BC010: Work with County and power companies to identify roads within the Township/Borough considered "critical;" these would be the first priority for clearing after an event involving downed power lines.	14
BC032: Applicable municipalities will communicate with property owners or renters within the 100-year floodplain regarding potential flood hazards. Letters may include the following information: local flood hazard, flood safety, flood insurance information, property protection measures, natural and beneficial functions of the local floodplain, a map of the local flood hazard area, information about hazard notification systems, floodplain development permit requirements, and substantial improvement/damage requirements.	14
FB001: Dredge and clean banks of Brady's Run Creek. Install riprap to prevent additional erosion and flooding.	14
BB001: Investigate opportunities, such as the CRS program, to reduce NFIP needs and costs.	14
DarlT003: Conduct industrial park water system upgrades.	14
DarlT001: Secure an emergency generator for redundant power to the Township Municipal Building.	13
DT001: Secure and install a backup generator for municipal building.	13
BC019: Continue to use and improve GIS capability to identify and prioritize hazards and critical infrastructure for mitigation.	13
BC020: Identify insurable County and municipal-owned, flood-prone buildings and infrastructure, and take appropriate mitigation methods if located in a SFHA. Continually monitor and update, as necessary.	13
BC023: Municipalities will aggressively enforce building and safety codes for all buildings, including industrial uses.	13
BC033: Remove blight/abandoned buildings, especially in Ambridge Borough.	13
NB001: Stream Bed Debris Removal ~ Removal of objects and debris from Blockhouse Run that may increase flooding potential.	13
NB006: Stream Bank Stabilization ~ Prevent continued washout of the Blockhouse Run and Pave Run stream banks.	13
RB001: Work with County and stakeholders to secure funding to install some type of above ground barrier and containment facilities to prevent/reduce hazardous material incidents on vulnerable roadways.	13
NB002: Retaining Wall Replacement / Elimination ~ Repair or replace existing stove retaining walls along hillsides in town or eliminate the walls and grade the land where appropriate.	13
NG003: Clean and widen Little Jordan Creek and construct berms to contain floodwaters.	13
FreeB001: Remove streambed debris from 3rd Avenue to 8th Street, past the Borough Garage.	13
BT001: Mudlick Run, which runs parallel to Mudlick Hollow Road, is eroding the creek bank and causing damage to Mudlick Hollow Road, creating a potential hazard. Installation of gabion baskets or large riprap stone to protect the roadway is needed.	13
BT002: Two Mile Run Creek is creating significant erosion in the area of two bridges that cross the Creek within Two Mile Run Park. Bridge approaches need to be secured with gabion baskets or similar protection. Bridge footings are being eroded underneath the creek.	13
SHB006: Two blighted properties are falling down and in danger of collapse. This has created a public hazard in the area of North Jordan Street and Hill Road in the Borough.	13
HT002: Mitigate slip-slide prone areas through hillside stabilization projects and stormwater retention sites. These areas are vulnerable to hazard events at all times but vulnerability may be worse during flood events.	13
KB001: Secure alternate electrical supply (i.e., generator) for Borough.	13
Low Priority	
ER001: Update and promote information on the floodplain management ordinance to remain compliant with the NFIP.	12
BC012: Promote reverse notification systems in high-hazard areas.	12
BC021: Implement a building-hardening program for critical facilities and infrastructure to protect against terrorism.	12

Mitigation Action	Score
SHB002: Route 51, Jordan Streets, and South Heights (State Route) area sewers need to be repaired to be able to take the runoff from the hillside through the main route in the Borough. There is a lot of flooding, and the sewers will not hold the runoff. There is no map of the sewer system; the Borough also needs a study and map of these sewers.	12
SHB004: Crawford Street Creek – The Borough has repaired the sewers, but the runoff is still great. The sewers need to be made bigger and better (expanded capacity) to keep water flowing and to prevent flooding.	12
SHB005: Railroad Street – The Creswell Heights Joint Authority has buildings in this area. If the dam were to break, this could possibly flood the area. There are also buildings near railroad tracks. The Borough needs to install a safety net in the area to protect the water supply for three areas.	12
BC015: Improve the design, routing, and traffic control functions on high-risk roadways.	11
BC016: Implement debris-flow projects, including slope stabilization, energy dissipation, or vegetative plantings.	11
BC025: Planning Commission and applicable municipal offices will review their comprehensive plans to ensure that designated growth areas are not within high-hazard areas identified in this plan.	11
BC034: Support equipment needs for local public works departments to ensure readiness for sudden onset hazard events.	11
FB002: Add storm drains to Main Street to prevent flooding.	11
NB007: Joint Emergency Operations Center Generator ~ Provide the Daugherty Township Municipal Building with a standby generator for use as a joint EOC between New Brighton Borough, Pulaski Township, and Daugherty Township.	11
NB009: Installation of Warning Siren System	11
MB001: Install a stormwater conveyance system and/or maintain/rehabilitate existing drainage ways to address roadway flooding during rain events.	11
NG001: Install an emergency notification siren to alert residents when hazardous conditions exist. This will also be used to alert the Fire Department.	11
NG002: Install reserve power generator in VFC Community Hall (for sheltering).	11
SHB001: Route 51, Jordan Street, Emergency Route is a landslide-prone area and a route for evacuation. Shore up hillside to prevent landslides, and prune trees to prevent blocking of Route 51.	11
SHB003: Fourth Street Creek – This creek runs off of the hill at the Fourth Street extension, leading to floods. The Borough needs a bigger pipe put in to take the water to the river during heavy rains.	11
ER002: Monitor land subsidence and structural deficiencies to prepare and eliminate mine subsidence.	11
PT001: Mitigate potential landslide occurrences.	
PT002: Identify and implement mine subsidence mitigation measures.	
RT002: Install permanent or mobile generator for the municipal building.	11
BC022: Participate in emergency planning for applicable hazard and emergency response events. Specific types of planning relevant to the County and its municipalities include EAPs for dams, radiological emergency plans for nuclear incidents, winter preparedness plans, evacuation signage plans, Phase II Act 167 Stormwater Management Plan, and commodity flow studies. Additionally, other plans should be reviewed to ensure coordination with hazard mitigation planning techniques.	10
BC035: Support residents and local businesses in testing properties for radon exposure.	10
BC004: Maintain compliance with and good standing in the NFIP, including adoption and enforcement of floodplain management requirements (e.g., regulating all new and substantially improved construction in special-hazard flood areas), floodplain identification and mapping, and flood insurance outreach to the community. Further meet and/or exceed the minimum NFIP standards and criteria through the following NFIP-related continued compliance actions identified in subsequent initiatives.	9
BC013: Identify and monitor transportation routes of hazardous materials. Implement safety projects where applicable.	9
BC014: Work with County to implement transportation upgrades to roads with high flooding vulnerability. Projects could include culvert enhancement, culvert replacement, and road elevation.	9
BC024: Continue to map potential natural gas and petroleum transmission lines.	9
BC026: Encourage all critical government facilities to have COOP and COG plans and to begin implementing appropriate backup systems.	9

