Bradford County 2020 Hazard Mitigation Plan

Bradford County Department of Public Safety

MCM Consulting Group, Inc.
Solutions for an unsafe world.

Certification of Annual Review Meetings

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED? *	SIGNATURE
2021			
2022			
2023			
2024			
2025			

**Confirm yes here annually and describe on record of change 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)

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

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1. Introduction

1.1. Background

The Bradford County Board of Commissioners, in response to the Disaster Mitigation Act of 2000 (DMA 2000), organized a countywide hazard mitigation planning effort to prepare, adopt and implement a multi-jurisdictional Hazard Mitigation Plan (HMP) for Bradford County and all its 51 municipalities. The Bradford County Department of Public Safety was charged by the County Board of Commissioners to prepare the 2020 plan. The 2015 HMP has been utilized and maintained during the 5-year life cycle.

The Bradford County Commissioners were successful in securing hazard mitigation grant funding to update the county hazard mitigation plan. The pre-disaster mitigation grant funding was administered by the Pennsylvania Emergency Management Agency and provided to Bradford County as a sub-grantee. The Bradford County Commissioners assigned the Bradford County Department of Public Safety with the primary responsibility to update the hazard mitigation plan. MCM Consulting Group, Inc. was selected to complete the update of the HMP. A local hazard mitigation planning team was developed comprised of government leaders and citizens from Bradford County. This updated HMP will provide another solid foundation for the Bradford County Hazard Mitigation Program.

Hazard mitigation describes sustained actions taken to prevent or minimize long-term risks to life and property from hazards and to create successive benefits over time. Pre-disaster mitigation actions are taken in advance of a hazard event and are essential to breaking the disaster cycle of damage, reconstruction and repeated damage. With careful selection, successful mitigation actions are cost-effective means of reducing risk of loss over the long-term.

Hazard mitigation planning has the potential to produce long-term and recurring benefits. A core assumption of mitigation is that current dollars invested in mitigation practices will significantly reduce the demand for future dollars by lessening the amount needed for recovery, repair and reconstruction. These mitigation practices will also enable local residents, businesses and industries to reestablish themselves in the wake of a disaster, getting the economy back on track sooner and with less interruption.

1.2. Purpose

The purpose of this All-Hazard Mitigation Plan (HMP) is:

- To protect life, safety and property by reducing the potential for future damages and economic losses that result from natural hazards;
- To qualify for additional grant funding, in both the pre-disaster and the post-disaster environment;
- To speed recovery and redevelopment following future disaster events;
- To demonstrate a firm local commitment to hazard mitigation principles; and
- To comply with both state and federal legislative requirements for local hazard mitigation plans.

1.3. Scope

This Bradford County Multi-Jurisdictional Hazard Mitigation Plan serves as a framework for saving lives, protecting assets and preserving the economic viability of the fifty-one municipalities in Bradford County. The HMP outlines actions designed to address and reduce the impact of a full range of natural hazards facing Bradford County, including drought, earthquakes, flooding, tornados, hurricanes/tropical storms and severe winter weather. Manmade hazards such as transportation accidents, hazardous materials spills and fires are also addressed.

A multi-jurisdictional planning approach was utilized for the Bradford County HMP update, thereby eliminating the need for each municipality to develop its own approach to hazard mitigation and its own planning document. Further, this type of planning effort results in a common understanding of the hazard vulnerabilities throughout the county, a comprehensive list of mitigation projects, common mitigation goals and objectives and an evaluation of a broad capabilities assessment examining policies and regulations throughout the county and its municipalities.

1.4. Authority and Reference

Authority for this plan originates from the following federal sources:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended
- Code of Federal Regulations (CFR), Title 44, Parts 201 and 206
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended
- National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 *et seq.*

Authority for this plan originates from the following Commonwealth of Pennsylvania sources:

- Pennsylvania Emergency Management Services Code. Title 35, Pa C.S. Section 101

- Pennsylvania Municipalities Planning Code of 1968, Act 247 as reenacted and amended by Act 170 of 1988
- Pennsylvania Storm Water Management Act of October 4, 1978. P.L. 864, No. 167

The following Federal Emergency Management Agency (FEMA) guides and reference documents were used to prepare this document:

- FEMA 386-1: *Getting Started*. September 2002
- FEMA 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses. August 2001
- FEMA 386-3: Developing the Mitigation Plan. April 2003
- FEMA 386-4: *Bringing the Plan to Life*. August 2003
- FEMA 386-5: Using Benefit-Cost Review in Mitigation Planning. May 2007
- FEMA 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning. May 2005
- FEMA 386-7: Integrating Manmade Hazards into Mitigation Planning. September 2003
- FEMA 386-8: Multijurisdictional Mitigation Planning. August 2006
- FEMA 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects. August 2008
- FEMA Local Multi-Hazard Mitigation Planning Guidance. July 1, 2008
- FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. January 2013

The following Pennsylvania Emergency Management Agency (PEMA) guides and reference documents were used to prepare this document:

- PEMA: Hazard Mitigation Planning Made Easy!
- PEMA Mitigation Ideas: Potential Mitigation Measures by Hazard Type: A Mitigation Planning Tool for Communities. March 6, 2009
- PEMA: Standard Operating Guide. October 18, 2013

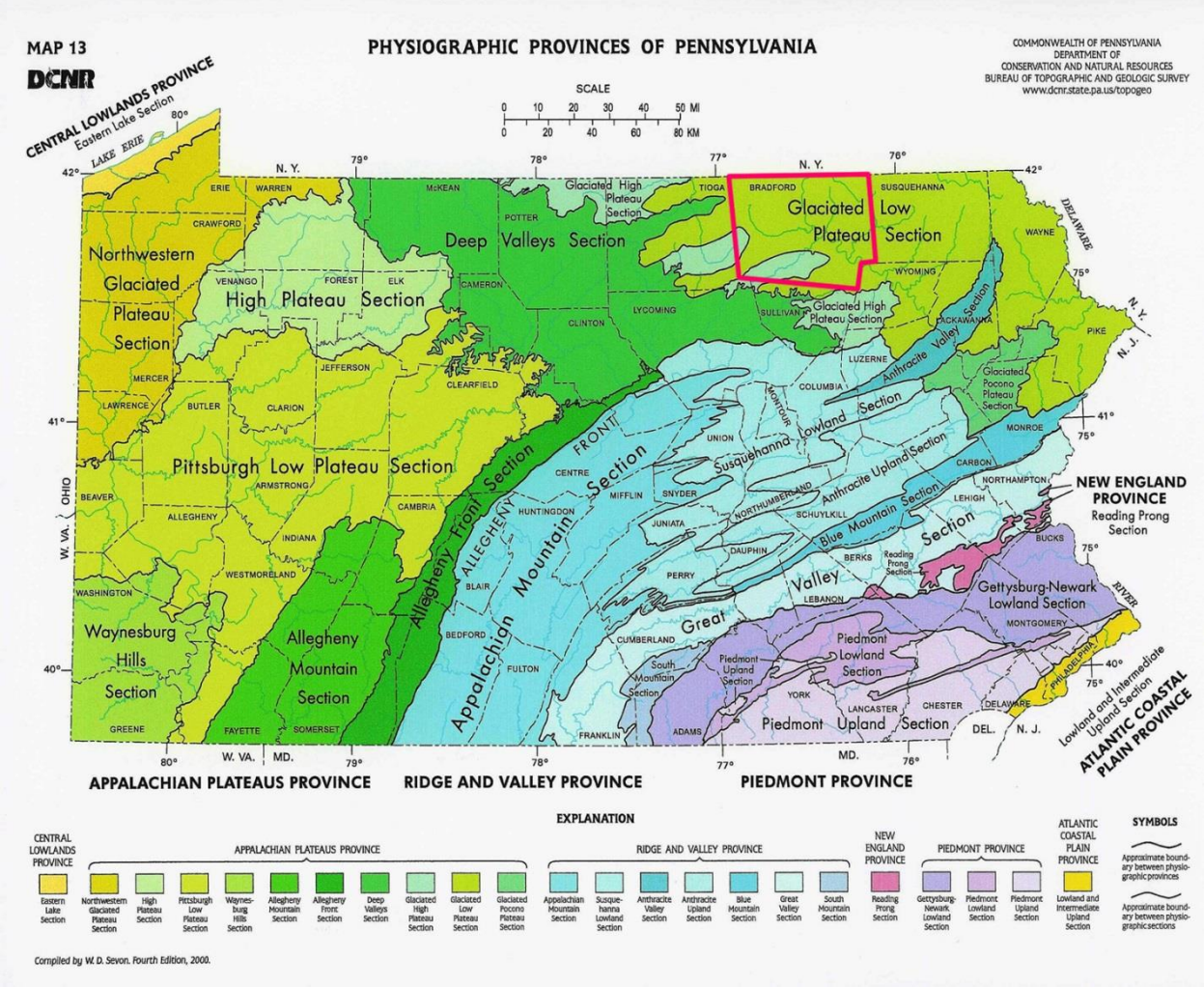
2. Community Profile

2.1 Geography and Environment

Established February 21, 1810, from parts of Lycoming and Luzerne counties, Bradford County is in the northeastern portion of Pennsylvania; and originally called Ontario County. Bradford County reorganized and separated from Lycoming County on October 13, 1812. Bradford County borders are Tioga County on the west, Lycoming County on the southwest; Sullivan County to the south, Wyoming County on the southeast, Susquehanna County to the east, and to the north by Chemung and Tioga counties, New York.

Bradford County is in a region known as the Endless Mountains. The Endless Mountains region is part of the Appalachian Mountains chain, consisting of a dissected plateau that is part of the Allegheny Plateau. Most of the county is located within the Glaciated Low Plateau Section of the Appalachian Plateaus Province, as shown in *Figure 1 - Physiographic Provinces of Pennsylvania* Bradford County has an elevation range from 600 to 2380 feet above sea level. Glaciation in northeastern Pennsylvania was by the Ontario lobe glacier. Presumably, due to the more rugged topography in this area, erosion is a more dominant process. The topography consists of rounded hills and broad to narrow valleys, modified by glacial erosion and deposition. Sandstone and siltstone form much of the bedrock in this region. Geologic formations can restrict the nature and extent of surface development and affect the quality and quantity of groundwater.

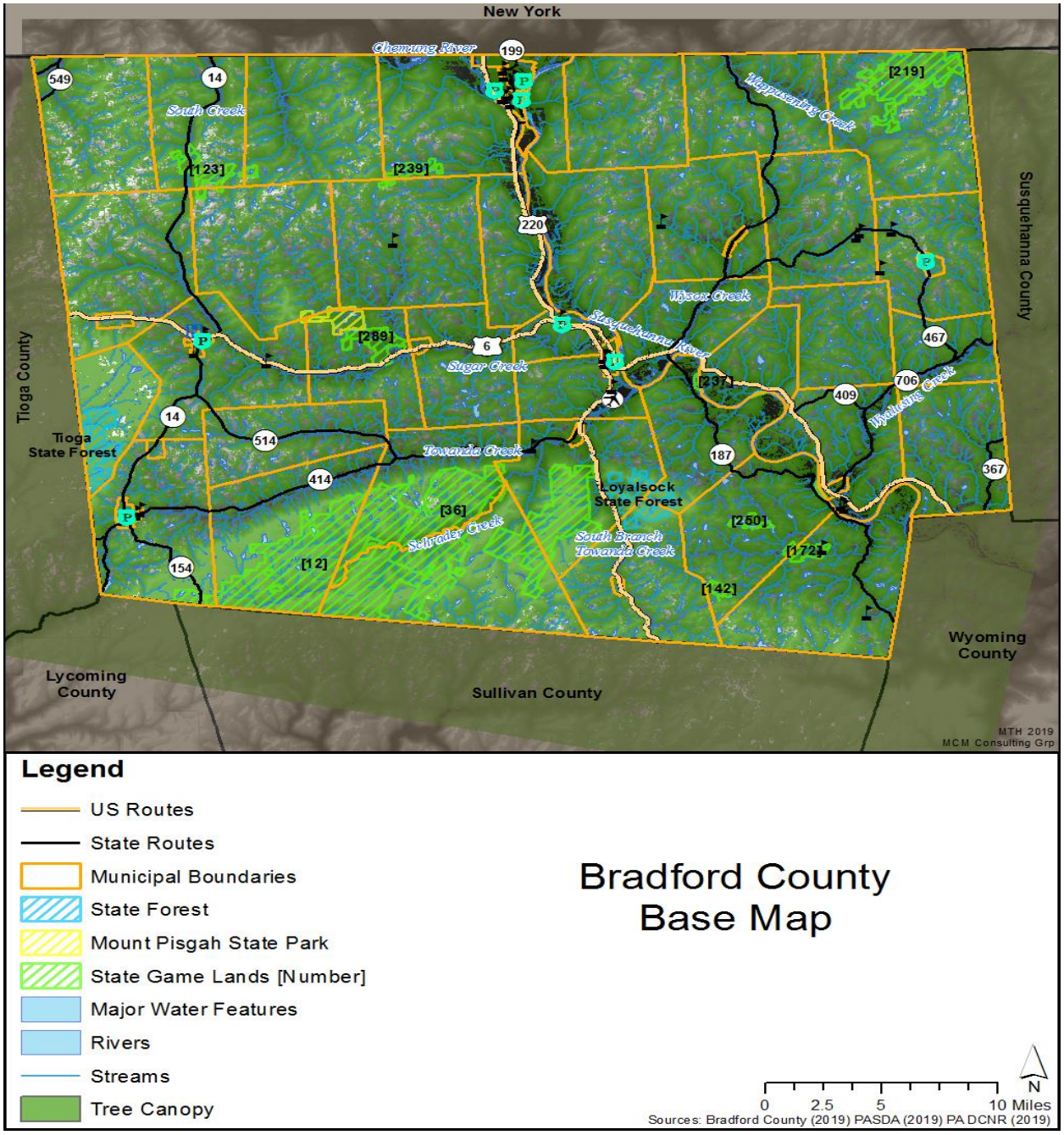
Figure 1 - Physiographic Provinces of Pennsylvania



Bradford County has a total land area of approximately 1,151 square miles, making it the second largest county in Pennsylvania. The water area of Bradford County is nine square miles.

A base map of Bradford County is shown in *Figure 2 - Bradford County Base Map*.

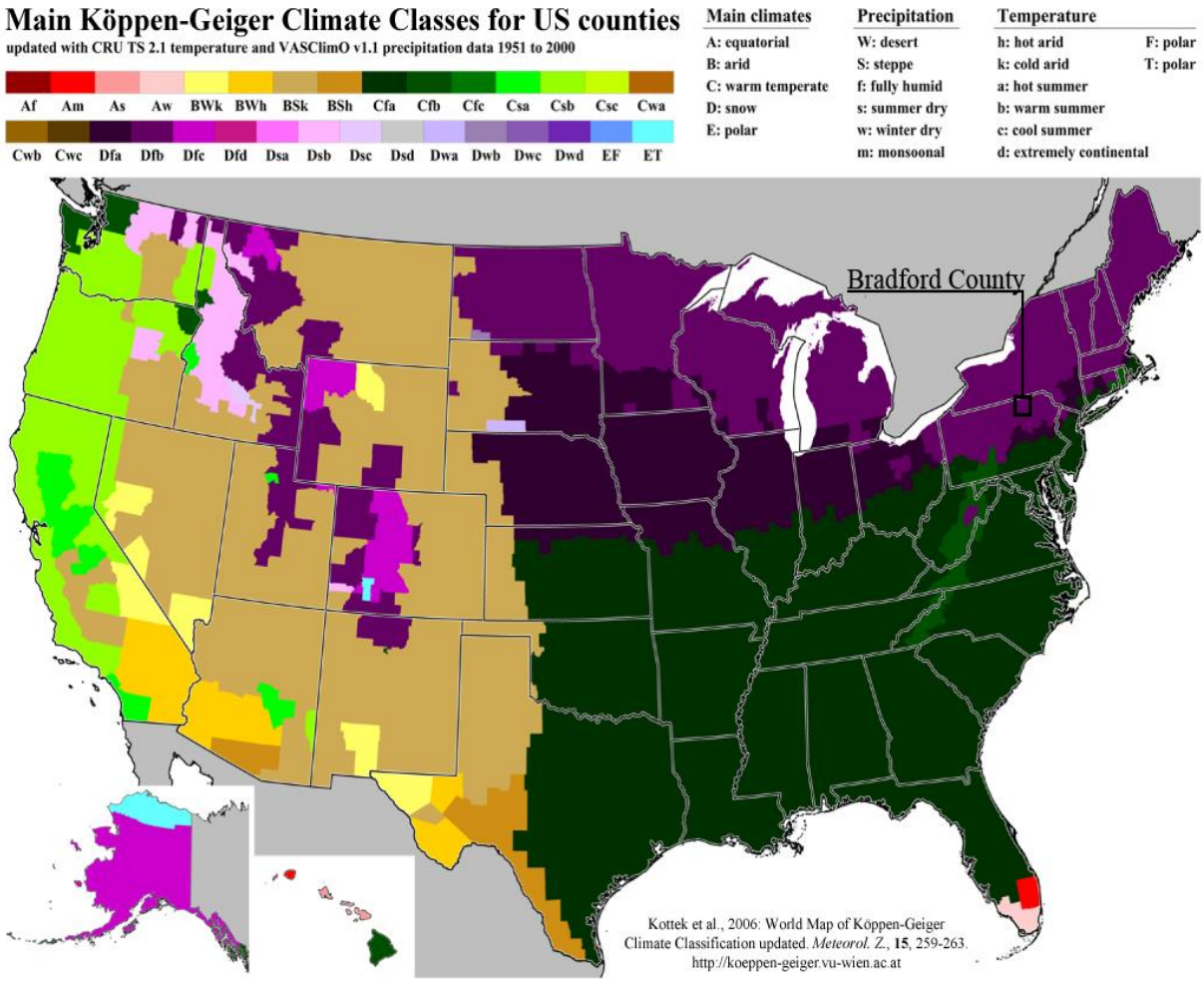
Figure 2 - Bradford County Base Map



The Köppen-Geiger system chart classifies Pennsylvania (to include Bradford County) as a continental/micro-thermal climate; with a scheme of warm summer continental climate. *Figure 3 - Köppen-Geiger System Chart* shows the Pennsylvania Map of Köppen climate classification. While the sixty-seven counties of Pennsylvania share many weather similarities, there are also a few unique characteristics to certain regions. Typically, the northern counties of Pennsylvania have colder temperatures and more snow in

the winter. The weather extremes in Bradford County are the primary contributors to many of the natural hazard events within the county; to include flash floods, hurricanes and tropical storms, winter storms, tornadoes, drought, extreme temperatures, and high wind.

Figure 3 - Köppen-Geiger System Chart



In addition to the devastating effects weather can have on specific hazards, weather often impedes emergency response. Two of the county's biggest weather-related vulnerabilities are severe winter weather and flash flooding. Weather always plays a large part in disaster response, requiring emergency planning to account for all weather variations, regardless of the event.

Bradford County has an annual mean temperature of 48.7° F and an annual precipitation of 37.7 inches, according to the Bradford County Comprehensive Plan. The Köppen-

Geiger system also indicates that Bradford County lies within the moderate rain exposure zone, with 20" to 40" annually.

Mineral resources found in Bradford County include flagstone, gravel sand, sandstone, natural gas, and coal. The north branch of the Susquehanna River flows into Pennsylvania through Bradford County. Other major waterways and watersheds are Chemung River, Sugar Creek, Towanda Creek, Wyalusing Creek and Wysox Creek.

2.2 Community Facts

Like much of rural Pennsylvania, natural resources have been the foundations of Bradford County's economy and way of life since its establishment. Residents today still enjoy a predominantly rural landscape of forested hills and mountains, agricultural valleys, and small towns and villages at rural crossroads.

Classified as a sixth-class county, Bradford County is governed by three elected commissioners. Bradford County's division is into fourteen boroughs and thirty-seven townships. Nearly 62,000 people call Bradford County "home".

Manufacturing, education, health and social services and agriculture make up Bradford County's economy.

From the 1840s into the 20th century, farmers and forestland owners cleared timber from their lands in Bradford County. This raw timber floated downstream on streams and rivers, milled and supplied seaboard cities with building materials.

Land, rail, and mill owners built many of Bradford County's towns and villages from the prosperity in timber. Victorian architecture is in abundance across the county. According to the 2010 Bradford County Comprehensive Plan, approximately forty percent of housing units constructed were from 1939 and earlier.

There are three hospitals located in Bradford County:

- Guthrie Towanda Memorial Hospital, Towanda;
- Guthrie Robert Packer Hospital, Sayre;
- Guthrie Troy Community Hospital, Troy.

Also, there are five local Guthrie health System clinics and one Arnot Health Clinic.

There are seven public school districts providing education and serving 15,000 students through grade K through twelve. The public-school districts are:

- Athens Area School District
- Canton Area School District (also in Lycoming and Tioga counties)
- Northeast Bradford School District
- Sayre Area School District
- Towanda Area School District
- Troy Area School District

- Wyalusing Area School District (also in Wyoming County)

Private schools within Bradford County are:

- Canton Country School, Canton
- Children's Place, Sayre
- Epiphany School (Catholic) K-8, Sayre
- Freedom Lane Academy, Milan
- G&G Learning Center, Rome
- Maranatha Mission Learning Community Branch 19, Canton
- North Rome Christian School
- South Hill Amish School, Wyalusing
- St. Agnes Elementary School, Towanda
- Union Valley Christian School, Ulster
- Valley View Amish School, Pike Township
- Wyalusing Valley Children's Center Inc., Wyalusing

Post-secondary education facilities are available in Bradford County, to include:

- Keystone College
- Lackawanna College Towanda Center
- Northern Tier Career Center
- Robert Packer School of Nursing

Bradford County has five chambers of commerce. These groups provide opportunities for business and economic development and provide a link between businesses and community resources by promoting tourism, heritage and recreation resources and community events. The chambers of commerce in Bradford County are:

- Central Bradford County Chamber of Commerce
- Canton Area Chamber of Commerce
- Greater Wyalusing Chamber of Commerce
- Greater Valley Chamber of Commerce
- Troy Chamber of Commerce

In 2008, unconventional Marcellus shale gas exploration became prevalent. The influx of natural gas company employees, corporate staffing and subcontractors has impacted Bradford County's infrastructure. According to FracFocus a chemical disclosure registry, there were approximately 990 hydraulic fracturing gas wells registered in Bradford County between 2010 and January 2019.

2.3 Population and Demographics

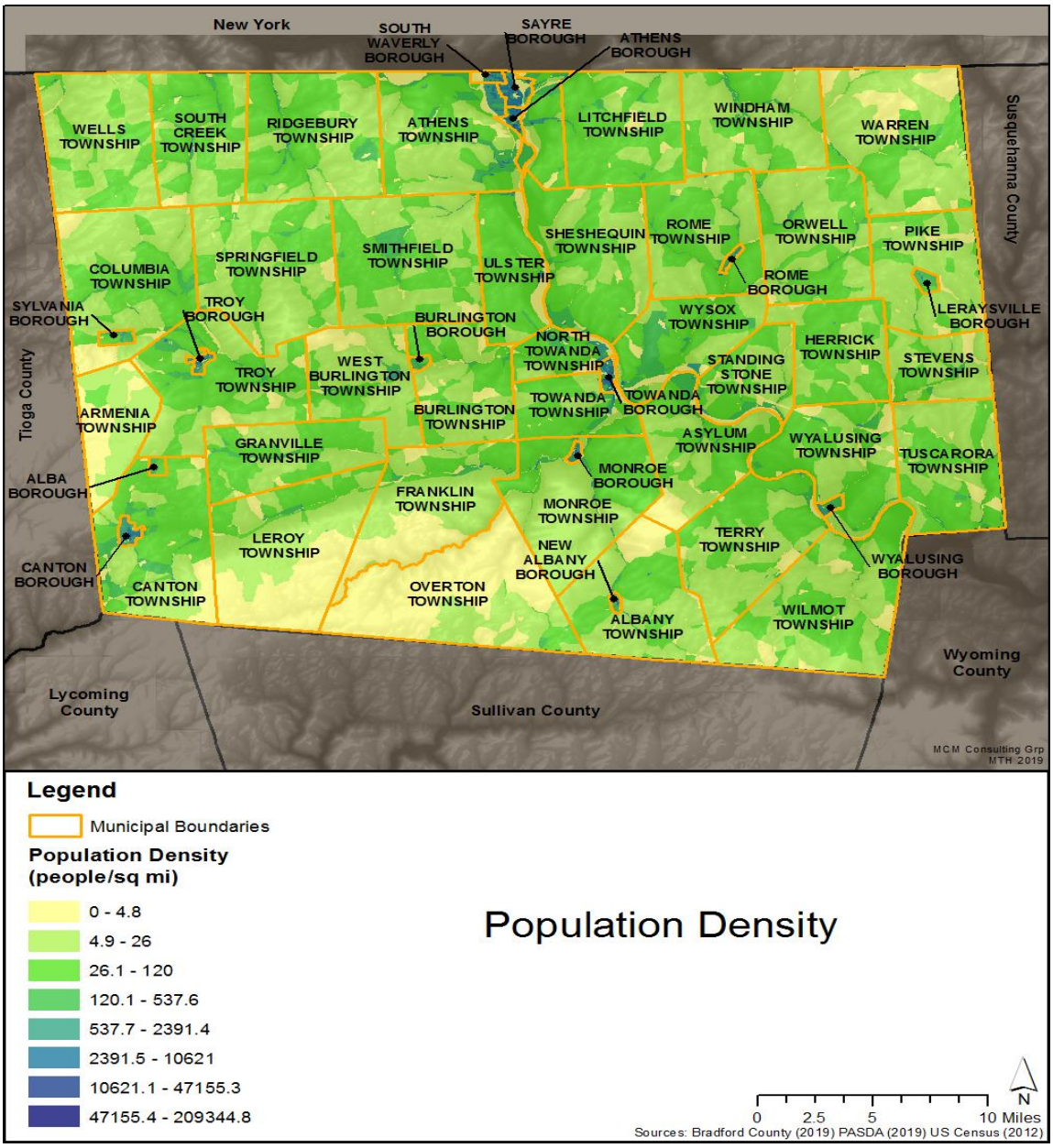
There are five municipalities in Bradford County with over 2,000 residents and include: Sayre Borough (5,467) Athens Township (5,145), Athens Brough (3,287), Towanda Borough (2,848) and Ridgebury Township (2,097). This is according to population figures

published by the U.S. Census in the 2012-2016 American Community Survey 5-Year Estimates and published in the Bradford County Comprehensive Plan.

Population estimates for July 1, 2017 was 60,853 for the county, this is a -3.0 percent estimated change from April 1, 2010 to July 1, 2017. With the population decrease, the population is also aging. The percentage of county population over sixty-five years of age has increased by over four percent; and, there is a decrease by five percent in the county's population generally considered to be within family forming ages (ages twenty to forty-four) since 2000. The 2010 U.S. Census reports that there are 54.6 persons per square mile in Bradford County.

A population density map for Bradford County is shown in *Figure 4 - Population Density*.

Figure 4 - Population Density



According to the U.S. Census QuickFacts estimated July 1, 2017 Estimates, Bradford County's population is:

White – 97.1 percent
Black or African American – 0.7 percent
American Indiana/Alaska Native – 0.3 percent
Asian – 0.6 percent
Native Hawaiian/Pacific Islander – 0.0 percent
Two or more races – 1.2 percent
Hispanic or Latino – 1.4 percent

The U.S. Census Bureau QuickFacts for 2016 reports a total of 1,345 employer establishments in Bradford County. Between 2013 and 2017, fifty-seven percent of the population age sixteen years or older were in the civilian labor force. This is just slightly below the sixty-three percent of the same age group in the civilian labor force nationwide. Major employers are the natural gas industry, DuPont, Global-Tungsten and Powders (former Sylvania), Jeld-Wen, and Cargill Regional Beef. Cargill Regional Beef is one of nine Cargill protein plants with approximately 1,200 employees, and processes about 1,500 head of cattle per day.

Emergency planners can communicate with the citizens of Bradford County with the help of the following information:

- 2.2 percent of persons age 5-years+ speak a language other than English at home.
- 82.4 percent of households have a computer, and of this 73.8 percent have a broadband internet subscription.

2.4 Land Use and Development

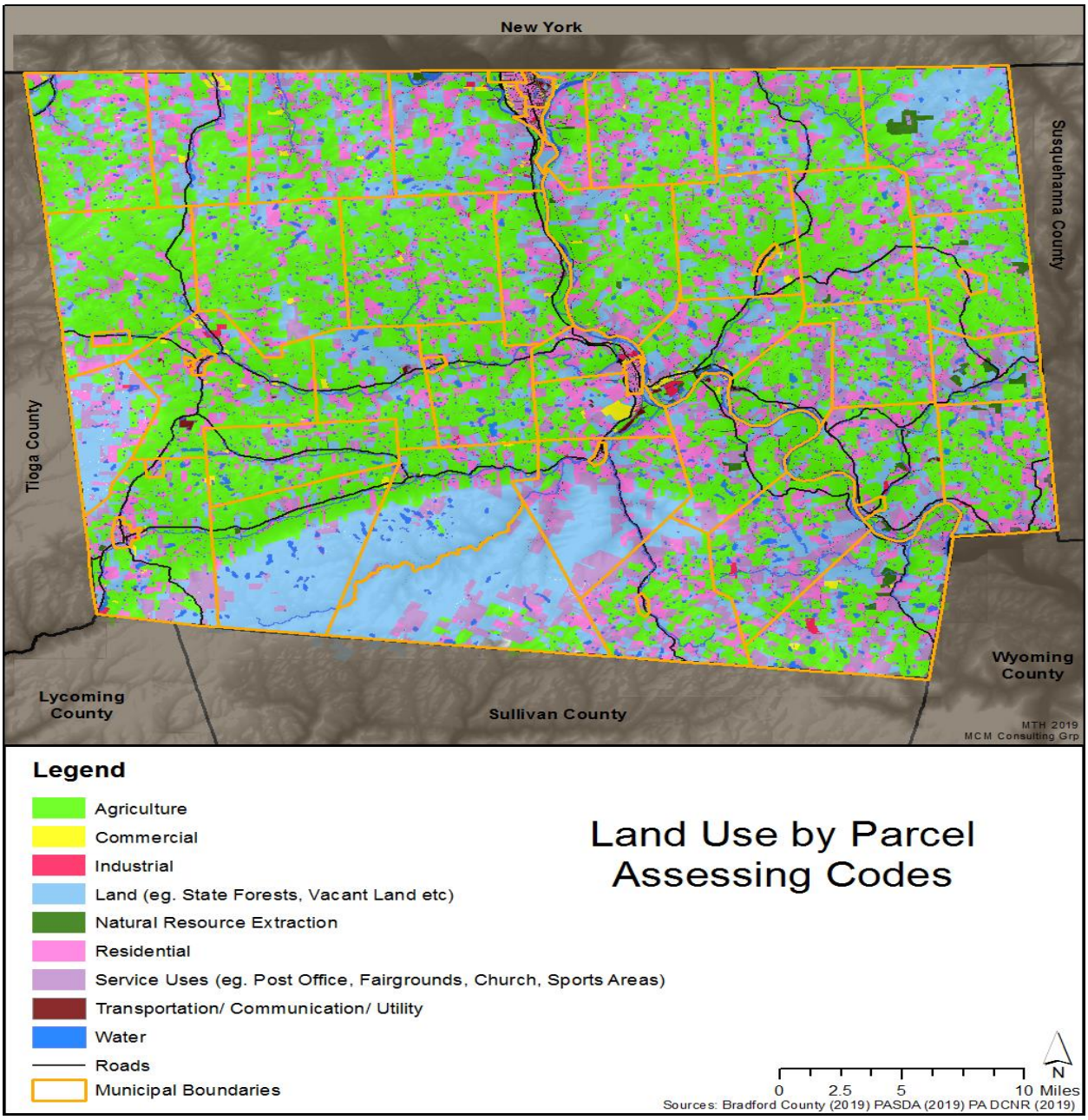
Residents and visitors enjoy the outdoor recreation, rural landscapes, forested hills, agricultural valleys, mall towns and villages and breath-taking vistas available in Bradford County. Approximately fifty-nine percent of the 1,151 square miles within Bradford County are forest cover. The predominate hardwoods are oak, maple, charry and ash; with hemlock and pine being predominate softwoods.

The Bradford County Comprehensive Plan outlines three main existing land use categories including developed, undeveloped and surface water. Bradford County categorizes developed land uses to include:

- Agricultural, includes land engaged in active production of agricultural products, pastureland and associated land uses;
- Residential, comprised of housing and associated lots;
- Commercial, includes land sustaining retail and service businesses in free-standing buildings, individual parcels or in multi-tenant buildings;
- Mixed use;
- Industrial, includes land involved in the manufacture, production, processing or movement of goods;
- Transportation features, includes right-of-way lines of highways, local roads, rail lines and associated facilities including those within Public Lands; and
- All public lands include State Parks and Game Lands, State Forest, and county and local parks.

Bradford County also has identified intact forest blocks over one-square mile in size. These un-fragmented forest blocks are suitable habitat for native species, and because of their proximity to each other become natural corridors for species movement. *Figure 5 - Parcel Accessing Codes* shows land use by parcel assessing codes.

Figure 5 - Parcel Accessing Codes



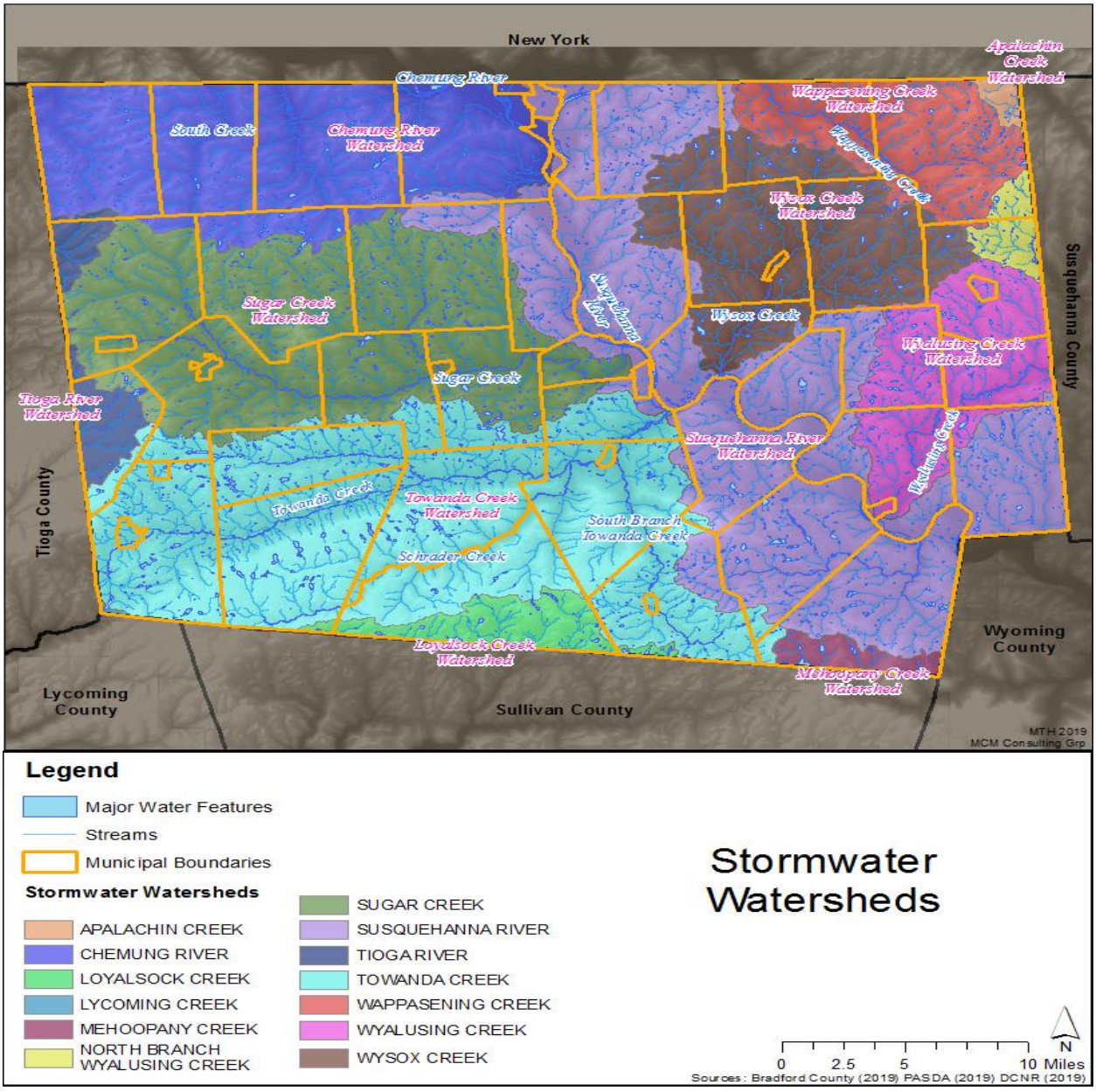
Surface water within Bradford County includes rivers, streams and water bodies. Some of these recognized physical assets are:

- The North Branch of the Susquehanna River
- Chemung River
- Major river tributary streams:

- Sugar Creek
- Towanda Creek
- Wyalusing Creek
- Wysox Creek

Figure 6 - Stormwater Watersheds shows stormwater watersheds in Bradford County.

Figure 6 - Stormwater Watersheds



- Public recreation water bodies:
  - Sunfish Pond in the Sunfish Pond County Park
  - Cooks Pond in the Cook's Pond County Park

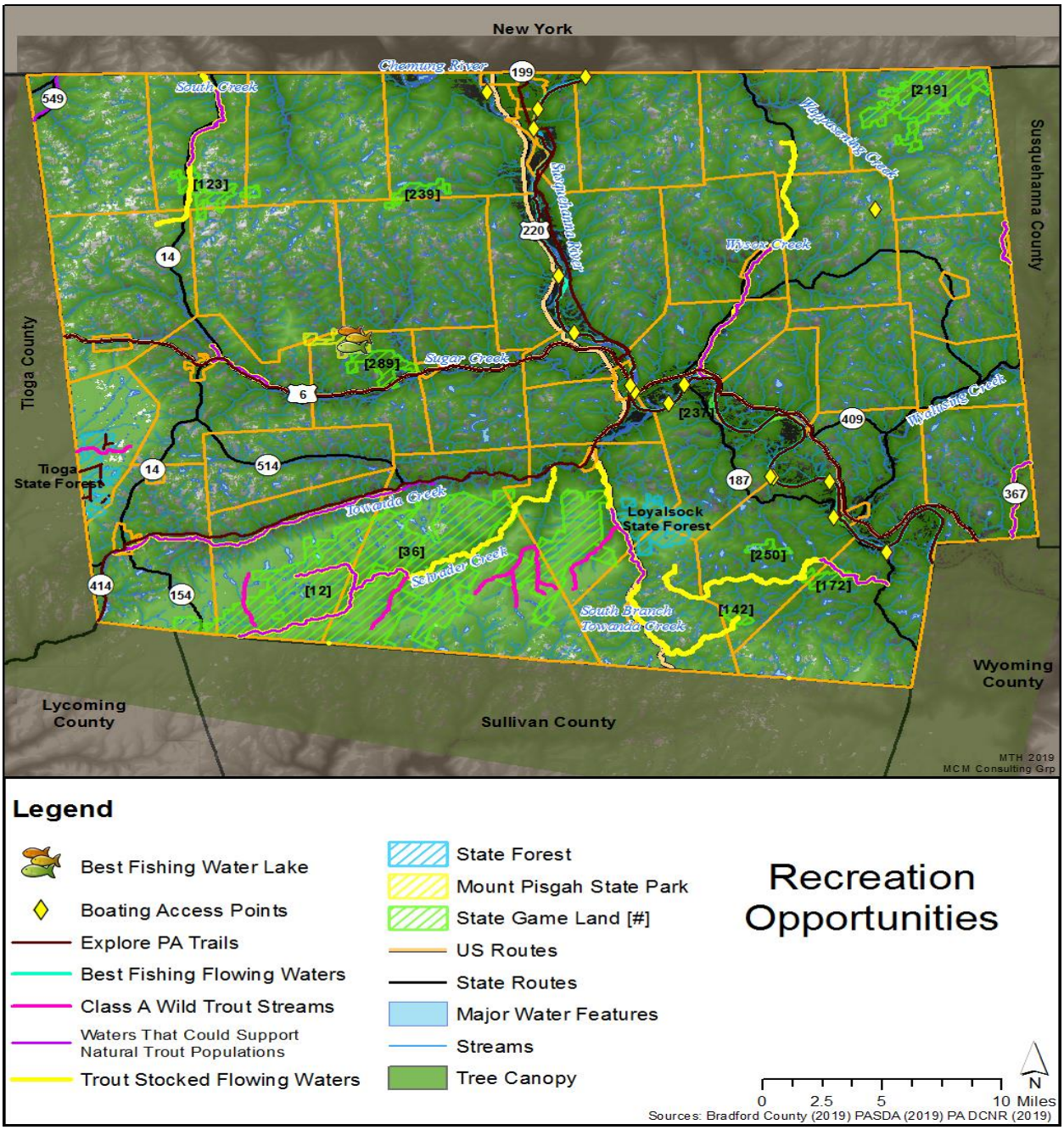
- Stephen Foster Lake located in Mount Pisgah State Park

The Pennsylvania Game Commission owns and manages ten tracts with approximately 35,000 acres of state games lands in Bradford County. These tracts are:

- State Game Lands 12, located in the Canton area
- State Game Lands 36, located in Monroeton and West Albany townships
- State Game Lands 123, located around Checkerville in Springfield and South Creek townships
- State Game Lands 142, located near New Albany
- State Game Lands 172, located in Wyalusing
- State Game Lands 219, located in Warren Township
- State Game Lands 237, located in Terry and Asylum townships
- State Game Lands 239, located in Athens Township
- State Game Lands 250, located near Wyalusing in Terry Township
- State Game Lands 289, located in West Burlington Township

Bradford County recreation opportunities map is shown in *Figure 7 - Recreation Opportunities*.

Figure 7 - Recreation Opportunities



2.5 Data Sources

- 2018 Bradford County Comprehensive Plan
- National Oceanic and Atmospheric Administration
- U.S. Census 2012-2016 American Community Survey
- Wikipedia – Bradford County, Pennsylvania
- bradfordcountypa.org

- Building Science Corporation at https://buildingscience.com/documents/building-science-insights-newsletters/bsi-025-altered-states-and-queen-victoria
- https://fracfocusdata.org/DisclosureSearch/Search.aspx
- Wyalusing, PA - Cargill

3. Planning Process

3.1. Update Process and Participation Summary

The Bradford County Hazard Mitigation Plan update began December 13, 2018. The Bradford County Commissioners were able to secure a hazard mitigation grant to start the process. The Bradford County Department of Public Safety was identified as the lead agency for the Bradford County Hazard Mitigation Plan update. The planning process involved a variety of key decision makers and stakeholders within Bradford County. Bradford County immediately determined that the utilization of a contracted consulting agency would be necessary to assist with the plan update process. MCM Consulting Group, Inc. was selected as the contracted consulting agency to complete the update of the hazard mitigation plan. The core hazard mitigation team, which was referred to as the steering committee, included officials from the Bradford County Department of Public Safety, Bradford County GIS, Bradford County Planning Commission and MCM Consulting Group, Inc. (MCM).

The process was developed around the requirements laid out in the Federal Emergency Management Agency (FEMA) Local Hazard Mitigation Crosswalk, referenced throughout this plan, as well as numerous other guidance documents including, but not limited to, Pennsylvania's All-Hazard Mitigation Standard Operating Guide, FEMA's State and Local Mitigation Planning How-to Guide series of documents (FEMA 386-series) and the National Fire Protection Association (NFPA) 1600 Standard on Disaster/Emergency Management and Business Continuity Programs.

MCM Consulting Group, Inc. assisted the Bradford County Department of Public Safety in coordinating and leading public involvement meetings, local planning team meetings, analysis and the writing of the HMP. The Bradford County Local Planning Team worked closely with MCM in the writing and review of the HMP. MCM conducted project meetings and local planning team meetings throughout the process. Meeting agendas, meeting minutes and sign in sheets were developed and maintained for each meeting conducted by MCM. These documents are detailed in Appendix C of this plan.

Public meetings with local elected officials were held, as well as work sessions and in-progress review meetings with the Bradford County Local Planning Team and staff. At each of the public meetings, respecting the importance of local knowledge, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capabilities assessment and review and eventually adopt the county hazard mitigation plan. Bradford County will continue to work with all local municipalities to collect local hazard mitigation project opportunities.

The HMP planning process consisted of:

- Applying for and receiving a hazard mitigation planning grant (HMPG) to fund the planning project.

- Announcing the initiative via press releases and postings on the county website.
- Involving elected and appointed county and municipal officials in a series of meetings, training sessions and workshops.
- Identifying capabilities and reviewed the information with the municipalities.
- Identifying hazards.
- Assessment of risk and analyzing vulnerabilities.
- Identifying mitigation strategies, goals and objectives.
- Developing an implementation plan.
- Announcing completion via press releases and postings on the county website.
- Plan adoption at a public meeting of the Bradford County Board of Commissioners.
- Plan submission to FEMA and PEMA.

The 2020 Bradford County HMP was completed October 4, 2019. The 2020 plan follows an outline developed by PEMA which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. The 2020 HMP format is consistent with the PEMA recommended format. The 2020 Bradford County HMP has additional hazard profiles that were added to the HMP and these additional profiles increased the subsections in section 4.3 of the HMP.

3.2. The Planning Team

The 2020 Bradford County Hazard Mitigation Plan update was led by the Bradford County Steering Committee. The Bradford County Steering Committee provided guidance and leadership for the overall project. The steering committee assisted MCM Consulting Group, Inc. with dissemination of information and administrative tasks. *Table 1 – Steering Committee* outlines the individuals that comprised this team.

Table 1 – Steering Committee

Bradford County Hazard Mitigation Plan Update Steering Committee		
Name	**Organization**	**Position**
Robert Barnes	Bradford County Department of Public Safety	Director
Sarah Neely	Bradford County Department of Public Safety	EMA Coordinator
Nancy Mechling	Bradford County Department of Public Safety	Administrative Assistant
Matt Williams	Bradford County Planning Commission	Director
Rich Lasko	Bradford County GIS	GIS Analyst
Robert Anderson	MCM Consulting Group, Inc.	Senior Consultant
Corbin Snyder	MCM Consulting Group, Inc.	Project Coordinator
Michael Rearick	MCM Consulting Group, Inc.	Project Manager

In order to represent the county, the Bradford County Steering committee developed a diversified list of potential Local Planning Team (LPT) members. Members that participated in the 2015 hazard mitigation plan were highly encouraged to join the 2020 team. The steering committee then provided invitations to the prospective members and provided a description of duties to serve on the LPT. The following agencies, departments and organizations were invited to participate in the LPT: Bradford County Commissioners, Bradford County Planning Commission, Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Parks, DCNR Bureau of Forestry, Bradford County Historical Society, PennDOT, Pennsylvania State Police, Bradford County Conservation District, Bradford County School District, Bradford County Fire Chiefs, Bradford County Ambulance, Bradford County Sheriff and all fifty-one municipalities. The invitations for membership of the LPT were disseminated by the Bradford County Emergency Management Agency utilizing letters, email and telephone calls. The LPT worked throughout the process to plan and hold meetings, collect information and conduct public outreach.

The stakeholders listed in *Table 2 - Local Planning Team* served on the 2020 Bradford County Hazard Mitigation Local Planning Team, actively participated in the planning process by attending meetings, completing assessments, surveys and worksheets and/or submitting comments.

Table 2 - Local Planning Team

Bradford County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Chris Kaiden	Sayre Borough	Elected or Appointed Official
Kurt Lafy	Sheshequin Township	Elected or Appointed Official
Joe Engel	DCNR	Elected or Appointed Official
Jared Dressler	PA DEP	Elected or Appointed Official
Tony Liguori	PA DEP	Elected or Appointed Official
John Sullivan	Asylum Township	Elected or Appointed Official
Robin Smith	Athens Township	Elected or Appointed Official
Chuck Carver	WAB-WAVR	Elected or Appointed Official
Derrick Hall	Greater Valley EMS	Elected or Appointed Official
Matt Williams	Bradford County Planning Department	Director
Rich Lasko	Bradford County GIS	GIS Analyst
Daryl Miller	Bradford County Commissioner	Elected or Appointed Official
Doug McLinko	Bradford County Commissioner	Elected or Appointed Official
Sarah Neely	Bradford County EMA	EMA Coordinator
Robert Barnes	Bradford County EMA	Director
Nancy Mechling	Bradford County EMA	Administrative Assistant
Amy Seeley	Canton Borough	Elected or Appointed Official
Linda Leonard	South Creek Township	Elected or Appointed Official
George Ballenstedt	Athens Township	Elected or Appointed Official

Bradford County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Gary Ferguson	Canton Township	Elected or Appointed Official
Jason Krise	Leroy Township	Elected or Appointed Official
Larry Fleming	Granville Township	Elected or Appointed Official
Steven Harris	Armenia Township	Elected or Appointed Official
Mary Hastings	Wells Township	Elected or Appointed Official
Ronald Woolf	Columbia Township	Elected or Appointed Official
David Henry	Herrick Township	Elected or Appointed Official
Gale Bowen	Windham Township	Elected or Appointed Official
William Franklin	Warren Township	Elected or Appointed Official
Fred Wheaton	Warren Township	Elected or Appointed Official
Carl Yurgatis	Tuscarora Township	Elected or Appointed Official
Brenda Ferguson	Stevens Township	Elected or Appointed Official
Lee Allen	Asylum Township	Elected or Appointed Official
James Drake	Litchfield Township	Elected or Appointed Official
Robert McKee	Ulster Township	Elected or Appointed Official
John Lukach	Standing Stone Township	Elected or Appointed Official
Stacy Hart	Terry Township	Elected or Appointed Official
John McNeal	Franklin Township	Elected or Appointed Official
Gary Scranton	Towanda Township	Elected or Appointed Official
Joanne Vago	Wyalusing Borough	Elected or Appointed Official
Michelle McGroarty	Overton Township	Elected or Appointed Official
Bryce Adams	Wilmot Township	Elected or Appointed Official
Mike Turner	Wilmot Township	Elected or Appointed Official
John Shimko	Wells Township	Elected or Appointed Official
Ed Bustin	Bradford County Commissioner	Elected or Appointed Official
Doug Clearwater	Pike Township	Elected or Appointed Official
Mary Moon	Albany Township	Elected or Appointed Official
Ted Tomlinson	Leroy Township	Elected or Appointed Official
Curtis Ferris	Herrick/Orwell Township	Elected or Appointed Official
Laurence Sherman	Burlington Borough	Elected or Appointed Official
Gerald Sheetz	North Towanda Township	Elected or Appointed Official
Marvin Meteer	Wyalusing Township	Elected or Appointed Official
Larry Kneller	Wyalusing Township	Elected or Appointed Official
Art Allyn	Wyalusing Township	Elected or Appointed Official
Vernon Perry	Monroe Township	Elected or Appointed Official
Laura Hewitt	Monroe Borough	Elected or Appointed Official
Lanny Stethers	Wyalusing Township	Elected or Appointed Official
Gerald Stroh	Rome Township	Elected or Appointed Official
Mark Burgess	Athens Borough	Elected or Appointed Official
Scott Riley	Athens Borough	Elected or Appointed Official
Jennifer Chilson	Ulster Township/Burlington Township	Elected or Appointed Official
Dale Palmer	Alba Borough	Elected or Appointed Official
Dan Close	Troy Borough	Elected or Appointed Official

Bradford County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
John Roloson	Springfield Township	Elected or Appointed Official
Craig Harkness	Smithfield Township	Elected or Appointed Official
Cory Goodwin	Smithfield Township	Elected or Appointed Official
John Mosser	Canton Borough	Elected or Appointed Official
Linda Laurence	Sylvania Borough	Elected or Appointed Official
Lonna Bly	Troy Township	Elected or Appointed Official
Tammi Tolada	Ridgebury Township	Elected or Appointed Official
Charles Woodward	West Burlington Township	Elected or Appointed Official

3.3. Meetings and Documentation

Monthly public meetings with local elected officials and the local planning team were held. At each of the public meetings, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capability assessment and review and eventually adopt the multi-jurisdictional HMP. *Table 3 - HMP Process Timeline* lists the meetings held during the HMP planning process, which organizations and municipalities attended and the topic that was discussed at each meeting. All meeting agendas, sign-in sheets, presentation slides, any other documentation is located in Appendix C.

A final public meeting was held on September 4, 2019 to present the draft plan and invite public comments. The meeting was advertised in the local newspaper and also made available digitally on the Bradford County web site at: www.bradfordcountypa.org/2019-bradford-county-hazard-mitigation/. The Bradford County website was used to make a digital copy of the draft hazard mitigation plan available.

The public comment period remained open until October 4, 2019. All public comments were submitted in writing to Sarah Neely at the Bradford County Department of Public Safety. All public comments have been included in this plan in Appendix C.

Table 3 - HMP Process Timeline

Bradford County HMP Process - Timeline		
Date	**Meeting**	**Description**
12/13/18	Bradford County Hazard Mitigation Plan (HMP) Kick-Off Meeting	Identified challenges and opportunities as they relate to fulfilling the DMA 2000 requirements. Identified existing studies and information sources relevant to the Hazard Mitigation Plan. Identified stakeholders, including the need to involve local officials.
1/28/19	Local Planning Team Initial Meeting	Defined hazard mitigation planning and identified roles and responsibilities. Discussed the 2015 hazard mitigation plan and defined a timeline to complete the update.

Bradford County HMP Process - Timeline		
Date	**Meeting**	**Description**
1/28/19	West Council of Governments Meeting	Risk assessment and capability assessment surveys
02/07/19	East Council of Governments Meeting	Risk assessment and capability assessment surveys
02/27/19	Local Planning Team Meeting	Risk assessment and capability assessment work
03/20/19	Local Planning Team Meeting	Risk factor assessment, finalize capability assessment
05/08/19	Local Planning Team Meeting	Review draft risk assessment section and start the mitigation strategy section
05/08/19	Public Meeting	Conducted a public meeting to review the draft risk assessment section of the Bradford County Hazard Mitigation Plan update.
06/05/19	Local Planning Team Meeting	Goals, objectives, actions development.
07/09/19 – 07/11/19	Local Planning Team Meeting	Mitigation Strategy – Project opportunity form development
08/07/19	Local Planning Team Meeting	WebEx – Mitigation Strategy
09/04/19	Local Planning Team Meeting	Draft 2019 HMP review
09/04/19	Bradford County Hazard Mitigation Plan – Draft Plan Review Public Meeting	An update of the hazard mitigation planning process was delivered. The Draft HMP was reviewed with the municipal representatives and public. Attendees were informed about the timeline and their opportunity to review the entire draft plan and provide written comments for inclusion into the plan.

3.4. Public and Stakeholder Participation

Bradford County engaged numerous stakeholders and encouraged public participation during the HMP update process. Advertisements for public meetings were completed utilizing the local newspaper and the Bradford County website. Copies of those advertisements are located in Appendix C. Municipalities and other county entities were invited to participate in various meetings and encouraged to review and update various worksheets and surveys. Copies of all meeting agendas, meeting minutes and sign-in sheets are located in Appendix C. Worksheets and surveys completed by the municipalities and other stakeholders are located in appendices of this plan update as well. Municipalities were also encouraged to review hazard mitigation related items with other constituents located in the municipality like businesses, academia, private and nonprofit interests.

The tools listed below were distributed with meeting invitations, provided directly to municipalities to complete and return to the Bradford County Department of Public Safety or at meetings to solicit information, data and comments from both local municipalities and other key stakeholders. Responses to these worksheets and surveys are available for review at the department of public safety.

1. **Risk Assessment Hazard Identification and Risk Evaluation Worksheet:** Capitalizes on local knowledge to evaluate the change in the frequency of occurrence,

magnitude of impact and/or geographic extent of existing hazards and allows communities to evaluate hazards not previously profiled using the Pennsylvania Standard List of Hazards.

2. **Capability Assessment Survey:** Collects information on local planning, regulatory, administrative, technical, fiscal and political capabilities that can be included in the countywide mitigation strategy.
3. **Municipal Project Opportunity Forms and Mitigation Actions:** Copies of the 2015 mitigation opportunity forms that were included in the current HMP were provided to the municipalities for review and amendment. The previous mitigation actions were provided and reviewed at update meetings. Previous still valid 2015 project opportunities and new 2020 municipal project opportunity forms are located in Appendix G**.**

A schedule that provided appropriate opportunities for public comment was utilized during the review and drafting process. Any public comment that was received during public meetings or during the draft review of the plan were documented and included in the plan. Copies of newspaper public meeting notices, website posted public notices and other correspondence are included in Appendix C of this plan.

To increase public input, a community preparedness survey was made available online at surveymonkey.com. Additionally, an interactive hazard mapping tool was developed by the Bradford County Planning Commission. In total, forty-five responses were received and then documented in the plan.

Bradford County invited all contiguous counties to review the 2020 draft hazard mitigation plan. A letter was sent to the emergency management coordinator in Tioga, Lycoming, Sullivan, Wyoming and Susquehanna Counties on September 5, 2019. Copies of these letters are included in Appendix C.

3.5. Multi-Jurisdictional Planning

Bradford County used an open, public process to prepare this HMP. Meetings and letters to municipal officials were conducted to inform and educate them about hazard mitigation planning and its local requirements. Municipal officials provided information related to existing codes and ordinances, the risks and impacts of known hazards on local infrastructure and critical facilities and recommendations for related mitigation opportunities. The pinnacle to the municipal involvement process was the adoption of the final plan. *Table 4 - Worksheets, Surveys and Forms Participation* reflects the municipality participation by completing worksheets, surveys and forms.

Table 4 - Worksheets, Surveys and Forms Participation

Municipality Participation in Worksheets, Surveys and Forms			
Municipality	**Capability Assessment Survey**	**Risk Assessment Hazard Identification and Risk Evaluation Worksheet**	**Hazard Mitigation Opportunity Form Review and Updates**
Alba Borough	X		X
Albany Township	X	X	X
Armenia Township	X	X	X
Asylum Township	X	X	
Athens Borough	X	X	X
Athens Township	X	X	X
Burlington Borough			
Burlington Township	X	X	X
Canton Borough	X	X	X
Canton Township	X	X	X
Columbia Township	X	X	
Franklin Township	X	X	X
Granville Township	X	X	X
Herrick Township	X	X	X
LeRaysville Borough	X	X	X
Leroy Township	X	X	X
Litchfield Township	X	X	X
Monroe Borough	X	X	X
Monroe Township	X	X	X
New Albany Borough	X	X	X
North Towanda Township	X	X	X
Orwell Township	X	X	
Overton Township	X	X	
Pike Township	X	X	X
Ridgebury Township	X	X	
Rome Borough	X	X	X
Rome Township	X	X	
Sayre Borough	X	X	X
Sheshequin Township	X	X	
Smithfield Township	X	X	X
South Creek Township	X	X	X
South Waverly Borough	X	X	X
Springfield Township	X	X	X
Standing Stone Township	X	X	
Stevens Township	X	X	X
Sylvania Borough	X	X	X
Terry Township	X	X	X

Municipality Participation in Worksheets, Surveys and Forms			
Municipality	**Capability Assessment Survey**	**Risk Assessment Hazard Identification and Risk Evaluation Worksheet**	**Hazard Mitigation Opportunity Form Review and Updates**
Towanda Borough	X	X	X
Towanda Township	X	X	
Troy Borough	X	X	X
Troy Township	X	X	
Tuscarora Township	X	X	X
Ulster Township	X	X	X
Warren Township	X	X	X
Wells Township	X	X	X
West Burlington Township	X	X	X
Wilmot Township	X	X	X
Windham Township	X	X	X
Wyalusing Borough	X	X	X
Wyalusing Township	X	X	X
Wysox Township	X	X	X

All fifty-one municipalities within Bradford County have adopted the 2015 Bradford County Hazard Mitigation Plan as the municipal hazard mitigation plan. The Bradford County Local Planning Team goal is 100% participation by municipalities in adopting the 2020 Bradford County Hazard Mitigation Plan.