Mitigation Action	Score
BC005: Promote or adopt higher regulatory and zoning standards to manage flood hazard risk; specifically, through updates to the building codes, flood ordinances, and subdivision and land development ordinances. Goals of increased standards are to ensure new buildings and infrastructure are discouraged or prohibited in high-hazard areas in their jurisdiction.	8
BC006: The County will work with DCED, Beaver County Conservation District, other State agencies, and the municipalities to provide model zoning regulations for floodplain restrictions that comply with the PA MPC.	8
BC017: Implement stormwater management projects to facilitate stormwater flow during severe storms.	8
BC031: Establish all-hazard resource centers located in the County Courthouse, Chamber of Commerce, municipalities, local libraries, and senior centers. Centers will serve as repositories for information on local hazard identification, preparedness, and mitigation strategies for use by citizens, realtors, and lenders. Centers would display literature about the NFIP; FIRMs; books about mitigation for homeowners; and copies of "Are You Ready Guide," "Protecting Building Utilities from Flood Damage," and "Seeking Shelter from the Storm."	8
BC008: Assess and update emergency operations center equipment to improve communication. Targeted needs include repeaters to strengthen radio signals and installing PEMARS radio antennae, as well as generators/backup power in municipal buildings, police stations, and public works garages.	7
BC009: Install back-up power at critical facilities in the Township/Borough.	7
NB003: Penn Avenue Hillside Stabilization ~ Construct structure to prevent debris and land movement onto the 800 block of Penn Avenue.	7
BC002: Develop and implement an enhanced all-hazards, public outreach / education / mitigation information program on natural hazard risks, and outline the ways in which the program(s) can strengthen community mitigation and preparedness efforts.	6
BC018: Beaver County will work with municipalities to collect or update information on the number and location of all repetitive loss properties to plan future mitigation actions.	6
BC028: Reinstate the Beaver County CERT program to recruit and train interested citizens in Beaver County to assist first responders at specified emergencies throughout the County.	6
BC029: Investigate the possibility of a county burn building to assist the training of volunteer fire departments.	6
BC030: Develop and maintain a comprehensive list of relevant regional agencies, including Council of Governments, River Basin Commissions, and MPOs.	6

Notes:
CAV = Community Assistance Visit
CDBG = Community Development Block Grant
CERT = Community Emergency Response Team
COG = Continuity of Government
COOP = Continuity of Operations
CRS = Community Rating System
DCED = Pennsylvania Department of Community and Economic Development
EAP = Emergency Action Plan
EOC = Emergency Operations Center
FEMA = Federal Emergency Management Agency
FIRM = Flood Insurance Rate Map
FPA = Floodplain Administrator
GIS = Geographic information system
HMA = Hazard Mitigation Assistance
HUD = U.S. Housing Urban Development
ISO = Insurance Services Office
MPC = Pennsylvania Municipalities Planning Code
MPO = Metropolitan Planning Organizations
NFIP = National Flood Insurance Program
NFPA = National Fire Protection Association
OES = Office of Emergency Services
PADEP = Pennsylvania Department of Environmental Protection
PDM = Pre-Disaster Mitigation Program
PEMA = Pennsylvania Emergency Management Agency
PEMARS = Pennsylvania Emergency Management Agency Radio System
SFHA = Special Flood Hazard Area
TBD = To Be Determined
VFC = Volunteer Fire Company

Mitigation Action Worksheets were developed for each project included in the HMP. Action Worksheets were developed for County projects after a review of the total list of actions, while municipal actions were submitted via a Mitigation Action Worksheet. Where possible, the prioritization of municipal actions corresponds with the information and requested prioritization received from the community. The prioritization provided in the PA-STEEL table; however, is based off County ranking and may differ slightly from the municipal ranking. For instance, a municipality may have submitted a Mitigation Action Worksheet where the project was designated as high priority; however, the County (PA-STEEL) prioritization considers it a medium priority. The only impact any difference in prioritization will have on implementation is that these actions may require more

immediate attention by the sponsoring municipality due to competing County priorities and limited available timeframes, County staffing, and County funding.

A blank Mitigation Action Worksheet template is included in Appendix H. The set of completed action worksheets and a table summarizing the worksheets by jurisdiction are presented in Appendix I.