4. Risk Assessment

4.1. Update Process Summary

A key component to reducing future losses is to first have a clear understanding of what the current risks are and what steps may be taken to lessen their threat. The development of the risk assessment is the critical first step in the entire mitigation process, as it is an organized and coordinated way of assessing potential hazards and risks. The risk assessment identifies the effects of both natural and human caused hazards and describes each hazard in terms of its frequency, severity and county impact. Numerous hazards were identified as part of the process.

A risk assessment evaluates threats associated with a specific hazard and is defined by probability and frequency of occurrence, magnitude, severity, exposure and consequences. The Bradford County risk assessment provides in-depth knowledge of the hazards and vulnerabilities that affect Bradford County and its municipalities. This document uses an all-hazards approach when evaluating the hazards that affect the county and the associated risks and impacts each hazard presents.

This risk assessment provides the basic information necessary to develop effective hazard mitigation/prevention strategies. Moreover, this document provides the foundation for the Bradford County Emergency Operations Plan (EOP), local EOPs and other public and private emergency management plans.

The Bradford County risk assessment is not a static document, but rather, is a biennial review requiring periodic updates. Potential future hazards include changing technology, new facilities and infrastructure, dynamic development patterns and demographic and socioeconomic changes into or out of hazard areas. By contrast, old hazards, such as brownfields and landfills, may pose new threats as county conditions evolve.

Using the best information available and geographic information systems (GIS) technologies, the county can objectively analyze its hazards and vulnerabilities. Assessing past events is limited by the number of occurrences, scope and changing circumstances. For example, ever-changing development patterns in Pennsylvania have a dynamic impact on traffic patterns, population density and distribution, storm water runoff and other related factors. Therefore, limiting the risk assessment to past events is myopic and inadequate.

The Bradford County Local Planning Team reviewed and assessed the change in risk for all natural and human caused hazards identified in the 2015 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Pennsylvania 2018 Hazard Mitigation Plan but not included in the 2015 Bradford County Hazard Mitigation Plan that could impact Bradford County. The team utilized the hazard identification and risk evaluation worksheet that was provided by the Pennsylvania Emergency Management Agency.

The Bradford County Steering committee met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. Forty-nine of fifty-one municipalities returned completed worksheets, along with one completed by the Bradford County DCNR office, and one completed by county officials. This information was combined with the county information to develop an overall list of hazards that would need to be profiled.

Once the natural and human caused hazards were identified and profiled, the local planning team then completed a vulnerability assessment for each hazard. An inventory of vulnerable assets was completed utilizing GIS data and local planning team knowledge. The team used the most recent Bradford County assessment data to estimate loss to particular hazards. Risk factor was then assessed to each profiled hazard utilizing the hazard prioritization matrix. This assessment allows the county and its municipalities to focus on and prioritize local mitigation efforts on areas that are most likely to be damaged or require early response to a hazard event.

4.2. Hazard Identification

4.2.1. Presidential and Gubernatorial Disaster Declarations

Table 5 - Disaster and Emergency Declarations Affecting Bradford County presents a list of all Presidential and Governor's Disaster Declarations that have affected Bradford County from 1954 through 2018, according to the Pennsylvania Emergency Management Agency.

Table 5 - Disaster and Emergency Declarations Affecting Bradford County

Disaster and Emergency Declarations Affecting Bradford County *(PEMA)* ***Event also received Small Business Administration Loan Assistance**		
Date	**Type**	**Cause**
September, 1955	Gubernatorial Disaster Declaration	Drought
September, 1963	Presidential Disaster Declaration	Drought
January, 1966	Gubernatorial Disaster Declaration	Heavy Snow
February, 1972	Gubernatorial Disaster Declaration	Heavy Snow
June, 1972	Presidential Disaster Declaration	Flood (Agnes)
February, 1974	Gubernatorial Disaster Declaration	Truckers Strike
September, 1975	Presidential Disaster Declaration	Flood (Eloise)
October, 1976	Presidential Disaster Declaration	Flood
January, 1978	Gubernatorial Disaster Declaration	Heavy Snow
February, 1978	Gubernatorial Disaster Declaration	Blizzard
March, 1993	Presidential Disaster Declaration	Blizzard
January, 1994	Presidential Disaster Declaration	Severe Winter Storms

Disaster and Emergency Declarations Affecting Bradford County *(PEMA)* ***Event also received Small Business Administration Loan Assistance**		
Date	**Type**	**Cause**
August, 1994*	Gubernatorial Disaster Declaration	Flooding
September, 1995	Gubernatorial Disaster Declaration	Drought
January, 1996	Presidential Disaster Declaration	Severe Winter Storms
January, 1996	Presidential Disaster Declaration	Flooding
July, 1999	Gubernatorial Disaster Declaration	Drought
September, 1999	Presidential Disaster Declaration	Hurricane Floyd
September, 2003	Presidential Disaster Declaration	Hurricane Isabel/Henri
September, 2004	Presidential Disaster Declaration	Tropical Depression Ivan
April, 2005	Presidential Disaster Declaration	Severe Storms, Flooding, and
September, 2005	Gubernatorial Proclamation of Emergency	Hurricane Katrina
September, 2005	Presidential Proclamation of Emergency	Hurricane Katrina
June, 2006	Presidential Proclamation of Emergency	Flooding
September, 2006	Gubernatorial Proclamation of Emergency	Tropical Depression Ernesto
November, 2006	Presidential Proclamation of Emergency	Flooding
February, 2007	Gubernatorial Proclamation of Emergency	Severe Winter Storm
February, 2007	Gubernatorial Proclamation of Emergency	Regulations
April, 2007	Gubernatorial Disaster Declaration	Severe Storm
April, 2007	Gubernatorial Proclamation of Emergency	Severe Winter Storm
February, 2010	Gubernatorial Proclamation of Emergency	Severe Winter Storm
January, 2011	Gubernatorial Proclamation of Emergency	Severe Winter Storm
July 2011	Presidential Disaster Declaration	Severe Storms and Flooding
August, 2011 (amended September 2011)	Gubernatorial Proclamation of Emergency	Severe Storms and Flooding (Lee/Irene)
September, 2011	Presidential Proclamation of Emergency	Remnants of Tropical Storm Lee
September, 2011	Presidential Disaster Declaration	Remnants of Tropical Storm Lee
April, 2012	Gubernatorial Proclamation of Emergency	Spring Winter Storms
October, 2012	Gubernatorial Proclamation of Emergency	Hurricane Sandy
October, 2012	Presidential Proclamation of Emergency	Hurricane Sandy
June, 2013	Gubernatorial Proclamation of Emergency	High Winds, Thunderstorms, Heavy Rain, Tornado, Flooding
January, 2014	Gubernatorial Proclamation of Disaster Emergency	Extreme Weather, Utility Interruption
February, 2014	Gubernatorial Proclamation of Disaster	Severe Winter Storm
February, 2014	Gubernatorial Proclamation of Disaster	Severe Winter Storm
February, 2014	Gubernatorial Proclamation of Disaster Emergency	Severe Winter Storm
January, 2015	Gubernatorial Proclamation of Emergency	Severe Winter Storms

Disaster and Emergency Declarations Affecting Bradford County *(PEMA)* *Event also received Small Business Administration Loan Assistance		
Date	**Type**	**Cause**
August, 2015	Gubernatorial Proclamation of Emergency	Severe Storms
January, 2016	Gubernatorial Proclamation of Emergency	Severe Winter Storm
December 2016	Presidential Disaster Declaration	Severe Storms and Flooding
March, 2017	Gubernatorial Proclamation of Emergency	Severe Winter Storm
March, 2017	Gubernatorial Proclamation of Emergency	Severe Winter Storm
January, 2018	Gubernatorial Proclamation of Disaster Emergency	Opioid Crisis
March, 2018	Gubernatorial Proclamation of Emergency	Opioid Crisis, Severe Winter Storms

4.2.2. Summary of Hazards

The Bradford County Local Planning Team (LPT) was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2020 HMP Update. Following a review of the hazards considered in the 2015 HMP and the standard list of hazards, the local planning team decided that the 2020 plan should identify, profile and analyze twenty-three hazards. These hazards include all of the hazards profiled in the 2015 plan. The list below contains the hazards that have the potential to impact Bradford County as identified through previous risk assessments, the Bradford County Hazards Vulnerability Analysis and input from those that participated in the 2020 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

Identified Natural Hazards

Drought

Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds and low relative humidity can exacerbate the severity of drought. This hazard is of concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely impact these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses. (National Drought Mitigation Center, 2006).

Earthquake

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns.

Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons and disrupt the social and economic functioning of the affected area. Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking which is dependent upon amplitude and duration of the earthquake. (FEMA, 1997).

Extreme Temperatures

Extreme cold temperatures drop well below what is considered normal for an area during the winter months and often accompany winter storm events. Combined with increases in wind speed, such temperatures in Pennsylvania can be life threatening to those exposed for extended periods of time. Extreme heat can be described as temperatures that hover 10°F or more above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined.

Flood, Flash Flood, Ice Jam

Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period of time. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas. Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure.

Hurricanes, Tropical Storms

Hurricanes and tropical storms are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. While most of Pennsylvania is not directly affected by the devastating impacts cyclonic systems can have on coastal regions, many areas in the state are subject to the primary damaging forces associated with these storms including high-level sustained winds, heavy precipitation and tornados. Areas in southeastern Pennsylvania could be susceptible to storm

surge and tidal flooding. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea and Gulf of Mexico during the official Atlantic hurricane season which is typically June through November (FEMA, 1997).

Invasive Species

An invasive species is a species that is not indigenous to the ecosystem under consideration which thrives in the novel ecosystem. Such species often cause environmental or economic harm. Invasive species can be any type of organism, such as plants, fish, invertebrates, mammals, insects, and even diseases or pathogens. Not all non-native species cause problems, however many can cause agricultural hardships, defoliate and kill native plants and trees and interfere with native ecological systems.

Landslide

A landslide is the downward and outward movement of slope-forming soil, rock and vegetation reacting to the force of gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes and changes in groundwater levels. Mudflows, mudslides, rock falls, rockslides and rock topples are all forms of a landslide. Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, developed hillsides and areas recently burned by forest and brush fires. (Delano & Wilshusen, 2001).

Pandemic and Infectious Diseases

A pandemic occurs when infection from of a new strain of a certain disease, to which most humans have no immunity, substantially exceeds the number of expected cases over a given period of time. Such a disease may or may not be transferable between humans and animals. (Martin & Martin-Granel, 2006). Infectious diseases such as West Nile Virus or Lyme disease are also important to monitor and mitigate.

Radon Exposure

Radon is a cancer-causing natural radioactive gas that you can't see, smell, or taste. It is a large component of the natural radiation that humans are exposed to and can pose a serious threat to public health when it accumulates in poorly ventilated residential and occupation settings. According to the USEPA, radon is estimated to cause about 21,000 lung cancer deaths per year, second only to smoking as the leading cause of lung cancer (EPA 402-R-03-003: EPA Assessment…, 2003). An estimated 40% of the homes in Pennsylvania are believed to have elevated radon levels (Pennsylvania Department of Environmental Protection, 2009).

Tornado, Windstorm

A windstorm can occur during severe thunderstorms, winter storms, coastal storms, or tornados. Straight-line winds such as a downburst have the potential to cause wind

gusts that exceed 100 miles per hour. Based on 40 years of tornado history and over 100 years of hurricane history, FEMA identifies western and central Pennsylvania as being more susceptible to higher winds than eastern Pennsylvania. (FEMA, 1997). A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornados are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornados are a few dozen yards wide and touch down briefly, but even small, short-lived tornados can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Campgrounds and people staying in tents or mobile campers are also vulnerable to severe windstorms. Waterspouts are weak tornados that form over warm water and are relatively uncommon in Pennsylvania. Each year, an average of over 800 tornados is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002). Based on NOAA Storm Prediction Center Statistics, the number of recorded F3, F4, & F5 tornados between 1950-1998 ranges from <1 to 15 per 3,700 square mile area across Pennsylvania (FEMA, 2009). A waterspout is a tornado over a body of water (American Meteorological Society, 2009).

Wildfire

A wildfire is a raging, uncontrolled fire that spreads rapidly through vegetative fuels, exposing and possibly consuming structures. Wildfires often begin unnoticed and can spread quickly, creating dense smoke that can be seen for miles. Wildfires can occur at any time of the year, but mostly occur during long, dry hot spells. Any small fire in a wooded area, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness, negligence and ignorance. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Wildfires in Pennsylvania can occur in fields, grass, brush and forests. 98% of wildfires in Pennsylvania are a direct result of people, often caused by debris burns (PA DCNR, 1999). Wildfires can also be natural and important parts of some ecosystems.

Winter Storm

Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several

days. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility and disrupt transportation. The Commonwealth of Pennsylvania has a long history of severe winter weather. (NOAA, 2009).

Identified Human Caused Hazards

Civil Disturbance

Civil disturbance hazards encompass a set of hazards emanating from a wide range of possible events that cause civil disorder, confusion, strife and economic hardship. Civil disturbance hazards include the following:

- Famine; involving a widespread scarcity of food leading to malnutrition and increased mortality (Robson, 1981).
- Economic Collapse, Recession; Very slow or negative growth, for example (Economist, 2009).
- Misinformation; erroneous information spread unintentionally (Makkai, 1970).
- Civil Disturbance, Public Unrest, Mass Hysteria, Riot; group acts of violence against property and individuals, for example (18 U.S.C. § 232, 2008).
- Strike, Labor Dispute; controversies related to the terms and conditions of employment, for example (29 U.S.C. § 113, 2008).

Dam Failure

A dam is a barrier across flowing water that obstructs, directs, or slows down water flow. Dams provide benefits such as flood protection, power generation, drinking water, irrigation and recreation. Failure of these structures results in an uncontrolled release of impounded water. Failures are relatively rare, but immense damage and loss of life is possible in downstream communities when such events occur. Aging infrastructure, hydrologic, hydraulic and geologic characteristics, population growth and design and maintenance practices should be considered when assessing dam failure hazards. The failure of the South Fork Dam, located in Johnstown, Pennsylvania, was the deadliest dam failure ever experienced in the United States. It took place in 1889 and resulted in the Johnstown Flood which claimed 2,209 lives (FEMA, 1997). Today there are approximately 3,200 dams and reservoirs throughout Pennsylvania (Pennsylvania Department of Environmental Protection, 2009).

Drug Abuse

Pennsylvania and the nation at large is experiencing an epidemic of opioid drug addiction. There has been a rapid increase in the use of prescription and non-prescription opioid drugs in the United States beginning in the late 1990s and continuing throughout the first two decades of the 2000s. Opioids are a diverse class of moderately strong painkillers, including oxycodone, hydrocodone, and a very strong painkiller, fentanyl, which is synthesized to resemble other opiates such as opium-derived morphine and heroin.

The potency and availability of these substances, despite their high risk of addiction and overdose, have made them popular both as formal medical treatments and as recreational drugs. Due to their sedative effects on the part of the brain which regulates breathing, opioids in high doses present the potential for respiratory depression and may cause respiratory failure and death. It has become more useful to view opioid addiction as a disease rather than an illicit behavior requiring criminal consequences.

The Commonwealth of Pennsylvania, along with other states in the nation has enacted legislation to curb the prescription and distribution of these drugs to try to prevent addiction rising from abuse as a painkiller. This includes but is not limited to restrictions to prescribing to minors, quantity limits, a prescription database with entry requirements and other limits to its availability.

Emergency Response Organizations

Emergency Medical Services (EMS) and Fire Department Services play a crucial role in the emergency response system, and the wellness of these emergency services directly impacts many of the other hazards profiles in this report. Both EMS and Fire Services face challenges from lack of funding and lower rates of volunteerism.

Environmental Hazards

Environmental hazards are hazards that pose threats to the natural environment, the built environment and public safety through the diffusion of harmful substances, materials, or products. Environmental hazards include the following:

- Hazardous material releases; at fixed facilities or as such materials are in transit and including toxic chemicals, infectious substances, biohazardous waste and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)).
- Air or Water Pollution; the release of harmful chemical and waste materials into water bodies or the atmosphere, for example (National Institute of Health Sciences, July 2009; Environmental Protection Agency, Natural Disaster PSAs, 2009).
- Superfund Facilities; hazards originating from abandoned hazardous waste sites listed on the National Priorities List (Environmental Protection Agency, National Priorities List, 2009).
- Manure Spills; involving the release of stored or transported agricultural waste, for example (Environmental Protection Agency, Environmental Impacts of…, 1998).
- Product Defect or Contamination; highly flammable or otherwise unsafe consumer products and dangerous foods (Consumer Product Safety Commission, 2003).

Levee Failure

A levee is a human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to provide protection from temporary flooding (Interagency Levee Policy Review Committee, 2006). Levee failures or breaches occur when a levee fails to contain the floodwaters for which it is designed to control, or floodwaters exceed the height of the constructed levee. 51 of Pennsylvania's 67 counties have been identified as having at least one levee (FEMA Region III, 2013).

Nuclear Incidents

Nuclear accidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation (FEMA, 1997). Nuclear accidents/incidents can be placed into three categories: 1) Criticality accidents which involve loss of control of nuclear assemblies or power reactors, 2) Loss-of-coolant accidents which result 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, and 3) Loss-of-containment accidents which involve the release of radioactivity. The primary concern following such an incident or accident is the extent of radiation, inhalation, and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns, severe impairment), chronic health effects (e.g. cancer), and psychological effects. (FEMA, 1997).

Terrorism

Terrorism is use of force or violence against persons or property with the intent to intimidate or coerce. Acts of terrorism include active shooters, threats of terrorism, assassinations, kidnappings, hijackings, bomb scares and bombings, cyber-attacks (computer-based), and the use of chemical, biological, nuclear and radiological weapons. (FEMA, 2009).

Transportation Accidents

Transportation accidents can result from any form of air, rail, water, or road travel. It is unlikely that small accidents would significantly impact the larger community. However, certain accidents could have secondary regional impacts such as a hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are present. (Research and Innovative Technology Administration, 2009). Traffic congestion in certain circumstances can also be hazardous. Traffic congestion is a condition that occurs when traffic demand approaches or exceeds the available capacity of the road network. This hazard should be carefully evaluated during emergency planning since it is a key factor in timely disaster or hazard response, especially in areas with high population density. (Federal Highway Administration, 2009).

Urban Fire and Explosion

An urban fire involves a structure or property within an urban or developed area. For hazard mitigation purposes, major urban fires involving large buildings and/or multiple properties are of primary concern. The effects of a major urban fire include minor to significant property damage, loss of life, and residential or business displacement. Explosions are extremely rapid releases of energy that usually generate high temperatures and often lead to fires. The risk of severe explosions can be reduced through careful management of flammable and explosive hazardous materials. (FEMA, 1997).

Utility Interruption

Utility interruption hazards are hazards that impair the functioning of important utilities in the energy, telecommunications and public works and information network sectors. Utility interruption hazards include the following:

- Geomagnetic Storms; including temporary disturbances of the Earth's magnetic field resulting in disruptions of communication, navigation and satellite systems (National Research Council et al., 1986).
- Fuel or Resource Shortage; resulting from supply chain breaks or secondary to other hazard event.
- Electromagnetic Pulse; originating from an explosion or fluctuating magnetic field and causing damaging current surges in electrical and electronic systems (Institute for Telecommunications Sciences, 1996).
- Information Technology Failure; due to software bugs, viruses, or improper use (Rainer Jr., et al, 1991).
- Ancillary Support Equipment; electrical generating, transmission, system-control and distribution-system equipment for the energy industry (Hirst & Kirby, 1996).
- Public Works Failure; damage to or failure of highways, flood control systems, deep-water ports and harbors, public buildings, bridges, dams, for example (United States Senate Committee on Environment and Public Works, 2009).
- Telecommunications System Failure; Damage to data transfer, communications and processing equipment, for example (FEMA, 1997)
- Transmission Facility or Linear Utility Accident; liquefied natural gas leakages, explosions, facility problems, for example (United States Department of Energy, 2005)
- Major Energy, Power, Utility Failure; interruptions of generation and distribution, power outages, for example (United States Department of Energy, 2000).

4.2.3. Climate Change

Impacts of Climate Change on Identified Hazards

Humans have become the dominant species on Earth and our society and influence is globalized. Human activity such as the large-scale consumption of fossil fuels and deforestation has caused atmospheric carbon dioxide concentrations to significantly increase and a notable diversity of species to go extinct. The result is rapid climate change unparalleled in Earth's history and an extinction event approaching the level of a mass extinction (Barnosky et al., 2011; Wake & Vredenburg, 2008). The corresponding rise of average atmospheric temperatures is intensifying many natural hazards, and further threatening biodiversity. The effects of climate change are starting to be felt for some natural hazards, and these effects are expected to intensify over time as temperatures continue to rise.

The seemingly most apparent change that climate change is causing is regarding extreme temperature (Section 4.3.3). The annual average temperature has increased by 1.2˚F across the continental United States during the years 1986 to 2016 compared to the time period 1901 to 1960, and temperatures are expected to continue rising (Vose et al., 2017). In recent years, record high temperatures have outnumbered low temperatures (Meehl et al., 2009; Vose et al., 2017) so it expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated. While there may be fewer extreme cold events, those that do occur are expected to more often reach record setting low temperatures (Vose et al., 2017).

Less immediately apparent, climate change could increase the prevalence of the West Nile Virus (Section 4.3.8). Some studies show increased insect activities during a similar rapid warming event in Earth's history (Curano et al., 2008). Other studies make projections that with the warming temperatures and lower annual precipitation that are expected with climate change, there will be an expansion of the suitable climate for mosquitos and West Nile Virus, potentially increasing the risk that the disease poses (Harrigan et al., 2014). Climate change is also contributing to the introduction of new invasive species (Section 4.3.6). As maximum and minimum seasonal temperatures change, non-native species can establish themselves in previously inhospitable climates where they have a competitive advantage. This may shift the dominance of ecosystems in the favor of non-native species, contributing to species loss and the risk of extinction.

Climate change is likely to increase the risk of droughts (Section 4.3.1). Higher average temperatures mean that more precipitation will fall as rain rather than snow, snow will melt earlier in the spring, and evaporation and transpiration will increase. As such the risk of hydrological and agricultural drought is expected to increase (Sheffield & Wood, 2008; EPA, 2016). Correspondingly this will impact wildfires (Section 4.3.11). Drought is accompanied by drier soils and forests, resulting in an elongated wildfire season and more intense and long-burning wildfires (Pechony & Shindell, 2010). However, the Southwest United States is at a greater risk of this increased drought and wildfire activity than Bradford County in the Eastern United States.

While it may seem counterintuitive considering the increased risk of drought, there is also an increased risk of flooding associated with climate change (Section 4.3.4). As previously mentioned, warmer temperatures mean more precipitation will fall as rain rather than snow. Combined with the fact that warmer air holds more moisture, the result is heavier and more intense rainfalls. Pennsylvania has seen an increase in annual average precipitation of five to ten percent is the last century, with precipitation from extreme storms increasing seventy percent since 1958, and these numbers are expected to continue to rise (EPA, 2016). These changes to precipitation will impact agriculture and increase the risk of flooding and dam and levee failures. Similarly, winter storms are expected to become more intense, if possibly less frequent (Section 4.3.12).

Climate change is expected to result in more intense hurricanes and tropical storms (Section 4.3.5). With the rise of atmospheric temperatures, ocean surface temperatures are rising, resulting in warmer and moister conditions where tropical storms develop (Stott et al., 2010). A warmer ocean stores more energy and can fuel stronger storms. It is projected that the Atlantic hurricane season is elongating, and there will be more category 4 and 5 hurricanes than before (Trenberth, 2010). The unexpectedly devastating Hurricane Harvey in August 2017 in Houston is widely regarded as an example of a hurricane supercharged by warmer ocean temperatures (Trenberth et al., 2018).

The impacts of climate change are no longer hypothetical concepts set in the future, but rather tangible and hazardous realities. Hurricane Harvey's destruction is an example of the increased hazard of tropical storms. Additionally, wildfires in California are largely believed to be burning faster and hotter due to worsening drought conditions that are being caused by climate change (Cvijanovic et al., 2017). The wildfire season in California in both 2017 and 2018 each broke records for having unprecedentedly devastating fires. The November 2018 Camp Fire in Butte County California burned 153,336 acres, 18,804 structures (including the town of Paradise), and claimed 86 lives (Cal Fire, January 2019). While these specific events were not especially close to Pennsylvania, they are early illustrations of the impact that climate change is having, and they confirm the best available scientific predictions of what is to come. It is important to properly connect these intensifying occurrences to climate change in order to inform future actions for all hazards that climate change will impact.

On January 8 2019, Governor Tom Wolf issued executive order 2019-01, reestablishing the Governor's Green Government Council and setting achievable climate goals for the Commonwealth of Pennsylvania. The climate goals were based on the November 2018 report *Pennsylvania Climate Action Plan* (PA DEP, 2018) and include the following benchmarks for the Commonwealth:

- 26% reduction of net greenhouse gas emissions by 2025 (from 2005 levels).
- 80% reduction of net greenhouse gas emissions by 2050 (from 2005 levels).

These goals are like those that over twenty other states have set as targets in the last few years, and like those outlined in the international 2015 Paris climate agreement. From the year 2000 to 2015, Pennsylvania had the third most greenhouse gas emissions among states in the nation (EIA, 2018), making the Commonwealth an important state to work towards reducing emissions. The Green Government Council also is intended to reduce energy consumption within government agencies and included the following goals for all agencies under the Governor's jurisdiction (Exec. Order No. 2019-01):

- Collectively reduce overall energy consumption by three percent per year, and twenty-one percent by 2025 (from 2017 levels).
- Replace twenty-five percent of the state passenger car fleet with batter electric and plug-in electric hybrid cars by 2025 and evaluate opportunities for the reduction of vehicle miles traveled and incorporation of new technology where appropriate.
- Procure renewable energy to offset at least forty percent of the Commonwealth's annual electricity use and evaluate opportunities to source electricity through Pennsylvania Certified Tier I credits, and/or direct purchase of renewable power generation sited within Pennsylvania.
- Consider green options in any new building construction project with a goal of a ten percent reduction in the energy consumption over ANSI/ASHRAE/IES Standards.

This type of sudden global change is novel to humanity. All research and many recent events point to the intensification of the hazards mentioned above, especially if human society does not make swift and significant changes to reduce emissions and species losses. Individuals can work to reduce emissions and support green practices in their own ways; however, the most significant reductions are made on a systematic level.

4.3. Hazard Profiles

4.3.1. Drought

4.3.1.1 Location and Extent

While Pennsylvania is generally more water-rich than many U.S. states, the Commonwealth may be subject to drought conditions. A drought is broadly defined as a time period of prolonged dryness that contributes to the depletion of ground and surface water. Droughts are regional climatic events, so when such an event occurs in Bradford County, impacts are not restricted to the county and are often more widespread. The spatial extent of the impacted area can range from localized areas in Pennsylvania to the entire Mid-Atlantic region.

There are three types of drought:

Meteorological Drought – A deficiency of moisture in the atmosphere compared to average conditions. Meteorological drought is defined by the duration of the deficit and degree of dryness and is often associated with below average rainfall. Depending on the

severity of the drought, it may or may not have a significant impact on agriculture and the water supply.

Agricultural Drought – A drought inhibiting the growth of crops, due to a moisture deficiency in the soil. Agricultural drought is linked to meteorological and hydrologic drought.

Hydrologic Drought – A prolonged period without rainfall that has an adverse effect on streams, lakes, and groundwater levels, potentially impacting agriculture.

Bradford County has glaciated plateau topography which features extensive forest lands as well as scattered lakes, bogs and marsh wetlands. Bradford County has a predominantly rural landscape of forested hills and mountains, agricultural valleys, and small towns and villages at rural crossroads. There are approximately 6,000 acres of surface water in Bradford County, with the Susquehanna River and its tributaries as the primary source. The Susquehanna River traverses from north to south through the county, and there are natural as well as man-made ponds and lakes scattered throughout the county.

4.3.1.2 Range of Magnitude

Rural farming areas of Bradford County are most at risk when a drought occurs. A drought can be a significant financial burden as approximately 44% of the county land use is devoted to crop cultivation (Comprehensive Plan, 2018). Wildfires are often the most severe secondary effect associated with drought. Wildfires can devastate wooded and agriculture areas, threatening natural resources, structures near high wildfire loads, and farm production facilities. Prolonged drought conditions can have a lasting impact on the economy and can cause major ecological changes, such as increases in scrub growth, flash flooding and soil erosion.

Long-term water shortages during severe drought conditions can have a significant impact on agribusiness, public utilities, and other industries reliant on water for production services. *Table 7 - Drought Preparation Phases* shows the FEMA defined levels of drought severity along with suggested actions, requests and goals. Drought can cause municipalities to enforce water rationing and distribution.

The Commonwealth uses five parameters to assess drought conditions:

- Stream flows (compared to benchmark records).
- Precipitation (measured as the departure from normal, thirty year average precipitation).
- Reservoir storage levels in a variety of locations such as three New York City reservoirs in the upper Delaware River Basin.
- Groundwater elevations in a number of counties (comparing to past month, past year and historic record).
- Soil moisture via the Palmer Drought Index (See

Table 6 - Palmer Drought Severity Index) - a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature.

Table 6 - Palmer Drought Severity Index

Palmer Drought Severity Index	
Severity Category	**PDSI**
Extremely wet	4.0 or more
Very wet	3.0 to 3.99
Moderately wet	2.0 to 2.99
Slightly wet	1.0 to 1.99
Incipient wet spell	0.5 to 0.99
Near normal	0.49 to -0.49
Incipient dry spell	-0.5 to -0.99
Mild drought	-1.0 to -1.99
Moderate drought	-2.0 to -2.99
Severe drought	-3.0 to -3.99
Extreme drought	-4.0 or less

Table 7 - Drought Preparation Phases

Drought Preparation Phases *(PA DEP, 2017)*				
Phase	**General Activity**	**Actions**	**Request**	**Goal**
Drought Watch	Early stages of planning and alert for drought possibility	Increased water monitoring, awareness and preparation for response among government agencies, public water suppliers, water users and the public	Voluntary water conservation	Reduce water use by 5%
Drought Warning	Coordinate a response to imminent drought conditions and potential water shortages	Reduce shortages - relieve stressed sources, develop new sources if needed	Continue voluntary water conservation, impose mandatory water use restrictions if needed	Reduce water use by 10-15%
Drought Emergency	Management of operations to regulate all available resources and respond to emergency	Support essential and high priority water uses and avoid unnecessary uses	Possible restrictions on all nonessential water uses	Reduce water use by 15%

Local Water Rationing: With the approval of the Pennsylvania Emergency Management Council, local municipalities may implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. These individual water rationing plans, authorized through provisions of 4 PA Code Chapter 120, will 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, procedures are provided for granting of variances to consider individual hardships and economic dislocations. Local water rationing can strain the availability of consumable water for the community and can increase the county's vulnerability to other hazards such as severe weather, extreme heat, and public health emergencies.

4.3.1.3 Past Occurrence

Table 8 - Drought Occurrence shows declared drought status for Bradford County from 1980 to January 2019 as reported by the Pennsylvania Department of Environmental Protection (PA DEP) and the table also includes past disaster declarations impacting Bradford County due to drought events. *Figure 8 - History of Declared Drought Emergencies* shows the number of drought emergency declarations that have impacted Bradford County relative to other counties in the Commonwealth. The Pennsylvania Department of Environmental Protection reports that Bradford has had eight to eleven drought emergencies from 1980 through 2016. *Figure 9 - Palmer Drought Severity Index History* shows that Bradford County has experienced severe drought (PDSI ≤ -3) between five and ten percent of the time from 1895-1995, which gives a general idea of how often the county has been affected by drought events in the last century.

A significant drought occurred in 1963 when precipitation statewide averaged below normal for ten of twelve months. Drought emergency status led to widespread water use restrictions, and reservoirs dipped to record low levels. Corn, hay, and other agricultural products desiccated in parched fields, causing economic losses. Governor William Scranton sought drought aid for Pennsylvania in the face of mounting agricultural losses, and the event became a presidentially declared disaster in September 1963.

Another devastating drought occurred throughout the year in 1999, culminating with the governor of Pennsylvania declaring a drought emergency for most of the Commonwealth on July 21, 1999. Corn crop losses alone were estimated to be approximately $100 million with total crop losses estimated at over $500 million. Other than agricultural losses, the drought resulted in low stream levels which caused some deaths of fish in abnormally dry streams. The drought emergency was lifted on September 30, 1999 with the arrival of Hurricane Floyd on September 16, 1999.

Table 8 - Drought Occurrence

Drought Occurrence *(PA DEP, 2019)*			
Start	**End**	**Status**	**Duration**
11/18/1980	04/20/1982	Emergency	1 year, 5 months, 2 days
04/26/1985	12/19/1985	Watch	7 months, 23 days
07/07/1988	08/24/1988	Watch	10 months, 8 days
08/24/1988	12/12/1988	Warning	
12/12/1988	05/15/1989	Watch	
06/28/1991	07/24/1991	Warning	11 months, 26 days
07/24/1991	04/20/1998	Emergency	
04/20/1998	06/23/1992	Warning	
09/01/1995	09/20/1995	Warning	3 months, 17 days
09/20/1995	11/08/1995	Emergency	
11/08/1995	12/18/1995	Warning	
07/17/1997	01/16/1998	Watch	5 months, 30 days
12/03/1998	12/14/1998	Watch	1 year, 5 months, 2 days
12/14/1998	03/15/1999	Warning	
03/15/1999	06/10/1999	Watch	
06/10/1999	07/20/1999	Warning	
07/20/1999	09/30/1999	Emergency**	
09/30/1999	05/05/2000	Watch	
08/24/2001	06/14/2002	Watch	9 months, 21 days
09/05/2002	11/07/2002	Watch	2 months, 2 days
04/11/2006	06/30/2006	Watch	2 months, 19 days
08/06/2007	01/11/2008	Watch	5 months, 5 days
09/16/2010	11/10/2010	Watch	1 month, 25 days
08/05/2011	09/02/2011	Watch	28 days
03/24/2015	07/10/2015	Watch	3 months, 16 days
08/02/2016	11/03/2016	Watch	3 months, 1 day
12/26/2017	02/06/2018	Watch	1 month, 11 days
**Gubernatorial Disaster Declaration			

Figure 8 - History of Declared Drought Emergencies

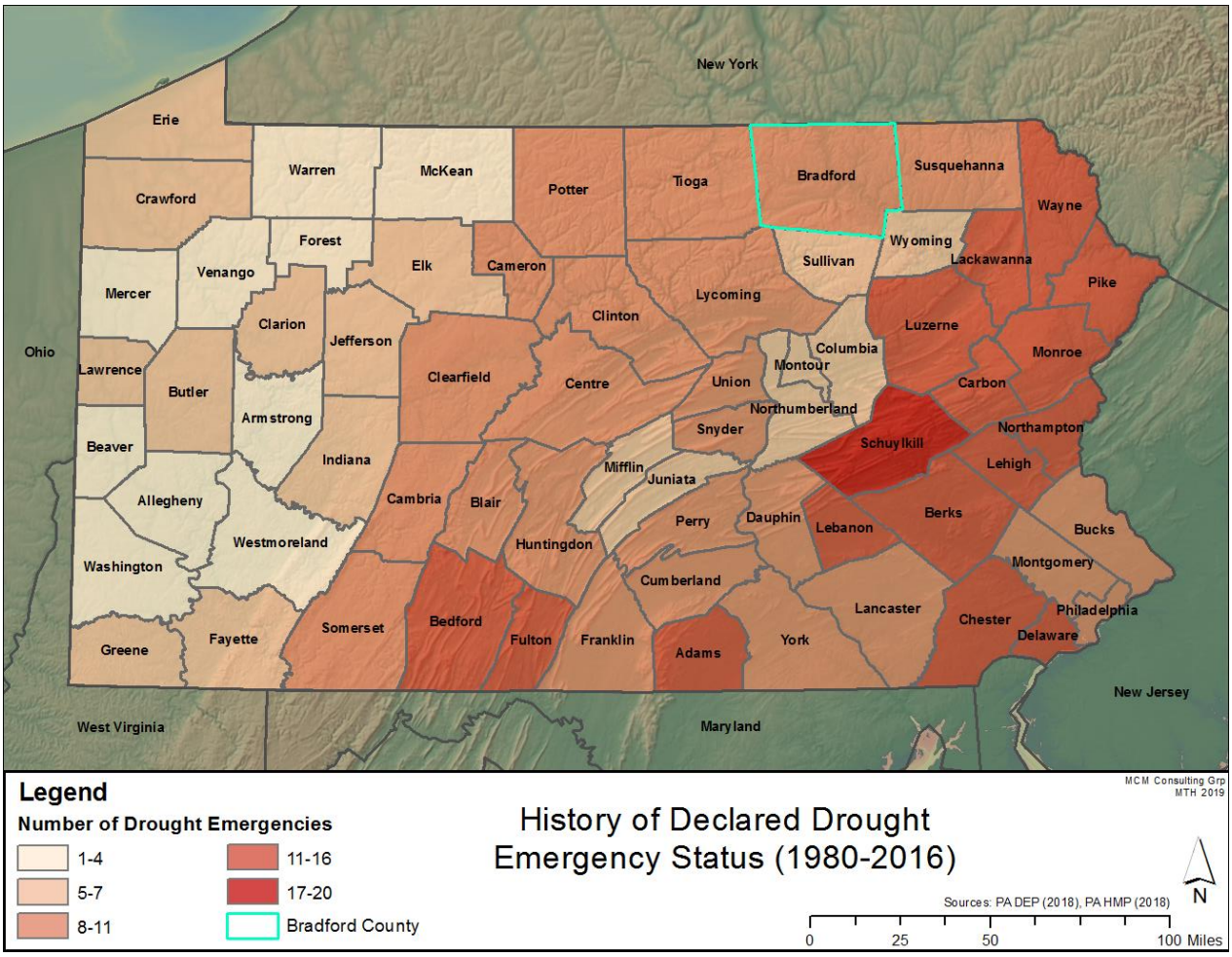
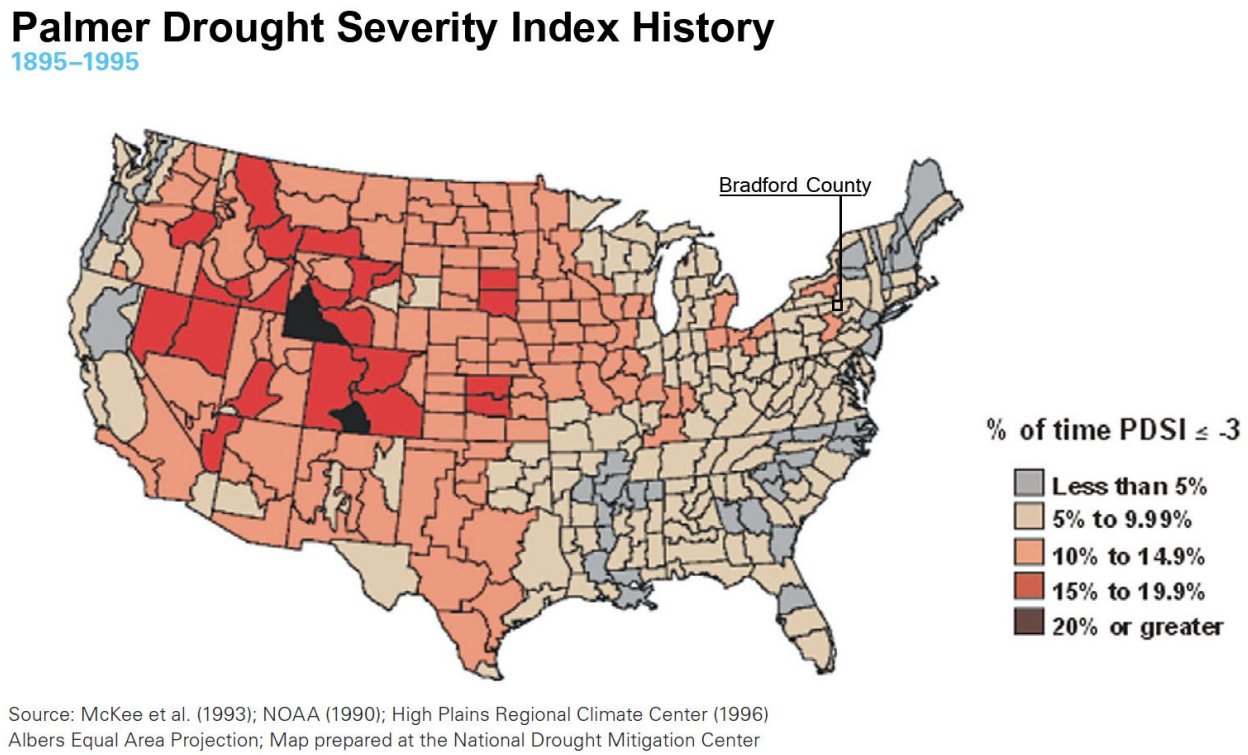

New York
Erie
Warren
McKean
Potter
Tioga
Bradford
Susquehanna
Wayne
Crawford
Forest
Wyoming
Venango
Elk
Cameron
Sullivan
Lackawanna
Mercer
Lycoming
Pike
Clarion
Clinton
Luzerne
Ohio
Jefferson
Columbia
Monroe
Lawrence
Clearfield
Montour
Centre
Union
Carbon
Butler
Armstrong
Northumberland
Snyder
Northampton
Beaver
Schuylkill
Indiana
Mifflin
Lehigh
Juniata
Allegheny
Cambria
Blair
Perry
Dauphin
Berks
Lebanon
Bucks
Westmoreland
Huntingdon
Washington
Montgomery
Cumberland
Lancaster
Philadelphia
Somerset
Bedford
Chester
Fayette
Fulton
Franklin
York
Delaware
Greene
Adams
New Jersey
West Virginia
Maryland
Legend
Number of Drought Emergencies
1-4
5-7
8-11
11-16
17-20
Bradford County
History of Declared Drought Emergency Status (1980-2016)
MCM Consulting Grp
MTH 2019
Sources: PA DEP (2018), PA HMP (2018)
N
0
25
50
100 Miles

Figure 9 - Palmer Drought Severity Index History



Source: McKee et al. (1993); NOAA (1990); High Plains Regional Climate Center (1996)
Albers Equal Area Projection; Map prepared at the National Drought Mitigation Center

4.3.1.4 Future Occurrence

It is difficult to forecast the exact severity and frequency of future drought events, and the future of climate change will lead to increased uncertainty and extremity of climate events, suggesting that it is best to be prepared for potentially adverse conditions. Bradford County has experienced severe drought between five and ten percent of the time between 1895 and 1995 (*Figure 9 - Palmer Drought Severity Index History)*, which can be used to make a rough estimate of the future probability of drought in Bradford County, although it does not account for changes introduced by climate change. Drought conditions are expected to become more severe with climate change, as evaporation and transpiration will increase with higher temperatures (Sheffield & Wood, 2008; EPA, 2016).

Figure 10 - Recent Drought Severity Index shows a recent Palmer Drought Severity Index reading for the continental United States and as of April 6, 2019, Bradford County is experiencing an extremely moist spell, with a PDSI above 4.0.

Figure 11 - Long-Term Drought Indicator shows that Bradford County is currently in the percentile that is second least vulnerable to drought events.

Figure 10 - Recent Drought Severity Index

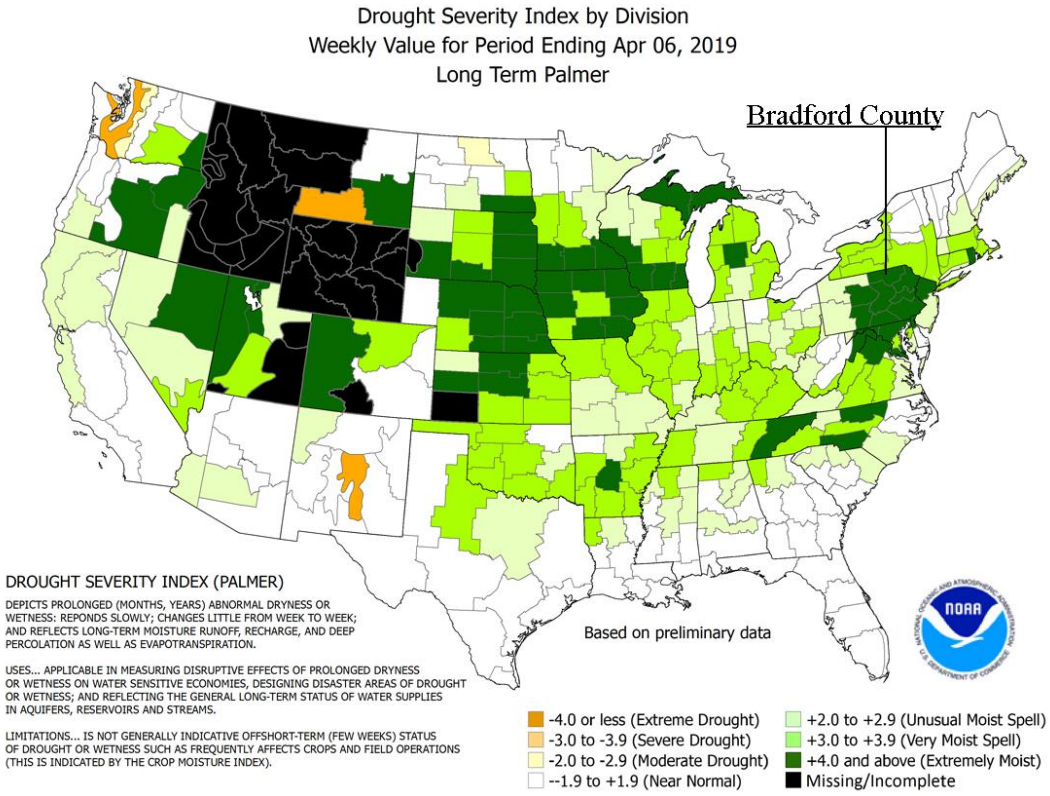
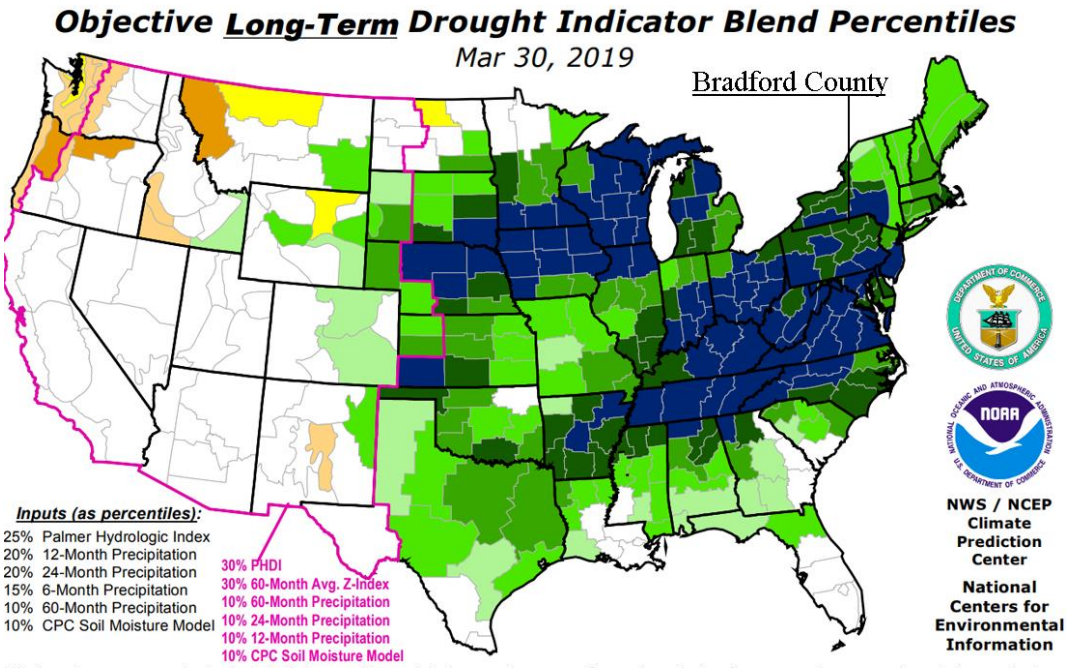


Figure 11 - Long-Term Drought Indicator



The long-term map approximates impacts that respond to precipitation over the course of several months to a few years, such as reservoir content, groundwater depth and lake levels. However, the relationship between indicators and impacts can vary significantly with location and season. This is particularly true of water supplies, which are additionally affected by source, and management practices.

4.3.1.5 Vulnerability Assessment

The most significant losses resulting from drought events are typically found in the agriculture sector. The 1999 Gubernatorial Proclamation was issued in part due to significant crop damage. Preliminary estimates by the Pennsylvania Department of Agriculture indicated possible crop losses across the Commonwealth in excess of $500 million. This estimate did not include a twenty percent decrease in dairy milk production which also resulted in million-dollar losses (NCDC, 2009).

While these were statewide impacts, they illustrate the potential for droughts to severely impair the local economy in more agricultural communities. As of the 2012 Census of Agriculture, there were an estimated 1,629 farms in Bradford County, at an average size of 189 acres. Bradford County ranks 14th of sixty-seven counties in the Commonwealth for agricultural production, totaling almost one hundred and twenty-nine million dollars (USDA, 2012). Most of this production comes from livestock, poultry and their products (~$100 million). The remaining agricultural production comes from crops, including nursery and greenhouse crops (~$29 million).

Water supplies are also vulnerable to the effects of drought. Public water service areas cover 1.3% of land area in the county, including Sayre Borough, Leraysville Borough, and most of South Waverly Borough, Athens Borough, Towanda Borough, Monroe Borough, Wyalusing Borough, New Albany Borough, Canton Borough, and Troy Borough (See *Figure 12 - Drought Vulnerability). Table 9 - Domestic Water Wells & Public Water Supply Area* shows the number of addressable structures that are in public water supply

areas by municipality, and residential versus commercial designations for these structures was not available at the time of this study.

The majority of the county relies on wells for their fresh drinking water. Droughts will quickly affect systems that rely on surface supplies, whereas systems with wells are more capable of handling short-term droughts without issue. Longer-term droughts inhibit the recharging of groundwater aquifers which has an impact on well owners. Depending on the severity of the drought, this could cause the well to dry up, rendering the well owner at a loss for useable water, meaning Bradford County residents who use private domestic wells are vulnerable to drought events. *Table 9 - Domestic Water Wells & Public Water Supply Area* shows the number of wells in each municipality in Bradford County. Well data was gathered from the Pennsylvania Groundwater Information System (PaGWIS), which relies on voluntary submissions by well drillers. While this is the best dataset of domestic wells available for Bradford County, it is not comprehensive due to the voluntary nature of the data submission. Not all wells were reported including a location designation.

Compared to the information reported in the previous hazard mitigation plan, there has been an increase in the number of domestic water wells throughout the county despite a slight population decrease. Considering the vulnerability of domestic wells to drought, their increased prevalence suggests an increase in drought vulnerability for the more rural regions of Bradford County.

The EPA provides a guide published in October 2017 for water utilities to aid in drought response and recovery. The guide outlines what goes into a good drought response plan, how to manage water supply and demand during a drought, best practices for communication and partnerships with other local utilities and provides case studies to discuss examples of drought management practices (EPA, 2017).

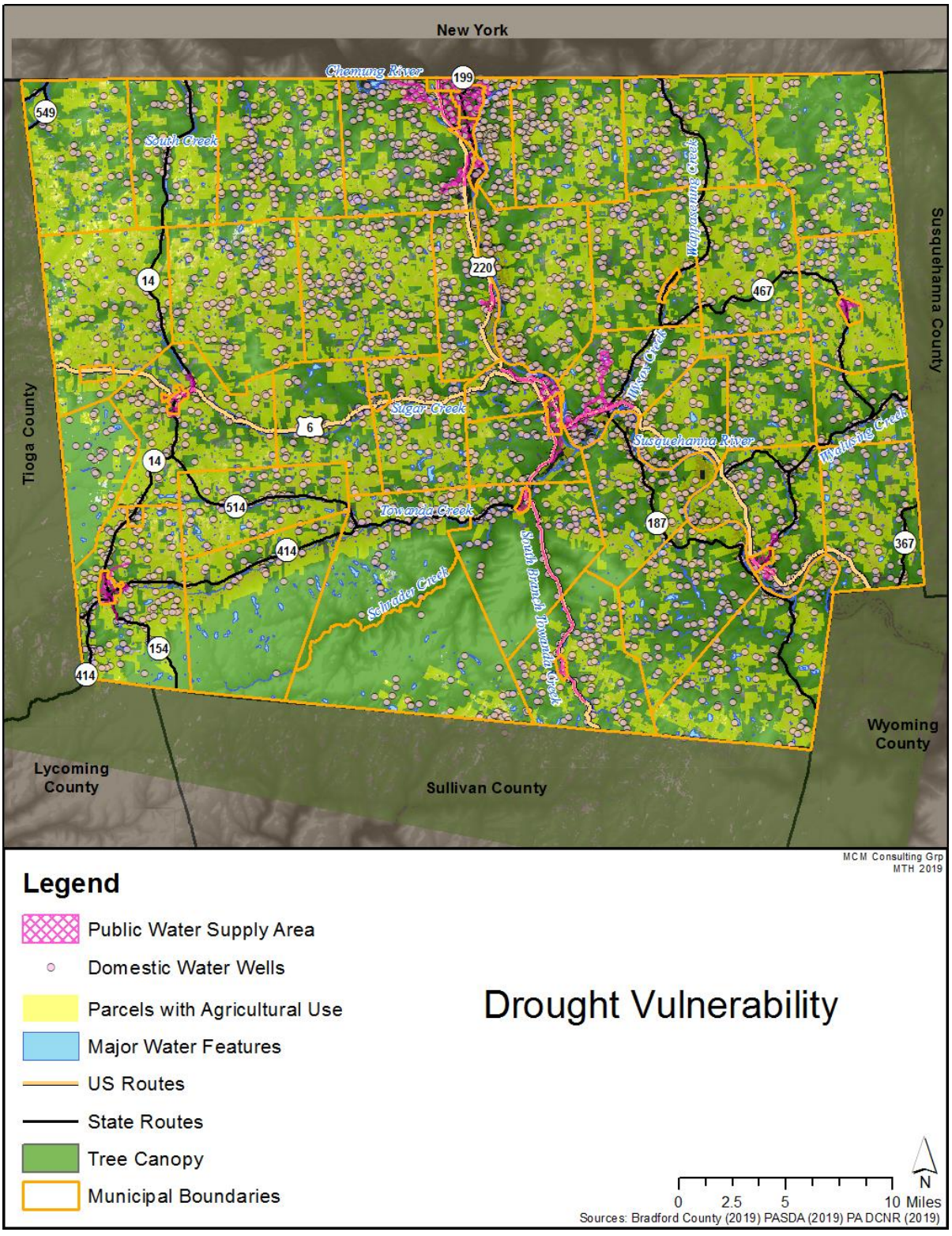
Table 9 - Domestic Water Wells & Public Water Supply Area

Domestic Water Wells & Public Water Supply Area (PWSA) *(PA GWIS, 2019; Bradford Co. GIS, 2019)*		
Municipality	**Domestic Water Wells**	**Structures in PWSA**
Alba Borough	33	0
Albany Township	182	43
Armenia Township	81	0
Asylum Township	134	19
Athens Borough	159	1,597
Athens Township	622	1,533
Burlington Borough	52	0
Burlington Township	124	0

Domestic Water Wells & Public Water Supply Area (PWSA) *(PA GWIS, 2019; Bradford Co. GIS, 2019)*		
Municipality	**Domestic Water Wells**	**Structures in PWSA**
Canton Borough	78	980
Canton Township	237	217
Columbia Township	130	30
Franklin Township	128	0
Granville Township	182	0
Herrick Township	149	0
Leraysville Borough	10	149
Leroy Township	108	0
Litchfield Township	279	0
Monroe Borough	21	238
Monroe Township	152	85
New Albany Borough	8	179
North Towanda Township	134	296
Orwell Township	190	0
Overton Township	114	0
Pike Township	92	0
Ridgebury Township	374	89
Rome Borough	79	71
Rome Township	194	70
Sayre Borough	426	2,783
Sheshequin Township	240	50
Smithfield Township	302	0
South Creek Township	101	0
South Waverly Borough	23	497
Springfield Township	205	0
Standing Stone Township	116	0
Stevens Township	101	0
Sylvania Borough	6	0
Terry Township	227	0
Towanda Borough	43	1,770
Towanda Township	81	263
Troy Borough	118	751
Troy Township	73	113

Domestic Water Wells & Public Water Supply Area (PWSA) *(PA GWIS, 2019; Bradford Co. GIS, 2019)*		
Municipality	**Domestic Water Wells**	**Structures in PWSA**
Tuscarora Township	122	0
Ulster Township	172	243
Warren Township	148	0
Wells Township	56	44
West Burlington Township	70	3
Wilmot Township	169	0
Windham Township	119	0
Wyalusing Borough	34	355
Wyalusing Township	214	4
Wysox Township	471	430
Unknown	84	0
Total	**7,767**	**12,902**

Figure 12 - Drought Vulnerability



4.3.2. Earthquake

4.3.2.1 Location and Extent

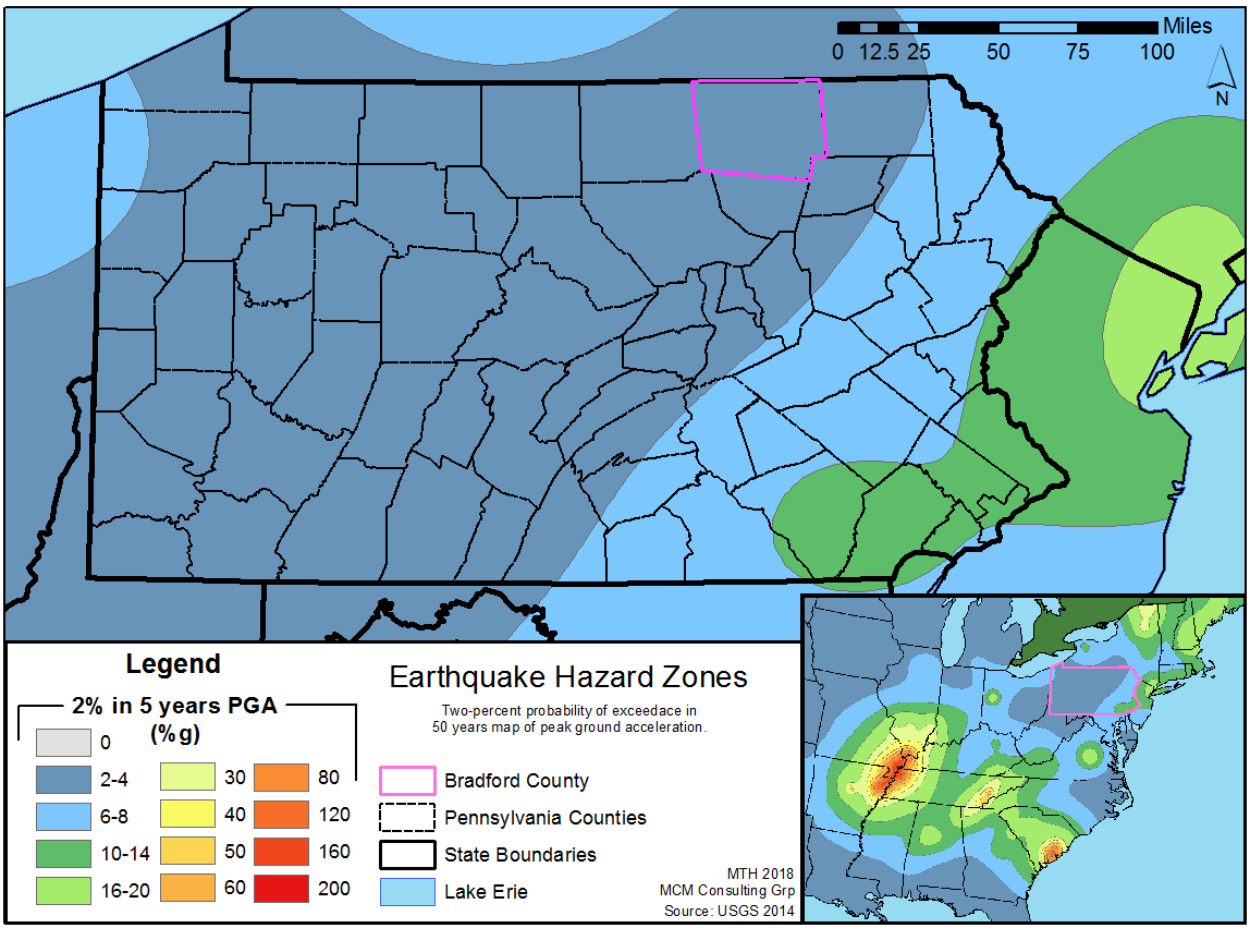
An earthquake is sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge off the earth's tectonic plates, a volcanic eruption, or by a human induced explosion (DCNR, 2007). Earthquake events in Pennsylvania, including Bradford County are usually mild events; impacting areas no greater than sixty-two miles in diameter from the epicenter. Most earthquakes occur along boundaries between tectonic plates, and some earthquakes occur at faults on the interior of plates. Today, Eastern North America, including Bradford County, Pennsylvania, is far from the nearest plate boundary. That plate boundary is the Mid-Atlantic Ridge and is approximately 2,000 miles to the east. The Ramapo Fault System runs through New York, New Jersey and eastern Pennsylvania (See *Figure 13 - Ramapo Fault System*). This fault system is associated with some small earthquakes, and it is thought unlikely to produce large earthquakes.

When the supercontinent of Pangaea broke apart about 200 million years ago, the Atlantic Ocean began to form. Since then, many faults have developed. Locating all the faults would be an idealistic approach to identifying the region's earthquake hazard; however, many of the fault lines in this region have no seismicity associated with them. The best way to determine earthquake history for Bradford County is to conduct a probabilistic earthquake-hazard analysis with the earthquakes that have already happened in and around the county (See *Figure 14 - Earthquake Hazard Zones*).

Natural gas extraction of the Marcellus Shale formation is prominent in Bradford County. Hydraulic fracturing or fracking is used to extract the gas, and the process is thought to lead to an increase seismic activity (Meyer, 2016).

Figure 13 - Ramapo Fault System

Figure 14 - Earthquake Hazard Zones



4.3.2.2 Range of Magnitude

Earthquakes result in the propagation of seismic waves, which are detected using seismographs. These seismograph results are measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. *Table 10 - Richter Scale* summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas. The Modified Mercalli Intensity Scale (*Table 11 - Modified Mercalli Intensity Scale*) is an alternative measure of earthquake intensity that is broken down by the impacts of the earthquake event. Earthquakes have many secondary impacts, including disrupting critical facilities, transportation routes, public water supplies and other utilities.

Table 10 - Richter Scale

Richter Magnitude	Earthquake Effects
Less than 3.5	Generally not felt, but recorded.

Richter Magnitude	Earthquake Effects
3.5-5.4	Often felt, but rarely causes damage.
Under 6.0	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas where people live up to about 100 kilometers across.
7.0-7.9	Major earthquake; can cause serious damage over large areas.
8.0 or greater	Great earthquake; can cause serious damage in areas several hundred kilometers across.

Table 11 - Modified Mercalli Intensity Scale

Scale	Intensity	Earthquake Effects	Richter Scale Magnitude
I	Instrumental	Detected only on seismographs	<4.2
II	Feeble	Some people feel it	
III	Slight	Felt by people resting; 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 damaged	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open	
X	Disastrous	Ground cracks profusely, many buildings destroyed, liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed, general triggering of other hazards	<8.1
XII	Catastrophic	Total destruction, trees fall, ground rises and falls in waves	>8.1

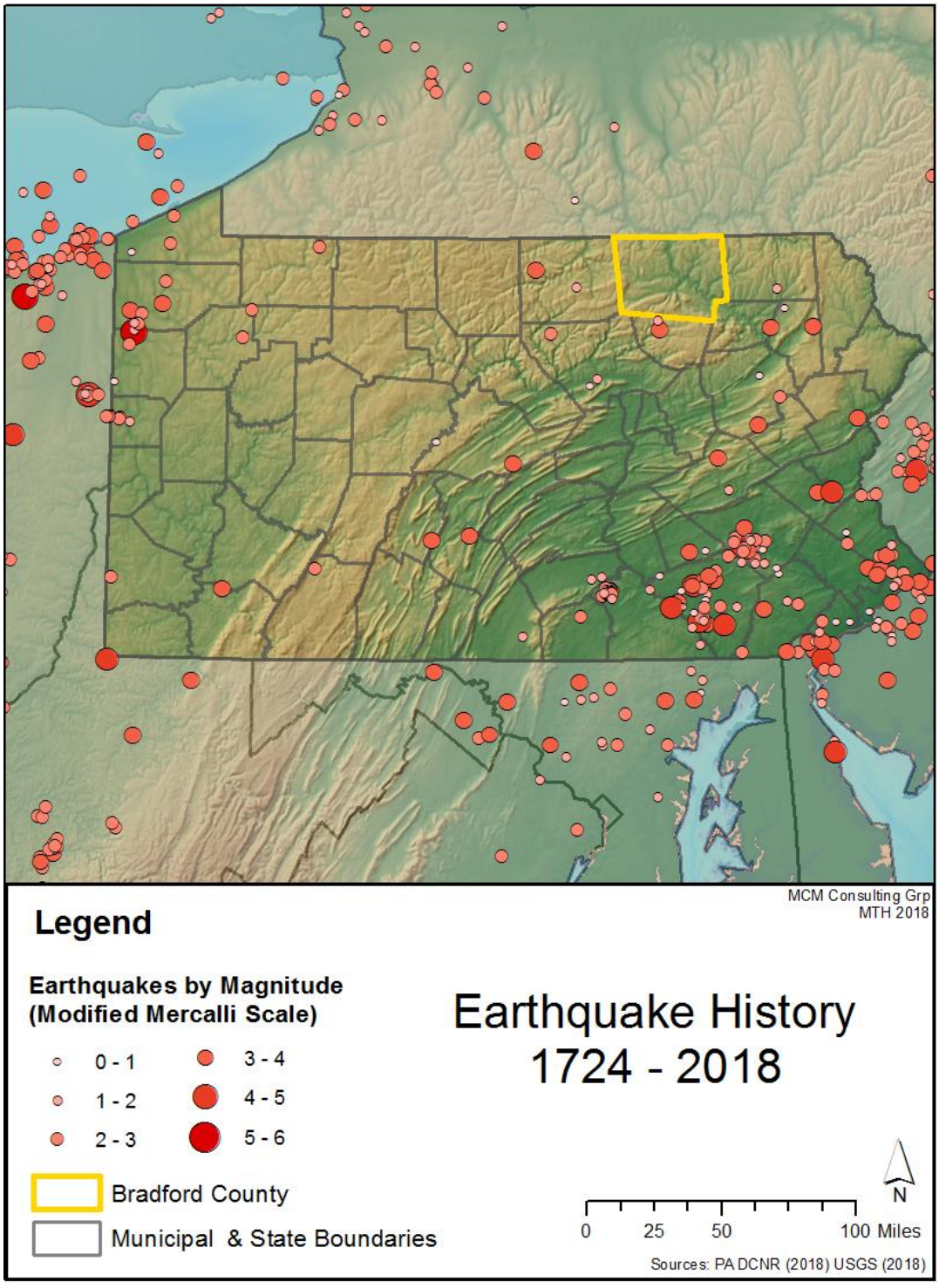
The strongest recorded earthquake in Pennsylvania was a magnitude 5.1 on the Richter Scale, so it could be expected that effects of such an event could be felt in Bradford County from earthquake events that happen around the Commonwealth.

4.3.2.3 Past Occurrence

No earthquakes have been recorded that originated in Bradford County. A total of eighteen earthquake events occurred within 100 miles of Bradford County between 1724 and December 2018 – all events were relatively minor quakes with Modified Mercalli magnitudes less than four. In four recorded incidents, Bradford has felt minor tremors; one in October 1983 (5.3), another in April 1984 (4.1), another in November 1988 (6.0) and one more on February 3rd, 2001 (2.9). There were no damages or injuries reported in the

county from any of these tremors. All earthquake events that occurred in the area surrounding Bradford County since 1724 can be seen in *Figure 15 - Earthquake History*.

Figure 15 - Earthquake History



4.3.2.4 Future Occurrence

Earthquake activity and intensities are difficult to predict, but a probabilistic analysis of prior earthquakes can assist in gauging the likelihood of future occurrences. *Figure 14 - Earthquake Hazard Zones* shows that Bradford County is in the lowest non-zero hazard zone for earthquake activity according to the USGS (2014), suggesting a low probability of earthquake occurrence. However, according to the USGS, there has been a recent trend increasing the frequency of magnitude 3 and larger earthquakes in the central and eastern US (*Table 12 - Recent Earthquake Trends in Central and Eastern United States*). This uptick in seismicity is considered to be due to hydraulic fracturing activities, and specifically occurs as a result of wastewater from the fracking process being injected into the earth (Meyer, 2016). Recent studies have moved towards being able to predict such induced seismicity by looking at uplift after injections, but more work needs to be done to confirm uplift as a reliable indicator of induced seismicity (Shirzei et al., 2016). As of December 2018, Bradford County has 1,097 active wells (PA DEP, 2018). It is important to note that seismicity can occur even after wells become inactive and injections rates decline (Shirzaei et al., 2016).

Table 12 - Recent Earthquake Trends in Central and Eastern United States

Earthquake Trends in Central and Eastern U.S. *(USGS, 2016)*	
Year	**Number of M3+ Earthquakes (average per year)**
1973-2008	21
2009-2013	99
2014	659
2015	1000+

4.3.2.5 Vulnerability Assessment

According to the U.S. Geological Society Earthquake Hazards Program, an earthquake hazard is anything associated with an earthquake that may affect a resident's normal activities. For Bradford County, this could include surface faulting, ground shaking, landslides, liquefaction, tectonic deformation, and seiches (sloshing of a closed body of water from earthquake shaking).

Earthquakes usually occur without warning and can impact areas a great distance from their point of origin (epicenter). Ground shaking is the greatest risk to building damage within Bradford County. Risk to public safety and loss of life from an earthquake is dependent upon the severity of the event. Injury or death to those inside buildings, or people walking below building ornamentation and chimneys is a higher risk to Bradford County's general public during an earthquake.

While historically the risk of earthquakes in north eastern PA is low (See *Figure 14 - Earthquake Hazard Zones*), the uptick in seismicity due to hydraulic fracturing increases the likelihood of Bradford County experiencing a damaging earthquake. Marcellus shale exploration for natural gas is widespread throughout Pennsylvania and in Bradford County specifically, meaning there has been widespread hydraulic fracturing. Considering the current knowledge of increased seismicity due to hydraulic fracturing, and the recent trends in Pennsylvania, Bradford County should expect to experience more magnitude 3 and larger earthquakes. Increased seismic activity is expected to last even after hydraulic fracturing stops, so the increased seismic risk should be expected to last well into the future. This induced seismicity is dependent on local conditions, and the impacts of hydraulic fracturing on earthquakes is variable geographically (Van der Baan & Calixto, 2017). While seismicity is likely to increase, it is thought that regions that before were relatively inactive seismically will not experience uncharacteristically catastrophic earthquakes due to hydraulic fracturing (Zhao et al., 2018).

4.3.3. Extreme Temperatures

4.3.3.1 Location and Extent

Extreme temperatures can be devastating – extreme heat can cause sunburn, heat cramps, heat exhaustion, heat stroke, and dehydration, while extreme cold can cause hypothermia and frostbite. Both can potentially cause long-lasting disabilities. *Figure 16 - Average Maximum Temperature* and *Figure 17 - Average Minimum Temperature* show the historical annual mean maximum and minimum temperatures for Pennsylvania. July has typically been the warmest month for Bradford County, with normal temperatures ranging from mid-70s to low 80s. January or February is typically the coldest month for Bradford, with normal temperatures ranging from teens to mid-30s. Temperatures can vary across Bradford County due to elevation changes in topography. *Figure 18 - Average Maximum Temperature Trends* and *Figure 19 - Average Minimum Temperature Trends* show how recent average temperatures are changing in Bradford County and the county at large, with Bradford County experiencing an increase in average minimum temperatures of two to four degrees Fahrenheit per century, and average maximum temperatures changing from zero to two degrees Fahrenheit per century (NOAA, 2019).

Figure 16 - Average Maximum Temperature

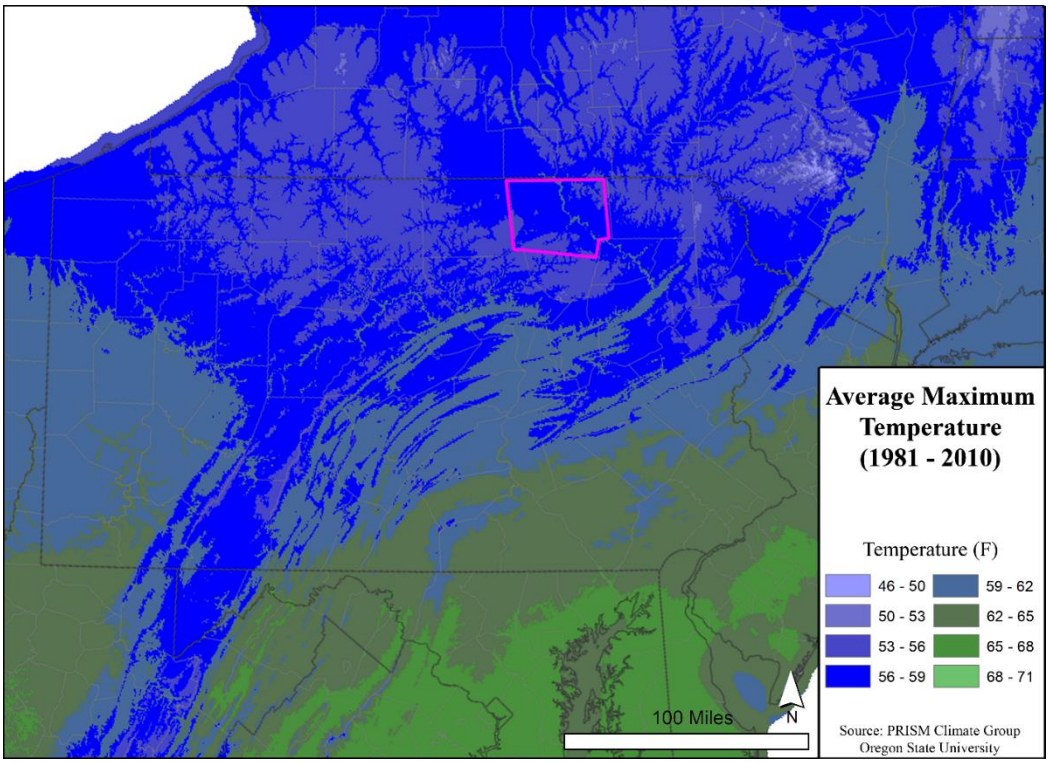


Figure 17 - Average Minimum Temperature

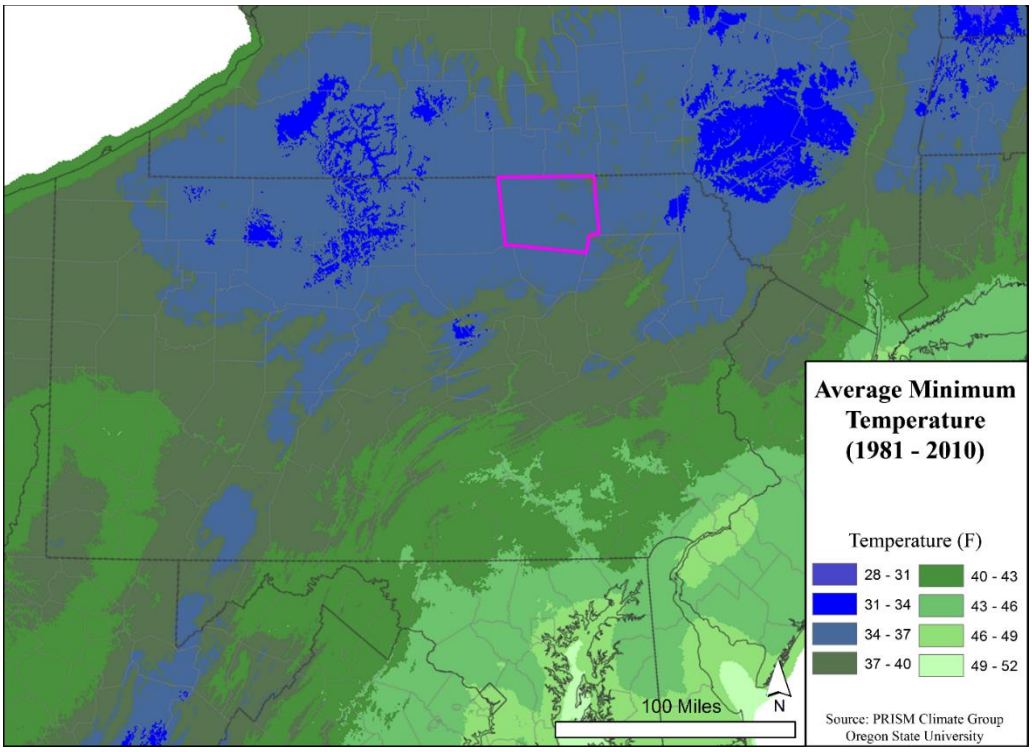


Figure 18 - Average Maximum Temperature Trends

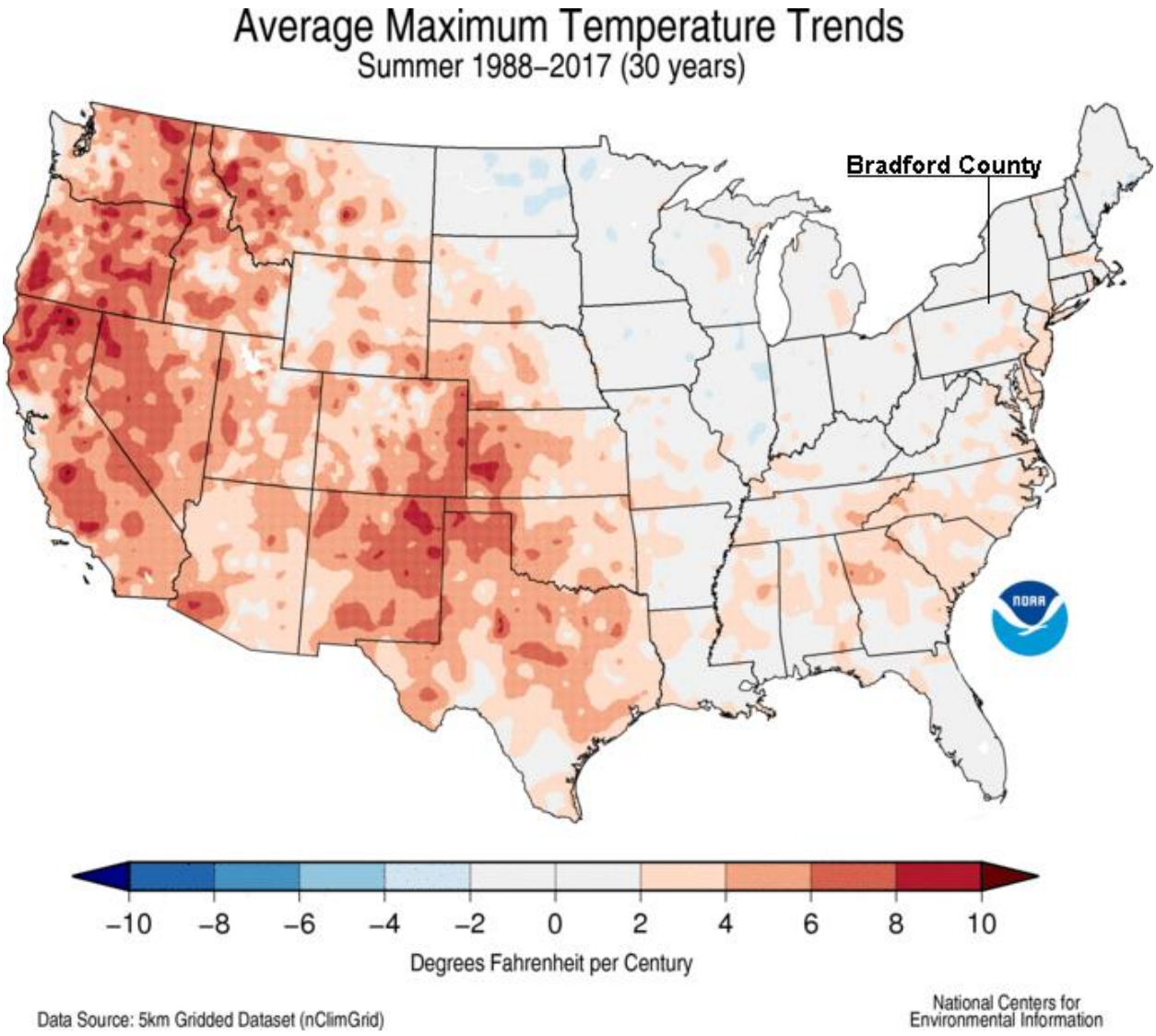
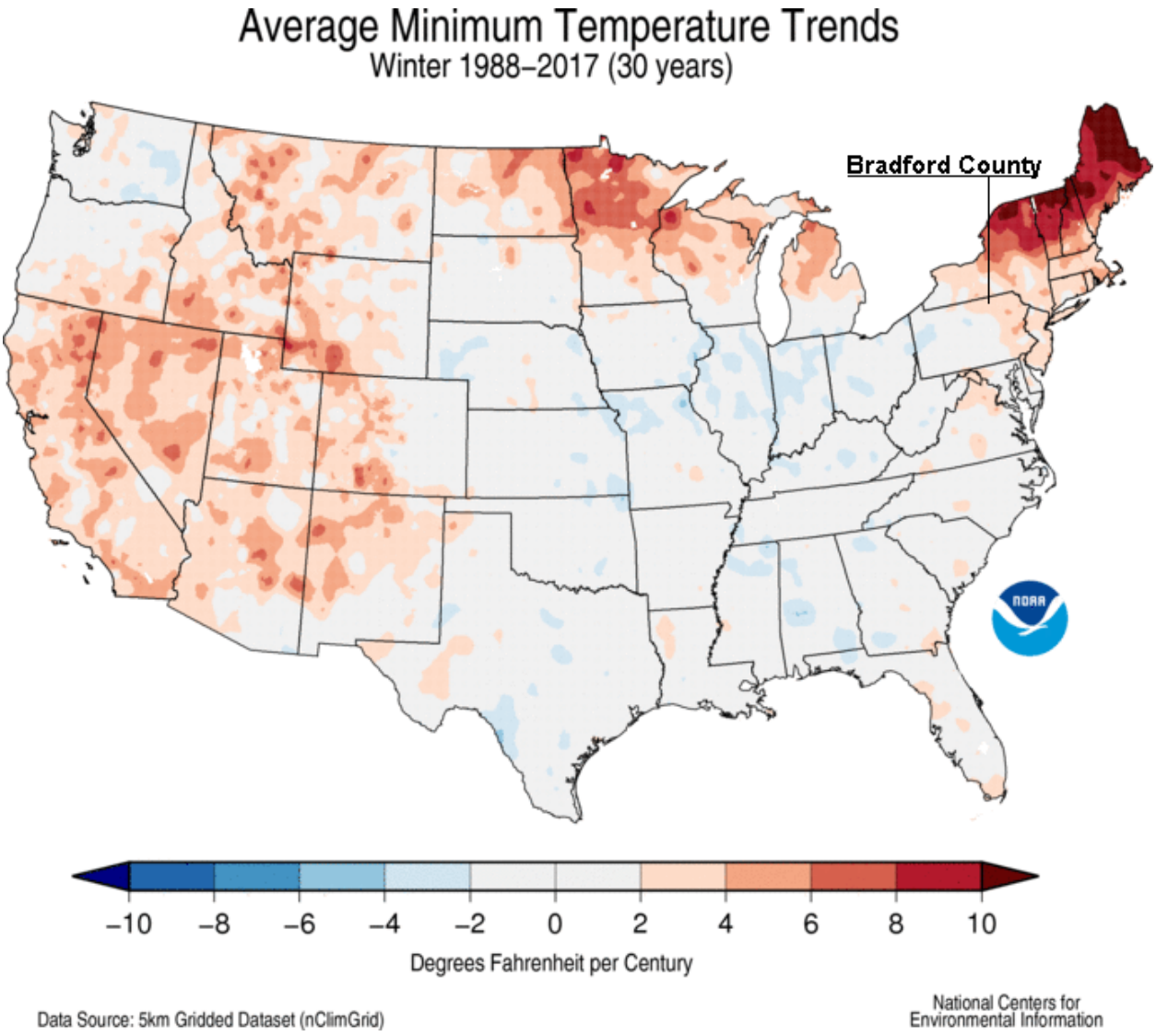


Figure 19 - Average Minimum Temperature Trends



4.3.3.2 Range of Magnitude

When extreme temperature events occur, they typically impact the entirety of Bradford County, including the surrounding region. Extreme heat is described as temperatures that hover at least 10ºF above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined. The apparent temperature of the air increases as relative humidity increases, and the National Weather Service created a Heat Index chart (*Figure 20 - National Weather Service Heat Index*) which shows the likelihood of heat disorders relative to the temperature and relative humidity. *Heat Advisories* are issued when the heat index will be equal to or greater than 100°F, but less than 105°F, *Excessive Heat Warnings* are issued when heat indices will attain or exceed 105°F, and *Excessive Heat*

Watches, are issued when there is a possibility that excessive heat warning criteria may be experienced within twelve to forty-eight hours (NOAA NWS, 2010). A potential worst-case extreme temperature scenario would be if widespread areas of the Commonwealth experienced 90°F or higher temperatures for an extended number of days. The heat could overwhelm the power grid and cause widespread blackouts, cutting off vital HVAC services for residents.

Extreme cold temperatures drop well below typical temperatures and are often associated with winter storm events. Wind can make the apparent temperature drop further, and exposure to such extreme cold temperatures can cause hypothermia, frost bite and death. The National Weather Service created a wind chill chart (*Figure 21 - National Weather Service Wind Chill*) which shows the time frostbite takes to set in depending on temperature and wind speed. Wind chill warnings are issued when wind chills drop to -25°F or lower. Wind chill advisories are issued in the southeast and western sections of Pennsylvania when wind chill values drop to -10°F to -24°F. South-central to northern sections of the Commonwealth when wind chills drop to -15°F to -24°F (NOAA NWS, 2010).

Figure 20 - National Weather Service Heat Index

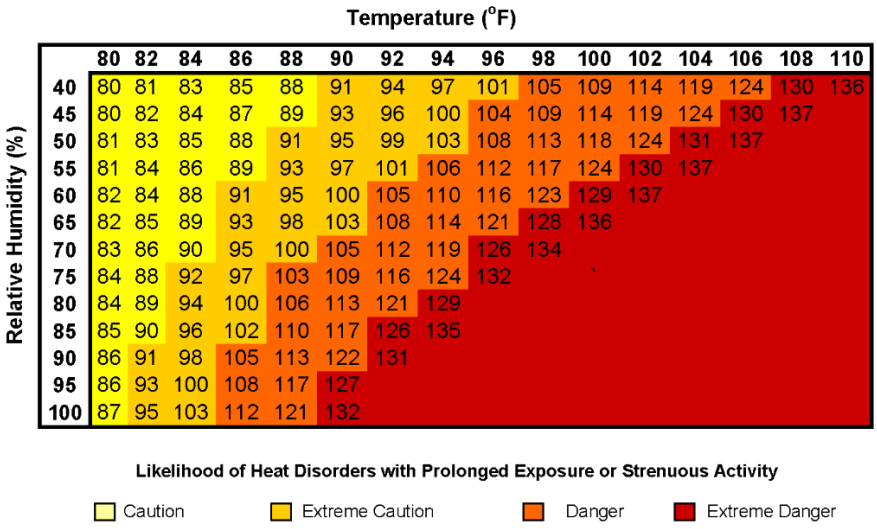
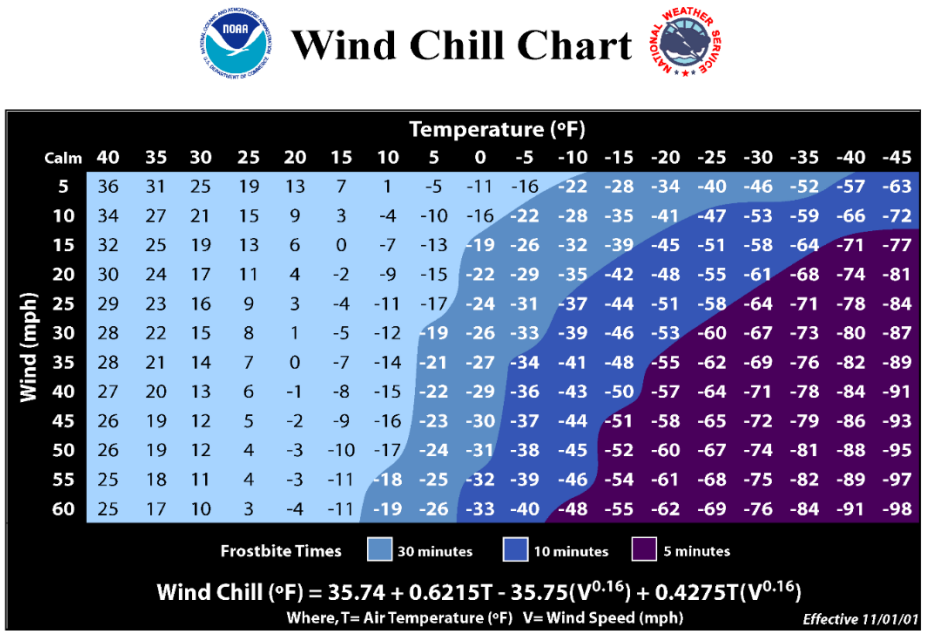


Figure 21 - National Weather Service Wind Chill



Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

Wind Chill (°F) = 35.74 + 0.6215T - 35.75($V^{0.16}$) + 0.4275T($V^{0.16}$)

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

4.3.3.3 Past Occurrence

In the state of Pennsylvania, there have been 315 extreme temperature events between 1950 and 2013, resulting in 587 deaths and 530 injuries (NCDC, 2013). Of those events, 71 were extreme cold (27 deaths, 129 injuries), and 205 were extreme heat (560 deaths, 401 injuries) (NCDC, 2013). From 1996 until December 2018, there were seven extreme cold events and one extreme heat event reported to the NOAA NCEI Storm Events database (see *Table 13 - Extreme Temperature History)*. While exact occurrence data for Bradford County is somewhat limited below, it should be assumed that the county experienced the effects of extreme temperatures more than it has been documented – these instances serve as a sample of all events. The fact that the NOAA NCEI reports only one extreme heat event for Bradford County does not mean it was the only extreme heat events to have impacted the county - it likely represents a reporting bias.

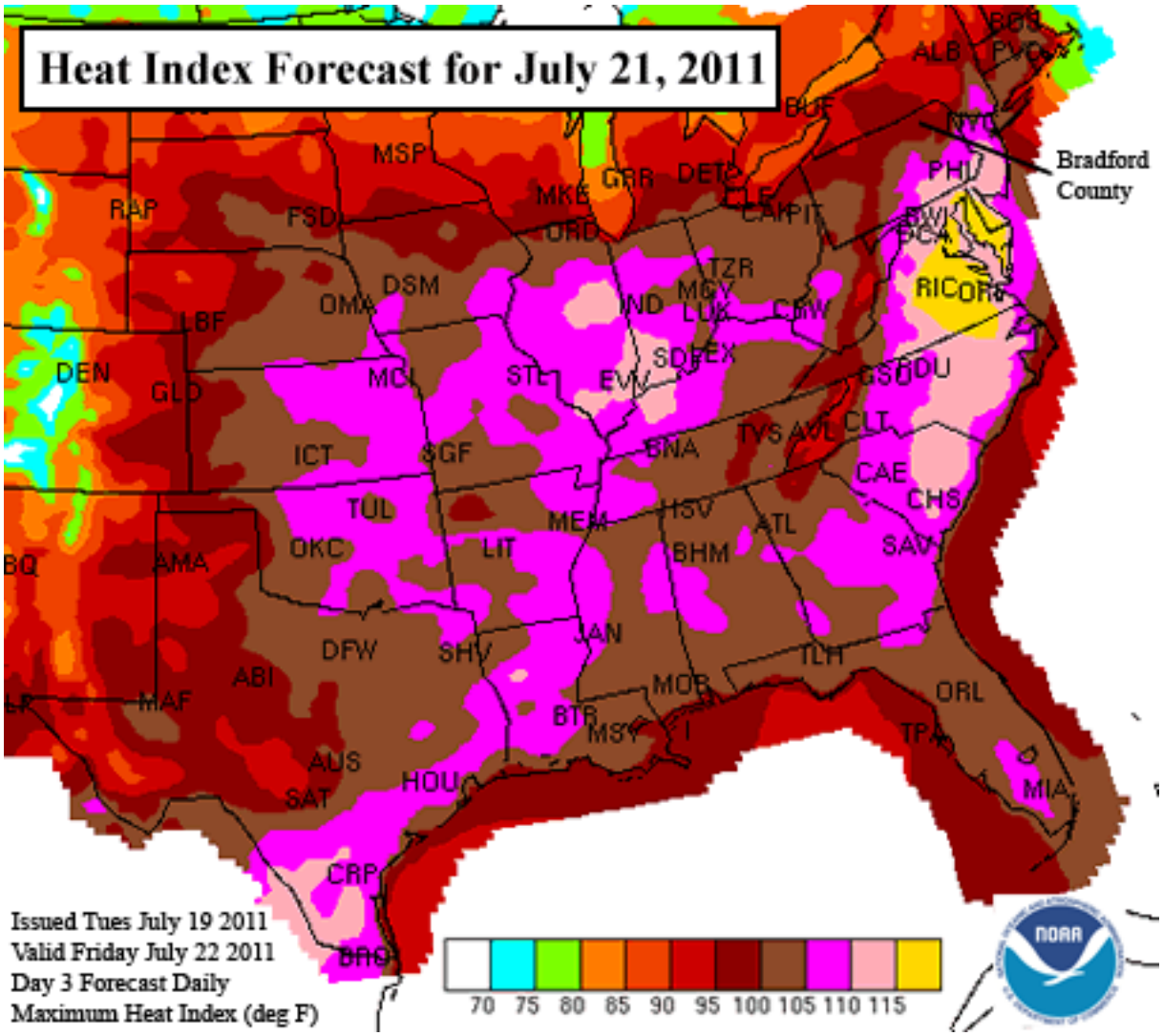
In 2011, Pennsylvania experienced record-breaking heat in nineteen counties and a total of 45 broken heat records. *Figure 22 - Heat Index Forecast for July 21, 2011* shows the temperatures for July 21, 2011. Pennsylvania was again hit with record breaking temperatures on July 9, 2012 when daily record highs were broken in several cities in eastern Pennsylvania, including Harrisburg, Lancaster, and Chambersburg, which each reached 101 °F (38.3 °C).

Table 13 - Extreme Temperature History

Extreme Temperature History *(NCEI, 2019)*			
Date	**Type**	**Property Damage**	**Description**
10/04/1996	Cold/Wind Chill	$0	A very cold air mass entered central New York and northeastern Pennsylvania on the morning of the 4th. Widespread freeze conditions were observed.
01/17/1997	Cold/Wind Chill	$0	A bitterly cold arctic air mass invaded northeast Pennsylvania during the evening hours of the 16th and remained over the area through the 18th. Air temperatures dropped to near zero degrees over much of the region by early morning of the 17th. During the day, readings only managed to reach the single digits and lower teens. That night, temperatures from 5 to 15 below zero were observed in many areas. Perhaps the biggest problem, though, was the strong winds accompanying this cold snap. Wind chills of 35 to 55 below zero were common over the northern tier of Pennsylvania on the morning of the 17th. This prompted many school districts to cancel classes that day.
09/28/2000	Extreme Cold/Wind Chill	$0	Extreme Cold or Wind Chill
08/01/2001	Heat	$0	August was a very warm month across northeast Pennsylvania. The first 9 days of the month featured a significant heat wave with several days of locations reporting temperatures in the upper 90's to lower 100's. Numerous high temperature records were set during this time. The heat wave peaked on the 9th when many locations saw temperatures above 100 degrees and some locations equaled or exceeded all-time temperature records for the month of August.
05/17/2002	Extreme Cold/Wind Chill	$8,000	A cold front went through the northern tier of Pennsylvania the morning of May 17th. A surface low pressure area moved east across the Tennessee Valley on the 17th to the mid-Atlantic region early on the 18th. Precipitation in the form of rain was spread east and north ahead of the surface low on the 17th. The rain over northern Pennsylvania changed to wet snow from west to east starting late on the 17th. Accumulations were mostly over 1500 feet in elevation with up to 6 inches above 2000 feet. The highest amount was 6 inches in Sylvania at 2200 feet. 2 inches fell in Montrose.
01/10/2004	Cold/Wind Chill	$5,000	Extreme Cold or Wind Chill
01/15/2004	Cold/Wind Chill	$10,000	Extreme Cold or Wind Chill
12/14/2005	Cold/Wind Chill	$0	Extreme Cold or Wind Chill

Extreme Temperature History *(NCEI, 2019)*			
Date	**Type**	**Property Damage**	**Description**
01/01/2006	Heat	$0	Central New York and Northeast Pennsylvania experienced one of the warmest Januarys on record since reliable records have been kept. January 2006 was the warmest January on record in Syracuse, New York. The average monthly temperature recorded at Hancock Field was 33.4 degrees, breaking the old record of 33.2 degrees set in 1990. There was also a lack of snow for the month, with only 12.1 inches recorded. This was the third lowest on record. Meanwhile, January was the second warmest on record in Binghamton, NY. The average temperature of 30.8 degrees fell short of the 31.5-degree record set in 1990. Wilkes-Barre Scranton International Airport recorded the second warmest January on record with an average temperature of 34.9 degrees. The warmest January on record remains 35.2 degrees in 1990.
07/21/2011	Excessive Heat	$0	High temperatures across the county reached well into the 90s each day. The cooperative observer at Towanda recorded a high of 97 degrees on the 21st, 98 degrees on the 22nd and 96 degrees on the 23rd.
03/17/2012	Heat	$0	Temperatures across northeast Pennsylvania were anomalously warm for the month, with the warmest stretch occurring from the 17th to the 23rd when temperatures reached well into the 70s, with readings as high as the lower 80s in typically warmer valley locations.

Figure 22 - Heat Index Forecast for July 21, 2011

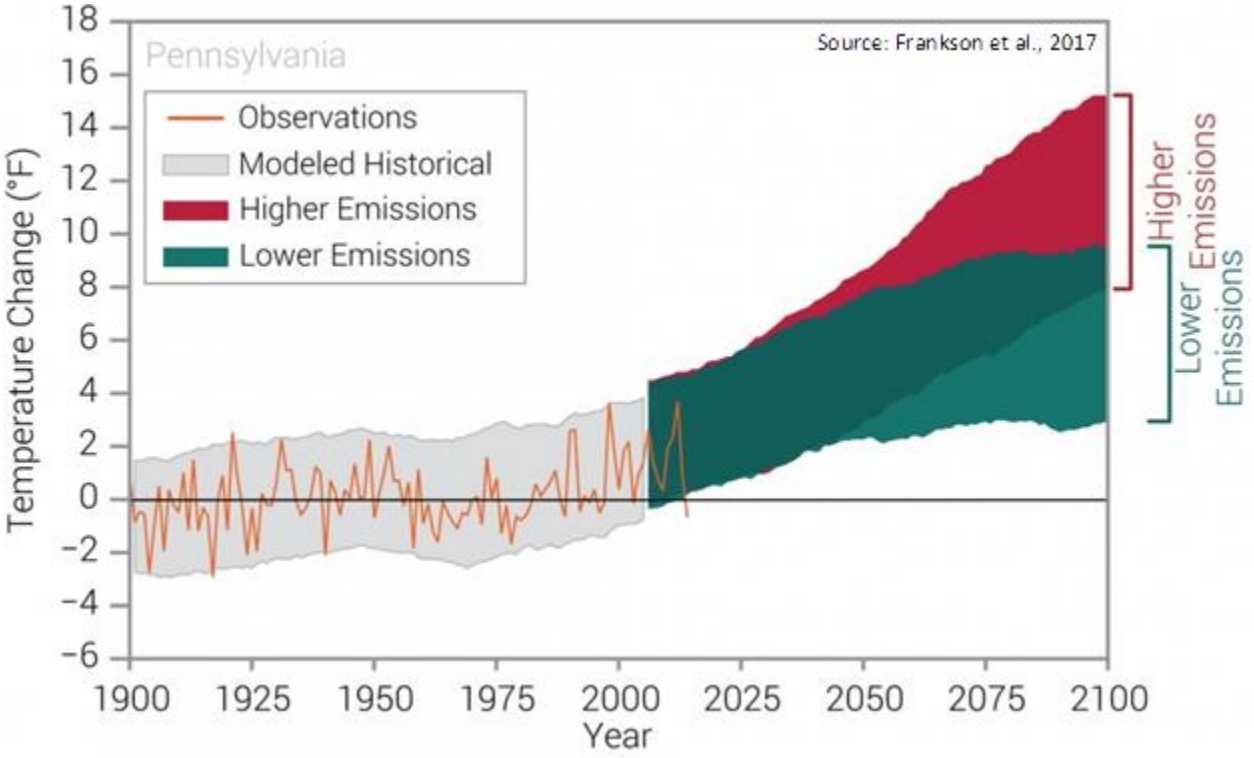


4.3.3.4 Future Occurrence

Extreme temperatures will continue to impact Bradford County. Anthropogenic climate change is causing extreme climatic events to occur more frequently, suggesting that extreme temperatures are becoming a more threatening hazard as the impacts of climate change intensify. The annual average temperature has increased by 1.2˚F across the continental United States during the years 1986 to 2016 compared to the time period 1901 to 1960 and temperatures are expected to continue rising (Vose et al., 2017). *Figure 23 - Observed and Projected Temperature Change* shows these projected changes in temperature for Pennsylvania based on climate models considering the possibilities of increased and decreased levels of greenhouse gas emissions (Frankson et al., 2017). In recent years, record high temperatures have outnumbered record low temperatures 2:1 (Meehl et al., 2009; Vose et al., 2017) so it is expected that the risk of extreme heat will

be amplified whereas the risk of extreme cold will be attenuated. The Northeastern United States is expected to experience 20-30 more days with temperatures above 90˚F, and 20-30 fewer days below freezing by approximately 2050 (Vose et al., 2017). While there may be fewer extreme cold events, those that do occur are expected to more often reach record setting low temperatures (Vose et al., 2017). Historically, Bradford County has had more extreme cold events than extreme heat due to the geographic location of the County, however this balance is expected to shift somewhat in the coming years to include a greater proportion of extreme heat events.

Figure 23 - Observed and Projected Temperature Change



4.3.3.5 Vulnerability Assessment

Extreme temperatures are usually a regional hazard when they occur. The elderly and young people (20.9% and 22% of the county's population as of 2017, respectively) are most vulnerable to extreme temperatures due to mobility challenges and disabilities (United States Census Bureau, 2018). Extreme temperatures can increase the demand for utility services, often resulting in an increased cost to consumers. The increased expense can make it difficult for the consumer to afford the service. The increased demand for services may cause a decrease in availability of these services or failure of the system. A decrease or failure of the utility system during extreme temperature events puts a large population at great risk. Extreme temperature events can also drastically increase the volume of emergency calls, potentially overwhelming the Public Safety Answering Point.

Extreme heat events may also contribute to drought conditions, which in turn increases the risk of wildfires.

4.3.4. Flood, Flash Flood and Ice Jams

4.3.4.1 Location and Extent

Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. Flash floods are the most common type of flooding in Bradford County. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas.

Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often then breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure.

Floodplains are lowlands adjacent to rivers, streams and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 4.3.4.4. However, in assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a 10% chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2% annual chance of occurring. The National Flood Insurance Program (NFIP) publishes digital flood insurance rate maps (DFIRMs). These maps identify the 1% annual chance of flood area. Special flood hazard area (SFHA) and base flood elevations (BFE) are developed from the 1% annual chance flood event, as seen in *Figure 24 - Flooding and Floodplain Diagram*. Structures located in the SFHA have a 26% chance of flooding in a thirty-year period. The SFHA serves as the primary regulatory boundary used by FEMA, the Commonwealth of Pennsylvania and Bradford County local governments. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to the following high risk special flood hazard areas in *Table 14 - Flood Hazard High Risk Zones*. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Bradford County with vulnerable structures and critical facilities identified using the most current DFIRM data for Bradford County dated 2016.

Past flooding events have been primarily caused by heavy rains which cause small creeks and streams to overflow their banks, often leading to road closures. Flooding poses a threat to critical facilities, agricultural areas, and those who reside or conduct business in the floodplain. The most significant hazard exists for facilities in the floodplain that process, use and/or store hazardous materials. A flood could potentially release and transport hazardous materials out of these areas. As the water recedes it would spread the hazardous materials throughout the area. Most flood damage to property and structures located in the floodplain is caused by water exposure to the interior, high velocity water and debris flow.

Figure 24 - Flooding and Floodplain Diagram

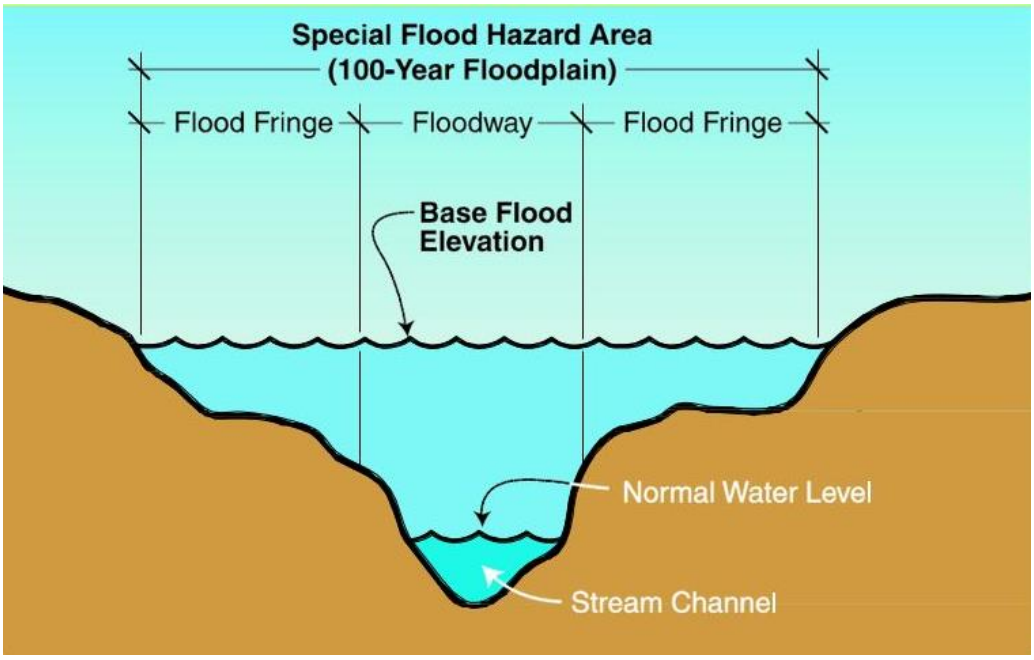


Table 14 - Flood Hazard High Risk Zones

Flood Hazard High Risk Zones *(FEMA, 2017)*	
Zone	**Description**
A	Areas subject to inundation by the 1% annual chance flood event. Because detailed hydraulic analysis have not been performed, no base flood elevations or flood depths are shown
AE	Areas subject to inundation by the 1% annual chance flood event determined by detailed methods. BFEs are shown within these zones.
AH	Areas subject to inundation by the 1% annual chance shallow flooding (usually areas of ponding) where average depths are 1-3 feet. BFEs derived from detailed hydraulic analysis are shown in this zone.

Flood Hazard High Risk Zones *(FEMA, 2017)*	
Zone	**Description**
AO	Areas subject to inundation by the 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1-3 feet. Average flood depths derived from detailed hydraulic analysis are shown within this zone.
AR	Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.

4.3.4.2 Range of Magnitude

The Susquehanna River is the largest waterway that passes through Bradford County. Other notable waterways include Towanda Creek and the Chemung River which meets with the Susquehanna River south of Athens.

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with steep slopes and little to no vegetative ground cover. The mountainous terrain of Bradford County can cause more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. Urbanization typically results in the replacement of vegetative ground cover with impermeable surfaces like asphalt and concrete, increasing the volume of surface runoff and stormwater, particularly in areas with poorly planned stormwater drainage systems. A large amount of rainfall over a short time span can cause flash floods. Additionally, small amounts of rain can cause floods in locations where the soil is frozen, saturated from a previous wet period, or if the area is rife with impermeable surfaces such as large parking lots, paved roadways and other developed areas. The county occasionally experiences intense rainfall from tropical storms in late summer and early fall which can potentially cause flooding as well.

Severe flooding can cause injuries and deaths and can have long-term impacts on the health and safety of the citizens. Severe flooding can also result in significant property damage, potentially disrupting the regular function of critical facilities and have long-term negative impacts on local economies. Industrial, commercial and public infrastructure facilities can become inundated with flood waters, threatening the continuity of government and business. The special needs population must be identified and located in flooding situations, as they are often home bound. Mobile homes are especially vulnerable to high water levels. Flooding can have significant environmental impacts when flood waters release and/or transport hazardous materials and can also result in spreading diseases.

Flash floods can occur very quickly with little warning and can be deadly because of the rapid rises in water levels and devastating flow velocities. The more developed areas in the county can be especially susceptible to flash floods because of the significant presence of impervious surfaces, such as streets, sidewalks, parking lots, and driveways.

Severe flooding also comes with many secondary effects that could have long lasting impacts on the population, economy and infrastructure of Bradford County. Power failures are the most common secondary effect associated with flooding. Coupled with a shortage of critical services and supplies, power failures could cause a public health emergency. Critical infrastructure, such as sewage and water treatment facilities, can be severely damaged, having a significant effect on public health. High flood waters can cause sewage systems to fail and overflow, contaminating groundwater and drinking water. Flooding also has the potential to trigger other hazards, such as landslides, hazardous material spills and dam failures.

The maximum threat of flooding in Bradford County is estimated by looking at potential loss data and repetitive loss data, both analyzed in the risk assessment portion of the hazard mitigation plan. In these cases, the severity and frequency of damage can result in permanent population displacement, and businesses may close if they are unable to recover from the disaster.

Estimation of potential losses is typically done with FEMA's Hazards U.S. (HAZUS) software. Unfortunately, due to errors encountered with version 4.2 (service pack 1), the HAZUS analysis was not available at the time of this report. The software was unable to process stream reaches for the Susquehanna River despite efforts with HAZUS support. For stream reaches that successfully processed, no reports were available due to the software crashing repeatedly. Efforts with FEMA's HAZUS support were not able to solve these fatal errors. In order to improve estimation of potential losses due to flooding in Bradford County, it is recommended that the county conduct a new HAZUS analysis when an updated version of the software becomes available.

In lieu of HAZUS analysis, MCM Consulting Group conducted a more rigorous vulnerability assessment utilizing FEMA's special flood hazard area maps for the region, Bradford County GIS data and prices associated with parcels where there were structures located within the FEMA designated 100-year floodplain (see

Table 18 - Municipal NFIP Policies & Vulnerability).

Although floods can cause deaths, injuries and damage to property, they are naturally occurring events that benefit riparian systems which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediment which improves soil fertility. However, human development often disrupts natural riparian buffers by changing land use and land cover, and the introduction of chemical or biological contaminants that often accompany human presence can contaminate habitats after flood events.

4.3.4.3 Past Occurrence

Bradford County has experienced numerous flooding, flash flooding and ice jam flooding events in the past. The flooding and flash flooding were caused by a variety of heavy

storms, tropical storms and other issues. A summary of flood event history for Bradford County from 1996 until February 2019 is found in

Table 15 - Flood Event History. Details of each event can be found in NOAA's NCEI Storm Events Database (www.ncdc.noaa.gov/stormevents).

There are few reports of ice jam flooding in Bradford County; however, on March 15, 2007, a heavy rainfall caused the melting of snowpack, and resulted in many rivers cresting from 0.5 to 2.0 feet above flood stage. Just north of the Bradford County border in New York State there were reports of ice jam flooding, as well as in neighboring Susquehanna County on the Susquehanna River.

Bradford County experienced significant damage from the remnants of Tropical Storm Lee in September 2011. Rome, Towanda, Macedonia, Wysox, Monroeton, East Athens, Powell, and Windham Center all reported significant flooding. Numerous roads were closed in the county due to flooding from creeks and streams. Numerous buildings were destroyed or suffered varying degrees of damage. This flooding event was the most significant and costly for Bradford County since Tropical Storm Agnes, with one fatality and over $31 million in damages reported in the county. This event was the only flooding event with any recoded injuries or fatalities in the study period. Pennsylvania Governor Corbett requested a presidential declaration from President Obama on September 12, 2011 due to the excess of damage throughout the Commonwealth of Pennsylvania. A presidential disaster declaration was issued for individual assistance and public assistance on September 13, 2011.

Bradford County experienced a significant severe flooding event on August 13 and 14 of 2018 with damages totaling nearly one million dollars. Most areas of the county were impacted by flooding with numerous road closures and washed out bridges. Several areas were evacuated, including New Albany, Wilmot, Terrytown and Ridgebury Township. Ridgebury Township experienced especially severe flooding, and boats were requested for evacuations in the township. The Berwick Turnpike was closed near the New York and Pennsylvania border due to flooding washout. In Troy, several people were trapped in a store, and swift water rescue crews were requested to help those trapped. The Towanda Creek at Monroeton crested at 17.31 feet on August 14th around 9:00 am, exceeding the moderate flood stage of 17 feet. There were also incidences of landslides in Bradford County as a result of this flooding event.

Table 15 - Flood Event History

Flood Event History *(NOAA, 2019)*			
Location	**Date**	**Type**	**Property Damage**
Bradford County	1972	Flooding	$0
Countywide	01/19/1996	Flash Flood	$21,100,000
Bradford County	11/09/1996	Flood	$0
Countywide	12/01/1996	Flash Flood	$20,000
Bradford County	12/02/1996	Flood	$0
Bradford County	01/08/1998	Flood	$25,000
Northeast Portion	06/13/1998	Flash Flood	$0
Bradford County	01/24/1999	Flood	$0
Bradford County	02/27/2000	Flood	$0
Countywide	04/04/2000	Flash Flood	$0
North Central Portion	05/10/2000	Flash Flood	$750,000
New Albany To Wilmot	07/30/2000	Flash Flood	$0
Countywide	03/30/2001	Flash Flood	$0
Ulster	04/03/2001	Flash Flood	$25,000
Bradford County	04/09/2001	Flood	$0
Central Portion	06/16/2001	Flash Flood	$0
Countywide	06/23/2001	Flash Flood	$0
Rome	03/26/2002	Flash Flood	$0
Bradford County	03/27/2002	Flood	$0
Countywide	05/28/2002	Flash Flood	$50,000
Bradford County	03/21/2003	Flood	$50,000
Countywide	05/01/2003	Flash Flood	$500,000
Countywide	06/21/2003	Flash Flood	$100,000
Athens To Towanda	08/09/2003	Flash Flood	$100,000
Towanda To Stevensville	09/04/2003	Flash Flood	$100,000
Bradford County	10/29/2003	Flood	$5,000
Bradford County	12/12/2003	Flood	$0
Bradford County	03/06/2004	Flood	$10,000
Troy, Monroeton	05/13/2004	Flash Flood	$40,000
Wilawana	07/23/2004	Flash Flood	$50,000
Litchfield	07/27/2004	Flash Flood	$20,000

Flood Event History *(NOAA, 2019)*			
Location	**Date**	**Type**	**Property Damage**
Big Pond, Wyalusing	07/31/2004	Flash Flood	$20,000
Countywide	09/17/2004	Flash Flood	$20,000,000
Bradford County	09/18/2004	Flood	$2,000,000
Bradford County	01/14/2005	Flood	$0
Bradford County	03/28/2005	Flood	$20,000
Bradford County	04/01/2005	Flood	$200,000
Countywide	04/02/2005	Flash Flood	$700,000
Sayre	06/10/2005	Flash Flood	$10,000
Bradford County	10/25/2005	Flood	$20,000
Bradford County	11/29/2005	Flood	$30,000
Bradford County	11/30/2005	Flood	$25,000
Bradford County	12/01/2005	Flood	$5,000
Burlington, Monroeton, Sayre	01/18/2006	Flash Flood	$20,000
Eastern Portion of Bradford, Wyalusing, Sayre	06/27/2006	Flash Flood	$35,010,000
Towanda	06/28/2006	Flood	$0
Rome, Wyalusing, Monroeton, Sayre	11/16/2006	Flash Flood	$57,000
Athens, Towanda	03/15/2007	Flood	$10,000
Athens	03/25/2007	Flood	$0
Evergreen, New Albany, Liberty Corners, Monroeton	03/05/2008	Flash Flood	$0
Leona, Troy McClure Arpt, Towanda Arpt, Monroeton, South Warren, Le Raysville	01/25/2010	Flash Flood	$20,000
Canton	03/10/2011	Flash Flood	$75,000
West Burlington	04/16/2011	Flash Flood	$25,000
North Towanda, Myersburg, Coryland, Sylvania, West Burlington	04/25/2011	Flash Flood	$30,000
Fassett	04/26/2011	Flash Flood	$3,000,000
Columbia Cross Roads	04/28/2011	Flash Flood	$75,000
Mosherville	05/19/2011	Flash Flood	$15,000
Windham, Powell, Athens, Monroeton, Macedonia, North Towanda, Wysox, Limehill, Rome, East Smithfield	09/07/2011	Flash Flood	$31,300,000
North Towanda	09/29/2011	Flash Flood	$0
Milan	06/23/2013	Flash Flood	$5,000
South Branch	07/26/2015	Flash Flood	$3,000,000
Canton, Minnequa, Franklindale, Burlington, Riggs, Towanda, Powell, Monroeton, Liberty Corners	10/21/2016	Flash Flood	$175,000
East Athens	07/20/2017	Flash Flood	$15,000

Flood Event History *(NOAA, 2019)*			
Location	**Date**	**Type**	**Property Damage**
Troy, Windham Center, Rome, Myersbug, Litchfield, Windham, North Rome	07/23/2017	Flash Flood	$585,000
West Warren, Warren Center, Rome, Cadis, Troy, Sylvania, Canton, Burlington, Minnequa, Alba	07/24/2017	Flash Flood	$452,000
Fassett, Ridgebury, Ulster, Milan, Athens, East Smithfield	07/25/2018	Flash Flood	$180,000
New Albany, Evergreen,	08/03/2018	Flash Flood	$145,000
New Albany, Laddsburg	08/07/2018	Flash Flood	$555,000
Troy, Fassett, Ridgebury, Burlington, Troy, Minnequa, Cedar Ledge, Bentley Creek, New Albany, Evergreen	08/13/2018	Flash Flood	$822,000
New Albany, Wilmot, Terrytown, Wyalusing, Monroeton	08/14/2018	Flash Flood	$145,000
New Albany, Laddsburg	09/03/2018	Flash Flood	$15,000
Ridgebury	09/18/2018	Flash Flood	$150,000
Mosherville	09/21/2018	Flash Flood	$5,000
New Albany	09/26/2018	Flash Flood	$3,000
		Total	**$121,864,000**

The National Flood Insurance Program identifies properties that frequently experience flooding. *Repetitive loss properties* are structures insured under the NFIP which have had at least two paid flood losses of more than $1,000 over any ten-year period since 1978. The hazard mitigation assistance (HMA) definition of a repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that has incurred flood-related damage on two occasions, in which the cost of the repair, on the average, equaled or exceeded twenty five percent of the market value of the structure at the time of each such flood event; and at the time of the second incidence of flood-related damage, the contract for flood insurance contains in-creased cost of compliance coverage.