SECTION 7 PLAN MAINTENANCE PROCEDURES

This section describes the system that Beaver County and all participating jurisdictions have established to monitor, evaluate, and update the hazard mitigation plan (HMP) (Section 7.1); implement the mitigation plan through existing programs (Section 7.2); and solicit continued public involvement for plan maintenance (Section 7.3).

7.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

Beaver County Emergency Services intends to remain intact as the organization responsible for monitoring, evaluating, and updating this Plan. Jeffrey Bolland of Emergency Services shall continue to serve as the HMP Coordinator for the Planning Team. Each participating jurisdiction is expected to retain a municipal hazard mitigation representative to support the jurisdiction's input to the monitoring, evaluating, and updating responsibilities identified in this section.

Table 7-1 identifies the members of the Hazard Mitigation Planning Team as of the date of this Plan.

Table 7-1. Hazard Mitigation Planning Team

Name	Title	Department / Agency
Jeffrey Bolland	Hazard Mitigation Planning Team Coordinator (HMP Coordinator)	County Emergency Services
Wesley Hill	County Representative	Director, County Emergency Services
Eric Brewer	County Representative	Deputy Director, County Emergency Services
James McCarthy	County Representative	Geographic Information Services (GIS), County Office of Emergency Services
Dan Distler	County Representative	Beaver County Conservation District
Frank Mancini	County Representative	Director, Beaver County Planning Commission
Bill Evans	County Representative	Beaver County Planning Commission
Frank Vescio	County Representative	Beaver County Planning Commission
Mike Demcak	Municipal Representative	City of Aliquippa
Joe Kauer	Municipal Representative	Ambridge Borough
Timothy Firich	Municipal Representative	Baden Borough
Dan Martone	Municipal Representative	Beaver Borough
Derek Lang	Municipal Representative	City of Beaver Falls
Jesse Lazzaro (LSSE)	Municipal Representative	Big Beaver Borough
Charles D. Bates	Municipal Representative	Bridgewater Borough
Bryan K. Dehart	Municipal Representative	Brighton Township
Rachel DelTondo	Municipal Representative	Center Township
Mark Taylor	Municipal Representative	Chippewa Township
Diane McKay	Municipal Representative	Conway Borough

Name	Title	Department / Agency
M. Bevois Walton	Municipal Representative	Darlington Borough
Jeffrey Frye	Municipal Representative	Darlington Township
Travis M. Cavanaugh	Municipal Representative	Daugherty Township
Jim Cable	Municipal Representative	East Rochester Borough
William Heaton	Municipal Representative	Eastvale Borough
Randy Kunkle	Municipal Representative	Economy Borough
Lisa Peacock	Municipal Representative	Fallston Borough
Dale Bonner	Municipal Representative	Frankfort Springs Borough
Shannon Schlosser	Municipal Representative	Franklin Township
Mark Forrest	Municipal Representative	Freedom Borough
Jerry Torrance	Municipal Representative	Georgetown Borough
TBD	Municipal Representative	Glasgow Borough
Jerry Torrance	Municipal Representative	Greene Township
Sharon L. Vinci	Municipal Representative	Hanover Township
Janet Miklos	Municipal Representative	Harmony Township
TBD	Municipal Representative	Homewood Borough
Jerry Torrance	Municipal Representative	Hookstown Borough
John Bates	Municipal Representative	Hopewell Township
Mark New and Debra Shaffer	Municipal Representative	Independence Township
Chuck Ward	Municipal Representative	Industry Borough
Andy Randza	Municipal Representative	Koppel Borough
Marilyn Zona	Municipal Representative	Marion Township
Amber Mineard	Municipal Representative	Midland Borough
Jeff McKay	Municipal Representative	Monaca Borough
Tom Albanese	Municipal Representative	New Brighton Borough
Don Cripe	Municipal Representative	New Galilee Borough
Walter C. Beighey, Jr., Eric Brewer	Municipal Representative	New Sewickley Township
Andy Randza	Municipal Representative	North Sewickley Township
TBD	Municipal Representative	Ohioville Borough
Bill Starn, Susan Pokego	Municipal Representative	Patterson Heights Borough
WR Livingston	Municipal Representative	Patterson Township
Linda McCoy	Municipal Representative	Potter Township
Doug Margetic	Municipal Representative	Pulaski Township
TBD	Municipal Representative	Raccoon Township

Name	Title	Department / Agency
Wesley Hill	Municipal Representative	Rochester Borough
Charles Etta	Municipal Representative	Rochester Borough
Norm Ely	Municipal Representative	Rochester Township
Laura Korcan	Municipal Representative	Shippingport Borough
Ashley Carr	Municipal Representative	South Beaver Township
Roberta Jones	Municipal Representative	South Heights Borough
Maureen Bostwick	Municipal Representative	Vanport Township
William Heaton	Municipal Representative	West Mayfield Borough
Ray Evans, Jr.	Municipal Representative	White Township

Notes:
LSSE Lennon, Smith, Souleret Engineering, Inc.
TBD To be determined

Understanding that individual commitments change over time, each jurisdiction and its representatives are responsible for informing the Beaver County HMP Coordinator of any changes in representation by formal letter. The HMP Coordinator will strive to keep the Planning Team makeup as a uniform representation of planning partners and stakeholders within the planning area. The HMP Coordinator shall maintain the current membership of the Planning Team on the Beaver County Emergency Services hazard mitigation website (http://www.beavercountypa.gov/emergency-services/emergency-services-hazard-mitigation) or in publicly accessible County records.

The following sections describe the monitoring, evaluating, and updating process and protocols for the Beaver County HMP.