A property is considered a *severe repetitive loss property* either when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value. As of September 30, 2018, there are one hundred repetitive loss properties and five severe repetitive loss properties in Bradford County. This is an increase from 2015 when there were fifteen repetitive loss properties, and still five severe repetitive loss properties.

Most municipalities in Bradford County participate in the NFIP except for Herrick Township. Information on each participating municipality is in

Table 18 - Municipal NFIP Policies & Vulnerability. Vulnerable buildings are broken down by parcel assessment use codes, with "other" comprising of industrial, agriculture, service, transportation, communication, utility, natural resources & other land uses. Assessed price comes from parcel data and should be considered a minimum estimated for building losses in the event of a catastrophic flood.

Table 16 - Repetitive Loss Properties

Repetitive Loss Properties *(PEMA, 2018)*					
Community Name	**Comm. Num.**	**Building Payments**	**Contents Payments**	**Losses**	**Properties**
Asylum Township	421048	$59,913	$23,047	14	4 Res
Athens Borough	420167	$244,954	$211,299	6	2 Res 1 Non-Res
Athens Township	420976	$2,543,142	$444,746	62	20 Res 1 Non-Res
Burlington Borough	420168	$32,601	$3,531	4	2 Res
Columbia Township	421059	$64,490	$17,655	7	2 Res
Granville Township	421066	$32,813	$ -	2	1 Res
Monroe Borough	420170	$261,588	$42,199	11	5 Res
Monroe Township	421083	$107,038	$14,868	9	4 Res
North Towanda Township	421087	$15,398	$2,917	2	1 Res
Orwell Township	421401	$12,299	$ -	2	1 Res
Ridgebury Township	420173	$87,363	$3,302	9	3 Res 1 Non-Res
Rome Borough	420174	$390,531	$17,001	9	4 Res
Sayre Borough	420175	$8,567	$13,503	3	1 Non-Res
Sheshequin Township	421102	$123,274	$57,813	13	4 Res 1 Non-Res
Stevens Township	421407	$64,432	$20,500	2	1 Res
Sylvania Borough	420177	$132,278	$ -	4	1 Res
Terry Township	421111	$326,572	$41,410	17	5 Res
Towanda Township	421113	$95,794	$65,333	6	3 Res
Troy Borough	420179	$30,847	$ -	8	2 Res
Ulster Township	421218	$390,591	$186,271	27	4 Res
Warren Township	421408	$144,711	$28,653	10	2 Res 3 Non-Res
Wilmot Township	421124	$303,762	$65,210	19	8 Res
Windham Township	421409	$25,806	$2,420	2	1 Res
Wyalusing Borough	420180	$216,165	$36,828	16	4 Res 1 Non-Res
Wyalusing Township	421126	$212,166	$39,840	15	2 Res 3 Non-Res

Repetitive Loss Properties *(PEMA, 2018)*					
Community Name	**Comm. Num.**	**Building Payments**	**Contents Payments**	**Losses**	**Properties**
Wysox Township	420977	$135,481	$10,536	5	2 Res
Totals		**$6,062,578**	**$1,348,882**	**284**	**88 Residential 12 Non-Res**

Table 17 - Severe Repetitive Loss Properties

Severe Repetitive Loss Properties *(PEMA, 2018)*					
Community Name	**Community Number**	**Building Payments**	**Contents Payments**	**Losses**	**Properties**
Athens Township	420976	$467,157	$59,049	10	3
Ulster Township	421218	$301,597	$ 80,771	20	1
Wyalusing Township	421126	$71,933	$ -	5	1
Total		**$ 840,687**	**$ 239,820**	**35**	**5**

Table 18 - Municipal NFIP Policies & Vulnerability

Municipal NFIP Policies & Vulnerability *(PEMA, 2018; Bradford Co. GIS, 2019)*						
Community Name	**Comm Num.**	**Losses**	**Active Contracts**	**Vulnerable Buildings By Assessment Use**		**Assessed Price**
Alba Borough	420166	0	3	Commercial Other Residential	1 2 8	$52,700 $4,950 $125,400
Albany Township	421047	0	2	Commercial Other Residential	9 5 6	$92,300 $38,700 $75,000
Armenia Township	421396	0	0	None	0	Not Applicable
Asylum Township	421048	32	8	Commercial Other Residential	1 28 12	$33,950 $249,600 $325,300
Athens Borough	420167	80	189	Commercial Other Residential	30 14 238	$1093,600 $83,700 $4,355,750
Athens Township	420976	132	29	Commercial Other Residential	2 17 51	$65,800 $506,150 $1,765,550
Burlington Borough	420168	10	2	Other Residential	2 7	$85,450 $142,100

Municipal NFIP Policies & Vulnerability *(PEMA, 2018; Bradford Co. GIS, 2019)*						
Community Name	**Comm Num.**	**Losses**	**Active Contracts**	**Vulnerable Buildings By Assessment Use**		**Assessed Price**
Burlington Township	421054	0	3	Commercial Other Residential	1 4 5	$23,150 $25,100 $170,650
Canton Borough	420169	4	9	Commercial Other Residential	4 2 25	$133,300 $0 $489,500
Canton Township	421397	3	5	Commercial Other Residential	4 3 29	$235,000 $64,300 $771,000
Columbia Township	421059	16	8	Other Residential	3 17	$321,100 $394,050
Franklin Township	421398	2	5	Commercial Other Residential	3 2 14	$57,600 $48,850 $303,300
Granville Township	421066	4	1	Commercial Other Residential	1 2 4	$28,700 $24,400 $114,150
Herrick Township	N/A	0	0	None	0	Not Applicable
Leraysville Borough	422334	0	0	None	0	Not Applicable
Leroy Township	421076	1	0	Other Residential	2 1	$66,150 $84,500
Litchfield Township	421400	2	0	Other	2	$9,450
Monroe Borough	420170	85	44	Commercial Other Residential	13 21 154	$507,350 $181,600 $4,559,250
Monroe Township	421083	51	23	Commercial Other Residential	1 25 56	$27,650 $301,750 $1,030,000
New Albany Borough	420172	0	1	Other Residential	2 1	$26,850 $18,150
North Towanda Township	421087	6	4	Other Residential	2 4	$104,450 $176,450
Orwell Township	421401	11	9	Other Residential	11 17	$278,950 $417,300
Overton Township	421402	1	1	Other	4	$105,400
Pike Township	421403	1	0	Other	2	$67,200
Ridgebury Township	420173	39	28	Commercial Other Residential	68 17 108	$647,400 $1,014,250 $2,266,302
Rome Borough	420174	17	8	Commercial Other Residential	45 4 36	$231,950 $34,600 $783,870

Municipal NFIP Policies & Vulnerability *(PEMA, 2018; Bradford Co. GIS, 2019)*						
Community Name	**Comm Num.**	**Losses**	**Active Contracts**	**Vulnerable Buildings By Assessment Use**		**Assessed Price**
Rome Township	422639	0	0	Commercial Other Residential	5 9 16	$10,600 $228,650 $322,600
Sayre Borough	420175	13	30	Commercial Other Residential	1 2 2	$0 $305,400 $75,200
Sheshequin Township	421102	58	22	Commercial Other Residential	1 11 15	$69,550 $214,100 $430,900
Smithfield Township	421104	0	3	Residential	7	$228,300
South Creek Township	421105	8	16	Commercial Other Residential	2 6 63	$55,750 $250,950 $1,149,950
South Waverly Borough	420176	3	3	Commercial Other Residential	1 3 10	$94,000 $13,600 $353,600
Springfield Township	421109	0	3	Other Residential	2 3	$7,600 $89,200
Standing Stone Township	421406	8	4	Other Residential	10 18	$107,500 $335,450
Stevens Township	421407	3	3	Commercial Other Residential	1 6 7	$34,400 $77,150 $170,800
Sylvania Borough	420177	9	4	Commercial Residential	1 13	$17,900 $341,800
Terry Township	421111	46	10	Other Residential	30 11	$301,000 $219,750
Towanda Borough	420178	13	20	Commercial Other Residential	16 1 9	$310,750 $11,150 $78,650
Towanda Township	421113	11	3	Commercial Other	1 4	$27,500 $167,350
Troy Borough	420179	9	10	Commercial Other Residential	10 4 5	$331,450 $51,800 $123,300
Troy Township	421114	9	11	Commercial Other Residential	5 13 25	$651,400 $310,950 $714,050
Tuscarora Township	421116	3	5	Other Residential	1 11	$0 $256,200
Ulster Township	421218	36	10	Other Residential	8 13	$66,050 $284,750

Municipal NFIP Policies & Vulnerability *(PEMA, 2018; Bradford Co. GIS, 2019)*						
Community Name	**Comm Num.**	**Losses**	**Active Contracts**	**Vulnerable Buildings By Assessment Use**		**Assessed Price**
Warren Township	421408	27	14	Commercial Other Residential	1 16 26	$12,900 $391,450 $628,200
Wells Township	421121	0	6	Commercial Other Residential	22 11 11	$254,150 $362,450 $241,150
West Burlington Township	421122	0	1	Commercial Other Residential	1 4 4	$0 $57,150 $114,100
Wilmot Township	421124	76	20	Other Residential	45 29	$622,550 $750,450
Windham Township	421409	8	10	Commercial Other Residential	8 18 17	$41,600 $343,000 $402,450
Wyalusing Borough	420180	27	0	Other	2	$1,200
Wyalusing Township	421126	42	25	Commercial Other Residential	20 40 23	$985,850 $923,400 $654,050
Wysox Township	420977	25	12	Commercial Other Residential	2 23 11	$18,750 $276,350 $226,650
Total		**931**	**627**	**Commercial** **Other** **Residential** **Overall Total**	**281** **445** **1,138** **1,864**	**$6,147,000** **$8,733,750** **$26,559,122** **$41,439,872**

4.2.4.4 Future Occurrence

Table 19 - Flood Probability Summary

Flood Probability Summary *(FEMA)*	
Flood Recurrence Intervals	**Annual Chance of Occurrence**
10-year	10.00%
50-year	2.00%
100-year	1.00%
500-year	0.20%

Flooding is a frequent problem throughout Pennsylvania. Bradford County will certainly be impacted by flooding events in the future – Bradford County experiences some degree of flooding annually. The threat of flooding is compounded in the late winter and early spring months, as melting snow can overflow streams, creeks and tributaries, increasing the amount of groundwater, clogging stormwater culverts and bridge openings. The NFIP recognizes the 1%-annual-chance flood, also known as the base flood or one-hundred-year flood, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1%-annual-chance flood is a flood which has a 1% chance of occurring over a

given year or is likely once every one-hundred years. The digital flood insurance rate maps (DFIRMs) are used to identify areas subject to the 1% annual-chance flooding. A property's vulnerability to a flood is dependent upon its location in the floodplain. Properties along the banks of a waterway are the most vulnerable. The property within the floodplain is broken into sections depending on its distance from the waterway. The ten-year flood zone is the area that has a ten percent chance of being flooded every year. However, this label does not mean that this area can-not flood more than once every ten years. It just designates the probability of a flood of this magnitude every year. Further away from this area is the fifty-year flood plain. This area includes all of the ten-year floodplain plus additional property. The probability of a flood of this magnitude occurring during a one-year period is two percent. A summary of flood probability is shown in *Table 19 - Flood Probability Summary*.

4.3.4.5 Vulnerability Assessment

River and Stream Flooding:

Bradford County is vulnerable to flooding events. Flooding puts the entire population at some level of risk, whether through the flooding of homes, businesses, places of employment, or the road, sewer and water infrastructure. Table 18 - Municipal NFIP Policies & Vulnerability

Table 18 - Municipal NFIP Policies & Vulnerability identifies how many structures located in the special flood hazard area by municipality using county GIS data. Critical facilities are facilities that if damaged would present an immediate threat to life, public health and safety. Facilities that use and store hazardous materials pose a potential threat to the environment during flooding events if flooding causes leaks or equipment failure. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Bradford County with vulnerable structures, critical facilities and hazardous material locations identified. There are twenty-nine critical facilities that are located within the special flood hazard area (*Table 20 - Critical Facilities Vulnerable to Flooding*). Total assessed price of these critical facilities is over $7.2 million which should be considered a low estimate considering several of the facilities were missing this metric.

Flash Flooding:

Flash flooding is a common occurrence in Bradford County, with regions that are more populated and have more impervious surfaces are typically more susceptible to flash flooding. According to local reports and data from NOAA, the following locations were identified as most prone to flash flooding: Athens, Milan, Monroeton, New Albany, North Towanda, Rome, Sayre, Towanda and Troy. These locations appear highlighted in *Figure 25 - Flooding Vulnerability*. In addition to these locations, the townships of Litchfield, Ulster and West Burlington were identified as also particularly prone to flash flooding.

Ice Jam Flooding:

While not apparent in the reported past occurrences from NOAA's Storm Events Database, there is a history of ice jam flooding within Bradford County. Areas along the Susquehanna River, Chemung River, Sugar Creek, Towanda Creek, Wyalusing Creek and Wysox Creek are most vulnerable to ice jam flooding.

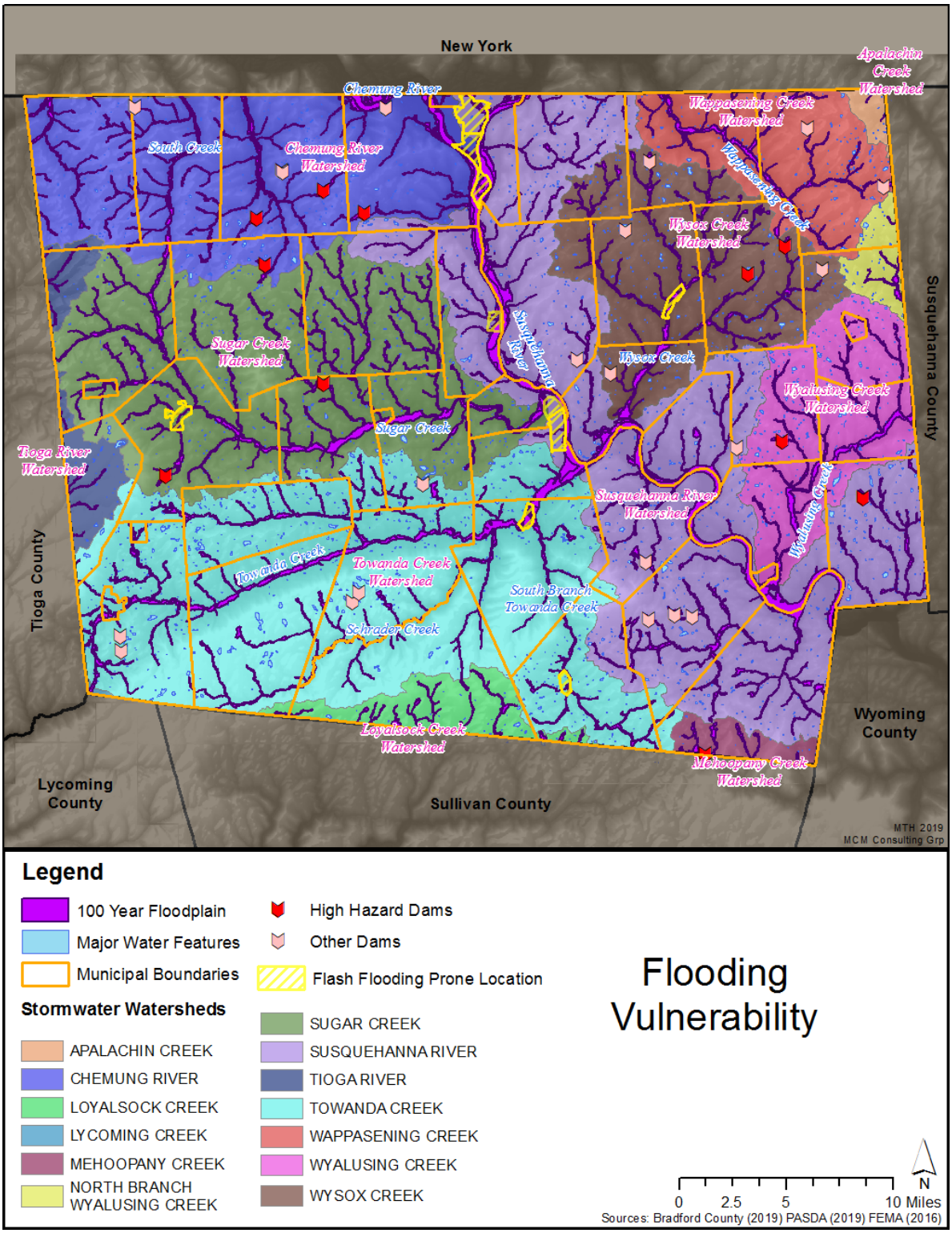
The Bradford County Hazard Mitigation Team will continue to work with municipalities to identify vulnerable locations to all types of flooding and identify vulnerable special needs populations and critical facilities. This will be a continuous process during the 2020-2025 mitigation plan period. As new data is developed, and new special needs facilities appear, the interface between flooding locations and the new data will be analyzed to identify new vulnerability.

Table 20 - Critical Facilities Vulnerable to Flooding

Critical Facilities Vulnerable to Flooding ***(Bradford Co GIS, 2019; PEMA, 2019)***				
Type	**Name**	**Municipality**	**Address**	**Assessed Price**
Landing Zone	Albany Twp 01 At New Albany School	Albany Township	Elem Ln (Wyalusing School)	$52,300
SARA Title 3	Eilenberger Spring	Albany Township	2336 Marsh Rd	$2
Child Care	Little Harvard Early Learning	Athens Borough	109 Susquehanna St	$86,000
Senior Housing	Chemung View Apartments	Athens Borough	222 Chestnut St	$330,000
School	Canton Elementary School	Canton Borough	545 E Main St	$1
Landing Zone	Canton Twp 01 At D & C Rentals	Canton Township	Route 414	$3000,000
Landing Zone	Franklin Twp 02 At Franklindale	Franklin Township	Route 414 (Grange Rd & Route 414)	Not Recorded
Landing Zone	Monroe Borough 01 At Mountaineer Park	Monroe Borough	Thrasher Ln (James Monroe &Thrasher Ln)	$1
School	Norther Tier Counseling	Monroe Township	2120 PA State Rte 414, Monroeton PA 18832	$8,000
Landing Zone	Orwell Twp 01 At Northeast School	Orwell Township	Route 487 (Route 487 & Panther Ln)	$1
Landing Zone	Orwell Township At Allis Hollow Lz 12	Orwell Township	Cragle Rd (Route 467 & Cragle Rd)	$1
School	Northeast Bradford High School	Orwell Township	526 Panther Ln	$1
Child Care	Arms Wide Open Daycare	Ridgebury Township	13584 Berwick Tpke	$170,000
Landing Zone	Ridgebury Twp 01 At Ridgebury Fire Dept	Ridgebury Township	Green Mountain Rd (Berwick Twp & Greenmountain Rd)	$2,000
Child Care	Head Start - Rome	Rome Borough	1355 Main St	$63,000

Critical Facilities Vulnerable to Flooding ***(Bradford Co GIS, 2019; PEMA, 2019)***				
Type	**Name**	**Municipality**	**Address**	**Assessed Price**
SARA Title 3	Washita Valley Enterprises	Sheshequin Township	360 Snyder Rd	$1
SARA Title 3	Leprino Foods Company	South Waverly Borough	217 Yanuzzi Dr	Not Reported
Landing Zone	Stevens Twp 01 At Stevensville	Stevens Township	Clapper Hill Rd (Jon Vandemark Land)	$1
SARA Title 3	Woc Energy South River Storage	Towanda Borough	9 S River St	$10
Landing Zone	Towamda Twp 01 At Bradford County Airport	Towanda Township	Airport Rd	$1
Child Care	Head Start - Troy	Troy Borough	141 Canton St	$173,000
Landing Zone	Troy Twp 02 At East Troy School	Troy Township		$27,500
Medical Facility	Arnot Medical Services Walk In	Troy Township	45 Mud Creek Rd	$250,000
Landing Zone	Warren Twp 02 At West Warren BP	Warren Township	Leraysville Rd	$3,000
Fire Department	Troy Fire Dept Station #2	West Burlington Township	15894 Route 6 , Troy PA 16947	$2,917
Child Care	Lori'S Bigger Dream	Wilmot Township	7665 Route 187	$1
Child Care	Wyalusing Valley Childrens Center	Wyalusing Township	42932 Route 6	$1
Landing Zone	Wyalusing Twp 01 At Camptown School	Wyalusing Township	Route 706	Not Reported
School	Wyalusing Valley Elementary School	Wyalusing Township	11450 Wyalusing New Albany Rd	$87,500

Figure 25 - Flooding Vulnerability



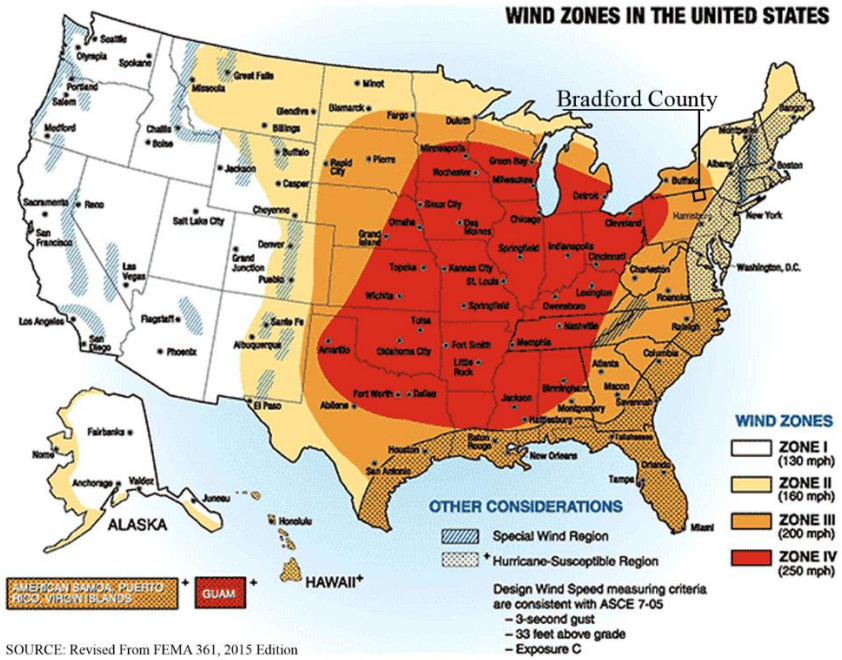
4.3.5. Hurricane, Tropical Storm

4.3.5.1 Location and Extent

Tropical depressions are cyclones with maximum sustained winds of less than thirty-nine miles per hour (mph). The system becomes a tropical storm when the maximum sustained winds reach between thirty-nine to seventy-four miles per hour. When wind speeds exceed seventy-four mph, the system is considered a hurricane. Tropical storms impacting Bradford County develop in tropical or sub-tropical waters found in the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea. Another type of tropical storm is nor'easters, which are large cyclones that rotate clockwise and are typically associated with the Atlantic Ocean and the East Coast of the United States between North Carolina and Massachusetts. The name nor'easter comes from the direction that the strongest winds typically blow from the cyclone.

While Bradford County is located over one hundred and fifty miles inland of the East Coast of the United States, tropical storms can track inland and cause heavy rainfall and strong winds. Bradford County is located just inland of the East Coast region designated by FEMA as being Hurricane-Susceptible (see *Figure 26 - Wind Zones*). Bradford County falls within the wind Zone III, which suggests that shelters and critical facilities should be able to withstand a three-second gust of wind up to two hundred miles per hour (*Figure 26 - Wind Zones*). All communities within Bradford County are equally subject to the impacts of hurricanes and tropical storms that track near the county. Areas in Bradford County which are subject to flooding, wind and winter storm damage are particularly vulnerable.

Figure 26 - Wind Zones



SOURCE: Revised From FEMA 361, 2015 Edition

4.3.5.2 Range of Magnitude

Table 21 - Saffir-Simpson Scale

Saffir-Simpson Hurricane Scale		
Category	Wind Speed	
	mph	knots
5	≥156	≥135
4	131-155	114-134
3	111-130	96-113
2	96-110	84-95
1	74-95	65-83
Non-Hurricane Classifications		
Tropical Storm	39-73	34-64
Tropical Depression	0-38	0-33

The impact tropical storm or hurricane events have on an area is typically measured in terms of wind speed. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale (*Table 21 - Saffir-Simpson Scale*). The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge potential (characteristic of tropical storms and hurricanes, but not a threat to inland locations like Bradford County). Categories three, four, and five are classified as "major" hurricanes. While major hurricanes comprise only twenty of all tropical cyclones making landfall, they account for over seventy percent of the damage in the United States. While hurricanes can cause high winds and associated impacts, it is also important to recognize the potential for flooding events during hurricanes, tropical storms and nor'easters; the risk assessment and associated impact for flooding events is included Section 4.3.4.5.

4.3.5.3 Past Occurrence

Table 22 - History of Coastal Storms lists all coastal storms that have impacted Bradford County from 1970 to December 2018. Although impacts of tropical storms are commonly felt in the Commonwealth, it is rare that a hurricane would track through Bradford County.

Hurricane Agnes was a severe coastal storm event in 1972 that impacted Bradford County. After making first landfall as a hurricane near Panama City, Florida, Agnes weakened and exited back into the Atlantic off the North Carolina coast. The storm skirted along the coast and made a second landfall near New York City as a tropical storm and merged with an extra-tropical low-pressure system over northern Pennsylvania. This brought extremely heavy rains to Pennsylvania, with a concentration of rain in the Susquehanna River Basin. Pennsylvania incurred $2.1 billion in damages and 48 deaths statewide. Fire and flood destroyed 68,000 homes and 3,000 businesses and left 220,000 Pennsylvanians homeless. The event triggered a Presidential Disaster Declaration for the region. Rainfall of seven to ten inches was noted across the Commonwealth,

with some areas reporting as much of eighteen inches locally. Many roadways in Bradford County were damaged, and the Tozers Bridge in Athens was washed away.

In September 2004 Tropical Storm Ivan caused extensive flooding as well, also resulting in a Presidential Disaster Declaration for regions in Pennsylvania. The Ivan event produced flooding somewhat less than 100-year event crests in some locations. Flooding damage in Bradford County totaled an estimated $22 million (NOAA Storm Events Database, 2019).

Tropical Storm Lee in September of 2011 was the most severe tropical storm to impact Bradford County, causing significant flooding and damage (see *Figure 27 - Tropical Storm Lee Rainfall Totals*). Bradford County had already been drenched by Hurricane Irene just one week prior to Tropical Storm Lee. Towanda and other surrounding communities received between six and fourteen inches of rain. Alba Borough recorded the highest amount of rain for the period at just over nine inches of rainfall. Although the recorded amount was nine inches, other locations in the county received up to fourteen inches of rain locally. According to the National Weather Service, over 2,000 people were evacuated and 3,000 homes and businesses flooded during the multi-day event. Over half of these structures received major damage or were considered uninhabitable. Almost every road in the county received some type of damage with most damage being considered major. Bradford County's Agricultural Community received severe damage of over $7 million dollars in crop damages. Many of the rural farms were wiped out by the damage. One death resulted from the flood in Bradford County when an elderly Towanda woman refused to evacuate her home was exposed to flood waters, ultimately dying from hypothermia.

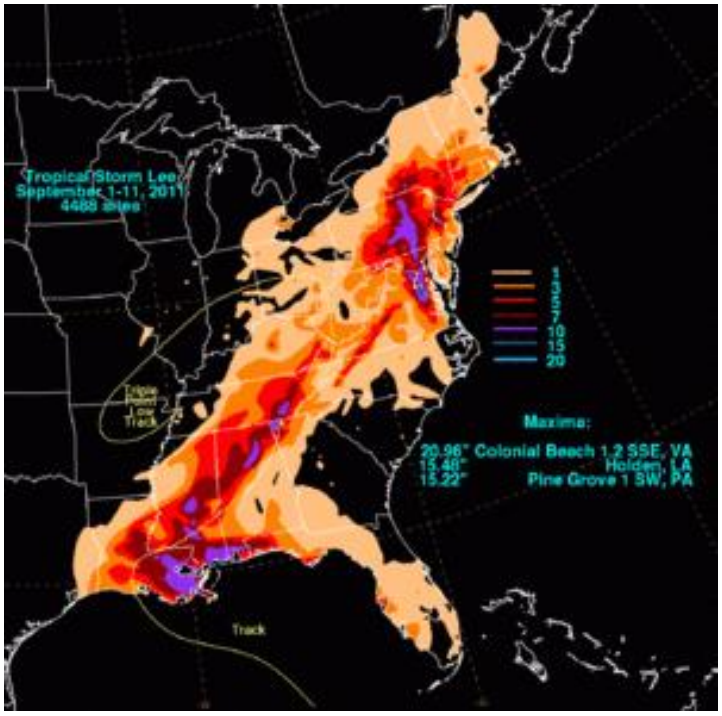
Hurricane Sandy was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season, and the second-costliest hurricane in US history. Sandy was a Category three storm at its peak intensity when it made landfall in Cuba. It was classified as a Category two storm off the coast of the Northeastern United States, but because of the unusual merge with a frontal system, the hurricane was termed "Superstorm Sandy." At least 285 people were killed along the path of the storm in seven countries. In the United States, there were seventy-two people killed with an additional eighty-seven fatalities as indirect result of the storm. Superstorm Sandy caused an estimated $65 billion in damages in the United States alone.

Table 22 - History of Coastal Storms

History of Coastal Storms Impacting Bradford County (NOAA NCEI, 2019)	
Year	**Name**
1954	Hurricane Hazel
1955	Hurricanes Connie & Diane

History of Coastal Storms Impacting Bradford County (NOAA NCEI, 2019)	
Year	**Name**
1972	Tropical Storm Agnes
1999	Hurricane Floyd
2003	Tropical Storm Henri
2003	Tropical Storm Isabel
2004	Tropical Depression Frances
2004	Tropical Depression Ivan
2005	Hurricane Katrina
2006	Tropical Depression Ernesto
2008	Hurricane Ike
2011	Hurricane Irene
2011	Tropical Storm Lee
2012	Hurricane Sandy
2017	Tropical Storm Cindy

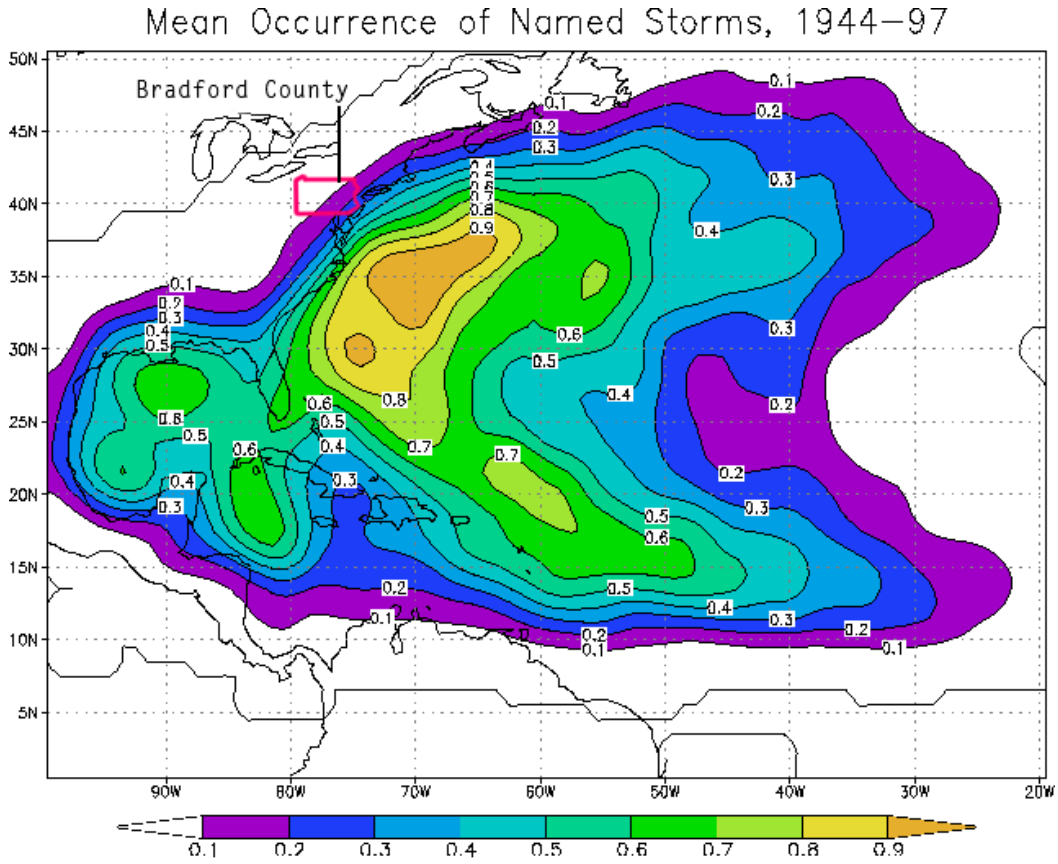
Figure 27 - Tropical Storm Lee Rainfall Totals



4.3.5.4 Future Occurrence

Although hurricanes and tropical storms can cause flood events consistent with 100- and 500-year flood levels, the probability of occurrence of hurricanes and tropical storms is measured relative to wind speed. *Table 23 - Annual Probability of Wind Speeds* shows the annual probability of winds that reach the strength of tropical storms and hurricanes in Bradford County and the surrounding areas based on a sample period of forty-six years. NOAA's Hurricane Research Division estimates that Bradford County will experience impacts from a named tropical storm or hurricane up to once every ten years, with a probability between zero and ten percent annually (*Figure 28 - Mean Occurrence of Named Storms 1944-1997).* However according to FEMA, there is a high probability each year that Bradford County will experience winds from coastal storms that could cause minimal to moderate damages (*Table 23 - Annual Probability of Wind Speeds*). The probability of winds exceeding 118 mph is less than 0.1% annually.

Figure 28 - Mean Occurrence of Named Storms 1944-1997



Average number of tropical storms and hurricanes that affect the area throughout the hurricane season. The data used was from 1944 to 1997 and counted hits when a storm or hurricane was within ~100 miles (165km).

Source:NOAA Hurricane Research Division 2015

Table 23 - Annual Probability of Wind Speeds

Annual Probability of Wind Speeds *(FEMA, 2000)*		
Wind Speed (mph)	**Saffir-Simpson Scale**	**Annual Probability of Occurrence (%)**
45-77	Tropical Storms// Category 1 Hurricane	91.59
78-118	Category 1 to 2 Hurricanes	8.32
119-138	Category 3 to 4 Hurricanes	.0766
139-163	Category 4 to 5 Hurricanes	.0086
164-194	Category 5 Hurricanes	.00054
195+	Category 5 Hurricanes	.00001

Climate change is causing atmospheric temperatures to rise, which corresponds to a rise in ocean surface temperatures, resulting in warmer and moister conditions where tropical storms develop (Stott et al., 2010). Warmer oceans store more energy, and are capable of fueling stronger storms and it is projected that Atlantic hurricanes will become more intense and produce more precipitation as ocean surface temperatures rise (Trenberth, 2010). There are expected to be more category four and five hurricanes in the Atlantic, and the hurricane season may be elongating. Bradford County can be affected by Atlantic coastal storms, so the county should be prepared to deal with impacts of coastal storms more frequently in the near future.

4.3.5.5 Vulnerability Assessment

The impacts of climate change are no longer hypothetical concepts set in the future, but rather tangible and hazardous realities. The unexpectedly devastating Hurricane Harvey in August 2017 in Houston is widely regarded as an example of a hurricane supercharged by warmer ocean temperatures (Trenberth et al., 2018). The damage Harvey caused to Houston was also exacerbated by urbanization, causing the storm system to stall over Houston with few locations where water could naturally sink into the ground (Zhang et al., 2018).

Tropical storms tracking nearby Bradford County can still cause high winds and heavy rains. A vulnerability assessment for hurricanes and tropical storms focuses on the impacts of flooding and severe wind. The assessment for flood-related vulnerability is addressed in Section 4.3.4.5 and discussion of wind related vulnerability is addressed in Section 4.3.12.5.

4.3.6. Invasive Species

4.3.6.1 Location and Extent

An invasive species is a species that is not indigenous to a given ecosystem and that, when introduced to a non-native environment, tends to thrive. The spread of an invasive species often alters ecosystems, which can cause environmental and economic harm and pose a threat to human health. The phenomenon of invasive species is due to human activity. Human society is globalized, and people have the capability to traverse the globe at rates unparalleled in the history of the Earth. Either intentionally or unintentionally,

other species may accompany people when they travel, introducing the stowaway species to a novel ecosystem. In a foreign ecosystem, a transported species may thrive, potentially restructuring the ecosystem and threatening its health. Common pathways for invasive species introduction to Pennsylvania include (PA DOA, 2010):

- Contamination of internationally traded products
- Hull fouling
- Ship ballast water release
- Discarded live fish bait
- Intentional release
- Escape from cultivation
- Movement of soil, compost, wood, vehicles or other materials and equipment
- Unregulated sale of organisms
- Smuggling activities
- Hobby trading or specimen trading

Invasive species threats are typically divided into two main subsets:

Aquatic Invasive Species (AIS) are nonnative, invertebrates, fishes, aquatic plants, and microbes that threaten the diversity or abundance of native species, the ecological stability of the infested waters, human health and safety, or commercial, agriculture, or recreational activities dependent on such waters.

Terrestrial Invasive Species (TIS) are nonnative plants, vertebrates, arthropods, or pathogens that complete their lifecycle on land whose introduction does or is likely to cause economic or environmental harm or harm to human health.

The location and extent of invasive threats is dependent on the preferred habitat of the species, as well as the species' ease of movement and establishment. *Table 1 - Prevalent Invasive Species* lists invasive species that have been found in Bradford County.

4.3.6.2 Range of Magnitude

Some invasive species are not considered agricultural pests, and do not harm humans or cause significant ecological problems. Other invasive species can have many negative impacts and cause significant changes in the composition of ecosystems. For example, the Emerald Ash Borer has a ninety-nine percent mortality rate for any ash tree it infects. Didymo, an aggressive form of algae not yet found in Bradford County, can clog waterways and smother native aquatic plants and animals.

The aggressive nature of many invasive species can cause significant reductions in biodiversity by crowding out native species. This can affect the health of individual host organisms as well as the overall well-being of the affected ecosystem. An example of a worst-case scenario for invasive species is the success of the Emerald Ash Borer in Bradford County and the surrounding region. The Emerald Ash Borer has already become established in Bradford County and the surrounding region, and there is a high mortality rate for trees associated with this pest. In recent years, hardwood forests in the county have been increasingly negatively impacted due to this invasive species and there have

been many ash tree fatalities. Degradation of forest health which cascades into other problems. Among other benefits, forests prevent soil degradation and erosion, protect watersheds, and sequester carbon from the atmosphere. Forests have a key role in hydrologic systems, so losing a forest amplifies the effects of erosion and flooding. Forest degradation also has adverse economic effects, impacting such activities as logging, tourism, foraging and other production activities dependent on lumber.

The magnitude of an invasive species threat is generally amplified when the ecosystem or host species is already stressed, such as in times of drought. The already weakened state of the native ecosystem causes it to more easily succumb to an infestation.

4.3.6.3 Past Occurrence

Invasive species have been entering Pennsylvania since the arrival of European settlers. There are large swatches of public forested land in Bradford County, including Mount Pisgah State Park, parts of Loyalsock and Tioga State Forest, and several State Game Lands. There are many invasive plants that are widespread in Bradford County that are common problems throughout the Commonwealth, some of the most problematic include:

- Japanese Knotweed
- Garlic Mustard
- Japanese Stiltgrass
- Multiflora Rose
- Japanese Barberry

In the past these species have been cut back to slow their spread and treated with foliar herbicide when they re-sprout. However, when species are so widespread and established, they may not be actively treated unless they are in a project area that is receiving attention otherwise.

There are several invasive pests that have moved through Bradford County and the surrounding region which have resulted in the deaths of many trees. PennDOT summarizes these invasive species:

> *Pennsylvania has been inhabited by an invasive beetle known as the Emerald Ash Borer. This green-colored insect has infested many ash trees, which has resulted in a pandemic level of dead ash trees. In addition, the Gypsy Moth Caterpillar defoliated Western Pennsylvania at least twice within the last twenty years. This insect infested the oak tree species and many of those trees have died as well. The Wooly Adelgid and needle blight fungi are also currently affecting the white pine and hemlock trees, resulting in their premature deaths. (PennDOT, 2017)*

These occurrences represent lost battles to invasive species, and these species are widespread in Bradford County and the surrounding region. Once a species is established in an area and it causes a change in the ecology, it can be quite difficult if somewhat futile to turn back the clock on the prevalence of the species; however, Bradford County can work towards limiting the spread and mitigating the negative impacts of such widespread

invasive species. In the case of the Emerald Ash Borer and other tree killing invasive species, PennDOT has identified one way that the threat needs to be mitigated in the wake of the surge of dead trees:

> *[The Emerald Ash Borer, Gypsy Moth and Wooly Adelgid] have left … tens of thousands of dead trees either within the State Department of Transportation's (PennDOT) right-of-way or on private property, but within close proximity to falling on our highways. Although random in nature, several fatalities have been associated with trees falling on motorists or motorists running into downed trees across the highway…*
>
> *PennDOT has been incorporating select tree removal into roadway construction projects using both federal and state funding. Since July 1, 2016, PennDOT Department Force Crews have also increased their efforts in select manual tree removal. This work is often done during the winter when crews are not engaged in snow removal operations. Dead tree removal is quickly becoming a major focus of PennDOT, however a sustained funding source to remove all of these potential hazards is simply not available. The PA Department of Agriculture has established strict firewood and lumber quarantine areas in some of these districts so additional costs may be incurred.*

Table 24 - Prevalent Invasive Species lists problematic non-native species that are established in Bradford County. While all species listed here are not native to Bradford County, those species highlighted in red are considered to pose a larger ecological threat than some of the others (see 4.3.6.5. Vulnerability Assessment for additional discussion). For some species such as the European Bark Beetle, the Sirex Woodwasp and the Emerald Ash Borer, Bradford County is on the edge of the species range, meaning control efforts taken in the county can help limit the propagation of the threat even beyond the county (*Table 25 - Vulnerable Species*).

Table 24 - Prevalent Invasive Species

Prevalent Invasive Species *(EDDMaps, 2019; PA DCNR, 2019; USDA FS, 2019; iMapInvasives, 2019)*		
Scientific Name	**Common Name**	**Type**
Corbicula fluminea	Asiatic Clam	Aquatic Animal
Cyprinus carpio	Common Carp	Aquatic Animal
Craspedacusta sowerbyi	Freshwater Jellyfish	Aquatic Animal
Etheostoma blennioides	Greenside Darter	Aquatic Animal
Misgurnus anguillicaudatus	Oriental Weatherfish	Aquatic Animal
Orconectes rusticus	Rusty Crayfish	Aquatic Animal
Dreissena polymorpha	Zebra Mussel	Aquatic Animal
Potamogeton crispus	Curly-Leaf Pondweed	Aquatic Plant
Myriophyllum spicatum	Eurasian Water-Milfoil	Aquatic Plant
Hydrilla verticillata	Hydrilla	Aquatic Plant

Prevalent Invasive Species *(EDDMaps, 2019; PA DCNR, 2019; USDA FS, 2019; iMapInvasives, 2019)*		
Scientific Name	**Common Name**	**Type**
Persicaria hydropiper	Marshpepper Knotweed, Smartweed	Aquatic Plant
Mentha aquatica	Water Mint	Aquatic Plant
Nasturtium officinale	Watercress	Aquatic Plant
Nymphoides peltata	Yellow Floatingheart	Aquatic Plant
Neonectria (N.) & Cryptococcus fagisuga	Beech Bark Disease Complex	Disease
Sirococcus clavigignenti-juglandacea-rum	Butternut Canker	Disease
Diaporthales: Cryphonectriaceae	Chestnut Blight	Disease
Discula destructiva	Dogwood Anthracnose	Disease
Hemiptera: Diaspididae	Elongate Hemlock Scale	Disease
Neonectria faginata	Neonectria Canker	Disease
Cronartium ribicola	White Pine Blister Rust	Disease
Coleoptera: Buprestidae	Emerald Ash Borer	Insect
Hymenoptera: Diprionidae	European Pine Sawfly	Insect
Letpidoptera: Tortricidae	European Pine Shoot Moth	Insect
Lepidoptera: Lymantriidae	Gypsy Moth	Insect
Adelges tsugae	Hemlock Woolly Adelgid	Insect
Plagiodera versicolora	Imported Willow Leaf Beetle	Insect
Coleoptera: Scarabaeidae	Japanese Beetle	Insect
Sirex noctilio	Sirex Woodwasp	Insect
Lonicera maackii	Amur Honeysuckle	Plant
Elaeagnus umbellata	Autumn Olive	Plant
Ranunculus bulbosus	Bulbous Buttercup	Plant
Cirsium vulgare	Bull Thistle	Plant
Lonicera spp.	Bush Honeysuckles (Exotic)	Plant
Cirsium arvense	Canada Thistle	Plant
Tussilago farfara	Colt's Foot	Plant
Securigera varia	Common Crown-Vetch	Plant
Phragmites australis ssp. australis	European Common Reed	Plant
Alliaria petiolata	Garlic Mustard	Plant
Berberis thunbergii	Japanese Barberry	Plant
Reynoutria japonica	Japanese Knotweed	Plant
Microstegium vimineum	Japanese Stiltgrass	Plant
Sorghum halepense	Johnson Grass	Plant
Lonicera morrowii	Morrow'S Honeysuckle	Plant
Rosa multiflora	Multiflora Rose	Plant
Conium maculatum	Poison Hemlock	Plant

Prevalent Invasive Species (EDDMaps, 2019; PA DCNR, 2019; USDA FS, 2019; iMapInvasives, 2019)		
Scientific Name	**Common Name**	**Type**
Lythrum salicaria	Purple Loosestrife	Plant
Phalaris arundinacea	Reed Canarygrass	Plant
Acorus calamus	Sweetflag, Calamus	Plant
Ailanthus altissima	Tree-Of-Heaven	Plant
Myosotis scorpioides	True Forget-Me-Not	Plant
Rubus phoenicolasius	Wineberry	Plant
Iris pseudacorus	Yellow Iris	Plant

4.3.6.4 Future Occurrence

According to the Pennsylvania Invasive Species Council (PISC), the probability of future occurrence for invasive species threats is growing due to the increasing volume of transported goods, increasing efficiency and speed of transportation, and expanding international trade agreements. Expanded global trade has created opportunities for many organisms to be transported to and establish themselves in new counties and regions. Climate change is contributing to the introduction of new invasive species. As maximum and minimum seasonal temperatures change, pests can establish themselves in previously inhospitable climates. This also gives introduced species an earlier start and increases the magnitude of their growth, possibly shifting the dominance of ecosystems in the favor of nonnative species.

In order to combat the increase in future occurrences, the PISC (a collaboration of state agencies, public organizations and federal agencies) released the Invasive Species Management Plan in April 2010 and updated the plan in 2017. The plan outlines the Commonwealth's goals for managing the spread of nonnative invasive species and creates a framework for responding to threats through research, action, and public outreach and communication. More information can be found at invasivespeciescouncil.com.

There are several invasive species that are found near Bradford County but have not yet been detected inside the county (see *Table 25 - Vulnerable Species)*. Especially in cases like this, control efforts, heightened awareness, and public outreach and education can help prevent an invasive species from becoming established. Once a species is established, it is much more difficult to eradicate it from an ecosystem meaning prevention is very important. Bush Honeysuckle species, the Spotted Lanternfly, Mile-A-Minute Vine and the Asian Long-Horned Beetle are all widespread and highly problematic in nearby counties but have not been reported in Bradford. The forests of Bradford County would greatly benefit if these species can be kept out of the area. There are isolated reports of the Spotted Lanternfly occurring in Bradford County, suggesting it may be recently moving into the area as of early 2019 and its control should be a priority. For a more inclusive

list of invasive plants found in Pennsylvania and a list of invasive plants on the Pennsylvania watch list, see the referenced PA DCNR publication "DCNR Invasive Plants" (PA DCNR, 2016).

Table 25 - Vulnerable Species

Vulnerable Species *(EDDMaps, 2019; PA DCNR, 2019; USDA FS, 2019; iMapInvasives, 2019)*		
Scientific Name	**Common Name**	**Type**
Nelumbo lutea	American Water Lotus	Aquatic Plant
Veronica anagallis-aquatica	Water Speedwell	Aquatic Plant
Ophiostoma novo-ulmi	Dutch Elm Disease	Disease
Ceratocystis fagacearum	Oak Wilt	Disease
Anoplophora glabripennis	Asian Long-Horned Beetle	Insect
Crytepistomus castaneus	Asiatic Oak Weevil	Insect
Adelges piceae	Balsam Woolly Adelgid	Insect
Scolytus schevyrewi	Banded Elm Bark Beetle	Insect
Phyllaphis fagi	Beech Woolly Adelgid	Insect
Fenusa pusilla	Birch Leafminer	Insect
Otiorhynchus sulcatus	Black Vine Weevil	Insect
Dryocosmus kuriphilus	Chestnut Gall Wasp	Insect
Hylastes opacus	European Bark Beetle (H. Opacus)	Insect
Contarinia baeri	European Pine Needle Midge	Insect
Epinotia nanana	European Spruce Needleminer	Insect
Gilpinia hercyniae	European Spruce Sawfly	Insect
Coleophora laricella	Larch Casebearer	Insect
Pristiphora erichsonii	Larch Sawfly	Insect
Homadaula anisocentra	Mimosa Webworm	Insect
Pristiphora geniculata	Mountain-Ash Sawfly	Insect
Asterolecanium minus	Oak Pit Scale A. Minus	Insect
Lepidosaphes ulmi	Oystershell Scale	Insect
Caliroa cerasi	Pear Sawfly	Insect
Taeniothrips inconsequens	Pear Thrips	Insect
Acantholyda erythrocephala	Pine False Webworm	Insect
Trichiocampus viminalis	Poplar Sawfly	Insect
Matsucoccus resinosae	Red Pine Scale	Insect
Hylurgus ligniperda	Redhaired Pine Bark Beetle	Insect
Diaspidiotus perniciosus	San Jose Scale	Insect
Scolytus multistriatus	Smaller European Elm Bark Beetle	Insect
Lycroma delicatula	Spotted Lanternfly (Lycorma)	Insect
Otiorhynchus ovatus	Strawberry Root Weevil	Insect

Vulnerable Species (EDDMaps, 2019; PA DCNR, 2019; USDA FS, 2019; iMapInvasives, 2019)		
Scientific Name	**Common Name**	**Type**
Lonicera spp. (species unknown)	Bush Honeysuckle (Species Unknown)	Plant
Heracleum mantegazzianum	Giant Hogweed	Plant
Lonicera japonica	Japanese Honeysuckle	Plant
Persicaria perfoliata	Mile-A-Minute Vine	Plant
Celastrus orbiculatus	Oriental Bittersweet	Plant
Cardamine impatiens	Touch-Me-Not Bittercress	Plant

4.3.6.5 Vulnerability Assessment

Bradford County's vulnerability to invasion depends on the species in question. Human activity and mobility are ever increasing, and combined with the prospects of climate change, invasive species are becoming increasingly threatening. Invasive species can have adverse economic effects by impacting agriculture and logging activities. Natural forest ecosystems provide clean water, recreational opportunities, habitat for native wildlife, and places to enjoy the tranquility and transcendence of nature. The balance of forest ecosystems and forest health are vulnerable to invasive species threats. While there are significant portions of state forest, state parks and game lands in Bradford County where forest managers can impact invasive species, private lands can provide refuge for invasive species if landowners are unaware of or apathetic towards the threat.

An interesting facet of the invasive species problem in Pennsylvania is that deer do not eat many invasive plants, giving invasive species a competitive advantage over the native species that fall prey to deer. As such, the management of deer populations in Bradford County has a significant impact on the vulnerability of an ecosystem to invasive species, where overpopulation of deer favors invasive species.

There are five primary components to managing invasive plants:

Prioritize: Public use areas such as state parks and other healthy forest ecosystems should be prioritized over developed and private areas. Locations with lower densities of invasive plants are often easier to control and should be given quick attention. Locations where humans are disturbing the landscape opens up niche space, and often times the aggressive invasive species move in faster than native species. Such locations include areas around road work, ditch/culvert work, logging activities, stream improvement/stabilization and bridge work. Some species pose a higher risk than others - invasive species are easiest to control before they become widespread and established in an area, and for that reason, species that are less widespread should be prioritized for management.

Species highlighted in red in *Table 24 - Prevalent Invasive Species* and *Table 25 - Vulnerable Species* have been species that have been considered priority species throughout Pennsylvania. Priority species of note for Bradford County include the Emerald Ash

Borer, Zebra Mussels, Japanese Knotweed, the Spotted Lanternfly and the Hemlock Woolly Adelgid.

Furthermore, it is best to act before a species can become established in the County, so management should be aware of invasive species found nearby Bradford County but are not yet present in the county (priority species in *Table 25 - Vulnerable Species*). Public outreach and education are important for these species in order to improve identification and prevention of invasion. The Asian Long-horned Beetle first attacks red maple trees, followed by many other hardwoods by boring half inch holes through the trees, weakening them structurally and causing limbs to break off, ultimately killing trees. Bradford County has many red and sugar maple trees, so if the Asian Long-horned Beetle ever became established in the county, it could spread quickly and have a devastating impact.

Locate: Detailed locations should be recorded for invasive plants so sites can be easily relocated, treated and monitored.

Delineate: The scale and extent of the infestation should be recorded and mapped so that the progress of the infestation can be monitored.

Control: Methods of control depend on the specific infestation, but the most common approaches are mechanical (cutting and hand-pulling) and chemical (herbicide treatments).

Monitor: Identified sites should be monitored and revisited as often as several times in a growing season (depending on the location/species). Monitoring can allow for early detection of spreading infestations. Most importantly, it prevents a relapse towards full-blown infestation.

4.3.7. Landslides

4.3.7.1 Location and Extent

Landslides are described as downward and outward movement of slope-forming soil, rock and vegetation reactive to the force of gravity. Rockfalls, rockslides, rock topples, block glides, debris flows, mudflows and mudslides are all forms of landslides. Natural causes of landslides include heavy rain, rapid snow melt, erosion, earthquakes and changes in groundwater levels. Landslides occur most frequently in areas with moderate to steep slopes and high precipitation, and most often slope failures happen during or after periods of sustained above average precipitation or snowmelt events. Human activity can increase the likelihood of landslides by reducing vegetation cover, altering the natural slope gradient or increasing the soil water content. One location where this type of human activity is common are areas that were excavated along highways and other roadways.

Most landslides in Bradford County are slow moving and more often cause property damage rather than causing human injury. These landslides are due to geologic properties of the area that make it easily prone to erosion. Bradford County lies within a region

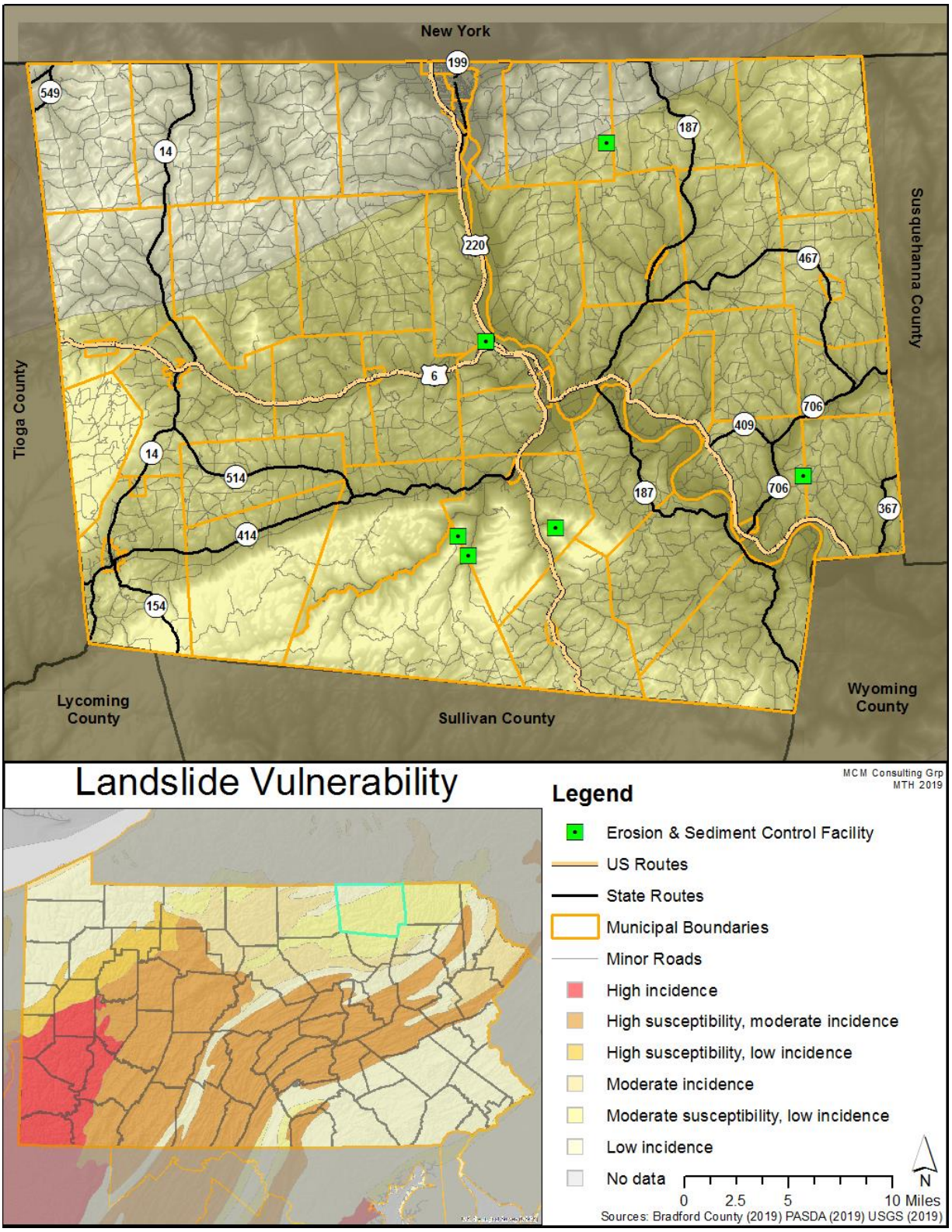
known as the Endless Mountains of northeastern Pennsylvania. The landscape is predominately forested hills and mountains, agricultural valleys and small towns and villages. Elevation in Bradford County ranges from 2,300 feet to 600 feet. Elevation change can be drastic in some areas of the county, and those locations are among the most vulnerable areas in the county to landslides.

4.3.7.2 Range and Magnitude

Landslides can cause damage to utilities as well as transportation routes, resulting in road closure or travel delays. Fortunately, deaths and injuries due to landslides are rare in Pennsylvania and Bradford County. Most reported deaths due to landslides have occurred when rockfalls or other slides along highways have involved vehicles. The most traveled highways in Bradford County include US Routes 6 and 220, and PA Routes 14, 187, 414, 549 and 706. Storm-induced debris flows can also sometimes cause death and injury. As residential and recreational development increases on and near steep mountain slopes, the hazard from these rapid events will also increase. Most Pennsylvania landslides are moderate to slow moving and damage property rather than people.

The Pennsylvania Department of Transportation and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of ten million per year is spent on landslide repair contracts across the Commonwealth and a similar amount is spent on mitigation costs for grading projects. A number of highway sites in Pennsylvania are in need of permanent repair at estimated costs of $300,000 to $2 million each (DCNR, 2010). The USGS considers the majority of Bradford County in a moderate susceptibility but low incidence zone, with the northwestern corner of the county falling in a low incidence zone (see *Figure 29 - Landslide Vulnerability)*. Areas that are susceptible to landslides are geologically prone to giving way after significant precipitation events.

Figure 29 - Landslide Vulnerability



4.3.7.3 Past Occurrence

No comprehensive list of landslide incidents in Bradford County is available, as there is no formal reporting system in place. PennDOT and municipal maintenance departments are responsible for slides that inhibit the flow of traffic or damage to roads and bridges, but they can generally only repair the road itself and right-of-way areas. There are several mudslides that were reported to NOAA's Storm Events Database that were associated with flooding events throughout the county (see *Table 26 - Landslide History*). This table represents a sampling of landslide events that have occurred in the county, not an all-inclusive list. There have been municipal reports of increased incidents of landslide with the recent wet spell starting with the flooding in August 2018 until February 2019.

During the 1972 Tropical Storm Agnes, landslides blocked the East Athens-Sheshequin Road (State Route 1043) at the Tioga Narrows. The Waverly Hill area in Standing Stone Township has also experienced landslides. On June 11, 1968, the Waverly Hill area experienced a landslide that resulted in the closure of Route 17. The slide was caused by a clogged storm water pipe, and runoff from the clogged pipe contributed to the landslide.

Table 26 - Landslide History

Landslide History ***(NOAA NCEI, 2019)***			
Location	**Date**	**Property Damage**	**Description**
State Route 187 in Wyalusing	06/26/1995	$1,000	A severe thunderstorm uprooted trees onto Pennsylvania State Route 187 in Wyalusing. The same thunderstorm complex proceeded to drop very heavy rain across southeast Bradford County. Numerous roadways were flooded and mudslides closed Pennsylvania State Route 187 in Wyalusing.
Asylum	06/23/2001	$0	Emergency management officials reported numerous road closures due to flash flooding from heavy thunderstorm rains. A mudslide was also reported in Asylum.
Route 220 in Monroe Township	03/05/2008	$0	A mudslide blocked the road across Route 220 in Monroe Township and closed the road at that location.
Columbia Cross Roads	04/28/2011	$75,000	Significant flash flooding developed, especially in the borough of Burlington. Eight to ten inches of water was flowing through the borough, with mudslides and numerous roads closed. Route 14 in Canton was closed due to flooding. Many roads were also flooded and closed in Troy.

4.3.7.4 Future Occurrence

Bradford County is not at high risk for landslides; however, mismanaged development in steeply sloped areas would increase the frequency of occurrence of landslides. Road cuts

are the most common development that puts an area at a heightened probability of a slide. The PA Department of Environmental Protection has an Erosion and Sediment (E&S) Program that sets requirements for development projects of a certain scale that are intended to mitigate erosion, which are similar practices to prevent causing landslides.

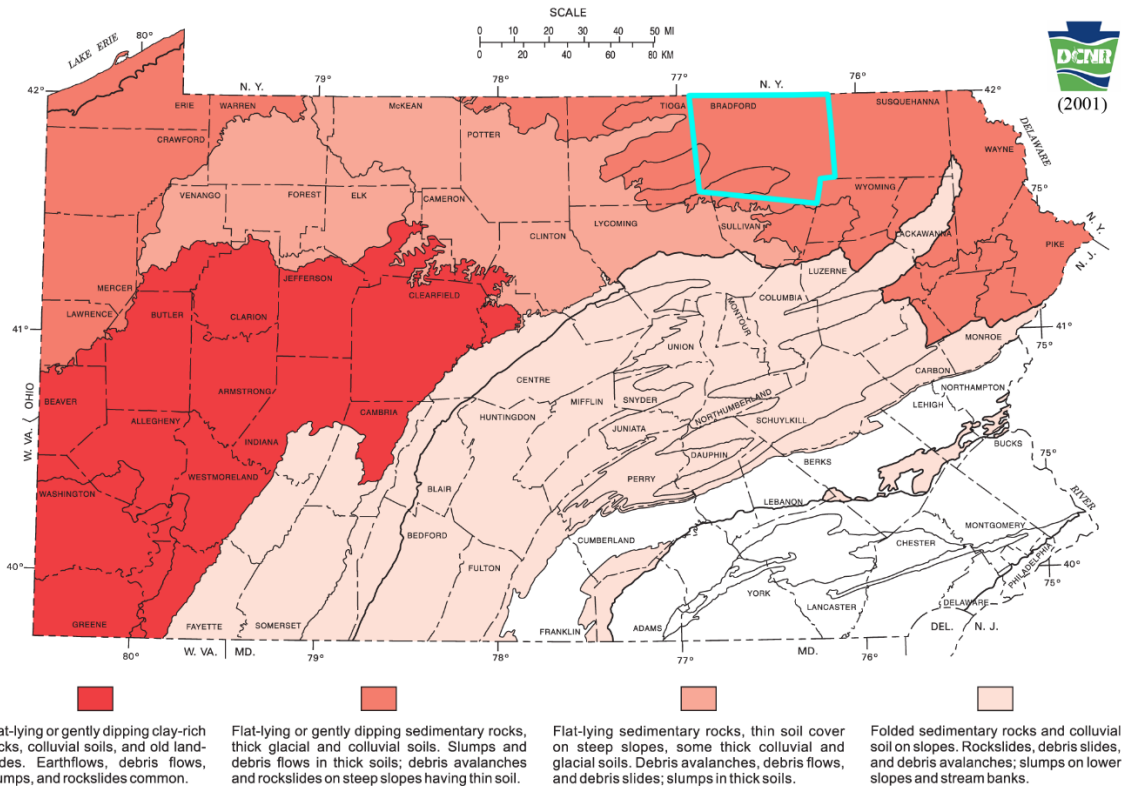
4.3.7.5 Vulnerability Assessment

Landslides are often precipitated by other natural hazards such as earthquakes or floods, and a serious landslide can cause millions of dollars in damages. Continued enforcement of floodplain management and proper road and building construction helps to mitigate the threat of landslides. Floodplain management is important where mining has occurred within proximity to watercourses and associated flat-lying areas. Surface water may permeate into areas that still have open fractures and the build-up of surface water in fractures could lead to unexpected flood events.

A comprehensive database for land highly prone to erosion and landslides is rare and was not available at the time of this report. Construction projects in Bradford County should be wary of erosion and the potential for landslides. There are several general factors that can be indicators of a landslide prone area:

- On or close to steep hills
- Areas of steep road cuts or excavations
- Steep areas where surface run-off is channeled
- Fan shaped areas of sediment and rock accumulations
- Evidence of past sliding such as tilted utility lines, tilted trees, cracks in the ground and irregularly surfaced ground.

Figure 30 - Landslide Rock Type



The distribution of types of landslides most likely to occur in different geologic settings in Pennsylvania. Stream-bank slumps, soil creep, and rockfall/rockslide combinations on cut slopes can occur throughout Pennsylvania.

4.3.8. Pandemic and Infectious Disease

4.3.8.1 Location and Extent

Pandemic & Epidemic

Pandemic is a widespread outbreak of infectious disease that impacts an extensive region, potentially spanning continents and having global impacts. An epidemic also refers to an outbreak of a rapidly spreading infectious disease but is more regional and less widespread than a pandemic. The spread of a disease depends on the mode of transmission of the disease, how contagious it is, and the amount of contact between infected and non-infected persons. In the event of a pandemic occurring in the eastern United States, the entirety of Bradford County would likely be affected. Strains of influenza, or the flu have caused epidemics and pandemics, and they commonly attack the respiratory tract in humans. Influenza pandemic planning began in response to the H5N1 (avian) flu outbreak in Asia, Africa, Europe, the Pacific, and the Near East in the late 1990s and early 2000s. Avian flu did not reach pandemic proportions in the United States, but the county began planning for flu outbreaks. The Pennsylvania Department of Health (PADOH) Influenza Pandemic Response Plan states that “an influenza pandemic is inevitable and

will probably give little warning" (PADOH, 2005). For this reason, influenza is a primary concern regarding pandemic and infectious disease in Bradford County.

Studies after the 2009 H1N1 influenza pandemic disproportionately impacted people younger than twenty-four (CIDRAP, 2010). Schools have potential to become outbreak centers due to their large young adult population, high levels of close social contact, and permeable boundaries. During a pandemic or disease outbreak, the population affected may exceed the seasonal norm of one-third of the student population. Because universities and schools can be sites of transmission, they may cause a virus to spread among the surrounding community as well.

Infectious Disease

West Nile Virus has been detected in all sixty-seven counties in the Commonwealth at least once in the past ten years, making it a hazard to Bradford County. The disease is commonly spread by ticks or insects such as the mosquito. West Nile causes headaches, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and death in its most serious form. Blacklegged ticks in Bradford County can also spread Lyme disease, a bacterial disease with symptoms including fever, headaches and a characteristic skin rash (erythema migrans). Untreated, Lyme disease can spread to joints, the heart and the nervous system (CDC, 2016).

The Zika Virus is another infectious disease that is spread by mosquito bites and it is related to West Nile Virus. Zika virus can also be spread through sexual intercourse, blood transfusion, or passed from mother to child in the womb. The virus was first identified in 1947, but largely came to the attention of the United States public in 2015 when there was an outbreak of Zika in Brazil. The direct illness caused by Zika can include fever, red eyes, joint pain, headache and a rash, or sometimes have no symptoms at all. Zika is troubling for pregnant mothers as the virus can result in microcephaly or cause other problems for brain development. For adults, the virus can be linked to increased incidence of Guillain-Barré syndrome.

4.3.8.2 Range of Magnitude

Pandemic

Advancements in medical technologies have greatly reduced the number of deaths caused by influenza over time. In the early 1900s, flu pandemics could cause tens of millions of deaths, while the 2009 Swine Flu caused fewer than 20,000 deaths worldwide, and many people infected with Swine flu in 2009 have recovered without needing medical treatment. However, the modern flu viruses are still quite dangerous. About seventy percent of those who were hospitalized with the 2009 H1N1 flu virus in the United States belonged to a high-risk group (CDC, 2009). High risk populations for influenza include children, the elderly, pregnant women, and patients with reduced immune system capability. Such high-risk populations are discussed in more detail in Section 4.3.8.5.

Infectious Disease

West Nile Virus originated in regions of East Africa around 1937 but spread globally. In 2012, West Nile Virus caused 286 deaths in the United States. Most West Nile infections in humans are subclinical, causing no symptoms. Approximately twenty percent of infections cause symptoms and less than one percent of cases result in severe neurological disease or death. Symptoms typically appear between two and fifteen days after infection and there is currently no vaccine for West Nile Virus. Person to person transmission of West Nile is less prevalent than person to person transmission of influenza.

Each year since 2005, there are consistently well over 3,000 cases of Lyme disease in Pennsylvania, with 6,470 confirmed cases in 2014 (CDC, 2016). While most cases of Lyme disease can be treated with a few weeks of antibiotic use, undetected Lyme disease can seriously damage a body's musculoskeletal and nervous system, sometimes resulting in death.

Zika virus has spread to Pennsylvania primarily by persons from Pennsylvania traveling to locations where the virus is a transmission risk. These places include certain countries in South America, Central America, the Caribbean, the Pacific Islands, Africa and Southeast Asia. No locations within the United States are considered to have significant risk of Zika virus transmission (PA DOH, 2019). If a Pennsylvania resident does contract Zika virus, preventing the spread of the disease is important. If an infected individual is bitten by a mosquito within three weeks of infection, the mosquito can transmit the virus to anyone else it bites. Infected individuals should strictly avoid any possibility of mosquito bites to prevent the spread of Zika virus. Additionally, Zika can be transmitted through sexual intercourse, so infected individuals should use condoms or abstain from sex while they have the virus.

4.3.8.3 Past Occurrence

Pandemic & Epidemic

Table 27 - Past Influenza Outbreaks and Pandemics

Past Influenza Outbreaks and Pandemics			
Year/Time Frame	**Common Name**	**Virus Type**	**Geographic Origin**
1889	Russian flu	H2N2 or H3N8	Russia
1918-1920	Spanish flu	H1N1	Germany, Britain, France and the United States
1957-1958	Asian flu	H2N2	China
1968-1969	Hong Kong flu	H3N2	Hong Kong
1976	Swine flu	H1N1	Fort Dix, United States
2006-2008	Avian (Bird) Flu	H5N1	India
2007	Equine flu	H3N8	Australia
2009	Swine Flu	H1N1	Mexico

Influenza outbreaks of Spanish flu, Asian flu, Hong Kong flu and Swine flu caused deaths in the United States and are considered pandemics. The 1918-1920 Spanish flu claimed fifty million lives worldwide and 500,000 in the United States with 350,000 cases in

Pennsylvania. The Asian flu caused about 1.5-2 million deaths worldwide with 70,000 deaths in the United States, peaking between September 1957 and March 1958. Approximately fifteen percent of the population of Pennsylvania was affected by Asian flu. The first cases of the Hong Kong flu in the U.S. were detected in September of 1968 with deaths peaking between December 1968 and January 1969 (Global Security, 2009).

The most recent global flu outbreak to impact Bradford County was the 2009 outbreak of Swine flu (H1N1). There were 10,940 cases reported in Pennsylvania resulting in seventy-eight deaths (PA DOH, 2010). On June 25, 2009, the Pennsylvania Department of Health listed Bradford County as having multiple confirmed cases of the Novel 2009 Influenza A/H1N1, after having no reported cases as of June 15, 2009 (See *Figure 31 - Novel 2009 A/H1N1 Confirmed Counts June 15, 2009* and *Figure 32 - Novel 2009 A/H1N1 Confirmed Counts June 25, 2009*).

Figure 31 - Novel 2009 A/H1N1 Confirmed Counts June 15, 2009 (PA DOH, 2009)

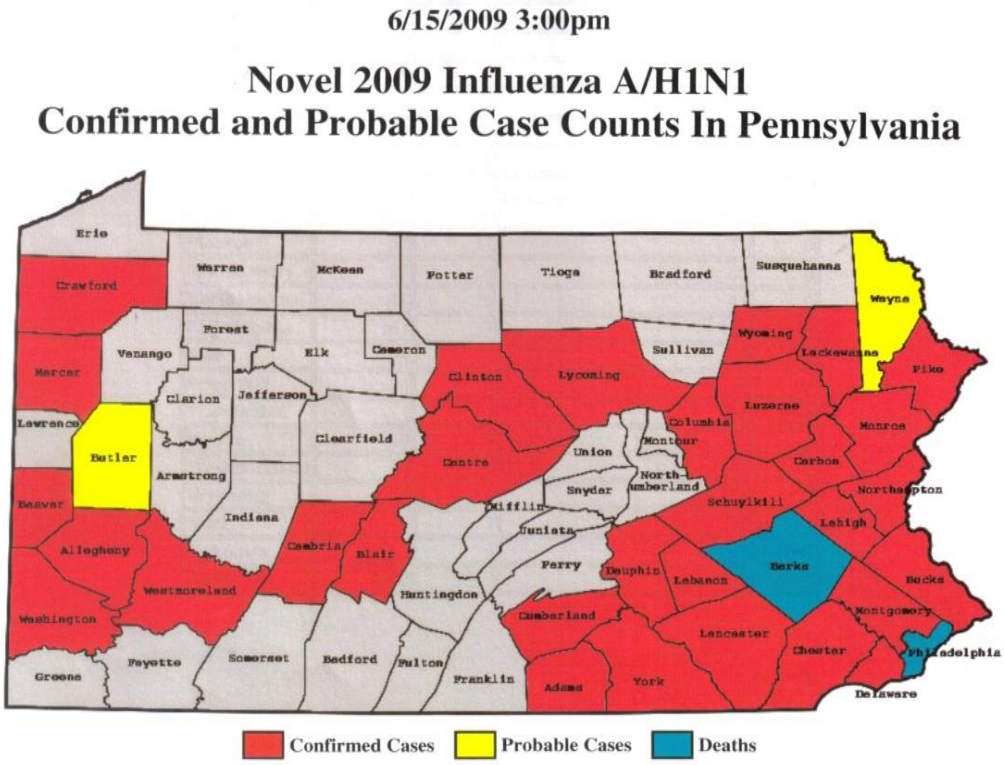
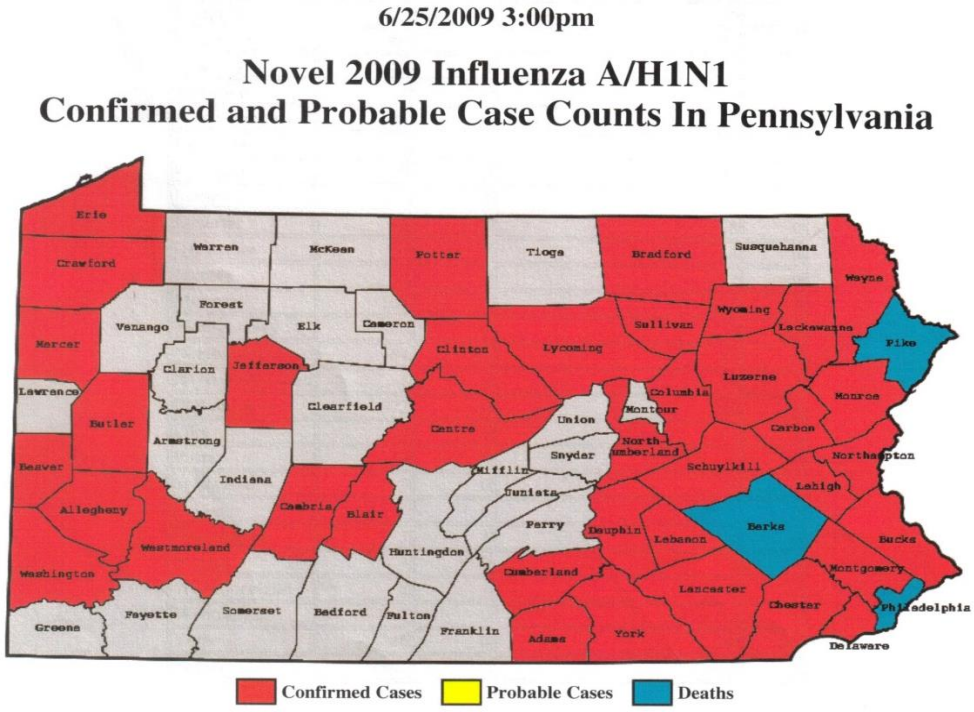


Figure 32 - Novel 2009 A/H1N1 Confirmed Counts June 25, 2009 (PA DOH, 2009)



Infectious Disease

West Nile Virus was first detected in Pennsylvania in the year 2000. The most annual reported cases of West Nile occurred in 2003, with 237 infected Pennsylvanians resulting in nine deaths. Since then, a comprehensive network has been developed in Pennsylvania to detect West Nile Virus, including trapping mosquitoes, collecting dead birds and monitoring horses, people, and in past years, sentinel chickens. West Nile Virus has been detected in fifty-seven of sixty-seven counties in the Commonwealth in 2018, with one human case (PA West Nile Virus Control Program, 2018). West Nile Virus has been detected in Bradford County in six of the last eighteen years with no reported human cases (See *Table 28 - West Nile Virus Reported Cases*).

Cases of Lyme disease are consistently reported in Bradford County and The Commonwealth at large. Additionally, the region has seen a recent spike in cases - reported cases are summarized in *Table 29 - Lyme Disease Reported Cases*.

From 2015 to May 2018 there have been over 230 cases of Zika virus reported to the Pennsylvania Department of Health (PA DOH), although the PA DOH reports that these have been cases where travelers returned from areas where Zika was common, and local transmission of Zika virus has not been identified. Of these cases, 183 were from cases where the symptomatic individual tested positive for Zika virus, fifty-one cases where asymptomatic individuals tested positive for Zika, and one presumed viremic blood donor

case where an individual who had no symptoms at the time of donating blood, but whose blood tested positive for Zika virus (PA HMP, 2018; PA DOH, 2018).

Table 28 - West Nile Virus Reported Cases

West Nile Occurrences *(PAWNVCP, 2019)*			
Year	**Positive Detection**	**Human Cases**	**Deaths**
2000	✓		
2001	✓	0	0
2002	✓	0	0
2003	✓	0	0
2004			
2005			
2006			
2007			
2008			
2009			
2010			
2011	✓	0	0
2012			
2013			
2014			
2015			
2016			
2017			
2018	✓	0	0
Total	**6 of 18 years**	**0**	**0**

Table 29 - Lyme Disease Reported Cases

Lyme Disease Reported Cases *(CDC, 2018)*			
Year	**Number of Cases**	**Year**	**Number of Cases**
1980	0	1999	<4
1981	0	2000	2
1982	0	2001	4
1983	0	2002	4
1984	0	2003	3
1985	0	2004	2
1986	0	2005	6
1987	0	2006	5
1988	0	2007	2
1989	0	2008	7
1990	<4	2009	13
1991	0	2010	10
1992	0	2011	46
1993	<4	2012	52
1994	<4	2013	99
1995	<4	2014	90
1996	<4	2015	180
1997	<4	2016	158
1998	5	**Total**	~702

4.3.8.4 Future Occurrence

Pandemic & Epidemic

The precise timing of pandemic influenza is uncertain, but occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or "novel" virus to which the population has no immunity. The emergence of a novel virus is the first step towards pandemic, and based on historical events, is expected to occur every eleven to forty-one years. In the event of an influenza pandemic, colleges and universities can play an integral role in protecting the health and safety of university members as well as the greater community.

In response to the 2009 H1N1 pandemic, the American College Health Association (ACHA) initiated a pandemic influenza surveillance project entitled the College Health Surveillance Network (CHSN) to gain an understanding of the influenza activity on college campuses. Epidemiologic data on novel H1N1 flu suggested significant risk among those in the college setting. Interested institutions of higher education voluntarily submitted data on a weekly basis regarding the number of new cases of influenza-like illnesses, and ACHA began reporting on the availability of the vaccine, along with the success uptake rate. This information was provided to the CDC, public health officials, and other college health professionals to continue assisting with tracking national vaccine trends. The H1N1 surveillance project was an important milestone for college health. Through the efforts of ACHA's national office and participating schools, the project resulted in an accurate representation of the epidemiology of the H1N1 outbreak on college campuses nationally. The data holds valuable lessons learned from the 2009 H1N1 outbreak.

Infectious Disease

Instances of West Nile Virus have been decreasing due to extensive planning and eradication efforts; however, the prospect of climate change could increase the prevalence of the virus. Some studies show increased insect activities during a similar rapid warming event in Earth's history (Curano et al., 2008). Other studies make projections that with the warming temperatures and lower annual precipitation that are expected with climate change, there will be an expansion of the suitable climate for mosquitos and West Nile Virus, increasing the risk that the disease poses (Harrigan et al., 2014).

The rise of Zika virus has also triggered enhanced mosquito control and general caution around mosquito borne viruses, resulting in generally successful control of Zika in Pennsylvania and fewer cases of West Nile Virus in recent years.

Lyme disease has become increasingly prevalent in recent years and is expected to continue this trend. Researchers point to climate change among other factors that bolster tick populations (Templeton, 2017). Ticks often use mice as hosts, and warmer winters have allowed small rodents such as mice to flourish, and in turn tick populations flourish. Human activity has also eliminated natural predators (like coyote) of small rodents, compounding the problem. Human suppression of natural fires may also increase the prevalence of ticks as fires in natural areas kill many insects including ticks, so fewer fires yield more ticks (Templeton, 2017).

4.3.8.5 Vulnerability Assessment

Certain groups are at higher risk of infectious disease infection, including people sixty-five years and older, children younger than five years, pregnant women, and people with certain chronic medical conditions. Such conditions include but are not limited to diabetes, heart disease, asthma, and kidney disease. Schools, convalescent centers, and other institutions serving those younger than five years old and older than sixty-five are locations that are conducive to faster transmission of influenza. More generally, areas

with higher population densities and places where people gather can be hotspots where influenza can spread more rapidly. *Figure 33 - Pandemic & Infectious Disease Vulnerability* shows the population density according to 2010 census data and locations of schools, daycares and health care facilities, shedding light on areas where the disease may more readily spread. The highest concentration of elevated-transmission risk locations in Bradford County such as schools and medical facilities are found in the Sayre, Athens and South Waverly Boroughs area.

Persons who spend time in wooded areas are most at risk for contracting Lyme disease via tick bite. The application of tick repellent with DEET or permethrin is highly recommended. Residents should conduct thorough tick checks after spending time in woodland areas and keep on the lookout for the characteristic "bulls-eye" rash indicative of a tick bite infected with Lyme disease.

Thanks to successful public awareness campaigns and prevention efforts, Zika virus has not become widespread in the United States. While cases the virus has been reported in Pennsylvania, local transmission risk remains rather low.

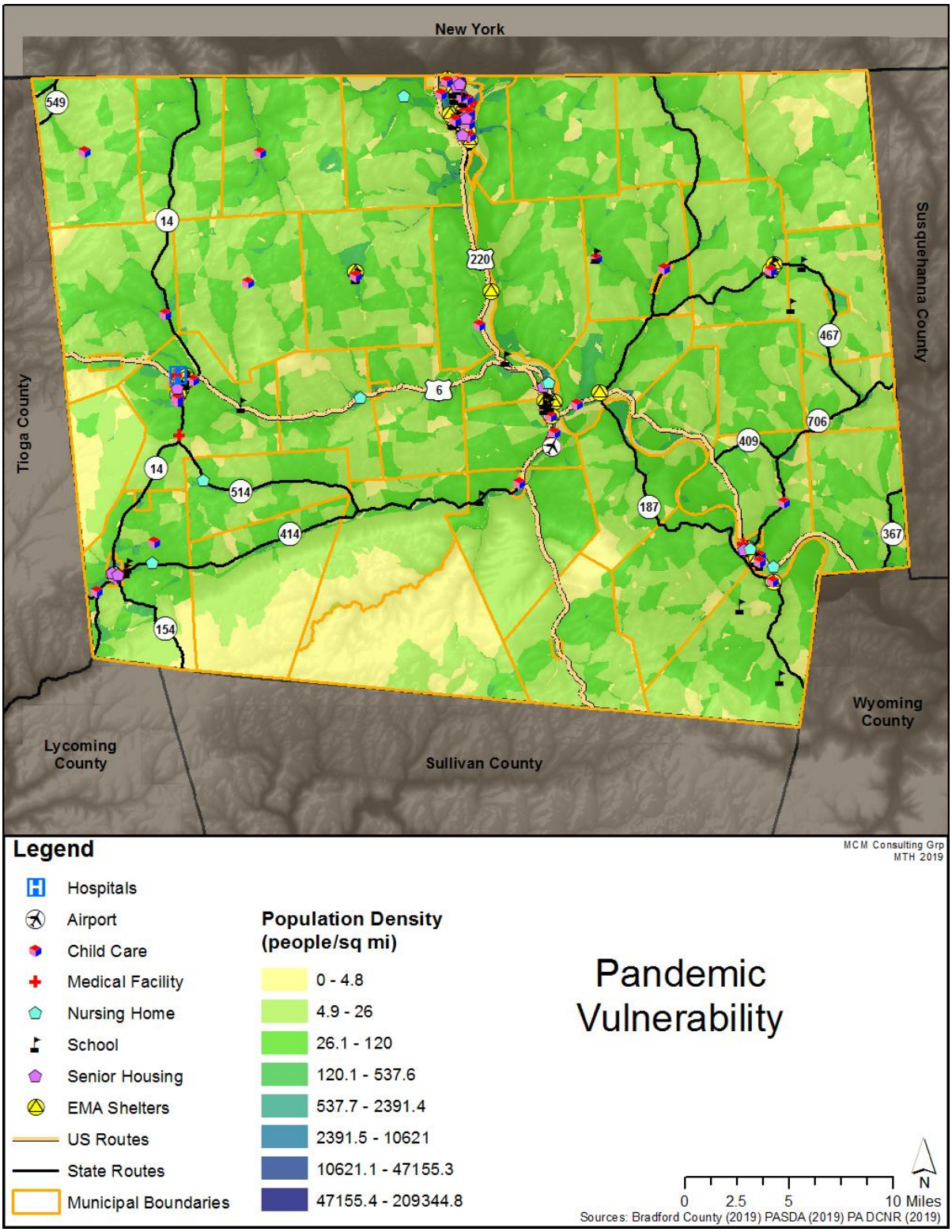
A pandemic will last much longer than most public health emergencies and may include waves of influenza activity separated by months – it has been typical for a second wave of influenza activity to occur three to twelve months after the first wave of cases. The number of healthcare workers and first responders available to work will likely be reduced – they will be at high risk of illness from exposure in the community and in healthcare settings. Some may miss work to care for ill family members, and resources in many locations could become limited, depending on the severity and spread of an influenza pandemic.

It is important to plan preparedness activities that will permit a prompt and effective public health response. The U.S. Department of Health and Human Services (HHS) supports the pandemic influenza activities in the areas of surveillance (detection), vaccine development and production, strategic stockpiling of antiviral medications, research, and risk communications. In May of 2005, the U.S. Secretary of HHS created a multi-agency National Influenza Pandemic Preparedness and Response Task Group. This unified initiative involves the CDC and many other agencies (international, national, state, local and private) in planning for a potential pandemic. Its responsibility includes revision of a U.S. National Pandemic Influenza Response and Preparedness Plan.

During a public health emergency, the Pennsylvania Department of Health (PA DOH) opens emergency medicine centers called "Points of Dispensing (PODs)" to ensure that medicine, supplies, vaccines, and information reach Pennsylvania residents during a public health emergency. An open POD is where the general public goes to receive free emergency medicine and supplies from public health officials, while a closed POD provides free emergency medicine and supplies to a specific community, like a university,

including faculty, staff and students. Dispensing of medications/vaccines is a core function of the Strategic National Stockpile's Mass Dispensing of Medical Countermeasures plan, and preparedness of an open POD.

Figure 33 - Pandemic & Infectious Disease Vulnerability



4.3.9. Radon Exposure

4.3.9.1 Location and Extent

Airborne radon gas is radioactive and is a step in the radioactive decay of uranium to radium. Radon is a noble gas, cannot be seen and has no odor. Like other noble gasses, radon gas is very stable, so it does not easily combine with other chemicals. Two isotopes of radon are commonly found: 222Rn and 220Rn. The 220Rn isotope has a very short half-life, so it often only exists for fifty-five seconds, not long enough to pose a hazard to humans. The 222Rn isotope has a half-life of 3.8 days which is long enough to pose a threat to humans. Still, due to the relatively short half-life of 222Rn, it only exists in relatively close proximity to its radioactive parent, usually within tens of feet away. Radon is a carcinogen and when inhaled, it causes humans to develop lung cancer.

Radon was discovered as a significant source of natural radiation for humans in 1984 in the Reading Prong geologic province in Eastern Pennsylvania (south of Bradford County), when routine monitoring of employees leaving the not yet active Limerick nuclear power plant showed readings that a construction worker working on the plant frequently exceeded expected radiation levels despite the fact that the plant was not active. The Environmental Protection Agency (EPA) guidelines state that mitigation actions should be taken if levels exceed 4pCi/L in a home, and most uranium miners have a maximum exposure of 67 pCi/L. Subsequent testing of the Limerick power plant worker's home showed high radon levels of 2,500 pCi/L (pico Curies per Liter), triggering the Reading Prong to become the focus of the first large-scale radon scare.

Radon gas is considered ubiquitous and can be found in indoor and outdoor environments, however there is no known safe level of exposure to radon. For most people in Pennsylvania, the greatest risk of radon exposure is from within their home in rooms that are below, directly in contact with, or immediately above the ground. Sources of radon include radon in the air from soil and rock beneath homes, radon dissolved in water from private wells and exsolved during water use (rare in Pennsylvania), and radon emanating from uranium-rich building materials such as concrete blocks or gypsum wallboard (also rare in Pennsylvania). Key factors in radon concentration in homes are the rates of air flow into and out of the house, the location of air inflow, and the radon content of air in the surrounding soil. Because of the flow dynamics of air inside of most houses, even a small rate of soil radon gas inflow can lead to elevated radon concentrations.

There are several factors that contribute to higher radon levels in soil gas:

- Proximity to elevated uranium rich deposits (>50ppm). Areas within a few hundred feet of such deposits are most at risk. Such deposits are rare in Pennsylvania.
- Some more common rocks have higher than average uranium content (5 to 50 ppm), and proximity to such rocks also increases the risk of radon exposure. These rock types include black shales as well as granitic and felsic alkali igneous

rocks. This is the most common source of high radon levels in Pennsylvania. The Reading Prong elevated radon levels come from Precambrian granitic gneisses.

- Other soil and bedrock properties that facilitate radon mobility. The amount of pore space in the soil and its permeability – more porous soils will allow radon to travel more easily. Limestone-dolomite soils can also be predisposed to collect radon from radium resultant from weathering of iron oxide or clay surfaces. In some cases (like in State College in Centre County, PA) even with underlying bedrock having normal uranium concentrations (.5 to 5 ppm), the vast majority of locations built on limestone-dolomite soils exceed radon concentrations of 4pCi/L, and many exceeded 20 pCi/L.

4.3.9.2 Range of Magnitude

According to the EPA, about 21,000 lung cancer deaths each year in the U.S. are related to radon - it is the second leading cause of lung cancer after smoking and the number one cause of lung cancer among nonsmokers. There is no evidence that children are at a greater risk than adults. Radon causes lung cancer by continuing to radioactively decay after being inhaled, and turning into a daughter product (218Po, 214Pb, 214Bi) which may become attached to lung tissue and induce lung cancer due to their continued radioactive decay. *Table 30 - Radon* Risk (EPA, 2017) describes the relative risk to lung cancer that people experience depending on the radon level and their experience with smoking.

The EPA reports that the national average radon concentration of indoor air of homes is about 1.3 pCi/L, and they recommend that homes be fixed if the radon level is 4pCi/L or more. There is however no safe level of radon exposure, so the EPA also recommends considering fixing a home if the radon level is between 2 pCi/L and 4 pCi/L.

Table 30 - Radon Risk

RADON LEVEL (pCi/L)	IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME…*	RISK OF CANCER FROM RADON EXPOSURE COMPARES TO…***	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 2pCi/L is difficult

RADON LEVEL (pCi/L)	IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME...*	RISK OF CANCER FROM RADON EXPOSURE COMPARES TO...***	ACTION THRESHOLD
0.4	About 3 people could get lung cancer	(Average outdoor radon level)	
NON-SMOKERS			
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 2pCi/L is difficult
0.4	-	(Average outdoor radon level)	
*Note: Risk may be lower for former smokers * Lifetime risk of lung cancer deaths from 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.*			

4.3.9.3 Past Occurrence

In 1984, the Pennsylvania Radon Bureau responded to the newly detected high radon levels with a massive radon monitoring, educational, and remediation effort. As of November 1986, over 18,000 homes had been screened for radon and approximately 59% were found to have radon daughter levels in excess of the 0.020 Working Level (WL) guideline. Radon daughter levels ranged up to 13 WL or 2600 pCi/L or radon gas.

The EPA estimates that the average indoor radon concentration in Pennsylvania basements is about 7.1 pCi/L (3.6 pCi/L on the first floor), well above their estimated national average of 1.3 pCi/L. Data on abundance and distribution of radon as it impacts individual houses in Bradford County and Pennsylvania at large is incomplete and biased towards higher radon concentrations – most data is based on test results submitted by concerned homeowners who suspect they might be at risk for high radon levels. Results are skewed to over-represent homes that have high radon levels and under-represent homes with low radon levels. Any homes with high radon levels are problematic, and there are many reported homes in Bradford County with elevated radon concentrations.

The Pennsylvania Department of Environmental Protection (PA DEP) provides information for homeowners about how to test for radon in their homes, and when they receive a test result over 4 pCi/L, the PA DEP Bureau of Radiation Protection works to

help homeowners repair the home and mitigate the hazard. The PA DEP records all the tests they receive and categorize them in a searchable database by zip code. *Table 31 - Radon Level Test Results* shows there are twelve zip codes in Bradford County where sufficient tests were reported for the PA DEP to report their findings. The highest average radon levels were reported from the 18854 zip code which covers parts of Standing Stone Township, Wysox Township, and Rome Township with maximum and average readings of 86.7 and 16.1 pCi/L respectively. Most reporting zip codes in Bradford County have average basement Radon levels above the suggested EPA action level of 4 pCi/L - The average basement reading for reporting zip codes in the County is 8.5 pCi/L, and the average first floor reading is 3.3 pCi/L.

Table 31 - Radon Level Test Results

Radon Level Test Results (PA DEP, 2018)				
Zip Code	**Location**	**Number of Tests**	**Max Result pCi/L**	**Average Result pCi/L**
16925	Basement	69	42.9	9
16936	Basement	40	83.2	8.5
16947	Basement	95	38.1	4.3
	First Floor	32	21.8	2.5
17724	Basement	82	43.7	8.4
	First Floor	33	14.9	2.6
18810	Basement	330	140.9	10
	First Floor	102	19.7	4.5
18831	Basement	33	56.7	6.2
18837	Basement	50	36.5	6
18840	Basement	980	192.1	11.5
	First Floor	155	94.7	5.3
18848	Basement	315	84.4	4.5
	First Floor	116	115.7	2.5
18850	Basement	41	42.2	7.5
18853	Basement	91	82	7.2
18854	Basement	33	86.7	16.1

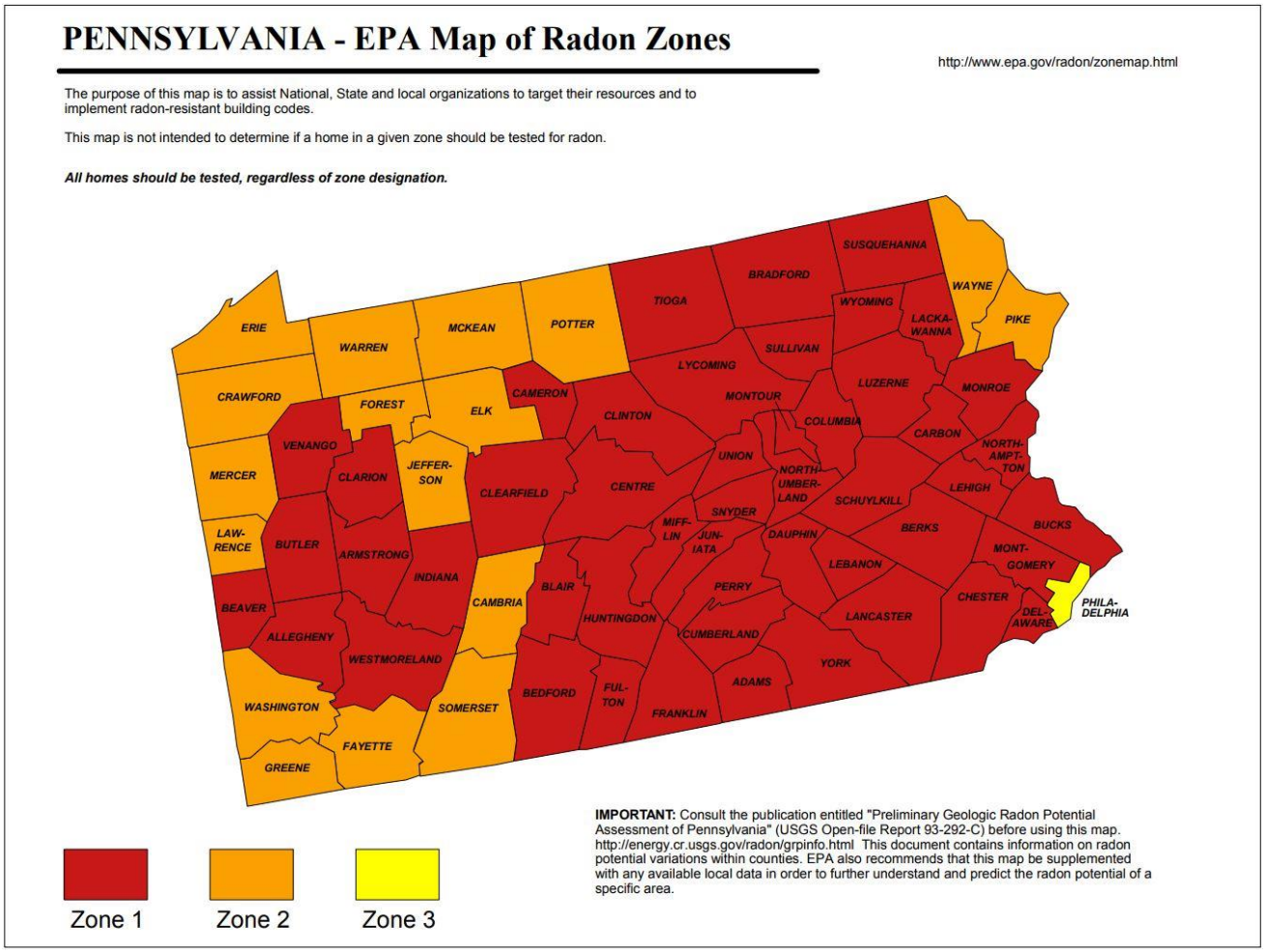
4.3.9.4 Future Occurrence

Radon exposure is inevitable given the geologic and geomorphic conditions in Bradford County. The EPA and USGS have mapped radon potential in the US to help target resources and assist local governments in determining if radon-resistant features are applicable for new construction. The designations are broken down in three zones and

are assigned by county, as shown in *Figure 34 – Radon Zones* (EPA, 2017). Each zone reflects the average short-term measurement of radon that can be expected in a building without radon controls. Bradford County is located within Zone 1, with a high potential for radon.

1. Zone 1 has the highest potential and readings can be expected to exceed the 4 pCi/L recommended limit.
2. Zone 2 has a moderate potential for radon with levels expected to be between 2 and 4 pCi/L and
3. Zone 3 has a low potential with levels expected to be less than 2 pCi/L.

Figure 34 – Radon Zones (EPA, 2017)

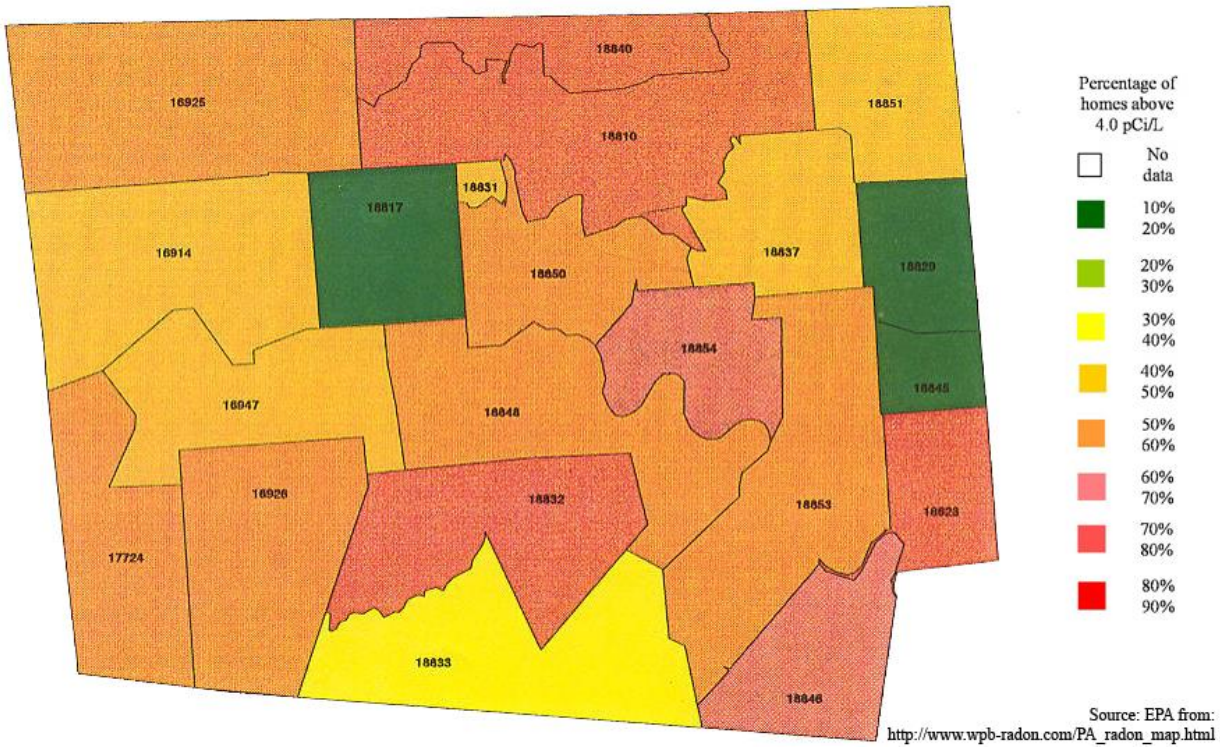


4.3.9.5 Vulnerability Assessment

Bradford County is in the EPA radon hazard zone 1, meaning there is a high risk of radon exposure. Older homes that have crawl spaces or unfinished basements are more vulnerable to having high radon levels. Average basement radon levels for homes who reported their results to the PA DEP are often found to be above the EPA action level of

4 pCi/L. *Figure 34 – Radon Zones (EPA, 2017)* shows the best available data from the EPA about the percentage of homes with radon levels at or above the EPA action level. Homeowners across Bradford County should test radon levels in their homes in order to determine their level of radon exposure. The EPA estimates that an average radon mitigation system costs approximately $1,200. The PA DEP Bureau of Radiation Protection provide short- and long-term tests to determine radon levels, as well as information on how to mitigate high levels of radon in a building. The 2018 PA HMP estimates that there are 23,704 buildings in Bradford County that are in areas with high radon test results, and the cost to mitigate the most impacted of those buildings (an estimated 20% of them or 4,741 buildings) would be $5,688,960.

Figure 35 - Radon Vulnerability



4.3.10. Tornados and Windstorms

4.3.10.1 Location and Extent

Tornados occur in the Commonwealth most frequently during the spring and summer months and are most likely at the warmest times of the day. In the past sixty-seven years, records show that 826 tornados have been reported in all sixty-seven counties in Pennsylvania during the period of 1950 - January 2017 (NOAA NCEI, 2017). The National Weather Service estimates that the Commonwealth will experience ten tornados annually. According to the National Centers for Environmental Information (NCEI), wind speeds in tornados range from values below that of hurricane speeds to more than 300

miles per hour. The NCEI continues by reporting that, "the maximum winds in tornados are often confined to extremely small areas and vary tremendously over short distances," which explains why one house may be completely demolished by a tornado and a neighboring house could be untouched. The width of tornados can vary greatly, from one hundred feet wide to over a mile, and the forward motion of tornados can range from speeds between zero and fifty miles per hour.

Windstorms may be caused by thunderstorms, hurricanes and tornadoes, but the most frequent cause of windstorms in Northeastern Pennsylvania are thunderstorms. Straight-line winds and windstorms are experienced on a more regional scale. While such winds usually also accompany tornados, straight-line winds are caused by the movement of air from areas of high pressure to low pressure. Windstorms are generally defined with sustained wind speeds of forty mph or greater, lasting for at least one hour, or winds of fifty-eight mph or greater lasting for any duration. A microburst is a very-localized column of sinking air, capable of producing damaging opposing and straight-line winds at the surface. A wind shear is usually found when a violent weather front is moving through; wind speeds have been recorded up to one hundred mph. Wind shear is defined as a difference in wind speed and direction over a relatively short distance in the atmosphere.

Figure 36 - Microburst

The air moves downward until at ground level. It then spreads outward in all directions.

4.3.10.2 Range of Magnitude

Each year, tornados account for $1.1 billion in damages and cause over eighty deaths nationally. 2011 was the second worst year on record for deadly tornados, the worst being 1936. The number of tornado reports has increased by 14% since 1950. While the extent of tornado damage is usually localized, the vortex of extreme wind associated with a tornado can result in some of the most destructive forces on Earth.

Rotational wind speeds can range from one hundred mph to more than 250 mph. In addition, a tornado's speed of forward motion can range from zero to fifty mph. Therefore, some estimates place the maximum velocity (combination of ground speed, wind speed, and upper winds) of tornados at about 300 mph. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. The most violent tornados have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly projectiles.

Damages and deaths can be especially significant when tornados move through populated, developed areas. The destruction caused by tornados ranges from light to inconceivable depending on the intensity, size and duration of the storm. Typically, tornados cause the greatest damages to structures of light construction. The Enhanced Fujita Scale, also known as the "EF-Scale," measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita Scale, also known as the "F-Scale," that was published in 1971. It classifies United States tornados into six intensity categories based upon the estimated maximum winds occurring within the wind vortex (*Table 32 - Enhanced Fujita Scale*). Since its implementation by the National Weather Service in 2007, the EF-Scale has become the definitive metric for estimating wind speeds within tornados based upon damage to buildings and structures. Previously recorded tornadoes are reported with the older F-Scale values, but *Table 32 - Enhanced Fujita Scale* shows F-Scale categories with corresponding EF-Scale wind speeds.

Figure 26 - Wind Zones in Section 4.3.5 described the wind speed zones developed by the American Society of Civil Engineers based on tornado and hurricane historical events. These wind speed zones are intended to guide the design and evaluation of the structural integrity of shelters and critical facilities. Bradford County falls within Zone III, meaning shelters and critical facilities should be designed to withstand a three-second gust of up to 200 mph, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm event. Therefore, these structures should be able to withstand the wind speeds experienced in an EF4 tornado event. While it is difficult to pinpoint the exact locations at the greatest risk of a tornado, the southeast, southwest and northwest sectors of the Commonwealth are more prone to tornados.

Tornados can have varying secondary effects. The most common is power failure. The severe wind can dismantle power sources and cause significant structural damage. Hazardous material spills can occur if a tornado comes near a holding tank, or the spill stems from a traffic accident caused by high winds.

Windstorms of all types have caused the following problems within Bradford County:

- Power failures lasting four hours or longer
- Loss of communications networks lasting four hours or more
- Residents requiring evacuation or provision of supplies or temporary shelter
- Severe crop loss and or damage

Table 32 - Enhanced Fujita Scale

Enhanced Fujita Scale			
EF-Scale Number	**Wind Speed (MPH)**	**F-Scale Number**	**Description of Potential Damage**
EF0	65–85	F0-F1	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornados with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86-110	F1	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	F1-F2	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	F2-F3	**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	166–200	F3	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	F3-F6	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.

4.3.10.3 Past Occurrence

Bradford County has experienced twenty-three tornados since 1950 (see *Table 33 - Tornado History*). One of the deadliest tornado events in Pennsylvania occurred on May 31, 1985, with a total of twenty-one tornados in the Ohio and Northwest Pennsylvania region (none of which tracked through Bradford County). These tornados resulted in seventy-six deaths, upwards of 1000 injuries, and hundreds of millions of dollars in property damage.

The most recent tornado to impact Bradford County occurred on June 13, 2018, when an EF2 tornado touched down in Granville Township along Granville road, heavily damaging a small machinery shop and the adjacent home. The tornado moved southeast into Leroy Township, then West Franklin, and ultimately lifted in Franklin Township. Across its path there were numerous homes destroyed and multiple trailers thrown by the winds. The maximum wind speeds were estimated at 120 mph. Total damages from the event were estimated at $500,000.

Aside from tornados, Bradford County has had 229 severe wind reports from 1969 through 2018 causing almost $2.7 million in property damage over the years (NOAA NCEI, 2018). Most often these are the result of intense thunderstorms, which often fell trees and damage power lines, causing power outages for upwards of four days in some areas.

One significant event occurred when Bradford felt the effects of Hurricane Sandy on October 29, 2012. Winds downed numerous trees and powerlines in the county. Peak sustained winds were estimated between thirty and forty mph with peak wind gusts estimated at sixty-five mph. The highest winds were over higher terrain on the southern part of the county and over some of the higher peaks on the west side of the county. At the height of the storm late in the evening, there were an estimated 5,000 people without power in the county and an estimated 110,000 without power statewide (NOAA NCEI, 2019). Detailed information for each severe wind report in Bradford County can be found in NOAA's Storm Events Database (www.ncdc.noaa.gov/stormevents).