7.1.1 Monitoring

The Planning Team shall be responsible for (1) monitoring progress on, and evaluating the effectiveness of, the HMP, and (2) documenting this progress in a progress report. Prior to Planning Team progress meetings (detailed below), Planning Team representatives may collect information from departments, agencies, and organizations involved with the mitigation activities identified in Section 6 of this Plan. The representatives will make phone calls and conduct meetings with persons responsible for initiating and/or overseeing the mitigation projects to obtain progress information. Copies of any grant applications filed on behalf of any of the participating jurisdictions shall be provided to the Planning Team. Further, the representatives shall obtain any public comments made on the Plan from their municipal supervisor, mayor, or councilperson, and provide public comments to the Planning Team for inclusion in the progress report.

The Planning Team representatives shall be expected to document the following, as needed and as appropriate:

- Hazard events and losses occurring in their jurisdiction including their nature and extent, and the effects that hazard mitigation actions have had on impacts and losses
- Progress on the implementation of mitigation actions, including efforts to obtain outside funding for mitigation actions
- Any obstacles or impediments to the implementation of actions
- Additional mitigation actions believed to be appropriate and feasible
- Public and stakeholder input and comment on the Plan

Local Planning Team representatives may use the progress reporting forms, Worksheets #1 and #3 in the Federal Emergency Management Agency (FEMA) 386-4 guidance document, to facilitate collection of progress data and information on specific mitigation actions.

7.1.2 Evaluating

The evaluation of the HMP is an assessment of whether the planning process and actions have been effective, whether the Plan's goals are being reached, and whether changes are needed. The plan will be evaluated on an annual basis to determine the effectiveness of the programs, and to reflect changes that may affect mitigation priorities or available funding.

The status of the HMP will be discussed and documented at a plan review meeting of the Hazard Mitigation Planning Team. At least 1 month before the progress plan review meeting, the Beaver County HMP Coordinator will advise Planning Team members of the meeting date, agenda, and expectations of the members. The Beaver County HMP Coordinator may also distribute additional flood mitigation survey and mitigation project opportunity forms for jurisdictions that may have new information and for jurisdictions that did not participate in the update process.

The Beaver County HMP Coordinator will be responsible for calling and coordinating the progress plan review meeting, and assessing progress toward achieving plan goals and objectives. These evaluations will assess whether:

- Goals and objectives address current and expected conditions
- The nature or magnitude of the risks has changed
- The HMP has been implemented into land use processes on the County and municipal levels
- Current resources are appropriate for implementing the HMP and if different or additional resources are now available
- Actions are cost effective
- Schedules and budgets are feasible
- Implementation problems exist—such as technical, political, legal, or coordination issues with other agencies
- Outcomes have occurred as expected
- Changes in County or municipal resources have impacted plan implementation (for example, funding, personnel, and equipment)
- New agencies, departments, or staff should be incorporated, including other local governments as defined under Title 44 of the Code of Federal Regulations (CFR), Section 201.6
- Documentation has been completed for any hazards that occurred during the last year

Specifically, the Planning Team will review the mitigation goals, objectives, activities, and projects using performance-based indicators, including:

- New agencies/departments created that have authority to implement mitigation actions or are required to meet goals, objectives, and actions
- Project evaluation based on current needs of the mitigation plan
- Project completion regarding progress of proposed or ongoing actions
- Under/over spending regarding proposed mitigation action budgets
- Achievement of the goals and objectives
- Resource allocation to note if resources are required to implement mitigation activities
- Timeframe comments on whether proposed schedules are sufficient to address actions

- Budget notes (in other words, if budget basis should be changed or is sufficient)
- Lead/support agency commitment notes (if there is a lack of commitment on the part of lead or support agencies)
- Resource comments regarding whether resources are available to implement actions
- Feasibility comments regarding whether certain goals, objectives, or actions prove to be unfeasible

Finally, the Planning Team will evaluate the ways other programs and policies have conflicted or augmented planned or implemented measures, and shall identify policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions (described further under the "Implementation of Mitigation Plan through Existing Programs" subsection presented below in Section 7.2). Other programs and policies can include those that address:

- Economic development
- Environmental preservation and permitting
- Historic preservation
- Redevelopment
- Health and/or safety
- Recreation
- Land use/zoning
- Public education and outreach
- Transportation

The Planning Team may refer to the evaluation forms, Worksheets #2 and #4 in the FEMA 386-4 guidance document to assist in the evaluation process.

The Beaver County HMP Coordinator shall be responsible for preparing an HMP Progress Report, which will be based on the provided local progress reports from each jurisdiction, information presented at the Planning Team meeting, and other information as appropriate and relevant. These reports will provide data for the 5-year update of this HMP and will assist in pinpointing implementation challenges. By monitoring the implementation of the Plan, the Planning Team will be able to assess which projects are completed, which projects are no longer feasible, and which projects may require additional funding.

This progress report shall apply to all planning partners who have provided input, and as such, shall be developed according to an agreed-upon format and with adequate allowance for input and comment of each planning partner prior to completion and submission to the State Hazard Mitigation Officer. Each planning partner will be responsible for providing this report to its governing body for their review.

During the Planning Team meeting, the planning partners shall establish a schedule for the draft development, review, comment, amendment, and submission of the HMP progress report to the State Hazard Mitigation Officer.

The Plan will also be evaluated and revised following any major disasters to determine whether the recommended actions remain relevant and appropriate. The risk assessment will also be revisited to see if any changes are necessary based on the pattern of disaster damages or if data listed in the Section 4.3 (Hazard Profiles) of this Plan have been collected to facilitate the risk assessment. These revisions are opportunities to increase the community's disaster resistance and build a better and stronger community.

7.1.3 Updating

Section 44 CFR 201.6.d.3 requires that local hazard mitigation plans be reviewed, revised as appropriate, and resubmitted for approval in order to remain eligible for benefits awarded under the Disaster Mitigation Act of 2000 (DMA 2000). The Beaver County Hazard Mitigation Planning Team has updated this Plan on a 5-year cycle from the date of initial plan adoption. This update to the Plan shows changes since the 2011 version, and the next update to the Plan will occur in 2021.

To facilitate the update process, the Beaver County HMP Coordinator—with support from the Planning Team—shall hold a meeting 3 years from the date of plan approval in 2016 to develop and commence with the implementation of a detailed plan update program. The Beaver County HMP Coordinator shall invite representatives from the Pennsylvania Emergency Management Agency (PEMA) to this meeting to provide guidance on plan update procedures. This program shall, at a minimum, establish the parties responsible for managing and completing the Plan update effort, features needed to be included in the updated plan, and a detailed timeline with milestones to ensure that the update is completed according to regulatory requirements.

At this meeting, the Planning Team shall determine the resources needed to complete the update. The Beaver County HMP Coordinator shall be responsible for ensuring that needed resources are secured.

Following each 5-year update of the mitigation plan, the updated plan will be distributed for public comment. After all comments are addressed, the HMP will be revised and distributed to all Planning Team members, special-purpose district participants, and the Pennsylvania State Hazard Mitigation Officer. During this update process, the Planning Team will invite jurisdictions that were nonparticipating during the last update or not as involved in the planning process, as well as additional relevant stakeholders and outside agencies, to join the Planning Team to ensure as comprehensive inclusion as possible.

7.2 IMPLEMENTATION OF MITIGATION PLAN THROUGH EXISTING PROGRAMS

The intention of the Planning Team and participating jurisdictions is to incorporate mitigation planning as an integral component of daily government operations. Planning Team members will work with local government officials to integrate the newly adopted hazard mitigation goals and actions into the general operations of government and partner organizations. Further, the sample adoption resolution (located in Section 8) includes a resolution item stating the intent of the local governing body to incorporate mitigation planning as an integral component of government and partner operations. By doing so, the Planning Team anticipates the following:

1) Hazard mitigation planning will be formally recognized as an integral part of overall emergency management efforts.
2) Hazard mitigation planning will be formally recognized as an integral part of land use policies and mechanisms.
3) The HMP, the Comprehensive Plans for Beaver County and its municipalities, and County and municipal Emergency Operations Plans (EOP) will become mutually supportive documents that work in concert to meet the goals and needs of County residents.
4) Duplication of effort can be minimized.

7.2.1 Integration of Mitigation into Ongoing and Future Planning Mechanisms

As noted in Section 6, Beaver County has made a concerted effort to reduce their vulnerability to natural and non-natural hazards in its planning and in its daily operations since the Beaver County HMP was last updated in 2011. The County and its jurisdictions have implemented various programs and projects to reduce the impacts of hazards, including property acquisition and the stormwater rehabilitation project. These projects, programs, and regulations have reduced risk caused by natural and non-natural hazards and support the goals and objectives of this Plan. It is the intent of the County and its participating municipalities to strengthen this

focus on mitigation by continuing existing policies, and by further implementing the mitigation policies contained in this Plan. Implementation actions will include incorporating the goals of the Plan into ongoing planning, zoning, building, and engineering activities. Specifically, the County will urge municipalities to take the following actions:

- Fund hazard mitigation projects or actions in operating budgets to the extent possible
- Notify other municipalities about grant and other funding opportunities as they arise
- Evaluate whether all construction projects meet hazard mitigation goals and objectives
- Use data and maps from this Plan as supporting documentation in grant applications
- Ensure local planning board or economic development groups identify hazard areas when assisting new businesses in finding a location
- Look at mitigation actions when allocating funding for the municipal budgets
- Incorporate hazard mitigation actions in daily operations and on all projects
- Include hazard mitigation when updating municipal ordinances
- Identify hazard areas in updates of comprehensive plans to identify land use issues
- Review the hazard mitigation plan prior to land use or zoning changes, and permitting or development decisions

The information on hazard, risk, vulnerability, and mitigation contained in this Plan is based on the best science and technology available at the time of the Plan's preparation. Additionally, certain plans, including the Act 167 Plan, were incorporated directly into this HMP. All participating jurisdictions recognize that this information can be invaluable in making decisions under other planning programs, such as comprehensive, capital improvement, and emergency management plans. Existing processes and programs through which the mitigation plan should be implemented are described below.

The plan participants will make every effort to implement the relevant sections and or data contained in the HMP utilizing administrative, budgetary, and regulatory processes as well as partnerships to the maximum extent, as described below.

Administrative

Administrative processes include departmental or organizational work plans, policies, or procedural changes, which could be addressed by the following departments:

- Public Works
- Planning Commission
- Emergency Services
- Behavioral Health and Developmental Service
- Children and Youth Services
- Office on Aging
- Waste Management

Additional administrative measures may include the creation of paid or unpaid internships to assist in HMP maintenance. Lastly, a reference to the HMP will be included in the risk reduction section of the Beaver County EOP and in municipal EOPs. Any updated Beaver County Comprehensive Plan will reference the HMP. In return, the County Comprehensive Plan (located on the Beaver County Planning Commission's website) was incorporated into multiple aspects of this HMP. Information from the Comprehensive Plan and other documents was used to formulate the County profile, identify the history of individual hazards, and detail the population projections in Beaver County.

Budgetary

In terms of budgetary processes, the County will review capital budgets and, if funding is available, include a line item for mitigation actions. In addition, the County will maximize mitigation aspects of proposed projects, and will encourage municipalities to do likewise.