Figure 37 - Tornado History 1950-2018

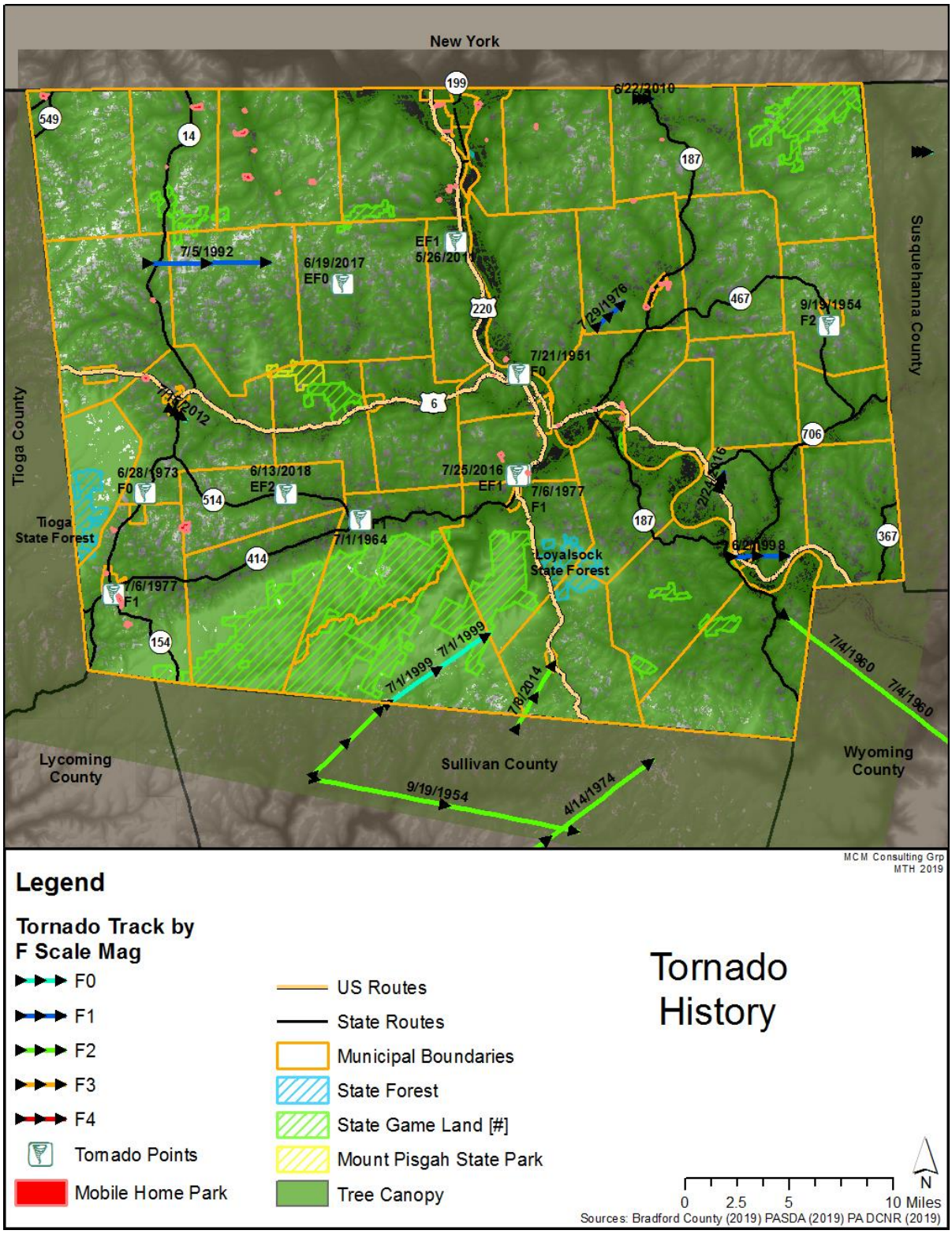


Table 33 - Tornado History

Tornado History *(NOAA NCEI, 2019)*					
Date	**Mag.**	**Deaths**	**Injuries**	**Damage**	**Event Narrative**
07/21/1951	F0	0	0	$250	Not Available
09/19/1954	F2	0	0	$2,500	Not Available
07/04/1960	F2	0	0	$25,000	Not Available
07/01/1964	F1	0	0	$250,000	Not Available
06/28/1973	F0	0	0	$2,500	Not Available
07/29/1976	F1	0	1	$25,000	Not Available
07/06/1977	F1	0	0	$25,000	Not Available
07/06/1977	F1	0	0	$2,500	Not Available
07/05/1992	F1	0	0	$2,500	Not Available
06/15/1993	F0	0	0		Not Available
06/22/1996	F1	0	0	$500,000	Event Narrative Below
The severe thunderstorm which produced golf-ball sized hail in Chemung and Schuyler counties in New York spawned a tornado as it crossed southeast Bradford County Pennsylvania. Initial damage occurred in Tuscarora Township, where a home received extensive damage. A 25-foot trailer was tossed about one hundred feet, and a garage was completely lifted off its foundation and destroyed. The tornado tracked to the southeast and moved into Braintrim Township in northwest Wyoming County around 3:15 PM, then Laceyville where severe tree damage was observed. A barn was destroyed with only one wall left standing. Many trees were sheared off or uprooted in town, and near the Laceyville Bridge as the tornado crossed the Susquehanna River. The tornado then moved into Windham Township at North Flats, along State Route 3001. One eyewitness was a car picked up and spun around, but the occupants were not injured. A mobile home was lifted off its foundation and pushed onto the street. Its occupants were unharmed. The tornado cut across a corn field and sheared off trees within a hedge row as it re-approached the Susquehanna River. Damage was spotty immediately after the tornado crossed the river northwest of Black Walnut. The next area of significant damage occurred about one-quarter mile north of Route 6, on State Route 4009, where many large trees were toppled. The tornado then moved southeast into Black Walnut where many homes were damaged on the north side of Route 6. One mobile home and several garages were completely destroyed. Nearly all the campsites located south of Route 6, along the northern shore of the Susquehanna River, were damaged by large trees downed by the tornado. The tornado crossed the Susquehanna River once again where it downed and uprooted several hundred trees within a 100-yard swath as it moved up a steep slope. The damage path narrowed near the top of the mountain. It was undetermined whether damage occurred downstream from this point, but an aerial survey indicated spotty damage toward the town of Scottsville. The tornado was rated as an F1, with wind speeds between 73 and 122 MPH. The damage path was at least 6 to 7 miles long and averaged 100 yards in width. As the storm crossed the border into Luzerne County, an F0 tornado touched down in the communities of Duryea and West Avoca. The tornado damaged several homes, with many more homes damaged by uprooted and snapped trees. A portion of these homes had roofing material blown off, gutters and siding separated. The damage path in Luzerne County was broken as the storm skipped to the east/southeast but extended a total of about one and a half miles.					
06/02/1998	F1	0	0	$400,000	Event Narrative Below

Tornado History *(NOAA NCEI, 2019)*					
Date	**Mag.**	**Deaths**	**Injuries**	**Damage**	**Event Narrative**
A supercell thunderstorm became tornadic over southeastern portions of the county in Terry township. Eyewitness reports and damage surveys indicate that the twister first touched down just east of Robwood mountain and just west of State Route 2015 around 9:45 pm EDT. At this location, a mobile home was knocked off its foundation about 8 feet and sustained heavy damage on its front side. Fortunately for the two occupants who were inside the structure when the tornado struck, a farm vehicle, pickup truck, and storage shed all acted to stop the forward momentum of the trailer and prevent it from rolling down a fairly steep hill just ahead. Another storage building just north of the mobile home was severely damaged with its roof completely torn off and some metal beams removed from the siding. As the tornadic cell continued eastward, the funnel appeared to elevate for a time with sporadic damage at tree top level for about a mile downstream. Once the storm crossed just east of Billetts Pond, it descended to flatten a large barn. Debris was scattered in all directions from where the barn once stood with a large section of the roof thrown 200-300 yards downwind. Meanwhile, a newly built home with a large rear deck only 150 yards or so from the barn sustained relatively minor damage. Further to the east through Wyalusing and Tuscarora townships, the damage path became somewhat discontinuous once again and was confined mainly to hilltop sections with trees sheared off. Structural damage was not seen in these areas as they were sparsely populated. From the spot where the twister first touched down in Terry township eastward to the Wyoming county line, the length of the damage path was about 6 miles. The widths varied from 200 to 400 yards. Emergency management officials tallied total damages at just under a half million dollars.					
07/01/1999	F0	0	0	$10,000	Event Narrative Below
An upper level atmospheric disturbance moved out of the Ohio Valley and produced scattered lines of thunderstorms from western New York into Pennsylvania during the evening. A severe thunderstorm developed on the southern edge of one of these lines of showers that was moving through north central Pennsylvania. This storm began rotating shortly after it developed north of Williamsport and dropped a tornado over northeast Lycoming county. The tornado then tracked northeast through Sullivan and into Bradford county shortly before 8 pm EDT. This weak tornado uprooted several dozen large trees and some powerlines in Overton Township as it moved over the ridgetops. Trees blocked county roads for several hours stranding some neighborhoods until the following morning. On Cahill Road, trees smashed into an unoccupied summer cabin, causing minor damage to the roof and a back porch.					
08/12/2005	EF0	0	0	$100,000	Event Narrative Below
The tornado initially touched down somewhere between South 4th Street and Olive Street to the southwest of Memorial Park Drive in South Towanda. The tornado then moved toward the southeast through a neighborhood between Thomas Street, 2nd Street, and Olive Street to Grant Street. The tornado crossed South Main Street near the American Legion, and then tracked down across Railroad Road before lifting near the Susquehanna River. Damage path about 1 mile long and up to 200 yards wide. Most of the damage associated with this small tornado was to trees and power lines. There were a few homes that lost some shingles and siding. One home along South Main Street across from the American Legion lost a small portion of its roof.					
06/22/2010	EF1	0	0	$100,000	Event Narrative Below
A tornado touched down on Osbourne Hill Road in northeast Windham Township around 8:30 pm EDT. Numerous trees were uprooted and snapped as the tornado tracked along Osbourne Hill Road, east toward Route 187. The heaviest damage was to a hillside close to where Osbourne Hill Road meets Route 187. Over 100 trees were snapped and uprooted on this hillside. The tornado then crossed Route 187 and uprooted and snapped trees along Huddle Road. One house had numerous trees down on the property, with one tree falling on the back of the house. Some minor roof damage was also done to this house. A camper was also flipped on Huddle Road. The tornado then tracked up a hillside east of Huddle Road and lifted.					
05/26/2011	EF1	0	0	$20,000	Event Narrative Below

Tornado History *(NOAA NCEI, 2019)*					
Date	**Mag.**	**Deaths**	**Injuries**	**Damage**	**Event Narrative**
A tornado touched down on a hillside about 1 mile southwest of Milan. The tornado then tracked to the northeast for about four-tenths of a mile before lifting near Route 220. Most of the damage was to trees. There was also a trailer that was damaged by the strong winds and falling trees.					
07/15/2012	EF0	0	0	$10,000	Event Narrative Below
A small tornado touched down near the intersection of Farmers Valley Road and Fallbrook Road, about 2 miles southwest of Troy. The tornado tracked almost parallel to Fallbrook Road and knocked down many large tree branches and wires along its path. At its peak intensity, the tornado lifted a garage roof and blew it across the road. Estimated winds at this point were about 80 mph. There were also a few small trees uprooted along the path, and a few shingles blown off several homes. The tornado crossed Route 14 just south of Fallbrook Road and lifted soon after on a small hillside that is about one mile south of Troy.					
07/08/2014	EF1	0	0	$110,000	Event Narrative Below
An EF1 tornado with maximum wind speeds of 100 mph, a path width of 500 yards and a path length of 4.5 miles knocked down numerous trees. A barn collapsed and a trailer was blown off its foundation and turned 90 degrees on Marsh Road. The metal roof of a barn was peeled off and blown 200 yards.					
02/24/2016	EF1	0	0	$25,000	Event Narrative Below
Around 7:20 PM EST, a tornado touched down just south of Route 6, a few miles north of Wyalusing in Bradford County Pennsylvania. The EF1 tornado tracked across Route 6 and lifted. Most of the damage produced by the tornado were, and a couple homes had roof damage. A garage was also heavily damaged. The estimated maximum wind speed for this tornado was 100 mph.					
07/25/2016	EF1	0	0	$25,000	Event Narrative Below
A National Weather Service Storm Survey team confirmed a tornado near Monroeton in Bradford County Pennsylvania. An EF-1 |tornado touched down north of Franklin road northwest of Monroeton and tracked southeast for 200 yards before ending. Wind speeds of 100 mph resulted in numerous snaps of softwood trees along the path of the tornado.					
06/19/2017	EF0	0	0	$50,000	Event Narrative Below
A tornado touched down on Water Street not far from Main Street in East Smithfield Bradford County PA around 12:20 pm EDT on Tuesday June 19th. The tornado knocked down many trees along its path with one tree crushing a pickup truck and others damaging homes. A barn lost part of its roof. The tornado tracked along or just north of Main Street in East Smithfield to Peas Hill Road |where it tracked up a hill and then dissipated in a woodlot.					
06/13/2018	EF2	0	0	$500,000	Event Narrative Below
A tornado touched down in Granville Township along Granville road and heavily damaged a small machinery shop and an adjacent home. The tornado continued southeast into Leroy Township and hit another house leading to a considerable amount of roof damage along with a trailer being thrown 80 yards. The tornado continued southeast into West Franklin near the intersection of Routes 414 and 514. Several additional homes and a church were damaged due to the tornado with one of the homes being destroyed. Further southeast, the tornado moved a trailer into a house and destroyed a garage. The tornado then lifted in Franklin Township leveling many trees along the path. Maximum estimated winds were 120 mph.					
Total		**0**	**1**	**$2,185,250**	

4.3.10.4 Future Occurrence

It is possible for a disastrous tornado to hit Bradford County. While the chance of being hit by a tornado is somewhat small, the damage that results when the tornado arrives can be devastating. An EF5 tornado with a 0.019 percent annual probability of occurring can carry wind velocities of 200 mph, resulting in a force of more than one hundred pounds per square foot of surface area. This is a "wind load" that exceeds the design limits of most buildings.

Based on tornado activity information for Pennsylvania between 1950 and 2002, Bradford County lies within an area that has experienced twenty to forty tornado events per square mile, which is equivalent to about one to four tornados per square mile every five years (Pennsylvania State Climatology). Additionally, based on historic patterns, tornados are unlikely to remain on the ground for long distances, especially in areas of the county with hilly terrain. However, the high historical number of windstorms with winds over fifty knots indicates that annual chance of a windstorm is higher.

According to FEMA (See the Hurricane Profile, Section 4.3.5 *Table 23 - Annual Probability of Wind Speeds)*, there is high probability (~92%) each year that Bradford County will experience winds of 45-77 mph; however, there is under a 10% chance of winds of 78-118 mph.

The number of days when tornados occur in the United States have decreased, however there has been an increase in tornado activity on those days. The tornado season has also been lengthening, with the season starting earlier than it has historically. Climate change is causing temperatures and air moisture to increase, and it is thought that these changes could result in an increase in frequency and intensity of tornadoes and severe wind storms; however, there is somewhat low confidence in these conclusions and there is still much uncertainty (Kossin et al., 2017).

4.3.10.5 Vulnerability Assessment

Tornados can occur at any time of the year, though they are more likely during peak months, which are during the summer for the northern part of the United States. Tornados are most likely to occur between 3 P.M. and 9 P.M. but have been known to occur at all hours of the day or night. Factors that impact the amount of damage caused by a tornado are the strength of the tornado, the time of day and the area of impact. Usually such distinct funnel clouds are localized phenomena impacting a small area; however, the high winds of tornados make them one of the most destructive natural hazards. There can be many secondary impacts of tornados and windstorms, including transportation accidents, hazardous material spills, flooding, and power outages. A proper warning system is vital for the public to be informed of what to do and where to go.

Dangers that accompany thunderstorms which can produce tornados:

- Flash floods – with 146 deaths annually nationwide
- Lightning – 75 to 100 deaths annually nationwide

- Damaging straight-line winds – reaching 140 mph wind speed
- Large hail – can reach the size of a grapefruit and causes several hundred million dollars in damages annually to property and crops.

Critical facilities are highly vulnerable to high windstorms. While many severe storms can cause exterior damage to structures, tornados can also completely destroy structures, along with their surrounding infrastructure, abruptly halting operations. Tornadoes are often accompanied by severe storms which can be threatening to critical facilities within the county in their own right. Many critical facilities are particularly vulnerable to power outages which can leave facilities functionless, potentially crippling infrastructure supporting the population of the county. With a storm's ability to destroy structures, citizens and their possessions are often left at the will of the storm. The elderly and disabled people are vitally at risk when faced with tornados. Without assistance to evacuate, they may be unable to prepare themselves or their homes and other possessions to safely weather the storm. Campgrounds and mobile homes are also particularly vulnerable to tornados and windstorms, and locations of some mobile home parks in Bradford County can be found in *Figure 37 - Tornado History 1950-2018*; however, this is not a comprehensive list of buildings vulnerable to strong windstorms. It should also be noted that the State Parks and State Forests in Bradford County have designated camping locations where visitors often pitch tents and can be vulnerable to severe windstorms.

The local economy can also be crippled by tornados and windstorms and their secondary effects when buildings and supporting infrastructure are destroyed in the storm. Power outages can create work stoppages while transportation accidents and road closings can limit the transportation of goods and services. Additionally, flooding cannot be discounted as it can destroy the physical structures, merchandise and equipment essential for business operation. In the case of hazardous material spills caused by windstorms, the local environment can also be negatively impacted, requiring extensive clean-up and mitigation efforts.

4.3.11. Wildfire

4.3.11.1 Location and Extent

The most prevalent causes of devastating wildfires are droughts, lightning strikes, arson, human carelessness, and in rare circumstances, spontaneous combustion. Most fires in Pennsylvania are caused by anthropogenic fires such as debris burns that spread and get out of control. A fire, started in somebody's backyard, could travel through dead grasses and weeds into bordering woodlands starting a wildfire. Major urban fires can cause significant property damage, loss of life, and residential or business displacement. While wildfires are a natural and essential part of many native Pennsylvania ecosystems (e.g. pitch pine – scrub oak woodlands), wildfires can also cause devastating damage if they are undetected and allowed to propagate unfettered. Wildfires most often occur in less developed areas such as open fields, grass, dense brush or forests where they can

spread rapidly by feeding off of vegetative fuels. Wildfires are most prevalent under prolonged dry and hot spells, or generally drought conditions. The greatest potential for wildfires (83% of all Pennsylvania wildfires) occur in the spring months of March, April, and May, and the autumn months of October and November. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris and increasing wildfire vulnerability. In the fall, the surplus of dried leaves is fuel for fires. *Figure 38 - Seasonal Wildfire Percentage* shows the wildfire percentage occurrence during each month occurring in Pennsylvania.

Approximately twenty-four percent of Bradford County is forested (Bradford Comprehensive Plan, 2018) and it contains State Game Lands 12, 36, 123, 142, 172, 219, 237, 239 and 250, Mount Pisgah State Park, and parts of the Tioga and Loyalsock State Forests.

Figure 38 - Seasonal Wildfire Percentage

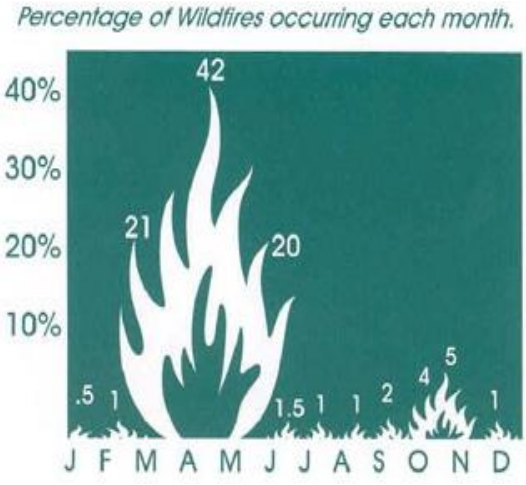
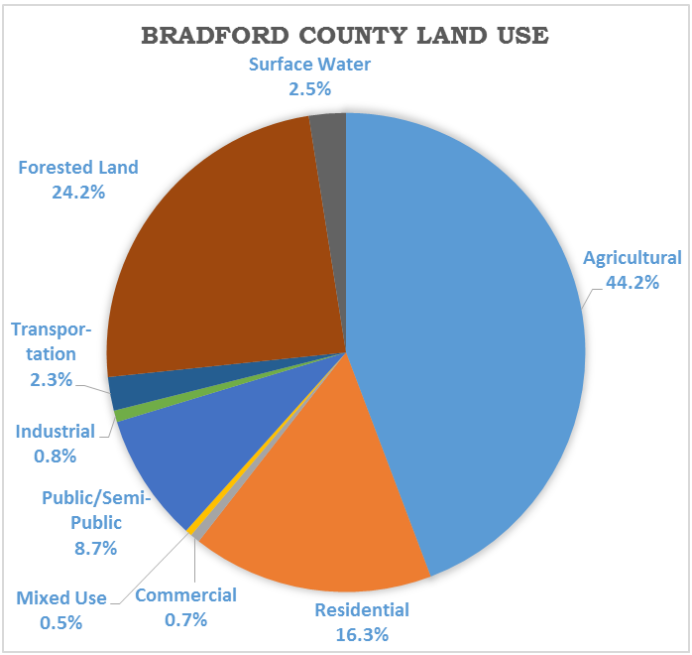


Figure 39 - Bradford County Land Use



4.3.11.2 Range of Magnitude

Forested areas, croplands and properties that are at the interface between wild lands and human development are most at risk for being impacted by and causing wildfires. If an urban fire or wildfire is not contained, secondary impacts such as power outages may result. Other negative impacts of wildfires include killing people, livestock, fish and wildlife and destroying valuable property, timber, forage, recreational and scenic values. Wildfires can also cause severe erosion, silting of stream beds and reservoirs, and flooding due to a loss of ground cover.

The United States Forest Service utilizes the Forest Fire Assessment System to classify the dangers of wildfire. *Table 34 - Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

Table 34 - Wildland Fire Assessment System

Wildland Fire Assessment System *(U.S. Forest Service)*	
Rank	**Description**
Low (L)	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
Moderate (M)	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
High (H)	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High (VH)	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme (E)	Fires start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens.

4.3.11.3 Past Occurrences

The Bradford County Knowledge Center has an extensive history of reported fires which appear below in *Table 35 - Fire Occurrences*. Not all of the reported fires are necessarily wildfire hazards as many occur in more urban environments; however, the reported brush fires appear highlighted in red in the table.

Bradford County is located largely in the Loyalsock Forest District, and

Table 36 - Wildfires in the Loyalsock District summarizes the history of wildfires in the Loyalsock District from 2003 to 2011. Data after 2011 was not available at the time of this report.

In recent years, the number of prescribed burns in Pennsylvania have been increasing. This corresponds to an embrace of the need for fire in many natural ecosystems and management strategies for reducing vulnerability to wildfires. *Table 35 - Fire Occurrences* lists two prescribed burns conducted by the PA Game Commission. In addition, in 2018 there were several prescribed burns in State Game Lands, including three locations State Game Lands 239 with a total area of eighty-five acres burned. (PA Prescribed Fire Council, 2018).

Table 37 - Pennsylvania Prescribed Burns shows prescribed burn data for Pennsylvania from 2010 to 2015. Statewide data for prescribed burns was not available after 2015.

Table 35 - Fire Occurrences

Fire Occurrences ***(Knowledge Center, 2019)***		
Title	**Location**	**Date**
Dumpster Fire	North Towanda Township	11/09/2012
Barn Fire	Rome Township	11/14/2012
Vehicle Fire	Wilmot Township	11/14/2012
Structure Fire	Athens Borough	11/19/2012
Structure fire	Athens Township	11/19/2012
Brush Fire	Sayre Borough	11/26/2012
Oven Fire	Rome Township	11/26/2012
Automatic Fire Alarm	Wyalusing Township	11/28/2012
Structure Fire	Orwell Township	11/29/2012
Industrial Fire	Athens Township	12/12/2012
Automatic Fire Alarm	North Towanda Township	12/13/2012
Structure Fire	Canton Township	12/15/2012
Fire Alarm	Sayre Borough	12/20/2012
Fire Alarm	Athens Township	12/21/2012
Vehicle Fire	W Burlington Township	01/07/2013
Vehicle Fire	Ulster Township	01/10/2013
Fire Alarm	Athens Borough	01/10/2013
VEHICLE FIRE	Columbia Township	01/14/2013
House Fire	Granville Township	01/15/2013
Vehicle Fire	Sayre Borough	01/16/2013
CO Detector	Athens Township	01/16/2013
House Fire	Sheshequin Township	01/23/2013
Structure Fire	Smithfield Township	01/27/2013
Structure Fire	Rome Township	01/30/2013
Structure Fire	North Towanda Township	01/30/2013
Structure Fire	Troy Borough	01/31/2013
House Fire		02/11/2013
Structure Fire	South Creek Township	02/13/2013
Structure Fire		02/19/2013
Structure Fire		02/22/2013

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Structure Fire		02/26/2013
Structure Fire		03/11/2013
Brush Fire	Monroe Township	03/11/2013
Structure Fire		03/12/2013
Structure Fire		03/14/2013
Chimney Fire		03/15/2013
Vehicle Fire		03/18/2013
Compressor Fire on Well Pad		03/19/2013
Garage Fire		03/19/2013
Structure Fire	Towanda Township	03/19/2013
Hay Bale Fire		03/25/2013
Motor Vehicle Accident		04/01/2013
Stove Fire	64 Shepard Rd in Sayre Borough	04/02/2013
House Fire		04/03/2013
Brush Fire	Springfield Township	04/04/2013
Brush Fire	Albany Township	04/05/2013
Red Flag Warning		04/05/2013
Field Fire		04/07/2013
Brush Fire		04/09/2013
Smoke in Memorial Personnal Care Home	Memorial Personal Care Home	04/09/2013
Brush Fire		04/22/2013
Burning Ban	Athens Township	04/26/2013
Brush Fire		05/04/2013
Structure Fire	Litchfield Township	05/07/2013
Garage Fire with Injuries		05/16/2013
Construction Equipment Fire	Tioga County	05/21/2013
Structure Fire		06/02/2013
Vehicle Fire		06/03/2013
Structure Fire		06/05/2013
Motor Home Fire	Herrick Township	06/05/2013
Electrical Fire		06/14/2013
House Fire	Athens Township	06/23/2013
Working Fire	Nasco Cabinetry	06/29/2013
Garage Fire	Wyalusing Township	09/16/2013

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Brush Fire	Leroy Township	09/21/2013
Structure Fire	Columbia Township	09/28/2013
Gas Well Flare Off	Ulster Township	09/30/2013
Structure Fire (Residential)	Leroy Township	11/03/2013
2nd Alarm House Fire	Ulster Township	11/07/2013
Brush Fire	Dodge Rd in Franklin Township	11/16/2013
Fire	13397 Berwick Turnpike in Ridgebury Township	01/13/2014
Structure Fire	7456 Route 414 in Leroy Township	01/13/2014
Structure Fire Pole Barn	Standing Stone Township	01/27/2014
Structure Fire	Terry Township	02/01/2014
Structure Fire	Ridgebury Township	02/06/2014
Automatic Fire Alarm		02/12/2014
Structure Fire	Athens Borough	02/12/2014
Structure Fire	Franklin Township	02/28/2014
Structure Fire		03/06/2014
Explosion at GTP		03/07/2014
Gas Well Compressor Fire	Herrick Township	03/09/2014
Brush Fire	Leroy Township	03/17/2014
Vehicle Fire	Herrick Township	03/19/2014
Brush Fire	Sheshequin Township	03/19/2014
Structure Fire		03/21/2014
Brush Fire		03/21/2014
Brush Fire	Burlington Township	03/21/2014
Brush Fire	Monroe Township	03/22/2014
Brush Fire	Canton Township	03/22/2014
Brush Fire	Monroe Township	03/22/2014
Brush Fire	Wyalusing Township	03/22/2014
Brush Fire	Albany Township	03/23/2014
Structure Fire		03/29/2014
Brush Fire	Monroe Township	04/03/2014
Brush Fire	Wyalusing Township	04/10/2014
Brush Fire	Orwell Township	04/10/2014

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Brush Fire	Troy Township	04/14/2014
Brush Fire	Monroe Township	04/14/2014
Brush Fire	Litchfield Township	04/14/2014
Brush Fire	Orwell Township	04/17/2014
Structure Fire	Stone Township	04/25/2014
Brush Fire	Canton Borough	04/28/2014
Structure Fire	Terry Township	04/29/2014
Fire in Basement		05/23/2014
Structure Fire	Stevens Township	06/12/2014
Trailer Fire	Athens Township	07/08/2014
Gas Well Flow Back Tank Fire		07/13/2014
Garage/ Apartment Fire		07/18/2014
Structure Fire	Troy Borough	08/11/2014
Garage Fire	Smithfield Township	08/25/2014
Silo Fire	Sheshequin Township	10/03/2014
Fire with Fire Fighter Injury	Stevens Township	11/03/2014
Brush Fire	Ridgebury Township	11/03/2014
Industrial Structure Fire		11/12/2014
Pole Fire	Towanda Borough	11/17/2014
Structure Fire (Residential)		11/25/2014
Structure Fire (Residential)		11/29/2014
Residential Trailer Fire		12/10/2014
Possible Well Fire	Asylum Township	12/12/2014
Structure Fire	Towanda Borough	12/13/2014
Residential Chimney Fire		12/15/2014
Structure Fire		12/18/2014
Residential Chimney Fire with Fire Fighter Injury		12/21/2014
Structure Fire	Springfield Township	01/05/2015
Structure Fire	South Creek Township	02/10/2015
Structure Fire		02/12/2015
Structure Fire	Litchfield Township	02/15/2015
Structure Fire	Troy Township	02/19/2015
Structure Fire	Albany Borough	02/21/2015

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Structure Fire	Ulster Township	02/21/2015
Structure Fire	Ulster Township	02/21/2015
Structure Fire	Troy Township	02/21/2015
Structure Fire	Franklin Township	02/22/2015
House Trailer Fire		02/25/2015
Trailer Fire	Granville Township	03/02/2015
Structure Fire	Towanda Borough	03/02/2015
Trailer Fire	Warren Township	03/08/2015
Structure Fire	Monroe Township	03/12/2015
Structure Fire	Litchfield Township	03/12/2015
Structure Fire	Athens Borough	03/23/2015
Structure Fire	Windham Township	04/05/2015
Brush Fire	West Burlington Township	04/06/2015
Brush Fire	Wysox Township	04/06/2015
Trailer Fire	McNett Township	04/13/2015
Brush Fire	Ridgebury Township	04/19/2015
Garage Fire	Athens Borough	04/19/2015
Brush Fire	Ridgebury Township	04/29/2015
Brush Fire	Windham Township	05/02/2015
Brush Fire	Ridgebury Township	05/02/2015
Brush Fire	Towanda Borough	05/11/2015
Brush Fire	Warren Township	05/11/2015
Industrial Fire		05/19/2015
Structure Fire	Litchfield Township	05/24/2015
Structure Fire	Canton Township	06/23/2015
Structure Fire	Athens Township	06/26/2015
Fire	West Burlington Township	08/08/2015
Structure Fire	Smithfield Township	09/17/2015
Structure Fire	Troy Township	10/18/2015
Structure Fire	Sayre Borough	11/04/2015
Trailer Fire		11/15/2015
Structure Fire		11/15/2015
Structure Fire		11/22/2015
Fire	Asylum Township	12/17/2015

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Fire	Asylum Township	12/18/2015
Structure Fire	Monroe Township	12/23/2015
Structure Fire		01/10/2016
Structure Fire	South Creek Township	01/19/2016
Barn Fire	460 Yale Rd in Ridgebury Township	01/20/2016
Structure Fire	South Creek Township	01/28/2016
Structure Fire (Residential)		01/29/2016
Structure Fire	Springfield Township	01/31/2016
Chimney Fire	Smithfield Township	02/12/2016
Barn Fire	Smithfield Township	02/20/2016
Brush Fire	Albany Township	02/29/2016
Fire	Monroe Township	02/29/2016
Brush Fires		03/07/2016
Brush Fire	Wysox Township	03/08/2016
Brush Fire	Leroy Township	03/08/2016
Brush Fire	Terry Township	03/18/2016
Structure Fire	Towanda Borough	03/20/2016
Structure Fire	Monroe Township	03/20/2016
Chimney Fire	Springfield Township	03/21/2016
Camper Fire	Athens Township	04/08/2016
Structure Fire	Towanda Borough	04/11/2016
Brush Fire	Monroe Township	04/16/2016
Brush Fire	Herrick Township	04/21/2016
School Township	Orwell Township	05/16/2016
Oberkamper Gas Well Flare Off		06/14/2016
Building Fire		06/18/2016
Structure Fire	Sayre Borough	06/21/2016
Structure Fire	Franklin Township	06/25/2016
EOC Activation	Sayre Borough	07/17/2016
Fire	1 Guthrie Square in Sayre Borough	07/17/2016
Brush Fire	Sayre Borough	07/23/2016
Structure Fire	Sayre Borough	07/26/2016
Structure Fire		08/08/2016

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Structure Fire	Towanda Borough	08/12/2016
Duct Work Fire		08/25/2016
Working Structure Fire		09/19/2016
Towanda Memorial Code Red Exercise	North Towanda Township	10/17/2016
Structure Fire	Smithfield Township	10/27/2016
Gas Well Flare Down		10/28/2016
Gas Well Flare Down		10/29/2016
Brush Fire		11/07/2016
Working Structure Fire		11/12/2016
Structure Fire	Athens Township	11/14/2016
Structure Fire	Wilmot Township	11/21/2016
Structure Fire	Sheshequin Township	12/14/2016
Structure Fire	Ridgebury Township	12/18/2016
Structure Fire	Terry Township	12/21/2016
Structure Fire	N Main St in Towanda Borough	12/24/2016
Structure Fire	Rome Township	12/31/2016
Fire	217 Lamoka Rd in Athens Township	01/04/2017
Structure Fire	Sayre Borough	02/03/2017
Structure Fire	Orwell Township	02/04/2017
Barn Fire	Granville Township	02/06/2017
Structure Fire	Canton Township	02/06/2017
Structure Fire	Orwell Township	02/20/2017
Structure Fire	Rome Borough	02/20/2017
Gas Line Explosion		02/20/2017
Brush Fire	Union Township	03/06/2017
Structure Fire	South Waverly Borough	03/14/2017
Structure Fire	Springfield Township	03/15/2017
Structure Fire	GTP Plant	03/17/2017
Chimney Fire	West Burlington Township	03/23/2017
Brush Fire	Union Township	04/15/2017
Brush Fire	Ridgebury Township	04/15/2017
Shed and Field Fire	Canton Township	04/18/2017
Chimney Fire	Athens Township	04/25/2017

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Working Fire	Asylum Township	04/30/2017
Building Fire GTP		05/08/2017
Structure Fire	Ulster Township	06/01/2017
Structure Fire	Columbia Township	06/07/2017
House Fire	Herrick Township	06/18/2017
Commercial Fire	Athens Township	09/23/2017
Brush Fire	Wyalusing Township	09/28/2017
Smoke in Building	Apartment Building	10/01/2017
Brush Fire	Wyalusing Township	10/01/2017
Brush Fire	Standing Stone Township	10/03/2017
Fire	Ulster Township	10/07/2017
Structure Fire	Wyalusing Township	10/16/2017
Propane Tank Car Blow Down		10/30/2017
EMTA Bus Fire		11/08/2017
House Fire	Canton Township	11/08/2017
Structure Fire	Sheshequin Township	11/13/2017
Structure Fire	McNett Township	12/24/2017
Structure Fire	Sheshequin Township	12/30/2017
Structure Fire	Columbia Township	01/04/2018
Working Fire JELD-WEN	Wysox Township	01/06/2018
Working Structure Fire	Golden Mile Road in Wysox Township	01/26/2018
Barn Fire		01/31/2018
Structure Fire	Asylum Township	02/28/2018
Barn Fire	Newell Road in Canton Township	03/06/2018
Structure Fire	Smithfield Township	03/16/2018
Vehicle Fire In Structure	Wilmot Township	03/19/2018
Gas Pad Explosion	Franklin Township	03/25/2018
House Fire	Granville Township	04/08/2018
Camper/Brush Fire	Granville Township	04/09/2018
Brush Fire	Asylum Township	04/13/2018
House Fire	Leroy Township	04/21/2018
Brush Fire	Litchfield Township	04/23/2018
Structure Fire	Franklin Township	04/23/2018

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Brush Fire And Working Structure Fire		05/02/2018
Forest Fire	Athens Township	05/02/2018
Garage Fire	Windham Township	05/05/2018
Structure Fire	Wyalusing Township	05/08/2018
Working Structure Fire	Franklin Township	05/20/2018
Structure Fire	Wyalusing Township	06/11/2018
Structure Fire	Columbia Township	06/15/2018
Structure Fire		06/23/2018
Structure Fire	12166 State Route 706	06/25/2018
Fire	State Route 706 in Stevens Twp	06/26/2018
Structure Fire	Tuscarora Township	07/11/2018
Structure Fire		07/17/2018
Structure Fire	Pike Township	07/20/2018
Car into Barn	Stevens Township	07/29/2018
Structure Fire	West Burlington Township	07/30/2018
Structure Fire	Smithfield Township	07/30/2018
Structure Fire	Athens Township	08/27/2018
Structure Fire	Towanda Borough	08/27/2018
Structure Fire	Sayre Borough	08/29/2018
Structure Fire	Franklin Township	09/03/2018
Structure Fire	Rome Township	09/09/2018
Structure Fire	Litchfield Township	10/02/2018
Structure Fire Rekindle	Litchfield Township	10/03/2018
Structure Fire	McNett Township	10/03/2018
Possible House Fire		10/18/2018
Structure Fire	Smithfield Township	10/30/2018
Apartment Fire	Canton Borough	11/01/2018
Chimney Fire	Franklin Township	11/01/2018
Working Structure Fire	Ulster Township	11/10/2018
Garage Fire	Rome Township	11/11/2018
Working Structure Fire	Troy Township	12/10/2018
Structure Fire	Litchfield Township	12/14/2018
Structure Fire		12/22/2018
Structure Fire		12/27/2018

Fire Occurrences *(Knowledge Center, 2019)*		
Title	**Location**	**Date**
Structure Fire	Franklin Township	01/09/2019
Structure Fire	South Creek Township	01/16/2019

Table 36 - Wildfires in the Loyalsock District

Wildfires in the Loyalsock District 2003-2011 *(2015 HMP)*				
Year	**Fires**	**% of Statewide**	**Acres**	**% of Statewide**
2003	21	5.1%	125.4	6.2%
2004	13	6.3%	2378.2	85.6%
2005	44	5.4%	552.7	12.9%
2006	4	0.4%	12.6	0.2%
2007	4	0.7%	0.5	0.0%
2008	10	1.5%	17.4	0.2%
2009	46	7.4%	192.8	3.2%
2010	34	6.0%	197.4	5.8%
2011	3	1.5%	0.5	0.1%

Table 37 - Pennsylvania Prescribed Burns

Pennsylvania Prescribed Burns *(PA DCNR, 2018)*				
Year	**All Agencies and Organizations - Number of Prescribed Fires**	**All Agencies and Organizations - Number of Prescribed Fire Acres**	**DCNR - Number of Prescribed Fires**	**DCNR - Number of Prescribed Fire Acres**
2010	56	2737	12	186
2011	70	6301	11	189
2012	96	4133	10	208
2013	142	8058	35	866
2014	161	7094	26	338
2015	244	14553	47	1317

4.3.11.4 Future Occurrence

Annual occurrences of urban and wildfires in Bradford County are expected. Urban fires are most often a result of human errors, outdated wiring or occasionally malintent (arson). The occurrence of large scale and intensity wildfires is somewhat unpredictable and highly dependent on environmental conditions and human response. Weather conditions play a major role in the occurrence of wildfires, so in the event of drought conditions, wildfire caution should be heightened. Any fire without the quick response or attention of fire-fighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire. The Bradford County Department of Public Safety coordinates countywide burn bans when the conditions are ideal for wildfires. Public information and press releases are issued to help decrease the risk of a major fire thus reducing the possibility of future occurrences. Bradford County Department of Public Safety disseminates all red flag warnings.

There are a few planned prescribed burns in Bradford County, including two locations in State Game Lands 123, and three more locations in State Game Lands 239.

Climate change is expected to bring an elongated wildfire season and more intense and long-burning fires (Pechony & Shindell, 2010). Unfortunately in some regions of the United States, this is not a hypothetical, but a devastating reality – Northern California has experienced unprecedentedly devastating wildfires in 2017 and 2018, and the fires are thought to be burning faster and hotter due to worsening drought conditions caused by climate change (Cvijanovic et al., 2017). Wildfire conditions in Pennsylvania are not nearly as severe as in Northern California currently, but the intensification is a signal that the changes brought by climate change are not to be ignored. In Pennsylvania, higher air temperatures and earlier warming in the spring is expected to decrease the surface soil moisture because of an increase in evaporation (Wehner et al., 2017), resulting in more wildfire prone conditions in the summer and fall (Shortle et al., 2015).

4.3.11.5 Vulnerability Assessment

The size and impact of a wildfire depends on its location, climate conditions and the response of firefighters. If the right conditions exist, these factors may often mitigate the effects of wildfires; however, during a drought, wildfires can be devastating. The highest risk for wildfires in Pennsylvania occurs during the spring (March–May) and fall (October–November) months. Firefighters and other first responders can encounter life threatening situations due to forest fires. Traffic accidents during a response and then the impacts of fighting the fire once on scene are examples of the first responder vulnerabilities.

The Wildland Urban Interface (WUI) was nationally mapped by a United States Department of Agriculture Forest Service effort in 2015 that used data from 1990-2010 to develop a robust dataset that relates housing density and vegetative density. The dataset provides a way to help identify locations where larger numbers of humans are living in or near natural areas that could be at risk in the event of a wildfire. The WUI defines two types of communities – interface and intermix: intermix WUI refers to areas where housing and wildland vegetation intermingle, and interface WUI refers to areas where housing is in the vicinity of a large area of dense wildland vegetation (Martinuzzi et al., 2015). Pennsylvania is among the states with the largest area of WUI and the most housing units in a WUI designated area. There are many locations within Bradford County that are identified as interface or intermix, some of which are adjacent to areas defined as having relatively high housing density. These regions represent the areas where human lives are most vulnerable to wildfires and can be located in *Figure 41 - Wild Urban Interface Locations*. As a compliment to these locations, *Figure 40 – Fire Departments and Forested* Areas shows the locations of fire departments as well as state owned natural areas which represent vast swatches of forests within the county.

Table 38 - Buildings in High Wildfire Hazard Areas shows the total addressable structures and critical facilities that are located in state game lands, state parks and locations designated by the Wildland Urban Interface. Wildfire hazard is defined based on conditions that affect wildfire ignition and/or behavior such as fuel, topography and local weather. Cells that have no entry had zero vulnerable addressable structures or critical facilities according to this analysis. The many addressable structures in the Wildland Urban Interface and Intermix zone are broken up by assessed parcel use codes – the “other” land use is comprised of Industrial, Agriculture, Service, Transportation, Communication, Utility, Natural Resources & other Land uses.

There are twenty-nine fire departments that cover Bradford County which can be seen in

Table 39 - Fire Departments. Each fire department conducts its own schedule of in-house training sessions for their members.

Table 38 - Buildings in High Wildfire Hazard Areas

Buildings in High Wildfire Hazard Areas (Bradford Co GIS, 2019; Radeloff et al. 2016)					
Municipalities	**State Forest, Parks & Game Lands**		**Wildland Urban Interface & Intermix**		
	Critical Facilities	**Addressable Structures**	**Critical Facilities**	**Addressable Structures**	
Alba Borough				Commercial Other Residential	2 9 39
Albany Township		2		Commercial Other Residential	10 2 19
Armenia Township		2		Other	1
Asylum Township		1		Other	2
Athens Borough			12	Commercial Other Residential	107 50 1314
Athens Township			11	Commercial Other Residential	478 63 963
Burlington Borough				Commercial Other Residential	1 4 36
Burlington Township				Other Residential	1 7
Canton Borough			12	Commercial Other Residential	144 157 695
Canton Township			2	Commercial Other Residential	8 12 77
Columbia Township				Residential	1
Franklin Township		1	2	Commercial Other Residential	8 10 31
Granville Township				None	0
Herrick Township				Other	1
Leraysville Borough				None	0
Leroy Township		6	1	Commercial Other Residential	2 4 18
Litchfield Township				Other Residential	1 20

Buildings in High Wildfire Hazard Areas *(Bradford Co GIS, 2019; Radeloff et al. 2016)*					
Municipalities	**State Forest, Parks & Game Lands**		**Wildland Urban Interface & Intermix**		
	Critical Facilities	**Addressable Structures**	**Critical Facilities**	**Addressable Structures**	
Monroe Borough			1	Commercial Other Residential	23 27 207
Monroe Township	1	7	1	Commercial Other Residential	1 19 95
New Albany Borough			1	Commercial Other Residential	24 25 128
North Towanda Township				Commercial Other Residential	1 5 5
Orwell Township				Other Residential	2 12
Overton Township		5		Other Residential	9 1
Pike Township				None	0
Ridgebury Township			2	Commercial Other Residential	100 58 140
Rome Borough			3	Commercial Other Residential	101 23 95
Rome Township			2	Commercial Other Residential	56 3 17
Sayre Borough			15	Commercial Other Residential	53 54 1475
Sheshequin Township				Other Residential	1 16
Smithfield Township		1		Residential	10
South Creek Township		1	1	Commercial Other Residential	9 19 110
South Waverly Borough			6	Commercial Other Residential	19 22 449
Springfield Township		1		Residential	2

Buildings in High Wildfire Hazard Areas *(Bradford Co GIS, 2019; Radeloff et al. 2016)*					
Municipalities	**State Forest, Parks & Game Lands**		**Wildland Urban Interface & Intermix**		
	Critical Facilities	**Addressable Structures**	**Critical Facilities**	**Addressable Structures**	
Standing Stone Township				Other Residential	8 17
Stevens Township				Commercial Other Residential	1 7 13
Sylvania Borough				Commercial Other Residential	3 6 46
Terry Township				Other Residential	39 27
Towanda Borough				Residential	9
Towanda Township				Commercial Residential	1 4
Troy Borough			10	Commercial Other Residential	44 80 360
Troy Township			1	Commercial Other Residential	74 7 59
Tuscarora Township			1	Other Residential	2 16
Ulster Township			2	Commercial Other Residential	2 7 54
Warren Township		3		Other Residential	86 33
Wells Township				Commercial Other Residential	18 2 17
West Burlington Township	1	10		None	0
Wilmot Township		2		Other Residential	19 14
Windham Township			1	Other Residential	8 23
Wyalusing Borough			6	Commercial Other Residential	55 114 228

Buildings in High Wildfire Hazard Areas *(Bradford Co GIS, 2019; Radeloff et al. 2016)*					
Municipalities	**State Forest, Parks & Game Lands**		**Wildland Urban Interface & Intermix**		
	Critical Facilities	**Addressable Structures**	**Critical Facilities**	**Addressable Structures**	
Wyalusing Township			2	Commercial Other Residential	4 7 36
Wysox Township				Commercial Other Residential	79 2 3
Total	**2**	**42**	**95**	**Commercial Other Residential**	**1428 978 6941**

Table 39 - Fire Departments

Fire Departments *(Bradford Co. GIS, 2019)*		
Municipality	**Station Name**	**Address**
Wysox Township	Wysox Vol Fire	111 Lake Rd, Wysox PA, 18854
Wyalusing Borough	Wyalusing Valley Vol Fire	24 Second St, Wyalusing PA, 18853
Wilmot Township	Wilmot Fire	58 River View Rd, Sugar Run PA, 18846
Warren Township	Warren Twp Vol Fire	3039 Warren Center Rd, Warren Center PA, 18851
Ulster Township	Ulster-Sheshequin Fire	85 Rescue St, Ulster PA, 18850
Troy Township	Troy Fire	88 Firehouse Dr, Troy PA, 16947
Towanda Borough	Towanda Fire	101 Elm St, Towanda PA, 18848
South Waverly Borough	South Waverly Vol Fire	57 Pleasant St, Sayre PA, 18840
South Creek Township	South Creek Fire Dept Station 2	33338 Route 14, Gillett PA, 16925
South Creek Township	South Creek Volunteer Fire Dept	6428 Roaring Run Rd, Gillett PA, 16925
Smithfield Township	Smithfield Twp Vol Fire	24 Village Green Way, East Smithfield PA, 18817
Sayre Borough	J.E. Wheelock Hose Co #5	217 Frank St, Sayre PA, 18840
Sayre Borough	Howard Elmer Hose Co #4	509 Powell St, Sayre PA, 18840
Sayre Borough	Sayre Boro Vol Fire	110 W Packer Ave, Sayre PA, 18840
Rome Borough	Rome Vigilante Engine	958 Main St, Rome PA, 18837
Ridgebury Township	Ridgebury Vol Fire	13238 Berwick Tpke, Gillett PA, 16925

Fire Departments *(Bradford Co. GIS, 2019)*		
Municipality	**Station Name**	**Address**
New Albany Borough	New Albany Vol Fire	71 Main St, New Albany PA, 18833
Monroe Borough	Monroeton Fire	8958 Burlington Tpke, Monroeton PA, 18832
Leraysville Borough	Leraysville-Pike Vol Fire	91 School St, Leraysville PA, 18829
Herrick Township	Herrick Twp Vol Fire	27 Hops Rd, Wyalusing PA, 18853
Franklin Township	Franklindale Fire	15 Grange Rd, Monroeton PA, 18832
Canton Borough	Canton Vol Fire	45 Park Pl, Canton PA, 17724
Athens Borough	Athens Boro Fire	2 S River St, Athens PA, 18810
Windham Township	Windham Twp Vol Fire	39158 Route 187, Rome PA, 18837
West Burlington Township	Troy Fire Dept Station #2	15894 Route 6, Troy PA, 16947
Athens Township - West	Athens Twp Fire	211 Herrick Ave, Sayre PA, 18840
Athens Township - East	Athens Twp Fire Station 2	64 Kirby St, Athens PA, 18810
Litchfield Township	Litchfield Vol Fire	1391 Hill Rd, Sayre PA, 18840
North Towanda Township	North Towanda Fire & Rescue	40 Hillcrest Dr, Towanda PA, 18848

Figure 40 – Fire Departments and Forested Areas

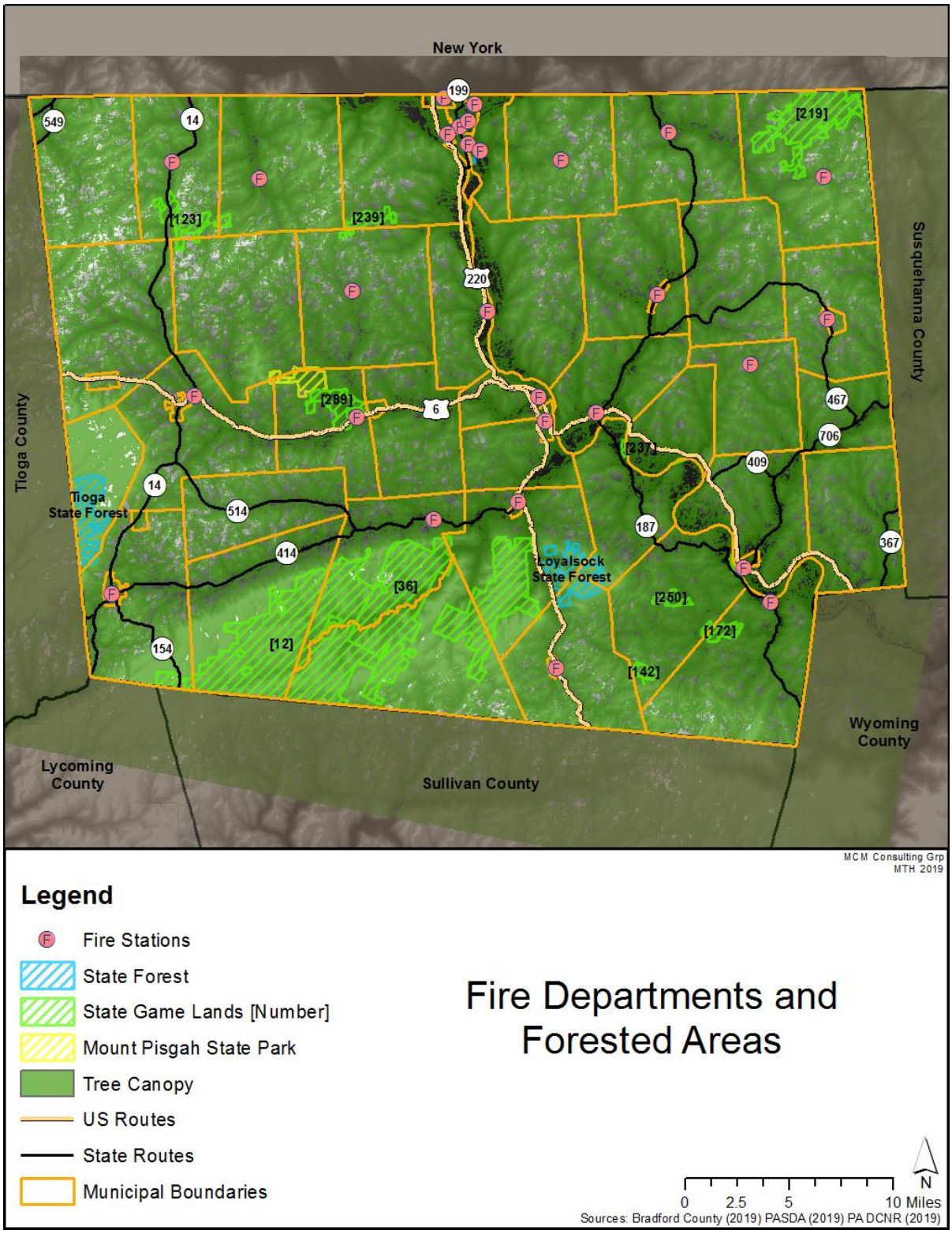
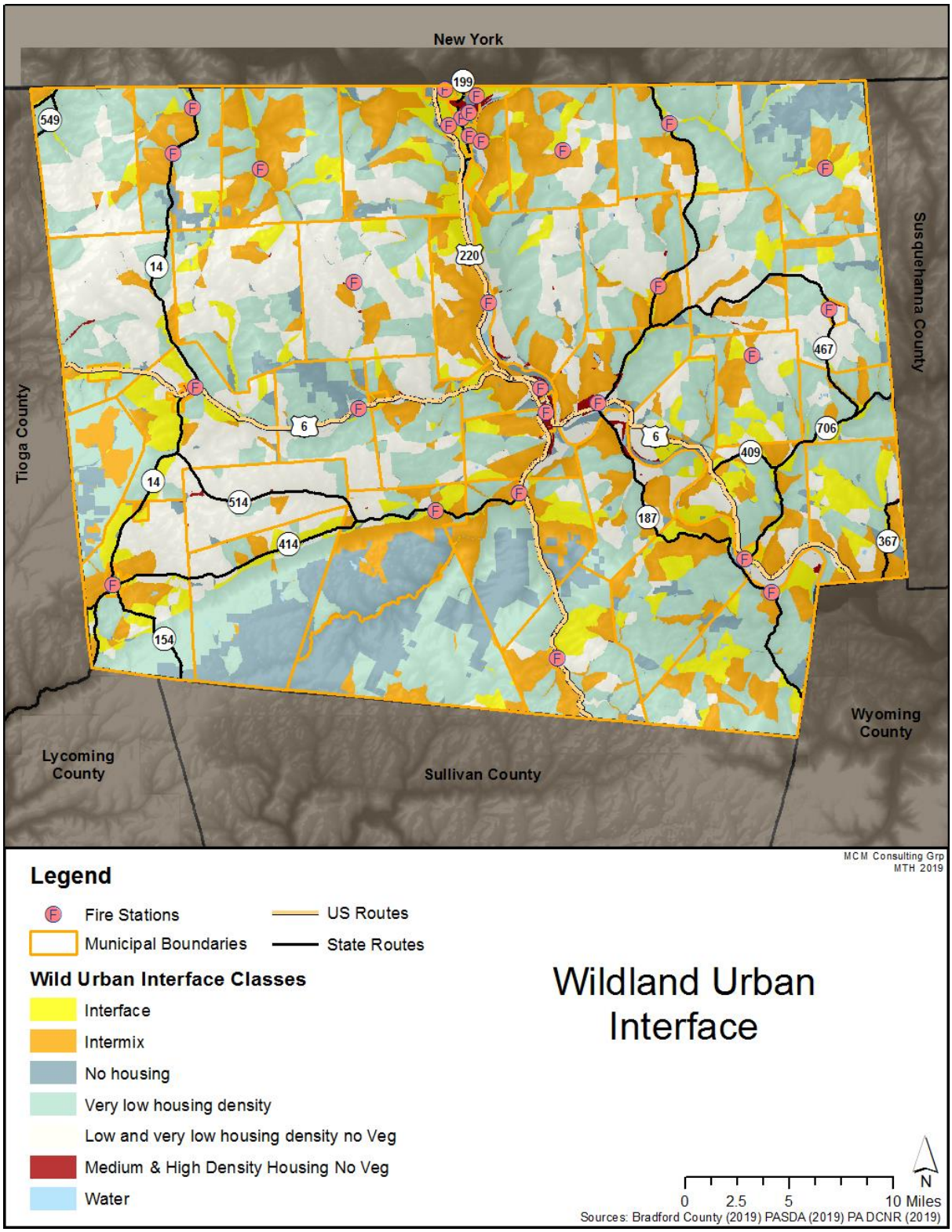


Figure 41 - Wild Urban Interface Locations



4.3.12. Winter Storms

4.3.12.1 Location and Extent

There is an average of thirty-five winter weather events that impact Pennsylvania each year. Such winter storms are regional events, so each county in Pennsylvania shares these hazards; however, the northern tier, western counties and mountainous regions generally experience storms more frequently and with a greater severity due to lake effects and geographic influence. Within Bradford County there are variations in the average amount of snowfall that is received throughout the county because of differences in terrain; higher elevations experience greater snowfalls than lower-lying areas.

On occasion Bradford County can be affected by a Nor'easter, depending on its track. A Nor'easter is a storm characterized by a central low-pressure area that deepens dramatically as it moves northward along the U.S. East Coast. The name came from the strong northeast winds that precede and accompany the storm as it passes over New England. Nor'easters are notorious for producing heavy snow in the Central and Northeastern Mountains (including the Poconos), but typically make lighter snow (or even no snow) for counties in the west. Nor'easters will ordinarily produce a heavy, wet snow. There is usually a fairly consistent demarcation between rain, mixed precipitation, and snow which moves along with the storm and generally parallel to the track of the surface low. The demarcation typically pivots with the storm as the track changes direction. The mixed precipitation and rainfall are generated when warmer marine air is pulled into the storm. The heaviest snow in a Nor'easter falls to the north and west of the track of the surface low (NWS).

4.3.12.2 Range of Magnitude

Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. Descriptions of types of winter storms can be found in *Table 40 - Winter Weather Events*. In severe cases, secondary effects of winter storms involve flooding, disruption to traffic, EMS response capabilities, communications, electric power and other utilities. Power outages can be caused by large amounts of snow or ice weighing on and breaking power lines. Especially in rural areas, loss of electric power can result in a loss of heat for residential customers, potentially posing a threat to human life.

Long cold spells can cause rivers and lakes to freeze over. A subsequent thaw and rise in the water level then break the ice into large chunks and can result in ice jams when the ice begins to flow. The ice jams can act as a dam and result in flooding. Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. While gradual melting of snow and ice provides excellent groundwater recharge, high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding. *Figure 42 - Pennsylvania Annual Snowfall 1981-2010* shows mean annual snowfall in Bradford County to be between thirty-one and fifty inches. *Table 41 - Recent Annual Snowfall by Snow Station* summarizes annual snowfall accumulation for recent years not

covered in Figure 42 - Pennsylvania Annual Snowfall 1981-2010 as recorded in the weather stations in Towanda and Canton.

Table 40 - Winter Weather Events

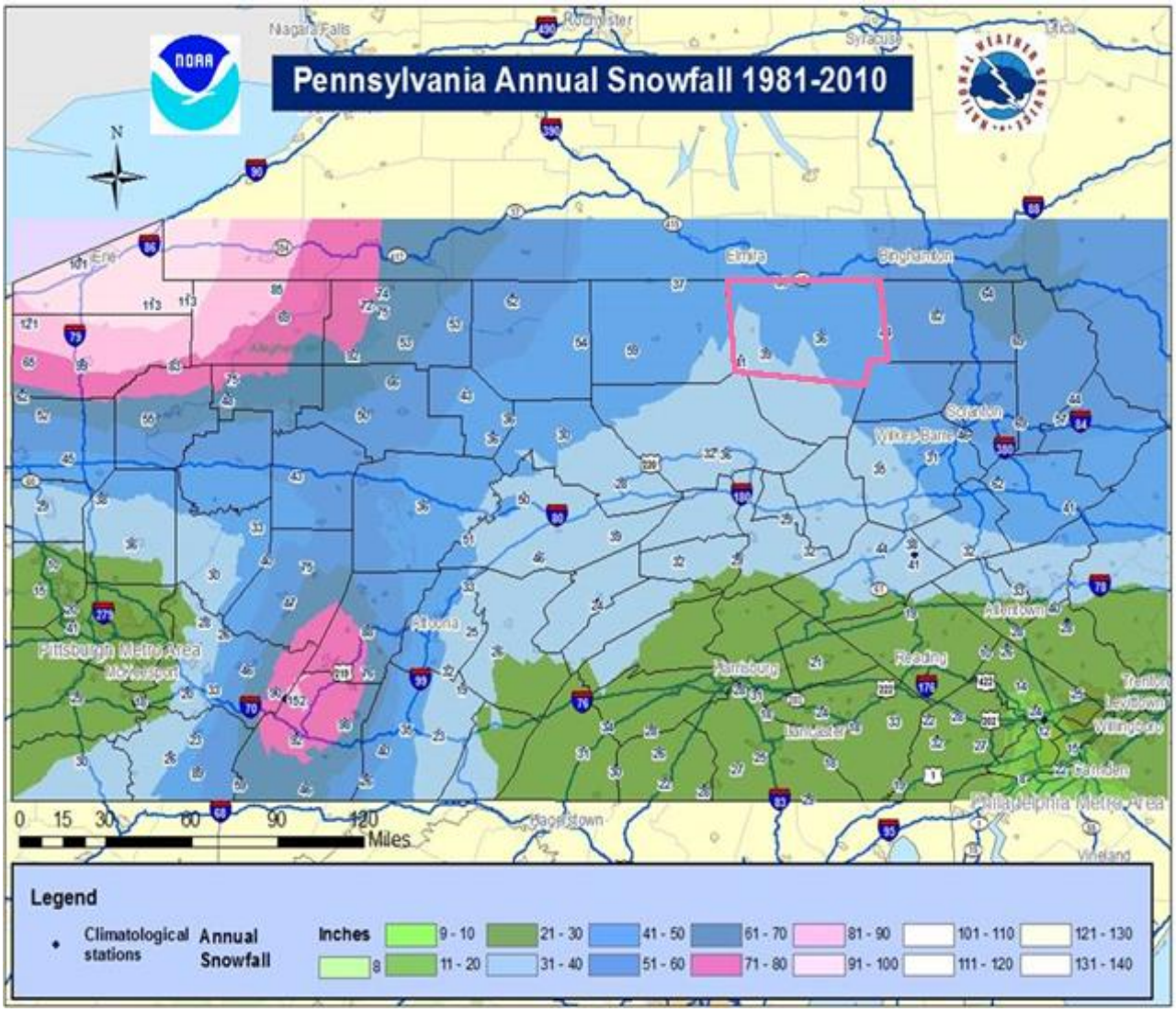
Winter Weather Events	
Weather Event	**Classification**
Heavy Snowstorm	Accumulations of four inches or more in a six-hour period, or six inches or more in a twelve-hour period.
Sleet Storm	Significant accumulations of solid pellets which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces posing hazards to pedestrians and motorists.
Ice Storm	Significant accumulations of rain or drizzle freezing on objects (trees, power lines, roadways, etc.) as it strikes them, causing slippery surfaces and damage from the sheer weight of ice accumulation.
Blizzard	Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period of time.
Severe Blizzard	Wind velocity of 45 miles per hour, temperatures of 10 degrees Fahrenheit or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period time.