Regulatory

Regulatory measures—such as the creation of executive orders, ordinances, and other directives—will be considered to support hazard mitigation in the following areas:

- Comprehensive Planning - Institutionalize hazard mitigation for new construction and land use
- Zoning and Ordinances
- Building Codes - Enforcement of codes or higher standard in hazard areas
- Capital Improvements Plan - Ensure that the person responsible for projects under this Plan evaluates whether new construction is in a high-hazard area, flood plain, etc., so the construction is designed to mitigate the risk. Revise requirements for this Plan to include hazard mitigation in the design of new construction.
- National Flood Insurance Program (NFIP) – Continue participation in this program and explore participation in Community Rating System (CRS) Program
- Continue to implement storm water management plans.
- Prior to formal changes (amendments) to master plans, zoning, ordinances, capital improvement plans, or other mechanisms that control development, all above-mentioned plans must be reviewed to ensure they are consistent with the hazard mitigation plan

Funding

The County and its jurisdictions will consider multiple grant sources to fund eligible projects. These opportunities may include, but are not limited to:

- Federal
    - Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation Program (PDM)
    - FEMA Flood Mitigation Assistance Program (FMA)
    - FEMA Hazard Mitigation Grant Program (HMGP-Stafford Act, Section 404)
    - U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG)
    - U.S. Department of Agriculture (USDA) -- USDA Community Facilities
    - Appalachian Regional Commission
    - U.S. Economic Development Administration (EDA) Public Works Program
- State
    - Pennsylvania Department of Transportation (PennDOT) Pennsylvania Infrastructure Bank
    - Act 13 Marcellus Shale Legacy Funds -- Flood Mitigation Program
- Nonprofit organizations, foundations, and private sources

Other potential federal funding sources include:

- Stafford Act, Section 406 – Public Assistance Program Mitigation Grants
- Federal Highway Administration
- Catalog of Federal Domestic Assistance
- U.S. Fire Administration – Assistance to Firefighter Grants
- U.S. Small Business Administration Pre and Post-Disaster Mitigation Loans
- U.S. Department of Economic Development Administration Grants
- U.S. Army Corps of Engineers
- U.S. Department of Interior, Bureau of Land Management
- Other sources as yet to be defined

Partnerships

The following opportunities for partnerships will be encouraged to provide a broader support and understanding of hazard mitigation:

- Existing Local Government Committees and Councils
  - Beaver County Local Emergency Planning Team (http://www.beavercountypa.gov/emergency-services/emergency-services-beaver-county-local-emergency-planning-committee)
  - Housing Authority of the County of Beaver (http://www.beavercountyhousing.org/)
  - Beaver County Conservation District (http://beavercountyconservationdistrict.org/)
- Creative Partnership Opportunities for Funding and Incentives
  - Public-Private Partnerships including utilities and businesses
  - State cooperation
  - In-kind resources
- Partnership Opportunities with other Federal, State, and Local Agencies
  - American Red Cross (ARC)
  - U.S. Army Corps of Engineers (USACE)
  - Department of Homeland Security (DHS)
  - Federal Emergency Management Agency (FEMA)
  - National Oceanic and Atmosphere Administration (NOAA)
  - National Weather Service (NWS)
  - Pennsylvania Department of Transportation (PennDOT)
  - Pennsylvania Department of Environmental Protection (PA DEP)
  - Pennsylvania State Police (PSP)
  - United States Department of Agriculture (USDA)
  - United States Department of Transportation (USDOT)
  - United States Geological Service (USGS)
  - Watershed Associations

During the Plan evaluation process, the Planning Team will identify additional policies, programs, practices, and procedures that could be modified to accommodate hazard mitigation actions, and will include these findings and recommendations in the HMP Progress Report.

7.3 CONTINUED PUBLIC INVOLVEMENT

Beaver County and participating jurisdictions are committed to the continued involvement of the public in the hazard mitigation process. Therefore, the Plan will be posted on the Beaver County Emergency Services website (http://www.beavercountypa.gov/emergency-services/emergency-services-hazard-mitigation), and copies of the Plan will be made available for review during normal business hours at the Beaver County Emergency Services main office. Beaver County will make electronic copies of the Plan available for local municipalies for public access.

The Beaver County HMP Coordinator will be responsible for receiving, tracking, and filing public comments regarding this HMP. The public will have an opportunity to comment on the Plan at the 3-year review meeting for the HMP and during the 5-year plan update. Beaver County will maintain an active link on the Emergency Services website to collect public comments.

The Beaver County HMP Coordinator is responsible for coordinating the Plan evaluation portion of the meeting, soliciting feedback, collecting and reviewing the comments, and ensuring their incorporation in the 5-year plan update, as appropriate. Additional meetings may also be held as deemed necessary by the Planning Team. The purpose of these meetings would be to provide an opportunity for the public to express concerns, opinions, and ideas about the mitigation plan.

The Planning Team representatives shall be responsible to ensure that:

- Public comment and input on the Plan, and hazard mitigation in general, are recorded and addressed, as appropriate. An opportunity to comment on the Plan will be provided directly on the project website, and provisions for public comment, in writing, will also be made. All public comments shall be addressed to:

  Hazard Mitigation Planning Team

  c/o Beaver County Emergency Services

  351 14th Street

  Ambridge, PA 15003

- Copies of the latest approved plan are available for review at the municipal buildings along with instructions to facilitate public input and comment on the Plan.
- Appropriate links to the Beaver County HMP website (http://www.beavercountyhmp.com) will be maintained. The website will be monitored throughout the course of the HMP update, and a draft copy of the Plan will be posted for public comment. Upon conclusion of the update, appropriate notifications and links to the County HMP will be maintained on the County Emergency Services website (http://www.beavercountypa.gov/emergency-services/emergency-services-hazard-mitigation).
- Public notices will be made, as appropriate, to inform the public of the availability of the Plan, particularly during plan update cycles.