Table 41 - Recent Annual Snowfall by Snow Station

Recent Annual Snowfall by Snow Station *(NOAA, 2019)*		
Winter Season	**Towanda**	**Canton**
2010-2011	57"	70.3"
2011-2012	13.8"	17.3"
2012-2013	30.5"	36.6"
2013-2014	51"	48.3"
2014-2015	36"	42"
2015-2016	11.4"	10.5"
2016-2017	50.8"	44.8"
2017-2018	9.6"	31.2"

Monthly Snowfall Average By Snow Station *(NOAA, 2019)*		
Month	**Canton**	**Towanda**
January	11.9"	11.1"
February	8.3"	7.3"
March	9"	7.5"
April	1.5"	1.6"
May	0"	0"
June	0"	0"
July	0"	0"
August	0"	0"
September	0"	0"
October	0.2"	0.2"
November	2.4"	1.9"
December	8"	6.1"
Annual	**41.3"**	**35.7"**

Figure 42 - Pennsylvania Annual Snowfall 1981-2010



4.3.12.3 Past Occurrence

Historically, winter storms have occurred on the average of five times a year in Bradford County. One of the most severe winter events in the county's history was in the winter of 1993 – 1994 when the state was hit by a series of protracted winter storms. The severity and nature of these storms combined with accompanying record-breaking frigid temperatures posed a major threat to the lives, safety and well-being of Commonwealth residents and caused major disruptions to the activities of schools, businesses, hospitals, and nursing homes. One of these devastating winter storms occurred in early January 1994 with record snowfall depths in many areas of the Commonwealth, strong winds and sleet/freezing rains. Numerous storm-related power outages were reported and as many as 600,000 residents were without electricity, in some cases for several

days at a time. A ravaging ice storm followed which closed major arterial roads and downed many trees and power lines. Utility crews from a five-state area were called to assist in power restoration repairs. Officials from PPL Corporation stated that this was the worst winter storm in the history of the company – related damage-repair costs exceeded $5,000,000. Serious and sporadic power supply outages continued through mid-January in many locations due to record cold temperatures. The entire Pennsylvania-New Jersey-Maryland grid and its partners in the District of Columbia, New York and Virginia experienced 15-30 minute rolling blackouts, threatening the lives of people and the safety of the facilities in which they resided. Power and fuel shortages affecting Pennsylvania and the East Coast power grid system required the Governor to recommend power conservation measures be taken by all commercial, residential and industrial power consumers. The record cold conditions (with temperatures as low as -31˚F) resulted in numerous water-main breaks and interruptions of service to thousands of municipal and city water customers throughout the Commonwealth. The extreme cold in conjunction with accumulations of frozen precipitation resulted in acute shortages of road salt. Trucks were dispatched to haul salt from New York to expedite deliveries to Pennsylvania Department of Transportation storage sites.

All recorded winter weather events in Bradford County from 1996 - 2018 are summarized in *Table 40 - Winter Weather Events*. No direct deaths or injuries were reported for the following winter weather events in Bradford. Detailed reports of each event can be found on NOAA's Storm Events Database (www.ncdc.noaa.gov/stormevents). These storms can result in closure of businesses and schools, blockages and damage to roadways, and loss of electricity and telephone service. The main transportation routes (US 6, US 220, PA 549, PA 14, PA 414, PA 187 and PA 706) are normally the opened immediately for emergency traffic, but secondary roads can remain impassable for days. Most residents and travelers in Bradford County are aware of the winter weather reputation in the county and avoid travel when under a winter storm watch.

The snowstorm on November 17, 2007 brought five to eleven inches of snowfall across the county, with even more accumulation at higher elevations. The storm caused power outages and road closures as the weight of the snow brought down trees and utility poles, causing approximately 1,000 customers in the county to be without power (NOAA NCEI, 2018).

Table 42 - Winter Storm History

Winter Storm History ***(NOAA NCEI, 2019)***					
Date	**Type**	**Property Damage**	**Date**	**Type**	**Property Damage**
01/02/1996	Heavy Snow	$3,000	02/17/2003	Heavy Snow	$50,000
01/07/1996	Heavy Snow	$20,000	12/06/2003	Heavy Snow	$20,000

Winter Storm History *(NOAA NCEI, 2019)*					
Date	**Type**	**Property Damage**	**Date**	**Type**	**Property Damage**
01/12/1996	Heavy Snow	$4,000	12/14/2003	Heavy Snow	$20,000
03/06/1996	Heavy Snow	$ -	01/10/2004	Cold/Wind Chill	$5,000
05/11/1996	Winter Weather	$ -	01/15/2004	Cold/Wind Chill	$10,000
10/04/1996	Cold/Wind Chill	$ -	02/03/2004	Heavy Snow	$10,000
01/17/1997	Cold/Wind Chill	$ -	03/16/2004	Heavy Snow	$20,000
12/10/1997	Heavy Snow	$ -	01/06/2005	Winter Weather	$20,000
12/29/1997	Heavy Snow	$ -	01/23/2005	Heavy Snow	$20,000
02/23/1998	Heavy Snow	$ -	03/01/2005	Heavy Snow	$20,000
01/02/1999	Ice Storm	$ -	03/24/2005	Heavy Snow	$10,000
01/08/1999	Winter Storm	$ -	10/25/2005	Winter Weather	$ -
01/13/1999	Winter Storm	$ -	12/14/2005	Cold/Wind Chill	$ -
03/06/1999	Heavy Snow	$ -	02/13/2007	Winter Storm	$ -
03/21/1999	Heavy Snow	$ -	04/15/2007	Winter Storm	$ -
01/12/2000	Heavy Snow	$ -	11/17/2007	Winter Weather	$5,000
01/20/2000	Heavy Snow	$ -	12/13/2007	Winter Storm	$ -
01/25/2000	Heavy Snow	$ -	03/04/2008	Ice Storm	$ -
01/30/2000	Heavy Snow	$ -	12/11/2008	Winter Storm	$25,000
02/13/2000	Ice Storm	$ -	12/19/2008	Heavy Snow	$ -
02/18/2000	Heavy Snow	$ -	10/15/2009	Winter Weather	$ -
09/28/2000	Extreme Cold/Wind Chill	$ -	02/10/2010	Winter Storm	$ -
02/24/2001	Ice Storm	$ -	02/25/2010	Winter Storm	$ -
03/04/2001	Heavy Snow	$ -	02/20/2011	Winter Storm	$ -
03/09/2001	Heavy Snow	$ -	02/25/2011	Winter Storm	$ -
03/21/2001	Heavy Snow	$ -	03/06/2011	Heavy Snow	$ -
12/08/2001	Heavy Snow	$ -	03/23/2011	Winter Storm	$ -
01/06/2002	Heavy Snow	$ -	12/26/2012	Winter Storm	$ -
01/19/2002	Heavy Snow	$ -	12/14/2013	Winter Storm	$ -
01/31/2002	Winter Storm	$ -	01/02/2014	Winter Storm	$ -
02/01/2002	Winter Storm	$ -	02/05/2014	Winter Storm	$ -
05/17/2002	Extreme Cold/Wind Chill	$8,000	02/13/2014	Winter Storm	$ -
12/11/2002	Winter Weather	$ -	11/26/2014	Winter Storm	$ -

Winter Storm History *(NOAA NCEI, 2019)*					
Date	**Type**	**Property Damage**	**Date**	**Type**	**Property Damage**
12/25/2002	Heavy Snow	$ -	02/01/2015	Heavy Snow	$ -
01/01/2003	Ice Storm	$70,000	03/14/2017	Heavy Snow	$ -
01/03/2003	Heavy Snow	$500,000	**Total**		**$840,000**

4.3.12.4 Future Occurrence

Climate change is expected to bring changes to the future of winter storms impacting Pennsylvania. Climate scientists believe that extreme winter storms are expected to occur more frequently – there have been about twice as many extreme snow events in the United States in the latter half of the 20th century as occurred in the first half (NOAA, 2018). While this uptick is caused in part by higher than normal ocean surface temperatures that result in an increased source of moisture for storms that develop over the Atlantic Ocean. Conditions for severe winter storms are particularly heightened in the eastern United States due to changes in atmospheric circulation patterns caused by higher temperatures and melting Arctic sea ice (Francis & Vavrus, 2012). Winters in 2000 and 2001 were mild in Pennsylvania and led to spring-like thunderstorms during the winter months rather than snowstorms. Such thunderstorms can be followed by cold fronts and winter storms resulting in temperature drops of 50˚F in a few short hours. With warmer average temperatures, more precipitation is expected to fall as rain rather than snow, and data from NOAA shows that Bradford County has experienced a significant decrease in the amount of snowfall relative to the amount of rainfall, with a change of -10% to -20% from 1949 to 2016 (NOAA, 2016; PA HMP, 2018). Even though average temperatures are expected to be higher overall and there are expected to be fewer extreme cold days, those that do occur are expected to more often reach record setting low temperatures (Vose et al., 2017).

Winter storms are a regular, annual occurrence in Bradford County and should be considered highly likely. Approximately thirty-five winter storm events occur across Pennsylvania annually and about five of which are estimated to significantly impact Bradford County each year.

4.3.12.5 Vulnerability Assessment

Winter storms are a frequent event in the county. Detrimental impacts of severe winter storms are mitigated by salting, plowing and snow removal by PennDOT and local municipalities. Icy and snow-covered roads often result in increases in traffic incidents. Swift response to utility outages during winter storms is another significant way to mitigate damages. Residents of the mountainous and more rural areas of the county may be more susceptible during severe storms, especially when emergency medical assistance is required due to the location's potential for isolation. There are rural areas which are

susceptible to isolation due to winter storms. Residents in outlying areas often find it beneficial to keep an emergency food and fuel stock in the event of isolation or utility interruption during a winter storm. The economic impacts from snow removal, road and infrastructure repair and other secondary effects impart a great strain on the budgets and material resources of local municipalities.

Even for communities that are prepared to respond to winter storms, severe events involving snow accumulations that exceed six or more inches in a twelve-hour period can cause a large number of traffic accidents, strand motorists due to snow drifts, interrupt power supply and communications, and cause the failure of inadequately designed and/or maintained roof systems. Similar to the vulnerability assessment discussion for tornados and severe wind, vulnerability to the effects of winter storms on buildings is dependent on the age of the building, construction material used and condition of the structure. Unfortunately, no comprehensive database of these variables could be identified for Bradford County.

4.3.13. Civil Disturbance

4.3.13.1 - Location and Extent

Civil disturbance refers to mass acts of disobedience where participants can become hostile to authority and there is a threat to maintaining public safety and order. Such disturbances can often be forms of protest in the face of socio-political problems. Riots have not been frequent occurrences throughout the history of the Commonwealth, however when they occur they can cause significant property damage, injury and even loss of life. The scale and scope of civil disturbance events varies widely. Government facilities, local landmarks, prisons, and universities are common sites where crowds and mobs may gather.

4.3.13.2 - Range of Magnitude

Civil disturbances 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. There are two types of large gatherings typically associated with civil disturbances: 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 merely 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 for a specific purpose. 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 may be more impulsive and emotional, and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators and strikers, though not all demonstrators and strikers are aggressive.

A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent and lawless. Similar to crowds, mobs have different levels of commitment and can be classified into four categories:

- **Aggressive Mob**: An aggressive mob is one that attacks, riots and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.
- **Escape Mob**: An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control and can be characterized by unreasonable terror.
- **Acquisitive Mob**: An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.
- **Expressive Mob**: An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent up emotions in highly charged situations.

In the event of a significant civil disorder event, local government operations and the delivery of services in the community may experience short-term disruptions. The greatest secondary effect is the impact on the economic and financial conditions of the affected community, particularly in relation to the property, facilities, and infrastructure damaged as a result of the disturbance. More serious acts of vandalism may result in limited power failure or hazardous material spills, leading to a possible public health emergency. Altered traffic patterns may increase the probability of a transportation accident.

Bradford County's greatest threat to civil disorder is in Towanda Borough, the county seat. Citizens, property, and infrastructure could be affected if a large-scale disorder were to take place. Typically, government facilities, landmarks, prisons, and universities are common sites where crowds or mobs may gather, and notable locations in Bradford County includes Bradford County Correctional in West Burlington Township.

4.3.13.3 - Past Occurrence

There have not been any recent major civil disorders and riots in Bradford County; however, there is one recorded incident that occurred in February 1974 that stemmed from a conflict between truckers and farmers. Pennsylvanian truckers went on a statewide strike in February 1974, causing frustration from dairy farmers in Bradford who feared monetary losses if their milk could not be transported. A violent confrontation between truckers and farmers was narrowly avoided, and State Police escorts and governmental negotiations were used to ensure the transport of the raw milk and mitigate the conflict.

4.3.13.4 - Future Occurrence

While unlikely, civil disturbances may occur in Bradford County, and it is difficult to accurately predict the probability of future occurrence for civil disturbance events over the long-term. It is estimated that a civil disturbance event could occur every 30 years or less in Bradford County.

4.3.13.5 - Vulnerability Assessment

All municipalities in Bradford County can be vulnerable to civil disturbance; however. the anticipated impact from such events is minimal. These events may be sparked for varying reasons and the seriousness of the event may well be exacerbated by how authorities handle the crowd. Some critical facilities are important to be aware of as both potential locations for civil disturbance events, and important locations during civil disturbance response. Maps showing critical facilities by municipality can be found in *Appendix D (Municipal Flood Maps)*.

4.3.14. Dam Failure

Due to security issues the Dam Failure profile can be found as Appendix I.

4.3.15. Addiction

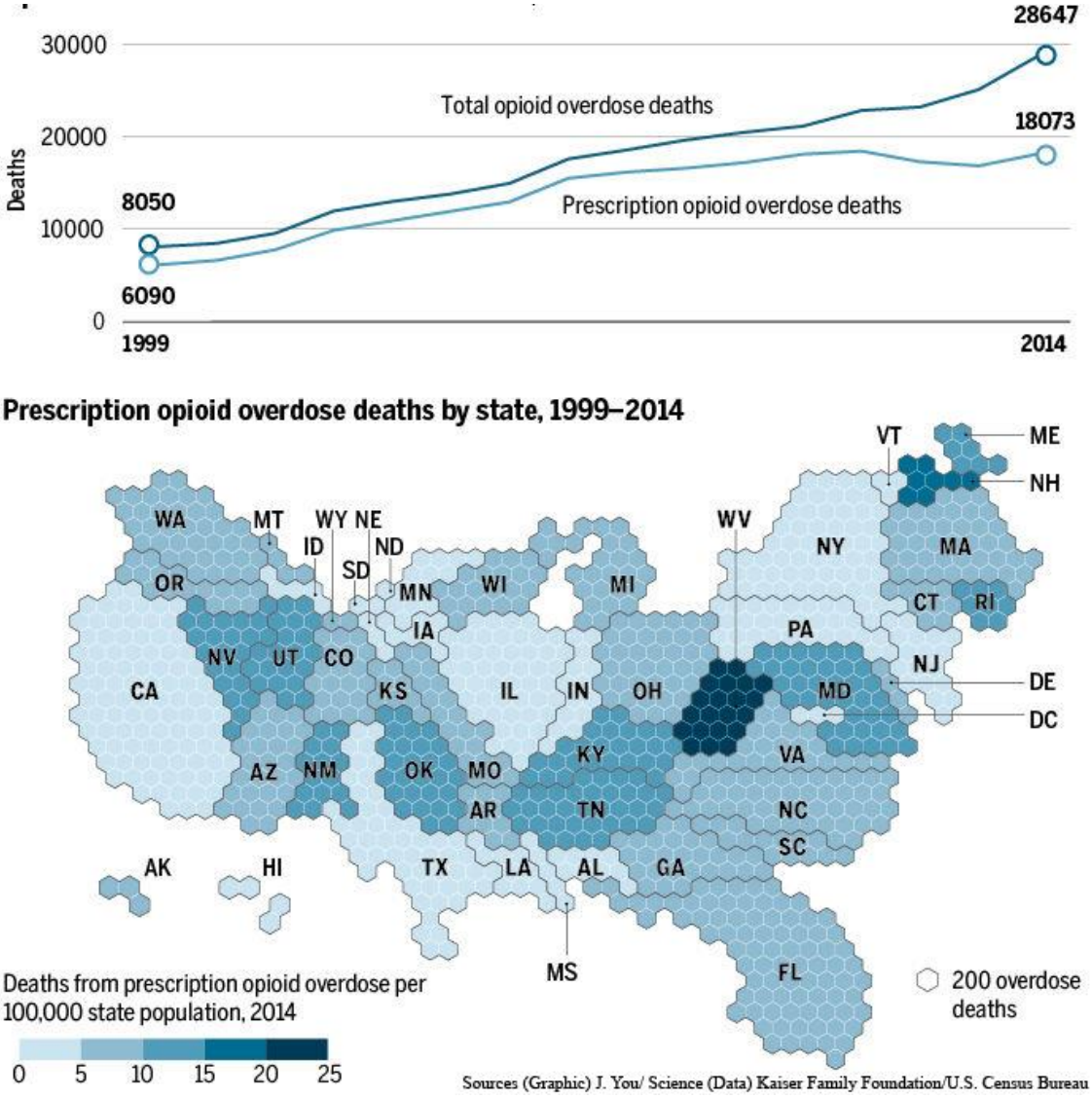
4.3.15.1 Location and Extent

Pennsylvania and the nation at large have been experiencing an epidemic of opioid drug abuse. Opioids are a class of drugs that interact with receptors on nerve cells in the body and brain, producing euphoria and pain relief (NIH, 2017). Opioid drugs are highly addictive, and the Commonwealth and country at large have been experiencing an epidemic of opioid addiction and abuse, resulting in increasing numbers of overdose deaths from both prescribed (e.g. fentanyl) and illicit (e.g. heroine) opioids (see *Figure 43 - US Opioid*

Deaths 1999-2014). Overdose deaths from opioids occur when a large dose slows breathing, which can be especially likely when opioids are combined with alcohol or antianxiety drugs. While generally prescribed with good intentions, opioids can often be over-prescribed, resulting in addiction due to their highly addictive nature.

The opioid crisis was declared to be a public health emergency on October 26, 2017. While the declaration provides validation for the scope and severity of the problem, it was not accompanied by any release of funding for mitigating actions. On January 10, 2018, Governor Wolf declared the Opioid Epidemic to be a statewide public health disaster emergency for Pennsylvania. The declaration is intended to enhance response and increase access to treatment.

Figure 43 - US Opioid Deaths 1999-2014



4.3.15.2 Range of Magnitude

According to the CDC, more than 140 Americans die every day from an opioid overdose. In 2014, 2,742 overdose deaths were reported across Pennsylvania. This number increased to 3,376 reported overdose deaths in 2015, an increase of 23.4 percent (DEA, 2015). Reported overdose deaths increased again in 2016 to 4,642, an increase of 37 percent from 2015 (DEA & PITT, 2017), then again to a total of 5,456 deaths in 2017. From 2015 to 2017, the increase in reported drug related overdose deaths in Pennsylvania increased 65%. This increase gave rise to the need for the gubernatorial disaster declaration in Pennsylvania that was made on January 10, 2018. Heroin and Fentanyl are the two drugs most often found in overdose deaths, and they are considered highly available and nearly ubiquitous in Pennsylvania (DEA & PITT, 2018).

4.3.15.3 Past Occurrence

In 2017, the national average of drug related overdose deaths was 22 deaths per 100,000 people. The death rate in Pennsylvania is nearly double this national average, at almost 43 deaths per 100,000 people. From 2014 to 2016, opioid related overdose deaths per 100,000 people in Bradford County increased from 18 to 27.1. The year of 2017 saw a slight decrease to 25 deaths per 100,000 people in Bradford County (DEA & Pitt, 2018). *Figure 44 - Pennsylvania Opioid Overdose Deaths 2015-2017* shows overdose deaths per 100,000 people from 2015 to 2017 for Pennsylvania by county. Prescription opioids were the most prevalent drugs present in opioid drug-related overdose deaths that occurred in Bradford County. *Table 43 - Pennsylvania Overdose Death History* shows recorded overdose deaths in Bradford County as reported by the PA Coroner's Office and Overdose Free PA. From 2014 to 2017, there has been a significant increase in the abuse of Fentanyl in Pennsylvania. Fentanyl is the most prevalent opioid drug trafficked, abused and overdosed on in Pennsylvania, and is found in 67% of overdose victims in 2017 in Pennsylvania (see *Table 44 - Drugs Present in 2017 PA Overdose Deaths*).

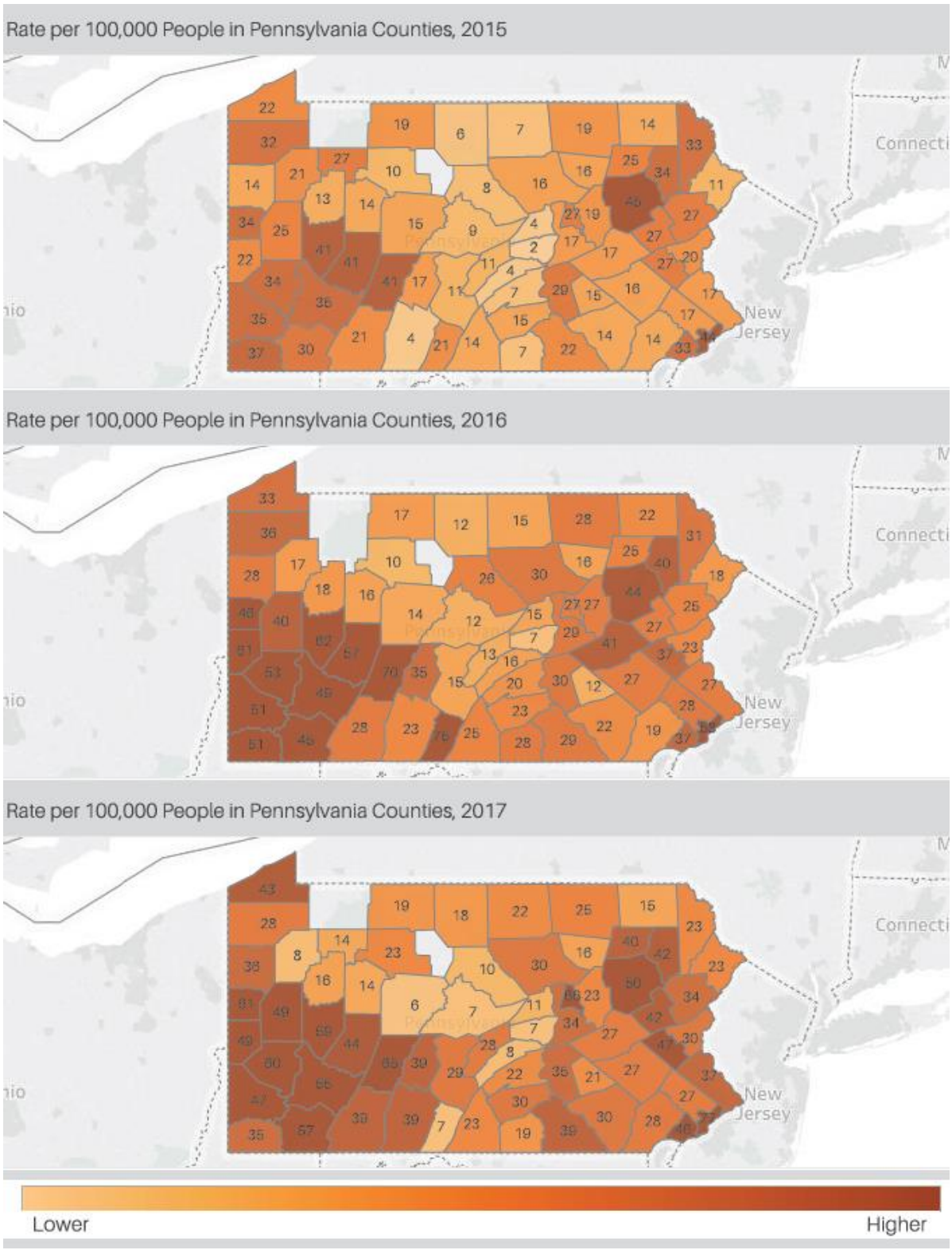
Table 43 - Pennsylvania Overdose Death History

Pennsylvania Overdose Death History *(PA Coroner's Office, Bradford County Coroner, 2019)*			
Year	**Overdose Deaths**	**Overdose Deaths / 100,000 People**	**Overdose Deaths / 100,000 People PA Wide**
2014	11	18	21.9
2015	16	26.11	26.7
2016	17	27.1	36.5
2017	15	25	42.5

Table 44 - Drugs Present in 2017 PA Overdose Deaths

Drugs Present in 2017 PA Overdose Deaths *(DEA & Pitt, 2018)*	
Drug Category	**Percent Reported Among 2017 Decedents**
Fentanyl	67%
Heroin	38%
Cocaine	32%
Benzodiazepines	31%
Prescription Opioids	20%
Ethanol	19%
FRSs & NPSOs	18%
Other Illicit Drugs	11%

Figure 44 - Pennsylvania Opioid Overdose Deaths 2015-2017



4.3.15.4 Future Occurrence

In the event of an opioid overdose, death can sometimes be prevented with the use of the drug naloxone. Emergency medical responders have access to the treatment, and as of 2015, naloxone is available without a prescription in Pennsylvania. Furthermore, with the January 10, 2018 Disaster Declaration, Emergency Medical Technicians (EMTs) are now allowed to leave naloxone behind at a scene, further increasing distribution and accessibility of this lifesaving medication. According to a study published in September 2018, drug users reported that users often have multiple overdoses in the course of their drug use, and the availability of naloxone has saved many lives (DEA & PITT, 2018). While the introduction of naloxone has been a significant benefit to the fight against opioid abuse, efforts to prevent overdoses are still underway.

Rather than reduce pain, in some cases high doses of opioid painkillers can actually increase pain due to a phenomenon known as opioid-induced hyperalgesia (OIH). It is however difficult to know how much of an influence OIH has on the opioid epidemic. Some researchers think that OIH could be increasing patients' pain and in turn, increasing their dosages and dependence on opioid drugs, suggesting that patients should work with lower dosages of opioids (Servick, 2016). However, other researchers are unsure of the importance of OIH for opioid users (Servick, 2016).

Opioid drugs have been a problematic and addictive solution for patients to deal with pain. Employing alternative approaches to pain management could prevent patients from ever being introduced to addictive opioids, especially considering the most common overdose drug in Bradford County has been prescription opioids (DEA & PITT, 2018). Medical marijuana is legal in Pennsylvania, and can be prescribed to those with severe chronic or intractable pain and even to those who have *"opioid use disorder for which conventional therapeutic interventions are contraindicated or ineffective, or for which adjunctive therapy is indicated in combination with primary therapeutic interventions"* (PA DOH, 2019). Another possible alternative pain treatment comes from hemp extracted cannabidiol, or CBD. Unlike THC (the psychoactive constituent of cannabis) CBD is non-psychoactive and does not have the same intoxicating effect as THC; however, CBD can provide relief from pain (Lynch & Campbell, 2011), inflammation (Burstein, 2015), anxiety (Scuderi et al., 2009) and even psychosis (Iseger & Bossong, 2015). CBD is legal without a prescription throughout the United States of America.

4.3.15.5 Vulnerability Assessment

Deaths from prescription opioid drugs like oxycodone, hydrocodone, and methadone have increased by more than four-fold since 1999. While opioid addiction is often viewed as a criminal problem, a more productive way to view the epidemic can be to view opioid addiction as a chronic disease. This paradigm shift moves away from faulting the abuser and incentivizing quick cures, to viewing the abuser as a patient and working towards

long-term management of the disease (ASAM, 2014). In general, it is important to consider alternative approaches to pain treatment in order to avoid beginning a dependence on highly addictive prescribed opioids.

The January 10, 2018 gubernatorial disaster declaration was accompanied by thirteen initiatives in three areas of focus which illustrate the current status of the opioid crisis in the Commonwealth as of January 2018:

Enhancing Coordination and Data Collection to Bolster State and Local Response

- **Establishes an Opioid Command Center Located at the Pennsylvania Emergency Management Agency (PEMA)**, which will house the Unified Opioid Coordination Group that will meet weekly during the disaster declaration to monitor implementation and progress of the initiatives in the declaration.
    - Expands Access to Prescription Drug Monitoring Program (PDMP) to Other Commonwealth Entities for Clinical Decision-Making Purposes to improve treatment outcomes and better monitor compliance among prescribers. Since 2016, 90,000 physicians have conducted more than 1 million searches on the PDMP.
    - Adds Overdoses and Neonatal Abstinence Syndrome (NAS) as Reportable Conditions in Title 28, Chapter 27 to the DOH in order to increase data collection and improve outcomes in both areas.
    - **Authorizes Emergency Purchase Under Procurement Code for Hotline Contract with Current Vendor,** giving DDAP further emergency purchase authorization to allow the department to enter into a contract with the current drug and alcohol hotline vendor to ensure uninterrupted services. To date, the 24/7 helpline, 1-800-662-HELP, has received more than 18,000 calls to connect those suffering from substance use disorder with treatment.

Improving Tools for Families, First Responders, and Others to Save Lives

- **Enables Emergency Medical Services Providers to Leave Behind Naloxone** by amending the current Standing Order to include dispensing by first responders, including Emergency Medical Technicians (EMTs). The existing naloxone standing order and funding for naloxone to first responders has allowed for more than 5,000 lives to be saved so sufferers can be linked to treatment for substance use disorder.
- **Allows Pharmacists to Partner with Other Organizations to Increase Access to Naloxone** by waiving regulations to allow pharmacists to partner with other organizations, including prisons and treatment programs to make naloxone available to at-risk individuals upon discharge from these facilities.
- Allows for the immediate temporary rescheduling of all fentanyl derivatives to align with the federal DEA schedule while working toward permanent rescheduling.

- **Authorizes Emergency Purchasing Under Section 516 of the Procurement Code** to allow for an emergency contract to expand the advanced body scanner pilot program currently in place at Wernersville that is used on re-entrants returning to the facility. This would prevent the program from lapsing.

Speeding Up and Expanding Access to Treatment

- **Waive the Face-to-Face Physician Requirement for Narcotic Treatment Program (NTP) Admissions** to allow initial intake review by a Certified Registered Nurse Practitioner (CRNP) or Physician Assistant (PA) to expedite initial intakes and streamline coordination of care when an individual is most in need of immediate attention.
- **Expand Access to Medication-Assisted Treatment (MAT)** by waiving the regulatory provision to permit dosing at satellite facilities even though counseling remains at the base NTP. This allows more people to receive necessary treatments at the same location, increasing their access to all the care and chances for recovery.
- **Waive Annual Licensing Requirements for High-Performing Drug and Alcohol Treatment Facilities** to allow for bi-annual licensure process which streamlines licensing functions and better allocates staff time. DDAP will request that facilities seek a waiver by filing exception requests to the annual licensing requirement.
- Waive the Fee Provided for in Statute for Birth Certificates for Individuals Who Request a Good-Cause Waiver by Attesting that They are Affected by OUD. This is of particular importance to individuals experiencing homelessness and other vulnerable populations who often cannot obtain copies of their birth certificates in order to access treatment and other benefits due to the financial requirements.
- **Waive Separate Licensing Requirements for Hospitals and Emergency Departments to Expand Access to Drug and Alcohol Treatment** to allow physicians to administer short-term MAT consistent with DEA regulations without requiring separate notice to DDAP.

4.3.16. Emergency Response Organizations

4.3.16.1 Location and Extent

Emergency Medical Services (EMS) and the Fire Services in Bradford County play a crucial role in the emergency response system, providing services ranging from emergency and medical transport for the sick and injured each year as well as fire and rescue responses. As stated in the Senate of Pennsylvania House of Representatives Final Senate Resolution 6 (SR6) Report, both EMS and Fires Services are in crisis due to the lack of funding and number of volunteers available to assume critical roles.

The citizens and visitors of the Commonwealth of Pennsylvania benefit daily from the services, knowledge and skills of the emergency services providers described below. Prehospital EMS encompasses a range of related activities, including 911 dispatch, response to the scene by ambulance, treatment and triage by EMS personnel, and transport to a care facility via ground and/or air ambulance. Importantly, it also includes medical direction provided through preestablished medical protocols or a direct link to a hospital or physician. EMS may encompass multiple levels of medical response, depending on how the system is configured in the community. EMS represents the first stage in a full continuum of emergency care that also includes hospital emergency departments (EDs), trauma systems/centers, inpatient critical care services, and interfacility transport.

Rural EMS and Fire services often travel longer distances per incident due to the larger service areas and lower population density in rural areas. This results in higher average costs per trip for the agency as compared to their urban counterparts that more often accrue costs due to a higher number of trips.

The EMS system has a number of notable strengths. Prehospital EMS is far more sophisticated and far more capable than it was forty years ago. The 911 emergency notification system is available to virtually all Pennsylvanians and is regarded as highly responsive and reliable. The system enables rapid response to medical emergencies and facilitates crucial lifesaving care. In addition, the broad availability of cell phones has expanded 911 access to emergency and trauma scenes where no help was available before. The development of automatic crash notification technology has also become more widely available, further improving emergency response. This innovation provides immediate and increasingly detailed crash information to dispatchers automatically, even before anyone on scene places a call.

In general, Pennsylvanians have access to rapid services in emergency situations. While there are many glaring exceptions, first responders in urban and suburban areas are generally able to arrive on scene within minutes of notification, with ambulance and fire service crews close behind. Moreover, with greater emphasis now being placed on bystander care and prearrival instructions provided by dispatchers, care to patients can be initiated even more rapidly.

Emergency Services personnel form the backbone of the prehospital care and fire services system despite working under conditions that are stressful and at times dangerous. Many of them provide their services on a volunteer basis. The sophisticated equipment now at the disposal of many emergency services providers, such as automated external defibrillators (AEDs) and 12-lead electrocardiographs (ECGs), as well as more effective medications, fire equipment and apparatus allow them to provide a much broader array of services than was available in years past.

Response times vary widely depending on the location where an incident occurs. Across the large, sparsely populated terrain of rural areas, emergency services response times

are significantly increased compared with those in urban areas. These prolonged response times occur at each step in activation and response, including time to notification, time from notification to arrival at the scene, and time from arrival on the scene to hospital arrival.

4.3.16.2 Range of Magnitude

Finances, changing political climates, poor leadership, or a significant high-profile event can all trigger a system to be declared as "failed." In some cases, a combination of these factors can create a perfect storm. Unfortunately, many "failed" systems are measured by recent events, no matter how successful they may have been in the past. Although finance troubles are often blamed on poor leadership, they actually have many root causes. Labor rates, benefits, poor productivity, operational design, insurance reimbursements and market regulation all have a significant direct impact on the financial viability of an organization. EMS is often underfunded and poorly reimbursed, and the lack of dedicated and stable funding sources will continue to challenge EMS systems.

Two fundamental yet misunderstood topics are the finances and economic variables that drive emergency service systems. These systems typically generate revenue through billing insurance, tax subsidies, memberships, direct sales, diversification into other lines of business or grants or fundraising. They spend a majority of these revenues on direct and indirect labor and benefits, with the remaining dollars going to infrastructure, fuel, medical supplies, fleet maintenance, dispatch, billing and other essential items with hopefully some left over for recapitalization and profit or fund balance development.

Private insurance typically pays based on negotiated rates or will pay full charges to a point, occasionally by sending the payment directly to the patient, thus making it difficult for the provider to collect. This is done as a way to strong-arm the provider into a lower negotiated rate.

More important to understand is that governmental and commercial EMS reimbursement rates aren't tied to local EMS market conditions, competition, regulations or EMS operational system design, and therefore have a set cost assumption. Demand for EMS services within a particular market place (a county for example) doesn't flow based on price and availability of EMS service, as a normal market would, but rather is influenced by uncontrollable things like population demographics and size, socioeconomics, population health, education and outside influences such as seasonality or things like influenza.

Given this, there's essentially a set amount of dollars that are available in the marketplace, and how these dollars are spent or divided among competitive providers can affect long-term financial stability. Marketplaces where more than one EMS provider exists yields a diseconomy of scale; things like dispatch, administrative, billing, fleet and other EMS functions are duplicated, thus driving up costs without an equal rise in dollars available to meet these expenses. In addition, competition often drives prices down in

things like facility-paid, nonemergency work or loss-leader wheelchair work in order to move market share from one provider's pocket to another, thus shrinking the pool of dollars available toward the lower band in the marketplace.

4.3.16.3 Past Occurrence

Most EMS agencies are private organizations that lack local funding and exist based on reimbursements received from insurance companies and self-pay users of the system. Due to the decreased reimbursements as described previously and the decrease in call volumes and the increase in number of treat-no transport call responses EMS agencies are failing. If left unattended the effect may have devastating effects on communities.

Legislative attempts to advancing an amended bill to enable reimbursements for patients that are treated but not transported to advance through the State House of Representatives. This will only solve one part of the ongoing issue. Without financial support from the community's EMS services may not be able to remain in operation to serve the same communities they have served for decades.

4.3.16.4 Future Occurrence

Volunteerism has been a significant component of the fire services. Most, if not all, members of our community Fire Departments are volunteers. Front and center it is commonly a problem retaining and recruiting volunteers to staff both fire and emergency medical services. There has been a decline in volunteerism due to the required training requirements for firefighters and emergency medical technicians (EMTs) in the region.

According to an article published in the NY Times "*The Disappearing Volunteer Firefighter*" (August 16, 2014) there are twice the number of volunteers compared to career firefighters. Most notably though is the number of volunteers that continue to drop by around 11% since the 1980s. With that trend it is suggested that the number of paid firefighters continues to grow.

Today, it is difficult for small communities to have a paid service therefore requiring the use of volunteers. The trend has devastating effects. With a decreased number of volunteers to not only perform the tasks associated with fires and rescue operations it is imperative to facilitate fundraising. If there is a decreased number of volunteers to raise funds then the operational needs are impacted as well. Without fundraising and community support these fire departments will experience broader challenges.

The individual volunteers also face many challenges. Most volunteers have to address their own needs by providing for their family and, in many cases, are part of a two-income family. In some cases, they may have to have multiple jobs to sustain their needs. It requires hundreds of hours to become certified as a firefighter. With the limitation of time, most members of our society find it personally challenging to find the time to dedicate to a volunteer position. Volunteers are becoming less reliable. Many current volunteers are aging and unable to perform at the same levels they once were able.

Fire Departments perform many tasks, just not fighting fires. It would perhaps be more appropriate to call these departments "All Hazards Departments" as they respond to various hazards such as vehicle accidents, commercial accidents, flooded basements, wires down, trees down, trench rescues, hazardous material spills, traffic control and sometimes even standbys to support other agencies or events to name only a few.

4.3.16.5 Vulnerability Assessment

The likelihood that EMS Agencies and Fire Services will fail is a real threat to our communities. Many communities have already experienced the unfortunate fact that ambulance services have failed. It is recommended that each municipality assess their own vulnerabilities by maintaining and building a relationship with their local providers to make the determination and begin to plan accordingly if a local service was to shut down the operation. The statistics, response times and all times associated with all units dispatched are easily obtainable from the local 911 Centers.

It is typical for fire services have greater response times during the day or during most business hours. Most 911 Centers have orders from various departments to dispatch additional services during the day due to the decreased numbers of volunteers available during the day, resulting in longer response times.

These departments must be supported to create and or discover new ways to not only recruit but to also retain volunteers. If left unattended the issues will continue and the lack of responses will grow, leaving the community more vulnerable to loss of life and loss of property.

It is recommended that the entire community be educated on the perpetual needs associated with providing these services. In addition, continued support and efforts to inform legislatures could all prove to be paramount in assuring these services remain in operation into the future. It is recommended that each municipality assess their own vulnerabilities by maintaining and building a relationship with your local providers to make the determination and begin to plan accordingly for the future.

Table 45 - Emergency Responders

Emergency Responders ***(Bradford Co. GIS, 2019)***		
Municipality	**Station Name**	**Address**
Wysox Township	Wysox Vol Fire	111 Lake Rd, Wysox PA, 18854
Wyalusing Borough	Wyalusing Valley Vol Fire	24 Second St, Wyalusing PA, 18853
Wilmot Township	Wilmot Fire	58 River View Rd, Sugar Run PA, 18846
Warren Township	Warren Township Vol Fire	3039 Warren Center Rd, Warren Center PA, 18851
Ulster Township	Ulster-Sheshequin Fire	85 Rescue St, Ulster PA, 18850
Troy Township	Troy Fire	88 Firehouse Dr, Troy PA, 16947

Emergency Responders *(Bradford Co. GIS, 2019)*		
Municipality	**Station Name**	**Address**
Towanda Borough	Towanda Fire	101 Elm St, Towanda PA, 18848
South Waverly Borough	South Waverly Vol Fire	57 Pleasant St, Sayre PA, 18840
South Creek Township	South Creek Fire Dept Station 2	33338 Route 14, Gillett PA, 16925
South Creek Township	South Creek Volunteer Fire Dept	6428 Roaring Run Rd, Gillett PA, 16925
Smithfield Township	Smithfield Township Vol Fire	24 Village Green Way, East Smithfield PA, 18817
Sayre Borough	J.E. Wheelock Hose Co #5	217 Frank St, Sayre PA, 18840
Sayre Borough	Howard Elmer Hose Co #4	509 Powell St, Sayre PA, 18840
Sayre Borough	Sayre Borough Vol Fire	110 W Packer Ave, Sayre PA, 18840
Rome Borough	Rome Vigilante Engine	958 Main St, Rome PA, 18837
Ridgebury Township	Ridgebury Vol Fire	13238 Berwick Tpke, Gillett PA, 16925
New Albany Borough	New Albany Vol Fire	71 Main St, New Albany PA, 18833
Monroe Borough	Monroeton Fire	8958 Burlington Tpke, Monroeton PA, 18832
Leraysville Borough	Leraysville-Pike Vol Fire	91 School St, Leraysville PA, 18829
Herrick Township	Herrick Township Vol Fire	27 Hops Rd, Wyalusing PA, 18853
Franklin Township	Franklindale Fire	15 Grange Rd, Monroeton PA, 18832
Canton Borough	Canton Vol Fire	45 Park Pl, Canton PA, 17724
Athens Borough	Athens Borough Fire	2 S River St, Athens PA, 18810
Windham Township	Windham Township Vol Fire	39158 Route 187, Rome PA, 18837
West Burlington Township	Troy Fire Dept Station #2	15894 Route 6, Troy PA, 16947
Athens Township - West	Athens Township Fire	211 Herrick Ave, Sayre PA, 18840
Athens Township - East	Athens Township Fire Station 2	64 Kirby St, Athens PA, 18810
Litchfield Township	Litchfield Vol Fire	1391 Hill Rd, Sayre PA, 18840
North Towanda Township	North Towanda Fire & Rescue	40 Hillcrest Dr, Towanda PA, 18848

4.3.17. Environmental Hazards

4.3.17.1 Location and Extent

Chemicals for industrial use and petroleum products can pose an environmental hazard when such materials are manufactured, extracted, used, stored or transported. Most hazardous materials incidents are unintentional; however, hazardous materials could also be released in a criminal or terrorist act. A release can result in injury or death and

may contaminate air, water and/or soils. Hazardous materials incidents can be generally broken down into the subcategories of transportation and fixed facility.

Tanker trucks, tractor trailers and rail cars often are used to transport hazardous materials. When there are transportation incidents involving these type of vehicles, hazardous materials can be released in significant quantities. *Figure 45 - Hazardous Material Locations* includes the major transportation routes through Bradford County, including US Route 6, 220 as well as State Routes 14, 187, 414, 549, 706.

Natural gas pipelines are often at higher capacity during cold winter months when people are utilizing natural gas more. There are numerous pipeline groups that run throughout Bradford County who primarily deal with natural gas products. The following three companies operate pipelines that transport products through Bradford County:

Tennessee Gas Pipeline Company: A subsidiary of Kinder Morgan Company, the Tennessee Gas Pipeline runs for a total of about 11,750 miles from Louisiana, the Gulf of Mexico and south Texas to the northeast United States, including New York City and Boston. The pipeline runs east-west through Bradford County. For more information see Kinder Morgan's pipeline portal at pipeportal.kindermorgan.com. Their headquarters is located at 1001 Louisiana Street Suite 1000, Houston, Texas 77002.

Stagecoach Gas Services LLC: Stagecoach Gas Services owns and operates plant facilities in Owego, NY, where natural gas is stored underground. The underground storage wells are connected to pipelines that transport the natural gas to or from other interconnecting pipeline companies for delivery to end users. They are also associated with Crestwood Midstream Partners LP. For more information contact Stagecoach Gas Services LLC at 801 Cherry Street, Suite 3800, Fort Worth, TX 76102 or at their website: www.stagecoachgs.com.

Sunoco Pipeline LP: Sunoco operates a pipeline running north/south at the western margin of Bradford County. This pipeline notably transports jet fuel, not natural gas.

Aside from these three companies that operate transport pipelines, there are several more who operate in Bradford County in either service or gathering capacities, including UGI Central Penn Gas, Repsol, Regency Energy Partners, Howard, and EOG Resources (Bradford Co. GIS, 2019). For locations of all pipelines in Bradford County, see *Figure 46 - Gas Well & Pipeline Locations*. Two other notable companies include:

Valley Energy, Inc: Valley Energy is a natural gas distribution/ service company located at 523 S. Keystone Ave, Sayre, PA 18840 and is a subsidiary of C&T Enterprises. They service eleven communities and over 8,000 customers in Bradford County, as well as Chemung and Tioga Counties in New York. All together they distribute gas through their 165 miles of pipeline.

Williams Company, Inc: In 2014, Williams acquired Access Midstream. Work continues to replace pipeline marker signs; however, you may encounter signage that includes the Access Midstream logo. Williams primarily operates gathering pipelines in Bradford

County. Williams can be contacted at the Williams Public Awareness Department, P.O. Box 18355 Oklahoma City, OK 73154, emergency contact 1-855-427-2875, or by email at PipelineSafety@Williams.com.

In Pennsylvania, facilities that use, manufacture, or store hazardous materials must comply with Title III of the federal Superfund Amendments and Reauthorization Act (SARA), and the Commonwealth's reporting requirements under the Hazardous Materials Emergency Planning and Response Act (1990-165), as amended. There are eighteen SARA Tier II facilities and fifty-two SARA Title III facilities in Bradford County (Bradford Co. GIS, 2019). A summary of these facilities by municipality can be seen below in *Table 49 – Municipal Summary of Hazardous Material Locations*, and a detailed report of these facilities can be found in Appendix E – Critical Facilities.

Fixed facilities are also monitored by the Environmental Protection Agency (EPA). The EPA has identified hazardous materials sites, not regulated by SARA Title III, and are known as Toxic Release Inventory (TRI) sites. Facilities which employ ten or more full-time employees and manufacture or process more than 25,000 pounds (or use more than 10,000 pounds) of any SARA Section 313-listed toxic chemical in the course of a calendar year are required to report TRI information to the EPA, the federal enforcement agency for SARA Title III and PEMA. As of February 2019, there are thirty-five entries in the TRI database in Bradford County (see *Table 49 – Municipal Summary of Hazardous Material Locations*).

Figure 45 - Hazardous Material Locations identifies locations that consume, store or release potentially hazardous materials and wastes. The map also shows land recycling cleanup locations, which are locations that fall into the jurisdiction of the Hazardous Sites Cleanup Act (HSCA) and are locations where the Department of Environmental Protection (DEP) provides funding and the authority to conduct cleanup actions because of hazardous substances have been released. The DEP also has the authority to force the persons responsible for the release to conduct cleanup actions or to repay public funds spent on a DEP funded cleanup action.

Oil and gas extraction facilities can also be sources of hazardous material release. *Figure 46 - Gas Well & Pipeline Locations* shows the location of all gas wells in the county along with their proximity to surface waters.

All of Bradford County is located on top of the Marcellus Shale formation. In recent years, Bradford County has experienced an expansion of natural gas exploration in the county since unconventional Marcellus Shale gas exploration became prevalent in 2008. The influx of natural gas company employees, corporate staffing and subcontractors has had a significant impact on the county's infrastructure. The extraction process is different from that of traditional natural gas extraction. Vertical and horizontal well drilling is usually necessary to access the Marcellus Shale. When horizontal drilling is necessary, hydraulic fracturing or fracking is often used. Fracking involves pumping millions of gallons of water into the well with other components and chemicals mixed in the brine.

Usually some type of fracturing process is implemented so that once the fracture is in place, the fluid assists the gas to excrete more easily.

The Pennsylvania Department of Environmental Protection (PA DEP) reported 47 permitted unconventional well sites in 2008, with an increase to 2,348 permitted unconventional wells as of October 2013 (2015 HMP), and up to 3,575 permitted Marcellus Wells as of April 2015 (Marcellus Observer, 2015). In February 2019, the DEP reports that Bradford County has the second most active wells out of counties in Pennsylvania, with 1,097 wells actively in use (PA DEP, 2019). Activities associated with the Marcellus Shale gas drilling and extraction has caused great concern for Bradford County and the municipalities. The public infrastructure has struggled to expand to accommodate the rapid growth in certain areas of the county. Additionally, concerns about water contamination, fires and other pollutions from the industry are significant issues as well.

Figure 45 - Hazardous Material Locations

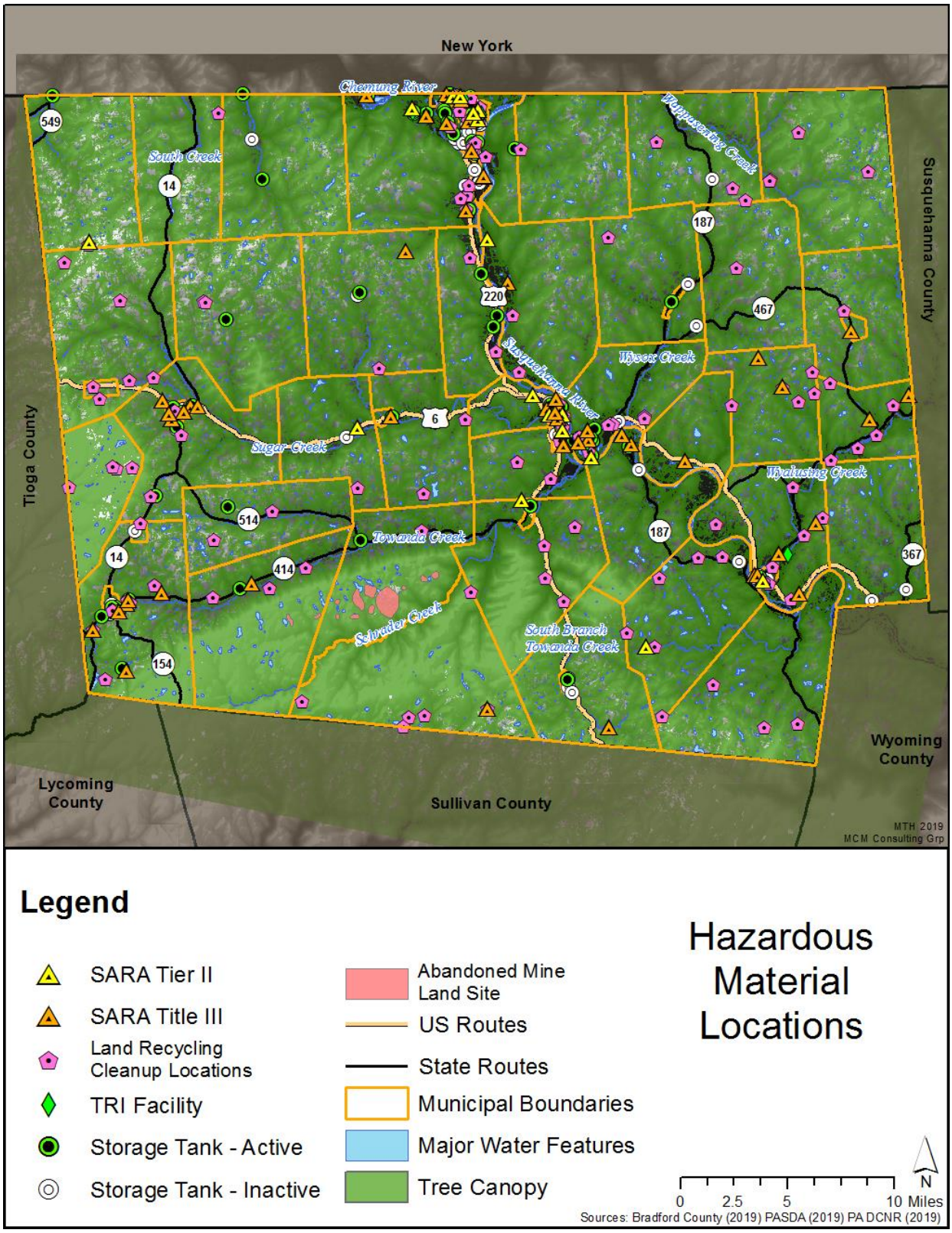
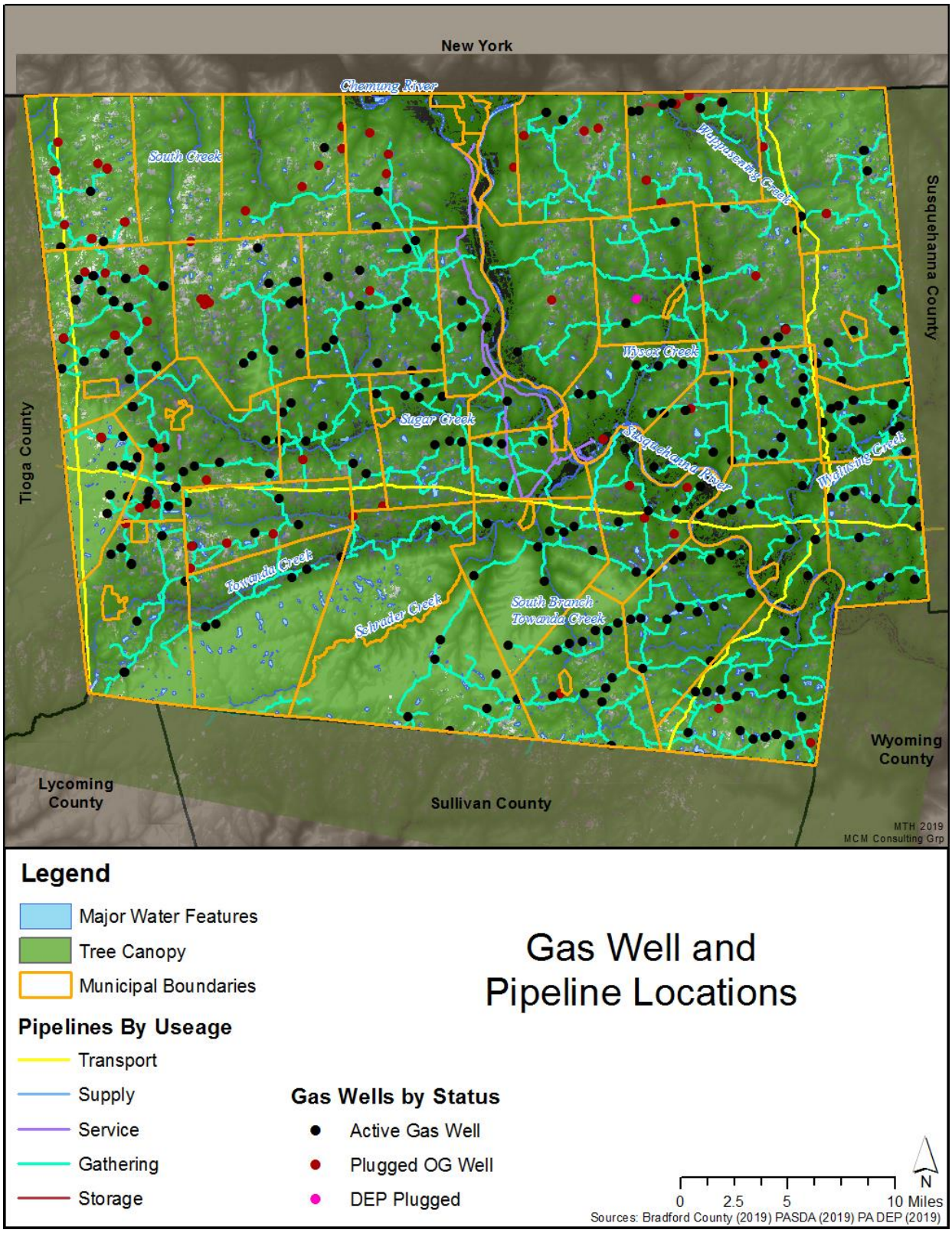


Figure 46 - Gas Well & Pipeline Locations



4.3.17.2 Range of Magnitude

Hazardous material releases can contaminate air, water and soil, and can possibly cause injuries, poisonings, or deaths. Hazardous materials fall into nine hazard classes:

Class 1 - Explosives

Class 2 - Gases (flammable, non-flammable, non-toxic, and toxic)

Class 3 - Flammable and combustible liquids

Class 4 - Flammable solids (spontaneously combustible materials, and dangerous when wet materials/water-reactive substances)

Class 5 - Oxidizing substance and organic peroxides

Class 6 - Toxic substances and infectious substances

Class 7 - Radioactive materials

Class 8 - Corrosive substances

Class 9 - Miscellaneous hazardous materials/products, substances or organisms.

All nine hazard classes can be found being transported and stored at fixed facilities. Certain conditions can exacerbate release incidents:

- Weather conditions affect how the hazard occurs (e.g. transportation accidents) and develops (dispersion can take place rapidly when transported by water and/ or wind). Release can be a secondary impact of natural hazards such as tornadoes or flooding.
- Micro-meteorological effects of buildings and terrain which alter the dispersion of hazardous materials
- Proximity to surface and ground water sources
- Compliance with applicable codes (e.g. building or fire codes) and maintenance failures (e.g. fire protection and containment features) can substantially increase the damage to the facility itself and to surrounding buildings

The type of material released, distance and related response time of emergency responders also significantly impact the severity and scope of hazardous material releases and clean-up efforts. Areas most proximal to the release are usually at greatest risk, but depending on the material, a release can travel great distances or remain present in the environment for long periods of time (e.g. centuries or millennia for some radioactive materials) resulting in chronic and extensive impacts on people and the environment.

Oil and gas well drilling can have a variety of detrimental effects on the environment.

The fluid used in hydraulic fracturing contains numerous chemicals that are harmful to the environment and health of people. The fluid that is recovered is referred to as frac fluid and it must be appropriately disposed of. Not all injected fracking fluids can be

recovered and disposed of, and they can often enter the local environment. Surface waters and soil are sometimes polluted by a salty wastewater product of oil and gas well drilling (brine) and from oil spills occurring at the drilling site or from a pipeline breach. This can spoil public drinking water supplies and be particularly detrimental to vegetation and aquatic animals, making water safety an important factor in oil and gas extraction (Gregory et al., 2011). In some cases, associated with fracking, methane has been found contaminating drinking water in surrounding areas (Osborn et al., 2011).

Abandoned oil, gas, coal and other types of wells and mines can contaminate groundwater and consequently drinking water wells when not properly plugged or remediated. Acid Mine Drainage (or AMD) is a term referring to the acidic and environmentally hazardous run-off that comes from abandoned mines.