The Beaver County HMP Coordinator shall ensure that:

- Public comment and input on the Plan (and hazard mitigation in general) are recorded and addressed, as appropriate
- The Beaver County Emergency Services website is maintained and updated, as appropriate
- All public and stakeholder comments received are documented and maintained
- Copies of the latest approved Plan are available for review at the County Emergency Services office, along with instructions to facilitate public input and comment on the Plan
- Public notices (including media releases) are made, as appropriate, to inform the public of the availability of the Plan, particularly during plan update cycles

SECTION 8 PLAN ADOPTION

By adopting the Beaver County Hazard Mitigation Plan (HMP), local governing bodies demonstrate their commitment to fulfill the mitigation goals and objectives outlined in the Plan. Adoption of the Plan by Beaver County and each participating jurisdiction legitimizes the Plan and authorizes responsible agencies to execute their responsibilities.

Each participating jurisdiction will continue with formal adoption proceedings upon conditional approval of this Plan from the Federal Emergency Management Agency (FEMA), known as Approval Pending Adoption (APA). Each participating jurisdiction understands that conditional approval of the Plan will be provided for those municipalities that meet the planning requirements with the exception of the adoption requirement, as stated above.

Following adoption or formal action on the Plan, each participating jurisdiction must submit a copy of the resolution or other legal instrument showing formal adoption (acceptance) of the Plan to the Beaver County Hazard Mitigation Coordinator. Beaver County will forward the executed resolutions to the Pennsylvania Emergency Management Agency (PEMA), who will subsequently forward the resolutions to FEMA. Each participating jurisdiction understands that FEMA will transmit acknowledgement of verification of formal Plan adoption and the official approval of the Plan to the Hazard Mitigation Coordinator. Resolutions reflecting the formal adoption of this HMP by the County and participating jurisdictions are included in Appendix F of this HMP. A sample resolution to be used by the County and its jurisdictions is provided on the following pages in Section 8.

Beaver County Hazard Mitigation Plan

County Adoption Resolution

Resolution No. _____

Beaver County, Pennsylvania

WHEREAS, the municipalities of Beaver County, Pennsylvania, are most vulnerable to natural and human-made hazards, which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, Beaver County acknowledges the requirement of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the Beaver County Hazard Mitigation Plan has been developed by Beaver County Emergency Services in cooperation with other County departments, local municipal officials, and the citizens of Beaver County, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the Beaver County Hazard Mitigation Plan, and

WHEREAS, the Beaver County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for the County of Beaver that:

- The 2016 Beaver County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the County, and
- The respective officials and agencies identified in the implementation strategy of the 2016 Beaver County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this _____ day of _____, 2016

ATTEST:

_____

BEAVER COUNTY COMMISSIONERS

By _____

By _____

By _____

Beaver County Hazard Mitigation Plan

Municipal Adoption Resolution

Resolution No. _____

< *Municipality Name*>, Beaver County, Pennsylvania

WHEREAS, the <*Municipality Name*>, Beaver County, Pennsylvania, is most vulnerable to natural and human-made hazards, which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, the <*Municipality Name*> acknowledges the requirement of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the Beaver County Hazard Mitigation Plan has been developed by Beaver County Emergency Services in cooperation with other County departments, and officials and citizens of <*Municipality Name*>, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the Beaver County Hazard Mitigation Plan, and

WHEREAS, the Beaver County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for the <*Municipality Name*>:

- The 2016 Beaver County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the <*Municipality Name*>, and
- The respective officials and agencies identified in the implementation strategy of the 2016 Beaver County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this _____ day of _____, 2016

ATTEST:

_____

< *MUNICIPALITY NAME*> REPRESENTATIVES

By _____

By _____

By _____

ACRONYMS AND ABBREVIATIONS

This resource identifies acronyms and abbreviations used in or supporting the hazard mitigation plan. These are based on documents included in the reference section, with modifications as appropriate to address the Beaver County-specific identifications and requirements.

%	Percent
%g	Percent acceleration force of gravity
°F	Degrees Fahrenheit
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
APA	Approval Pending Adoption
APPA	American Public Power Association
ARC	American Red Cross
BCTA	Beaver County Transportation Authority
BFE	Base flood elevation
BOCA	Building Officials Code Administration
BPRR	Buffalo and Pittsburgh Railroad
BRFPW	Pennsylvania Bureau of Rail Freight, Ports, and Waterways
BVPS	Beaver Valley Power Station
B-Scale	Beaufort Wind Scales
CDBG	Community Development Block Grant
CDC	Centers for Disease Control and Prevention
CERT	Community Emergency Response Team
cfs	Cubic feet per second
CFR	*Code of Federal Regulations*
COG	Continuity of government
COOP	Continuity of operations
CPC	Climate Prediction Center
CPR	Cardiopulmonary Resuscitation
CRREL	Cold Regions Research and Engineering Laboratory
CRS	Community Rating System
CSB	Chemical Safety Board
CSXT	CSX Transportation
DART	Demand and Response Transit
DCED	Pennsylvania Department of Community and Economic Development

DCNR	Pennsylvania Department of Conservation and Natural Resources
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
DHS	U.S. Department of Homeland Security
DI	Damage Indicators
DMA 2000	Disaster Mitigation Act of 2000
DOD	Degrees of Damage
DOE	U.S. Department of Energy
DOF	Dependent on funding
DOT	U.S. Department of Transportation
DR	Disaster Declarations
EAL	Emergency Action Levels
EAP	Education and Awareness Program
EAP	Emergency action plan
EDA	U.S. Economic Development Administration
EF Scale	Enhanced Fujita Scale
EM	Emergency management
EMA	Emergency Management Agency
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency operations plan
EPA	U.S. Environmental Protection Agency
EPCAMR	Eastern Pennsylvania Coalition for Abandoned Mine Reclamation
EPCRA	Emergency Planning and Community Right to Know Act
EPZ	Emergency planning zone
ESF	Emergency Support Function
FAA	Federal Aviation Administration
FARS	Fatality Analysis Reporting System
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIA	Flood Insurance Administration
FIRM	Flood Insurance Rate Map
FirstEnergy	FirstEnergy Nuclear Operating Company
FIS	Flood Insurance Study
Flu	Influenza
FMA	Flood Mitigation Assistance

F-Scale	Fujita Scale
g	Gravity
GBS	General building stock
GIS	Geographic Information System
GTRP	Greenways, Trails, and Recreation Program
HazMat	Hazardous materials
HAZUS	Hazards U.S.
HAZUS-MH	Hazards U.S. – Multi-Hazard
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating, ventilation, and air conditioning
IA	Individual Assistance
I-	Interstate
ILI	Influenza-like illnesses
ISO	Insurance Services Office, Inc.
K	Thousand ($)
Km	Kilometer
Kts	Knots
LCSN	Lamont-Doherty Cooperative Seismographic Network
LEMC	Local Emergency Management Coordinator
LEPC	Local Emergency Planning Committee
LPR	Local Plans and Regulations
LSSE	Lennon, Smith, Souleret Engineering, Inc.
M	Million ($)
MESO	Multi-Community Environmental Storm Observatory
mi	Mile
MMI	Modified Mercalli Intensity
mph	Miles per hour
MPO	Metropolitan Planning Organization
MRP	Mean return period
mw	Megawatts
N/A	Not applicable
NA	Not available
NASA	National Aeronautics and Space Administration

NCDC	National Climatic Data Center
NDMC	National Drought Mitigation Center
NDSP	National Dam Safety Program
NEHRP	National Earthquake Hazard Reduction Program
NEPA	National Environmental Policy Act
NESEC	Northeast States Emergency Consortium
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NGO	Nongovernmental organization
NHTSA	National Highway Traffic Safety Administration
NID	National Inventory of Dams
NIH	National Institute of Health
NIMS	National Incident Management System
NJOEM	New Jersey Office of Emergency Management
NLCD	National Land Cover Data
NLD	National Levee Database
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NRF	National Response Framework
NRCC	Northeast Regional Climate Center
NRCS	Natural Resource Conservation Service
NS	Norfolk-Southern Corporation
NSP	Natural Systems Protection
NSSL	National Severe Storms Library
NTAS	National Terrorism Advisory System
NTSB	National Transit Safety Board
NVRC	Northern Virginia Regional Commission
NWI	National Wind Institute
NWR	NOAA Weather Radio All Hazards
NWS	National Weather Service
NWSCOOP	NWS Cooperative Network
NYCOEM	New York City Office of Emergency Management
NYCEM	New York City Area Consortium for Earthquake Loss Mitigation
NYSDPC	New York State Disaster Preparedness Commission
ONJSC	Office of the New Jersey State Climatologist

PA	Pennsylvania
PA DCED	Pennsylvania Department of Community and Economic Development
PA DCNR	Pennsylvania Department of Conservation and Natural Resources
PA HMP	Pennsylvania 2013 Standard All-Hazard Mitigation Plan
PA-	Pennsylvania State Route ##
PA-STEEL	Political, Administrative, Social, Technical, Economic, Environmental, and Legal (Prioritization Method)
PAAC	Port Authority of Allegheny County
PADEP	Pennsylvania Department of Environmental Protection
PAG	Protective Action Guide
PaGWIS	Pennsylvania Groundwater Information System
PaSTAR	Pennsylvania Statewide Telecommunication Alerting and Reporting [Network]
pCi/L	picoCuries per liter
PDM	Pre-disaster Mitigation Program
PDSI	Palmer Drought Severity Index
PEIRS	Pennsylvania Emergency Incident Reporting System
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PGA	Peak ground acceleration
PHGA	Peak horizontal ground acceleration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIO	Public Information Officer
Planning Team	Beaver County Hazard Mitigation Planning Team
ppm	Parts per million
PRA	Probabilistic risk assessment
PSAP	Public Safety Answering Point
PSP	Pennsylvania State Police
PSU	Pennsylvania State University/Penn State University
RACES	Radio Amateur Civil Emergency Services
RCV	Replacement cost value
Region 13	Pennsylvania Region 13 Task Force
RF	Risk factor
RFC	Repetitive flood claims
RLP	Repetitive loss property
RS	RS Means Company, Inc.

RSI	Regional Snowfall Index
S-waves	Shear waves
SA	Spectral Association
SARA	Superfund Amendments and Reauthorization Act
SBA	Small Business Administration
SEPTA	Southeastern Pennsylvania Transportation Authority
SEVAN	Satellite Emergency Voice Alerting Network
SF	Summary file
SFHA	Special Flood Hazard Area
SHELDUS	Spatial Hazard Events and Loss Database for the U.S.
SHSP	State Homeland Security Program
SIP	Structure and Infrastructure Project
SOG	Pennsylvania All-Hazard Mitigation Planning Standard Operating Guide
SPC	Storm Prediction Center
SPI	Standardized Precipitation Index
Sq. Mi.	Square mile
SRL	Severe repetitive loss
TBD	To be determined
TDD	Telecommunications device for the deaf
TEIF	Total exposure in the floodplain
Tetra Tech	Tetra Tech, Inc.
TOD	Transit-oriented development
TRI	Toxic Release Inventory
US-	U.S. Route ##
USACE	U.S. Army Corps of Engineers
USC	*U.S. Code*
USD	U.S. dollar
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USGS	U.S. Geological Survey
VIP	Very important person
WISE	Wind science and engineering
WHO	World Health Organization
WMD	Weapons of mass destruction
WRPP	Watershed Restoration and Protection Program
WUI	Wildland urban interface