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

4.3.17.3 Past Occurrence

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) holds detailed accounts of hazardous material incident records associated with transportation. PHMSA has fifty-five reported incidents occurring in Bradford County between 1974 and February 2019 (see *Table 46 - Pipeline and Hazardous Materials Safety Administration Incidents*). Detailed reports can be found by looking up the report number at PHMSA's incident search page:
hazmatonline.phmsa.dot.gov/IncidentReportsSearch

The National Response Center lists sixteen hazardous material instances occurring in Bradford County between January 2000 and January 2014. The Commonwealth experienced 2,026 spills in 2011, thirty of which occurred in Bradford County.

Between 2012 and February 2019 there were eighty-nine Hazardous Material Incidents reported to the Knowledge Center. *Table 47 - Environmental Hazard Knowledge Center Incidents* reports the full list of Knowledge Center incidents, which includes many natural gas well incidents, frac fluid leaks, and other material spills.

There is one active coal mine in Bradford County. The Cook House strip mine is located in Wysox Township, south-east of Towanda Borough, south of Route 6 and just north of the Susquehanna River. There are also several abandoned mined land locations in Leroy and Franklin Townships (see *Figure 45 - Hazardous Material Locations*).

As of February 2019, the PA DEP identifies one hundred forty-four Land Recycling Cleanup Locations in Bradford County. Each appears on *Figure 45 - Hazardous Material Locations*.

Table 46 - Pipeline and Hazardous Materials Safety Administration Incidents

Pipeline and Hazardous Materials Safety Administration Incidents *(PHMSA, 2019)*				
Report Number	**Date**	**City**	**Route**	**Mode & Phase of Transport**
I-1974070513	06/24/1974	Towanda		
I-1975040068	01/17/1975	Towanda		
I-1975060192	05/28/1975	Sayre		
I-1976040157	01/21/1976	Sayre		
I-1977100521	09/13/1977	Towanda		
I-1980110191	10/15/1980	Towanda		
I-1983080060	07/05/1983	Sayre		
I-1983080060	07/05/1983	Sayre		
I-1989020269	01/31/1989	Towanda		
I-1990020105	01/29/1990	Franklindale	414	Highway, In Transit
I-1990040552	03/29/1990	Towanda	New James St	Highway, Loading
I-1992110365	09/13/1992	Towanda		Rail, In Transit
I-1992110365	09/13/1992	Towanda		Rail, In Transit
I-1993050710	05/11/1993	Athens	Ind Park Rd-Rd 1 Po Box 229	Highway, Unloading
I-1993081467	08/06/1993	Sayre	Stauffer Ind. Park	Highway, In Transit
I-1993120307	10/27/1993	Towanda	Gate House Hawes Street	Highway, Unloading
I-1995080555	10/10/1994	Canton	Route 414	Highway, In Transit
I-1996021115	02/07/1996	Towanda	Hawes St	Highway, Unloading
I-1997020254	01/02/1997	Towanda	Sylvania Plant	Rail, Unloading
I-1997060010	05/16/1997	Towanda	Hawes Street	Highway, Unloading
I-1997101681	10/23/1997	Sayre	North Thomas Ave.	Highway, Unloading
I-1997101599	10/23/1997	Middletown	Harrisburg Int'L Airport	Air, Unloading
I-1997120011	11/17/1997	Middletown	Adelia Street	Highway, In Transit
I-1998030273	01/26/1998	Warren	Bradley Street	Highway, Unloading
I-1998030584	02/14/1998	Warren		Rail, In Transit
I-1998040430	04/07/1998	Middletown	I-76 Pa Pike	Highway, In Transit
I-1998061086	05/29/1998	Wyalusing	Rt 706	Highway, Unloading
I-1998090927	08/25/1998	Middletown	Hiap Cargo Area Blcg 100	Air, Unloading
I-1998101279	09/28/1998	Towanda	Lehigh Secondary Track	Rail, In Transit Storage
I-1998111269	11/06/1998	Middletown	E Emaus Street	Rail, Unloading
I-1999020937	11/20/1998	Middletown	2030 N. Union St	Highway, In Transit
I-1999010475	12/01/1998	Middletown	Po Box 280 E Emmaus Street	Highway, Loading

Pipeline and Hazardous Materials Safety Administration Incidents *(PHMSA, 2019)*				
Report Number	**Date**	**City**	**Route**	**Mode & Phase of Transport**
I-1999020118	12/31/1998	Middletown	Commerce Dr	Highway, Unloading
I-1999060713	05/19/1999	Middletown		Highway, Unloading
I-1999080481	07/22/1999	Middletown		Highway, Unloading
I-1999111325	10/22/1999	Warren		Highway, Unloading
I-2000040132	03/03/2000	Warren	In Plant	Highway, Loading
I-2001020061	11/07/2000	Towanda	Patterson Blvd	Highway, Unloading
I-2000120876	11/07/2000	Towanda	Patterson Blvd	Highway, Unloading
I-2001120766	04/11/2001	Towanda	Masonite Rd	Highway, Unloading
I-2001081458	07/09/2001	Towanda	Patterson Blvd	Highway, Unloading
I-2002020955	12/06/2001	Towanda	Us6 In W Ysore	Highway, Unloading
I-2002061105	05/11/2002	Canton	Route 414	Highway, In Transit
I-2002071119	06/29/2002	Canton	Route 414	Highway, In Transit
I-2002080268	07/15/2002	Leona		Highway, In Transit
I-2004020421	02/02/2004	Warren	15 Bradley St	Highway, Unloading
I-2004030059	02/09/2004	Bradford	Rt 219	Highway, In Transit
I-2004050554	04/18/2004	Middletown	2030 N. Union Street	Highway, Loading
I-2004070703	06/23/2004	Warren	2 Crescent Park	Highway, Unloading
I-2005050170	04/02/2005	Canton	Route 414 West	Highway, In Transit
X-2009060309	06/09/2009	Sayre		Rail, In Transit
I-2009100080	08/23/2009	Canton Township	Route 14 At Tioga County Line	Highway, In Transit Storage
E-2012040321	04/03/2012	Athens Township	Sr 220 Int. W/ Wolcott Hlw.Rd	Highway, In Transit
I-2012080648	07/04/2012	Leroy Township	Yoder Pad 41Deg 40'-45.02'N 7	Highway, Loading
E-2017090185	09/11/2017	Sayre	217 Lamoka Road	Highway, Unloading

Table 47 - Environmental Hazard Knowledge Center Incidents

Environmental Hazard Knowledge Center Incidents *(Knowledge Center, 2019)*		
Date	**Location**	**Description**
09/18/2018	Columbia Township	EXER-Hazmat Spill Training Only - EXER
06/16/2018	Franklin Township	FUEL OIL SPILL
06/08/2018	Springfield Township	Gas Well Incident - Springfield Twp
03/15/2018	Ulster Township	NRC#1206912 DRILLING MUD ODOR

Environmental Hazard Knowledge Center Incidents *(Knowledge Center, 2019)*		
Date	**Location**	**Description**
11/25/2017	Bradford County	Small, Contained Ammonia Leak - Cargill
05/31/2017	Tuscarora Township	Chemical spill Tuscarora Twp Bradford Cn
12/03/2016	Bradford County	anhydrous ammonia leak
11/29/2016	Wyalusing Township	NRC#1165202 - ANHYDROUS AMMONIA RELEASE
11/05/2016	Wyalusing Township	NRC#1163361 - ANHYDROUS AMMONIA RELEASE
10/29/2016	Bradford County	Anhydrous Ammonia Leak
10/27/2016	Bradford County	Anhydrous Ammonia Leak Cargill Wyalusing
08/08/2016	Bradford County	Gas Well Blow Down
07/27/2016	Herrick Township	NRC #1154553 - ANONYMOUS COMPLAINT
07/26/2016	Herrick Township	NRC# 1154520 - UNKNOWN LIQUID SPILL
07/01/2016	Bradford County	Bradford County Haz Mat
03/13/2016	Bradford County	Silica Sand Release
10/29/2015	Bradford County	Hydraulic Fluid Leak
08/17/2015	Bradford County	ammonia leak Wyalusing
08/13/2015	Bradford County	Illegal Oil Disposal
07/18/2015	Bradford County	26 Macafee ROAD/Ulster township
04/30/2015	Bradford County	Tri axle rollover/brine spill
04/12/2015	Bradford County	Diesel Fuel Leak
04/07/2015	Bradford County	TRACTOR TRAILER ACCIDENT/FLUID SPILL
03/09/2015	Towanda Township	NRC#1110063 - GASOLINE DISCHARGED
01/26/2015	Towanda Borough	NRC#1106584 - CHEMICAL RELEASE
01/13/2015	Bradford County	FUEL SPILL ELMIRA ST ATHENS TWP
12/27/2014	Bradford County	Diesel Fuel Leak
12/20/2014	Bradford County	GAS SPILL
12/12/2014	Bradford County	Salt Brine Spill
12/12/2014	Bradford County	SHESHEQUIN TWP MVAP
10/17/2014	Bradford County	ATHENS TWP FUEL SPILL
08/22/2014	Bradford County	west burlington twp mva
07/31/2014	Bradford County	GASOLINE LEAK ULSTER TWP
07/15/2014	Bradford County	hydraulic spill
07/14/2014	Bradford County	Natural Gas Flare Off
06/12/2014	Pike Township	Gas Well Flare-Off
06/09/2014	Bradford County	METHANOL FIRE ALBANY TWP
06/04/2014	Bradford County	ORGANIC COMPOUND RELEASE AT GTP

Environmental Hazard Knowledge Center Incidents *(Knowledge Center, 2019)*		
Date	**Location**	**Description**
05/22/2014	Overton Township	FLARE TESTING - Bradford County
04/25/2014	Bradford County	Coreyland Rd. spill
04/03/2014	Wilmot Township	Gas Line Blown Down Wilmot Twp
03/26/2014	Herrick Township	Gas Well Flare Off
03/25/2014	Standing Stone Township	Gas Well Flare Off Standing Stone Twp
03/11/2014	Monroe Township	Monroe Twp, Gas Line blow down
02/21/2014	Herrick Township	Gas Well Flare
02/20/2014	Towanda Borough	ODOR INVESTIGATION
01/25/2014	Bradford County	ammonia leak
12/28/2013	Bradford County	fuel spill
10/30/2013	Springfield Township	Gasoline Spill Springfield Twp
09/20/2013	Bradford County	Bentonite Spill Asylum Twp
09/20/2013	Bradford County	WYALUSING TWP FUEL SPILL
09/19/2013	Bradford County	Well Flare Off Springfield Twp
09/17/2013	Wilmot Township	WILMONT TWP GAS WELL FLARE
09/16/2013	Bradford County	Orwell Twp flare off
09/08/2013	Bradford County	OVERTON TWP WELL FLARE
09/04/2013	Bradford County	WELL FLARE OFF
08/28/2013	Bradford County	DIESEL SPILL-WILAWANA DANDY
08/23/2013	Monroe Township	Gas Vent Monroe Twp
08/21/2013	Bradford County	Natural Gas Odor Investigation
08/21/2013	Bradford County	WELL FLARE-OFF-COLUMBIA TWP
08/21/2013	Smithfield Township	Gas Well Blow off Smithfield Twp
08/21/2013	Smithfield Township	Gas Release Smithfield Twp
08/19/2013	Bradford County	GAS FLARE COLUMBIA TWP
08/13/2013	Bradford County	Gas Well Flare Off-Armenia Twp
07/26/2013	Bradford County	GAS WELL FLARE OFF STEVENS TWP
08/12/2013	Bradford County	NATURAL GAS LEAK ATHENS TWP
08/05/2013	North Towanda Township	LEAK
07/30/2013	Bradford County	GAS WELL FLARE OFF-WILMOT TWP
07/26/2013	Bradford County	GAS WELL FLARE OFF STEVENS TWP
07/24/2013	Bradford County	Farm vehicle Spill
07/22/2013	Bradford County	WELL FLARE PIKE TWP
07/15/2013	Wilmot Township	Wilmot Twp, 1235 Burke Rd Gas Flare off

Environmental Hazard Knowledge Center Incidents *(Knowledge Center, 2019)*		
Date	**Location**	**Description**
07/13/2013	North Towanda Township	Gas Release
07/03/2013	Monroe Township	Gas Well Incident Monroe Twp
06/18/2013	Bradford County	Gas Well Flare Off in Asylum Twp
06/04/2013	Bradford County	GAS WELL FLARE-SMITHFIELD TWP
05/13/2013	Bradford County	GAS WELL FLARE OFF
05/09/2013	Bradford County	AMMONIA LEAK
04/21/2013	Bradford County	Gas Well Flare
04/06/2013	Bradford County	Gas Well Flare
04/04/2013	Bradford County	Gas Well Flare Off
03/26/2013	Bradford County	GAS WELL FLARE OFF
03/26/2013	Bradford County	FLARE OFF
03/25/2013	Bradford County	FLARE OFF
03/24/2013	Bradford County	FLARE OFF
02/28/2013	Bradford County	GAS RELEASE
01/03/2013	Granville Township	Controlled Release
12/14/2012	Athens Township	Pipeline Leakage
11/13/2012	Wilmot Township	Diesel Fuel Leak

4.3.17.4 Future Occurrence

Hazardous material release incidents are generally difficult to predict, but the presence and use of such known dangerous materials warrants preparation for release events. Emergency response in Bradford County should be prepared to handle the types of hazardous materials housed and used in the SARA Title III facilities, TRI facilities and oil and gas wells that are located in the county. The federal Superfund Amendments and Reauthorization Act (SARA) is also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), and Local Emergency Planning Committees (LEPCs) are designed by EPCRA to ensure that state and local communities are prepared to respond to potential chemical accidents.

4.3.17.5 Vulnerability Assessment

A hazardous material spill can be a secondary effect of a natural hazard such as flooding, other severe weather, or an earthquake. Due to the agricultural industry and traffic on transportation routes, Bradford County can be susceptible to manure spills.

Bradford County conducted a commodity flow study in 2014 to monitor what types of hazardous materials were being transported through and used in the county. *Table 48 - Commodity Flow Study Chemicals* summarizes the chemicals observed during highway

traffic monitoring in 2014 and gives a sense of the most prominent chemicals present on the highways of Bradford County. Populations, critical facilities and natural habitats within a quarter mile of major highways and railways are at risk for hazardous material transportation incidents.

Table 48 - Commodity Flow Study Chemicals

Commodity Flow Study Chemicals ***(Bradford CFS, 2014)***		
UN Number	**Classification**	**Name of Chemical(s)**
1971	Gases- flammable (including refrigerated liquids)	Natural gas, compressed
1203	Flammable Liquids (non-polar/water-immiscible)	Gasoline
1223	Flammable Liquids (non-polar/water-immiscible)	Kerosene
1863	Flammable Liquids (non-polar/water-immiscible)	Fuel, Aviation, turbine engine
1993	Flammable Liquids (non-polar/water-immiscible)	Diesel fuel, Fuel oil, Light Cycle oil, Low sulfur diesel, Ultra low sulfur diesel
1075, 1978	Gases- flammable (including refrigerated liquids)	Propane

According to GIS data available from the PA DEP as of February 2019, there are 903 reported wells in Bradford County, the vast majority of which are for Marcellus shale natural gas extraction (PA DEP, 2019). The below *Table 49 – Municipal Summary of Hazardous Material Locations* shows a summary of gas wells by municipality as well as domestic water wells, SARA and TRI facilities.

Private water supplies such as domestic drinking water wells in the vicinity of oil and gas wells are at risk of contamination from brine and other pollutants, including methane which can pose a fire and explosive hazard. Ideally, vulnerability of private drinking well owners would be established by comparing the distance of drinking water wells to known oil and gas well locations, but this extensive detailed data is not readily available at this time. Private drinking water is largely unregulated and information on these wells is voluntarily submitted to the Pennsylvania Topographic and Geologic Survey by water well drillers, and the existing data is largely incomplete and/or not completely accurate.

Table 49 – Municipal Summary of Hazardous Material Locations

Municipal Summary of Hazardous Material Locations *(PA DEP, 2019; PA GWIS, 2019; EPA, 2017; Bradford Co. GIS, 2019)*					
Municipality	**Gas Wells**	**SARA TIER II**	**SARA TITLE III**	**TRI**	**Domestic Water Wells**
Alba Borough					33
Albany Township	39		1		182
Armenia Township	20				81
Asylum Township	32		2		134
Athens Borough	1		3	5	159
Athens Township	9	1	4		622
Burlington Borough			1		52
Burlington Township	13				124
Canton Borough			1		78
Canton Township	21		5		237
Columbia Township	67				130
Franklin Township	7				128
Granville Township	17				182
Herrick Township	47		2		149
Leraysville Borough	1		1		10
Leroy Township	13		1		108
Litchfield Township	29				279
Monroe Borough					21
Monroe Township	24	1			152
New Albany Borough					8
North Towanda Township	8	2	4	14	134
Orwell Township	29				190
Overton Township	18		1		114
Pike Township	20				92
Ridgebury Township	11				374
Rome Borough					79
Rome Township	18				194
Sayre Borough		5	1	2	426
Sheshequin Township	9	1	1		240
Smithfield Township	34		1		302
South Creek Township					101

Municipal Summary of Hazardous Material Locations *(PA DEP, 2019; PA GWIS, 2019; EPA, 2017; Bradford Co. GIS, 2019)*					
Municipality	**Gas Wells**	**SARA TIER II**	**SARA TITLE III**	**TRI**	**Domestic Water Wells**
South Waverly Borough		1	2		23
Springfield Township	32				205
Standing Stone Township	22		1		116
Stevens Township	29		2		101
Sylvania Borough					6
Terry Township	42	1			227
Towanda Borough		2	4		43
Towanda Township	10				81
Troy Borough			4		118
Troy Township	46		2		73
Tuscarora Township	26				122
Ulster Township	16				172
Warren Township	21				148
Wells Township	24	1			56
West Burlington Township	28	1			70
Wilmot Township	44				169
Windham Township	25				119
Wyalusing Borough		1	2		34
Wyalusing Township	26		3	2	214
Wysox Township	25	1	3	12	471
Total	**903**	**18**	**52**	**35**	**7683**

4.3.18 Levee Failure

4.3.18.1 Location and Extent

Levees and floodwalls are man-made structures designed to protect specific areas from flooding. Failure of these structures occurs when floodwaters exceed the height of the structure, or when the maximum pressure exerted by the floodwaters against the levee/floodwall exceeds its capability.

There are four levee systems in Bradford County, protecting locations in Athens Borough, Sayre Borough and Monroe Borough. The Sayer Flood Protection Project consists of an earth levee built along the bank of the Susquehanna River, between South Higgins Street

and the former Lehigh Valley Railroad embankment (currently Thomas Avenue). The upstream Cayuta Creek channel and downstream Thomas Avenue Bridge were improved and stabilized, and drainage structures were constructed to provide interior drainage.

The Athens project involved the removal of gravel accumulations from the Susquehanna River at the mouth of Satterlee Creek and from the Chemung River immediately upstream of the Tioga Street Bridge. An earth levee was constructed along the bank of the Chemung River between Hoyt and Spruce Streets, and an existing earth levee between North and Elm Streets along the same bank of the Chemung River was also raised. A portion of an existing levee on South River Street along the bank of the Susquehanna River was reconstructed during the same effort (NLD, 2019). The levee system is operated by Sayre Borough. It should be noted that in *Table 50 – Bradford County Levee Details*, the Athens levee and the Susquehanna River Spoil Levee both have similar leveed areas, so much of the at risk population estimates cover the same area.

The locations of the levee systems in Bradford County are shown in *Figure 48 - Athens Levees* and *Figure 50 - Towanda Creek Levee System.*

Table 50 – Bradford County Levee Details

Bradford County Levee Details *(NLD, 2019)*					
Levee Name	**Municipality**	**Leveed Waterway**	**People at Risk**	**Structures at Risk**	**Property Value at Risk**
Towanda Creek Levee (Upstream)	Monroe Borough	Towanda Creek	40	17	$5.75 Million
Towanda Creek Levee (Midstream)	Monroe Borough	Towanda Creek	2	1	$318K
Towanda Creek Levee (Downstream)	Monroe Borough	Towanda Creek	0	0	$0
Sayre Flood Protection Project	Sayre Borough	Susquehanna River	78	38	$8.67 Million
Athens	Athens Borough	Chemung River	804	283	$167 Million
Susquehanna River Spoil Levee	Athens Borough	Susquehanna River	813	287	$167 Million

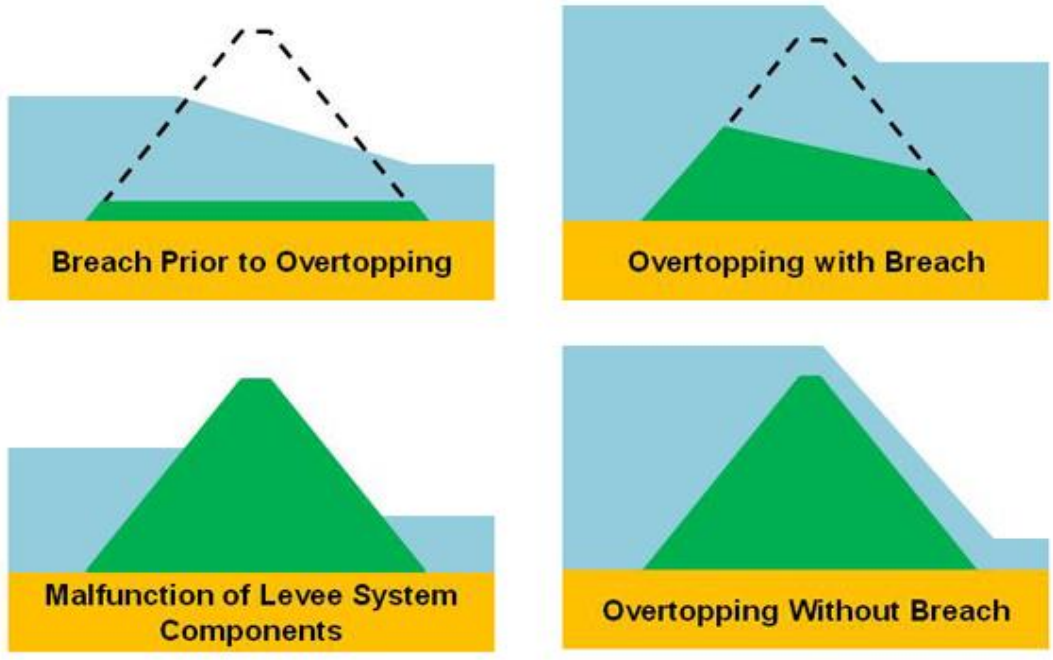
4.3.18.2 Range of Magnitude

Levee failures can pose a serious threat to communities located in flat or low-lying areas near bodies of water that are protected by levees. The impact of a levee failure is dependent on the volume of water behind the levee, the size of the failure and the amount of population or assets located in the protected area. The U.S. Army Corps of Engineers quantify flood risk associated with four scenarios as shown below in *Figure 47 - Types of Levee Failures*.

Levees require maintenance to continue to provide the level of protection they were designed and built for. Maintenance responsibility belongs to a variety of entities including, local, state and federal government as well as private landowners. Levee owners need to both maintain levees and pay for an independent inspection in order to have the levee certified as providing flood protection. The impacts of an un-certified levee include levee failure and insurance rate increases because FEMA identifies that the structures are not designed to protect the 1% annual-chance flood height on Flood Insurance Rate Maps. Levees designed and constructed by the PA Department of Environmental Protection (DEP) are then sponsored by the municipality in which it has been constructed. Sponsorship indicates the party that is responsible for the levee's operations and maintenance. Regardless of whether a levee is accredited, there is concern that property in these areas lack flood insurance.

Environmental impacts of a levee failure result in significant water quality and debris disposal issues. Flood waters can back up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. Unsecured containers of oil, fertilizers, pesticides, and other chemicals in the leveed area could also contaminate flood waters.

Figure 47 - Types of Levee Failures



4.3.18.3 Past Occurrence

Comprehensive information on past levee failures in Pennsylvania is difficult to come by, and historically few have been reported. No levee failures were reported to the Knowledge Center database between October 2012 and February 2019. There were news reports of levee related flood damage to the Chemung Levee in Athens, and in July 2013 the Athens

Chemung Levee repairs were under construction with an 80/20 federal/state match fund.

On September 7, 2011, the remnants of Tropical Storm Lee caused a catastrophic flash flood occurred in Monroe from the Towanda Creek, and the levee was destroyed by the flash flooding. Routes 220, 414 and 6 were all closed due to the flooding, and many homes were flooded as well. Damages to the area were estimated at $2 million (NOAA, 2019).

Flash flooding on June 27, 2006 caused significant damage throughout Bradford County, damaging ninety-nine homes, destroying one, flooding twelve businesses, damaging fifty roads and two bridges. In the flooding, approximately 300 people in Sayer and Athens were ordered to evacuate due to concerns about the levees holding; however, there were no reports of levees. The river did flood the Athens sewage plant, causing major water pollution problems for the area (NOAA, 2019).

4.3.18.5 Future Occurrence

Similar to dam failures, given certain circumstances, a levee failure can occur at any time. However, the probability of future occurrences can be reduced through proper design, construction, and maintenance measures. Most levees are designed to operate safely at specified levels of flooding. The age of the levee system, if not maintained, should also be considered regarding the potential for failures.

Vulnerability Assessment

When assessing the vulnerability of a community protected by a levee, there are three questions that the US Army Corps of Engineers (USACOE) uses to help judge the potential impact of a levee failure. These questions are:

1. What event could occur? (flood, storm, earthquake, other)
2. How will the levee perform during these events?
3. What are the consequences if the levee doesn't perform well, in particular, could any loss of life occur?

Using these questions as a framework the risk and vulnerability of the levee can be judged. There are three inspection rating classifications, these are shown in *Table 51 - Levee System Inspection Ratings*.

The three maps below show the details of leveed areas in Bradford County. Within the areas of Bradford County's levee systems, there are twenty critical facilities within 2,000 feet of a levee. More detailed information is shown in *Table 53 - Critical Facilities Vulnerable to Levee Break*. Structures that fall within the inundation area of levees or the 2,000 foot vulnerability buffer of a levee are summarized in *Table 52 - Structures Vulnerable to Levee Break.*

Table 51 - Levee System Inspection Ratings

Levee System Inspection Ratings *(USACOE, 2019)*	
Rating	**Description**
Acceptable	All inspection items are rated as Acceptable.
Minimally Acceptable	One or more inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.
Unacceptable	One or more inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections (previous Unacceptable items in a Minimally Acceptable overall rating) has not been corrected within the established timeframe, not to exceed two years.

Table 52 - Structures Vulnerable to Levee Break

Structures Vulnerable to Levee Break *(Bradford Co GIS, 2019; NLD, 2019)*			
Levee System	**Type**	**Structures in Inundation Area**	**Structures within 2,000 ft of Levee**
Athens Levees	Commercial	84	112
	Other	27	74
	Residential	364	977
Sayre Flood Protection Project	Commercial	0	215
	Other	1	62
	Residential	42	564
Towanda Creek Levees	Commercial	0	21
	Other	0	42
	Residential	1	249
Total		**519**	**2316**

Table 53 - Critical Facilities Vulnerable to Levee Break

Critical Facilities Vulnerable to Levee Break ***(Bradford Co GIS, 2019; NLD, 2019)***				
Name	**Address**	**Municipality**	**Facility Type**	**Levee Proximity**
Guthrie Clinic Athens	412 S. Main St., Athens, PA	Athens Borough	Medical Facility	Leveed Area
Little Harvard Early Learning	109 Susquehanna St., Athens, PA	Athens Borough	Child Care	Leveed Area
Chemung View Apartments	222 Chestnut St., Athens, PA	Athens Borough	Senior Housing	Leveed Area
First Presbyterian Church	622 1/2 S. Main St	Athens Borough	EMA Shelter	Leveed Area
UTC Railcar Repair Services, LLC	403 N. Thomas Ave, Sayre, PA	Sayre Borough	SARA Tier II	2000 ft Buffer
Verizon Sayre Co (Pa7040007)	121 W. Lockhart St. Ste. 1, Sayre, PA	Sayre Borough	SARA Tier II	2000 ft Buffer
Rynone Manufacturing Corp	297 Dominic Pace Industrial Pkwy., Sayre, PA	Sayre Borough	SARA Tier II	2000 ft Buffer
Williams Oil Company Athens Propane Storage	111 New St., Athens, PA	Athens Borough	SARA Title 3	2000 ft Buffer
Guthrie Sayre Practice	105 Desmond St., Sayre, PA	Sayre Borough	Medical Facility	2000 ft Buffer
Futures Community Support Group Home	111 E. Cherry St., Athens, PA	Athens Borough	Special Needs	2000 ft Buffer
Discover The World- Athens	207 N. Main St., Athens, PA	Athens Borough	Child Care	2000 ft Buffer
Helen House Daycare	94 Franks Ln., Monroeton, PA	Monroe Borough	Child Care	2000 ft Buffer
Head Start	116 Walnut St., Athens, PA	Athens Borough	Child Care	2000 ft Buffer
His Majesty Fellowship	191 Fourth St., Athens, PA 18810	Athens Borough	School	2000 ft Buffer
Athens Borough Police Department	2 S River St., Athens, PA 18810	Athens Borough	Police Station	2000 ft Buffer
Sayre Borough Police Department	234 S. Lehigh Ave., Sayre, PA 18840	Sayre Borough	Police Station	2000 ft Buffer
J.E. Wheelock Hose Co #5	217 Frank St., Sayre, PA 18840	Sayre Borough	Fire Department	2000 ft Buffer

Critical Facilities Vulnerable to Levee Break ***(Bradford Co GIS, 2019; NLD, 2019)***				
Name	**Address**	**Municipality**	**Facility Type**	**Levee Proximity**
Sayre Boro Vol Fire	110 W. Packer Ave, Sayre, PA 18840	Sayre Borough	Fire Department	2000 ft Buffer
Monroeton Fire	8958 Burlington Tpke., Monroeton, PA 18832	Monroe Borough	Fire Department	2000 ft Buffer
Athens Boro Fire	2 S. River St., Athens, PA 18810	Athens Borough	Fire Department	2000 ft Buffer

Figure 48 - Athens Levees

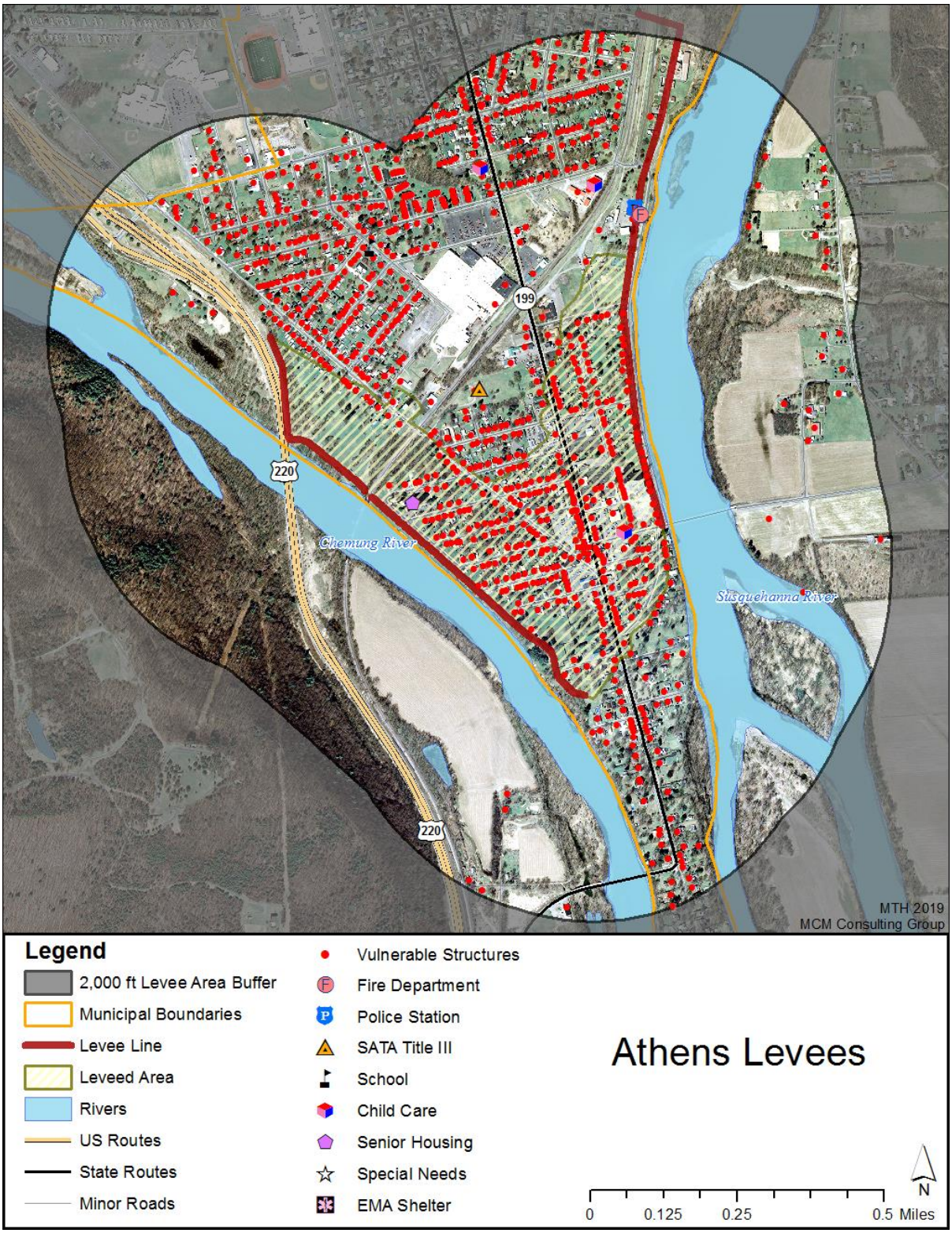


Figure 49 - Sayre Flood Protection Project

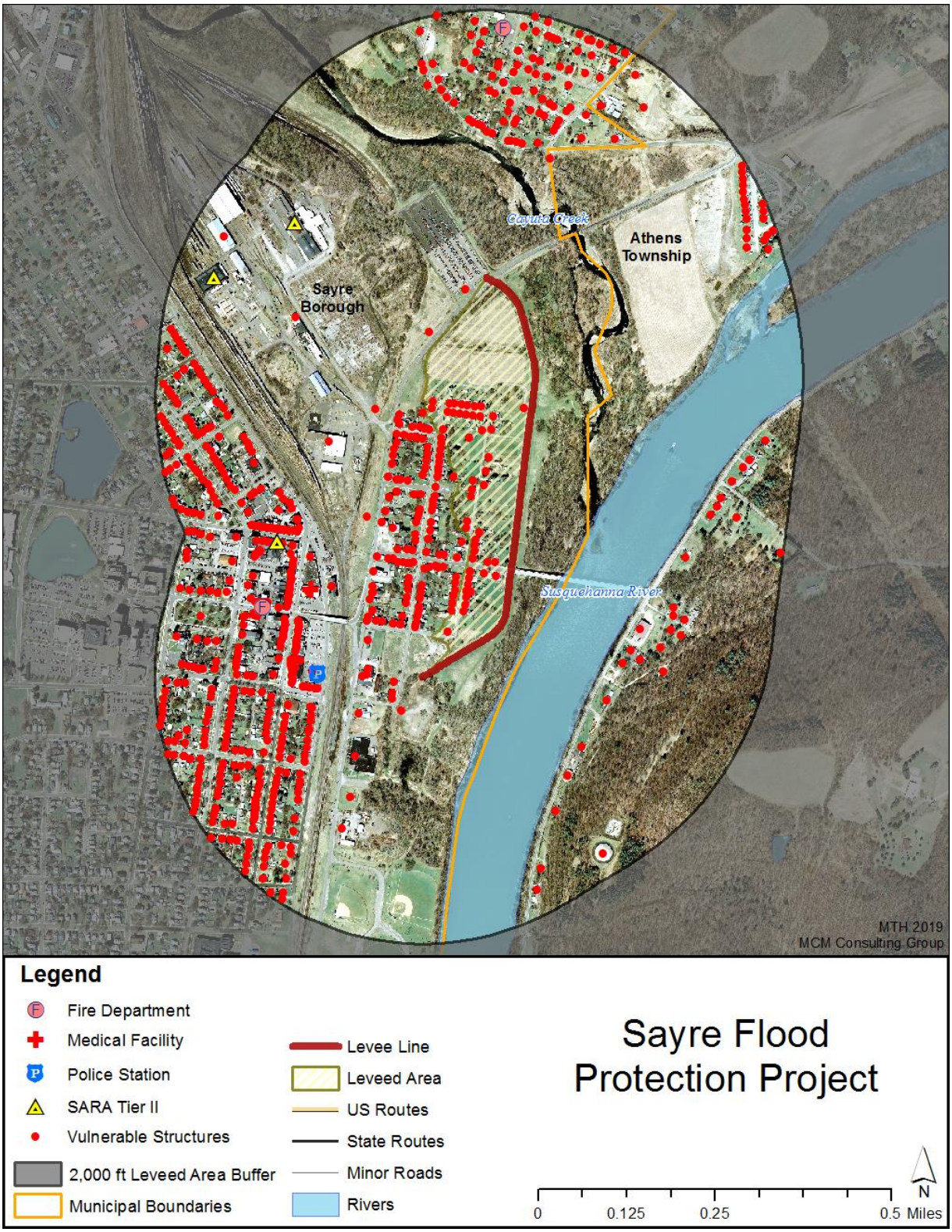
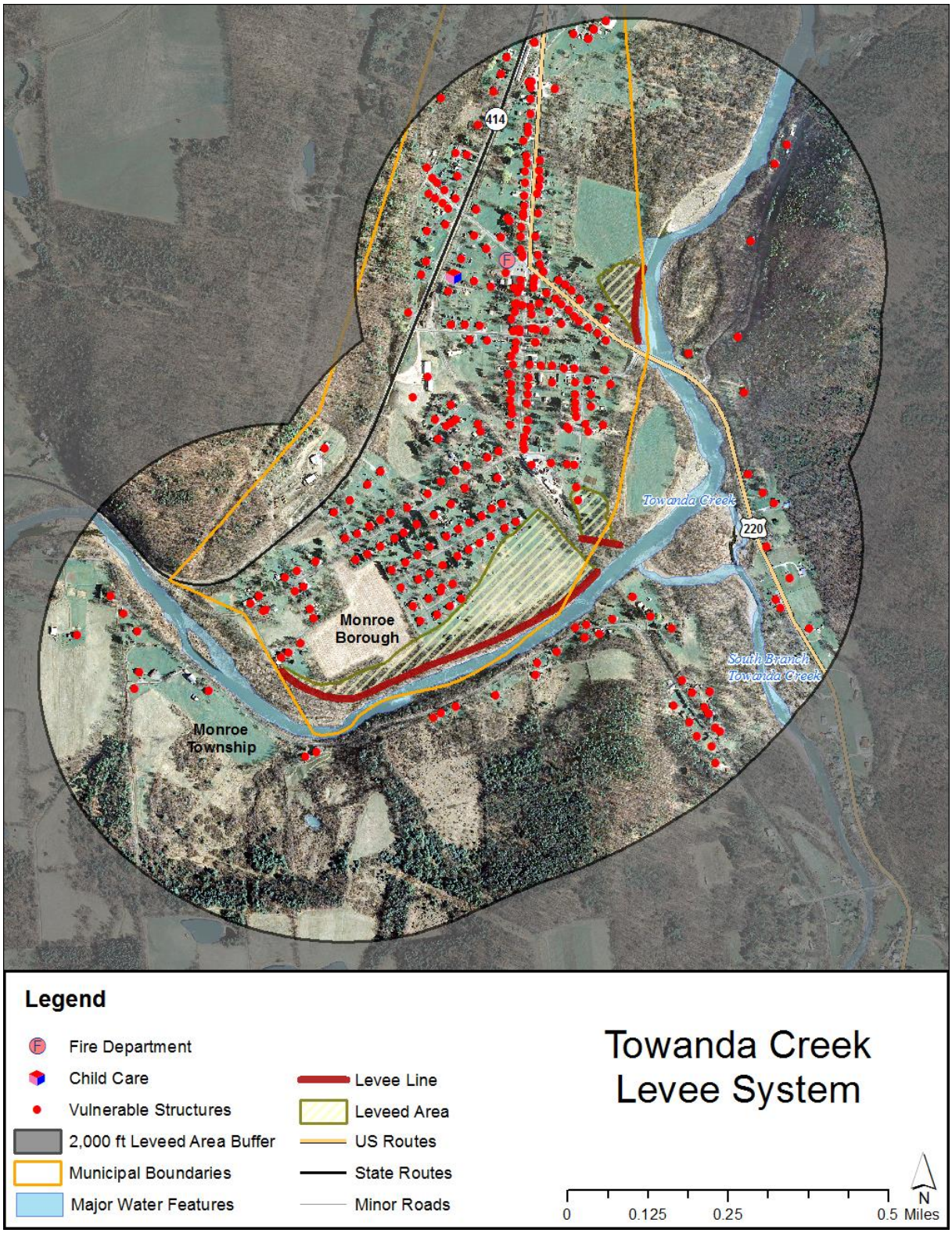


Figure 50 - Towanda Creek Levee System



4.3.19. Fixed Nuclear Incidents

4.3.19.1 Location and Extent

Nuclear accidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation. Nuclear accidents/incidents can be placed into three categories: 1) Criticality accidents which involve loss of control of nuclear assemblies or power reactors, 2) Loss-of-coolant accidents which result 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 and 3) Loss-of-containment accidents which involve the release of radioactivity. The primary concern following such an incident or accident is the extent of radiation, inhalation and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns and severe impairment), chronic health effects (e.g. cancer) and psychological effects.

For the purposes of reacting to a fixed nuclear facility emergency, there are two defined emergency planning zones (EPZs) for each nuclear facility. While actual impacts from a nuclear emergency are a result of unique geographic features, the two zones each have generally defined extents.

Plume Exposure Pathway EPZ: Has a radius of ~10 miles from a reactor site. Predetermined protective action plans are in place and include sheltering, evacuation and the use of potassium iodine where appropriate.

Ingestion Exposure Pathway EPZ: Has a radius of ~50 miles from each reactor site. Predetermined protective action plans are in place and are designed to avoid or reduce dose from potential ingestion of radioactive materials. These actions include a ban of contaminated food and water.

A power reactor facility makes electricity by continuously splitting uranium atoms. Within the Commonwealth of Pennsylvania there are five nuclear power stations. These are:

- Beaver Valley Power Station in Beaver County
- Limerick Generating Station in Montgomery County
- Peach Bottom Atomic Power Station in York County
- Susquehanna Steam Electric Station in Luzerne County
- Three Mile Island Nuclear Generating Station in Dauphin County

Bradford County is not within the 10 mile Plume Exposure Pathway for any fixed nuclear facilities; however, the southeastern portion of the county lies within the 50 mile ingestion exposure pathway for the Susquehanna Steam Electric Station in Luzerne County (see *Figure 51 - Nearby Nuclear Facilities*).

4.3.19.2 Range of Magnitude

In the event of a nuclear disaster, radioactive fallout would be the main danger of an incident within a 50-mile radius. Gamma rays from fallout can cause radiation sickness as a result of physical and chemical changes in the cells of the body. When a person is exposed to a large dose of radiation, the result is often death. Non-lethal doses in varying degrees would cause radiation sickness among the survivors. Depending on the location of the event, much of Bradford County could be in the Ingestion Exposure Pathway.

There are three categories of nuclear accidents:

- **Criticality accidents** involve loss of nuclear assemblies or power reactors.
- **Loss of coolant accidents** occur when 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** involve the release of radioactivity from materials such as tritium, fission products, plutonium and natural, depleted, or enriched uranium.

The Nuclear Regulatory Commission uses four classification levels for nuclear incidents:

Table 54 - Emergency Classification Levels

Emergency Classification Levels	
Notification of Unusual Event	Events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation occurs. This is the least serious of the four levels. The event poses no threat to the public or plant employees, but emergency officials are notified.
Alert	Events are in process or have occurred which involve an 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 EPA Protective Action guides (PAGs). Emergency agencies are notified and kept informed, but no action by the public is necessary.
Site Area Emergency	Involves events in process or which have occurred that result 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 the EPA PAGs except near the site boundary. Release of some radioactivity into the air or water is possible but is not expected to exceed Environmental Protection Agency Protective Action Guidelines (PAGs) beyond the site boundary.
General Emergency	Involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area. This is the most serious of the four classifications and is declared when an event at the plant has caused a loss of safety systems. If such an event

Emergency Classification Levels	
	occurs, radiation could be released that would travel beyond the site boundary. State and local authorities will take action to protect the residents living near the plant. Alert and notification systems would be sounded.

After a nuclear incident, the primary concern is the effect on the health of the population near the incident. The duration of primary exposure could range in length from hours to months depending on the proximity to the point of radioactive release. External radiation and inhalation and ingestion of radioactive isotopes can cause acute health effects (e.g. death, severe health impairment), chronic health effects (e.g. cancers) and psychological effects.

Potential environmental impacts specific to the 50-mile Ingestion Exposure Pathway EPZ include the long-term effects of radioactive contamination in the environment and in agricultural products. Bradford County can expect some radioactive contamination in the case of a nuclear incident. This is not a significant concern in terms of external exposure and immediate health risks, but even a small amount of radiation will require the protection of the food chain. Small amounts of radiation ingested over time could lead to future health issues. As a result, in the case of a nuclear incident, foodstuffs, crops, milk, livestock feed and forage, and farm water supplies will need to be protected from and tested for contamination. Additionally, spills and releases of radiologically active materials from accidents can result in the contamination of soil and public water supplies. Areas underlain by limestone and some types of glacial sediments are particularly susceptible to contamination.

4.3.19.3 Past Occurrence

There has been one nuclear incident above the Alert classification in the United States. In March 1979, a Site Area Emergency event occurred at Three Mile Island - Unit 2. This event is the most serious commercial nuclear accident in United States history. During this incident, equipment malfunctions, design-related problems, and worker errors led to a partial meltdown of the reactor core. The resulting contamination and state of the reactor core led to the development of a ten-year cleanup and scientific effort. Despite the severity of the damage no injuries due to radiation exposure occurred. There were however, significant health effects reported due to the psychological stress on the individuals living in the area.

There have been no nuclear plant failures that have directly affected Bradford County. The Susquehanna Steam Electric Station has been in operation since 1983, and there have been two reported emergencies at the station:

- In 1982, an electrical fire occurred at a switch box controlling the supply of cooling water to emergency systems. No injuries were reported.

- In 1985, approximately 10,000 gallons of radioactive water spilled at the Station's Unit 1 turbine building after a filtering system gasket failed.

4.3.19.4 Future Occurrence

Bradford County has minimum potential to be affected by a fixed nuclear facility's incident, but the possibility exists due to the proximity of the Susquehanna Steam Electric Station facility in Luzerne County.

The Three Mile Island incident which occurred in Pennsylvania is the only nuclear power plant General Emergency in the nation. Since the Three Mile Island incident, nuclear power has become increasingly safe and is one of the most heavily regulated industries in the nation. Despite the knowledge gained since then, there is still potential for a similar accident to occur again. The Nuclear Energy Agency of the Organization for Economic Co-Operation and Development notes that studies estimate the chance of protective barriers failing in a modern nuclear facility are less than one in 100,000 per year (Nuclear Energy Agency, 2005).

Across the United States, a number of *Unusual Event* and *Alert* classification level events occur each year at the 100+ nuclear facilities that warrant notification of local emergency managers. Of these, *Alert* emergencies occur least frequently. For example, in 1997, there were forty notifications of *Unusual Events* and three *Alert* events nationwide. Based on historical events, *Site Area Emergency* and *General Emergency* incidents are very rare.

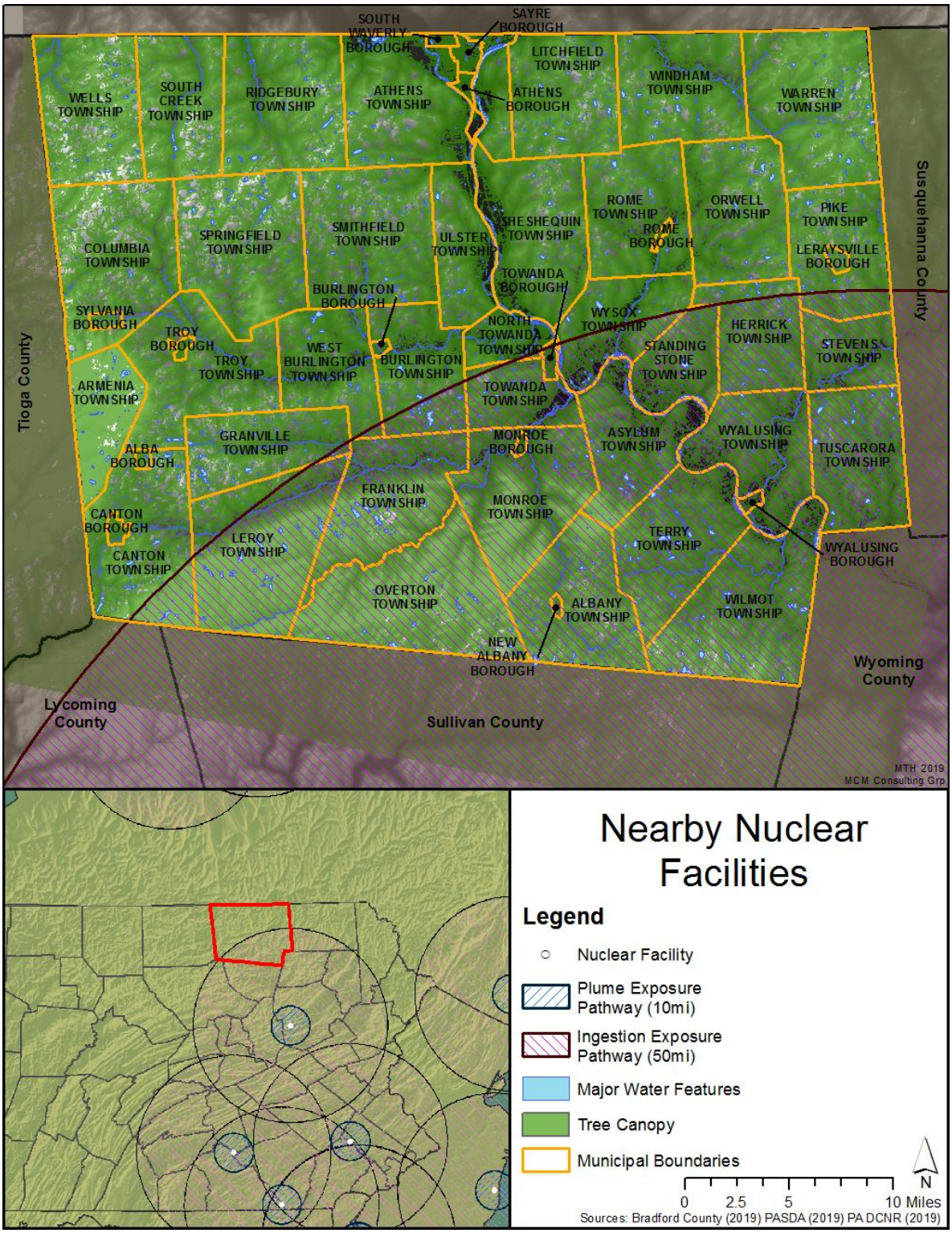
4.3.19.5 Vulnerability Assessment

The county's primary vulnerability to nuclear incidents comes in the form of food, soil, and water contamination. In terms of vulnerable land, the farmland in Bradford County's many farms is vulnerable to radiological contamination in a nuclear incident. In 2012, the market value of all agricultural products of these farms was nearly $129 million.

While unlikely that all agricultural products would be lost in the event of a nuclear incident, the County could expect some portion Bradford's agriculture economy to be lost. Time of year also impacts the vulnerability and losses estimated for a nuclear incident; an incident that occurs during the prime growing and harvesting season will have a larger impact on the county. For example, the incident at Three Mile Island occurred in the off-season; as a result, the Pennsylvania Department of Agriculture estimated that agricultural losses for the entire Commonwealth were less than $1 million.

Water contamination is also a concern in nuclear incidents. Public water supplies and the county's estimated 7,767 domestic drinking water wells are both vulnerable to the effects of a nuclear incident.

Figure 51 - Nearby Nuclear Facilities



4.3.20. Terrorism

4.3.20.1 Location and Extent

Following several serious international and domestic terrorist incidents during the 1990's and early 2000's, citizens across the United States paid increased attention to the potential for deliberate, harmful actions of individuals or groups. The term "terrorism" refers to intentional, criminal, malicious acts. The functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations 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*." (28 CFR §0.85)

The Federal Bureau of Investigation (FBI) further characterizes terrorism as either domestic or international, depending on the origin, base, and objectives of the terrorist organization. Often, the origin of the terrorist or person causing the hazard is far less relevant to mitigation planning than the hazard itself and its consequences. However, it is important to consider that the prevalence of Homegrown Violent Extremists (HVEs) has increased in recent years, with individuals able to become radicalized on the internet. In a speech on August 29, 2018 addressed to the 11th annual Utah National Security and Anti-Terrorism Conference, FBI Director Christopher Wray describes HVEs as "the primary terrorist threat to the homeland here today, without question."

Critical facilities are either in the public or private sector that provide essential products and/or services to the general public. Critical facilities are often necessary to preserve the welfare and quality of life in the county, or fulfill important public safety, emergency response, and/or disaster recovery functions. Critical facilities identified in the county are shelters; gas, electric and communication utilities; hospitals and other health care facilities; water and wastewater treatment plants, hazardous waste sites; and schools.

In addition to critical facilities, the county contains at risk populations that should be factored into a vulnerability assessment. These populations include not only the residents and workforce in the county, but also the tourists that visit the area on a daily basis, those that are traveling through the county on any of the major highways and marginalized groups such as LGBTQ persons and racial minorities. Potential targets for attack include:

- Commercial facilities
- Abortion or Family Planning Clinics and other organizations associated with controversial issues.
- Education facilities
- Events attracting large amounts of people
- Places of worship
- Industrial facilities, especially those utilizing large quantities of hazardous materials

- Transportation Infrastructure
- Historical sites
- Government Facilities

4.3.20.2 Range of Magnitude

Terrorism refers to the use of Weapons of Mass Destruction (WMD) (including, biological, chemical, nuclear, and radiological weapons) arson, incendiary, explosive, armed attacks, industrial sabotage, intentional hazardous materials releases and cyber-terrorism. Within these general categories, there are many variations. There are a wide variety of agents and ways for them to be disseminated, particularly in the case of biological and chemical weapons. Terrorist methods can take many forms, including:

- Active Shooter
- Agri-terrorism
- Arson/incendiary attack
- Armed attack
- Assassination
- Biological agent
- Chemical agent
- Cyber-terrorism
- Conventional bomb or bomb threat
- Hijackings
- Hazardous material release (intentional)
- Kidnapping
- Nuclear bomb
- Radiological agent

The rural areas of Bradford County are most susceptible to Agri-terrorism and school bomb threats. Agri-terrorism could have severe impacts on traditional family-operated farms, commercial agriculture operations, resource production facilities, and small-scale operations. In 2012, Bradford County had a high percentage of farmers that reported their principal occupation was farming. Agri-terrorism typically employ biological agents such as organisms or toxins that cause illnesses in people, livestock or crops. Some agents are difficult to detect, and they may only become active over time, so it can be difficult to diagnose a biological attack until victims are already displaying symptoms. Other agents have more apparent and immediate impacts. Individuals affected by a biological agent often require immediate attention from professional medical personnel, and in some cases require the victim to be quarantined.

Bomb threats can disrupt the learning atmosphere in schools, cause traffic to be rerouted, and uses taxpayer assets from deploying police and or fire units. Bradford County has seven school districts throughout the county and numerous non-public schools.

The areas along major transportation routes including US-6 and US-220 can be susceptible to forms of public transit terrorist attacks. More populated areas of the county can be susceptible to chemical, biological, radiological, nuclear or explosive (CBRNE) events due to the concentration and density of residential communities. Secondary effects from CBRNE incidents can be damaging as well. Mass evacuations could result in congestion of roadways and possibly result in breakdown of civil order, further exacerbating the situation. Government operations may be disrupted due to the need to displace or operate under reduced capacity. Radiation fallout, hazardous chemical introduction into the groundwater, or biologic/germ agents can cause long-term environmental damage.

Cyber terrorism is becoming increasingly prevalent. Cyber terrorism can be defined as activities intended to damage or disrupt vital computer systems. These acts can range from taking control of a host website to using networked resources to directly cause destruction and harm. Protection of databases and infrastructure are the main goals for a safe cyber environment. Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. The largest threat to institutions from cyber terrorism comes from any processes that are networked and controlled via computer. Any vulnerability that could allow access to sensitive data or processes should be addressed and any possible measures taken to harden those resources to attack.

4.3.20.3 Past Occurrence

Active shooters, as defined by the US Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area; in most cases, active shooters use firearm(s) and there is not necessarily a pattern or method to their selection of victims. Throughout the year in 2018, there were a total of 340 active shooter incidents in the United States according to the non-profit GunViolenceArchive.org. Often these shooters can be homegrown violent extremists. One significant event that occurred in Pennsylvania happened on October 27th, 2018, when eleven people were killed by a gunman in the Pittsburgh, PA neighborhood of Squirrel Hill. The gunman (a HVE) attacked the congregation at the Tree of Life Synagogue in a shooting that targeted the Jewish population and was fueled by the gunman's anti-Semitic, anti-immigrant, and anti-refugee sentiments.

Another high-profile shooting occurred at the Pulse Nightclub in Orlando, Florida on June 12th, 2016 where the LGBTQ community was targeted – forty-nine people were killed and fifty three were wounded. A few other significant active shooter events include those that occurred at Virginia Tech (April 2007), Sandy Hook elementary School (December 2012), San Bernardino California (December 2015), an Aurora, Colorado movie theater (July 2012) and a church in Charleston, South Carolina (June 2015). A 2014 study by the FBI concluded that there has been a significant recent increase in frequency

of active shooter incidents, and the vast majority (154 of 160 shooters between 2000 and 2013) were male (FBI, 2014). Of these 160 incidents, 45.6% took place in commercial environments, 24.3% took place in an educational environment, and the remaining 30.1% took place at other locations such as open spaces, military and other government properties, residential locations, houses of worship, and health care facilities (FBI, 2014). *Figure 52 - Active Shooter Incidents 2000-2013 (FBI, 2014)*Figure 52 - Active Shooter Incidents 2000-2013 (FBI, 2014) summarizes the FBI's findings in the study.

Significant international terrorism incidents in the USA include: the World Trade Center bombing in 1993, the bombing of the Murrow Building in Oklahoma City in 1995, and the September 11, 2001 attack on the World Trade Center. One of the aircrafts hijacked in the September 11, 2001 attack crash landed in Somerset County, Pennsylvania before it reached the intended target. While fatalities and destruction at the intended target were avoided, all passengers on the flight perished. Bradford County has not been directly impacted by any significant international terrorist incidents.

While the largest scale terrorist incidents have often had international stimulus, many other incidents are caused by home grown actors who may have become radicalized through hate groups either in real life or online, and who may struggle with mental health issues. Hate groups such as the Ku Klux Klan (KKK), Aryan Nation and, more recently, the Alt-Reich have been a part of domestic terrorism in different forms.

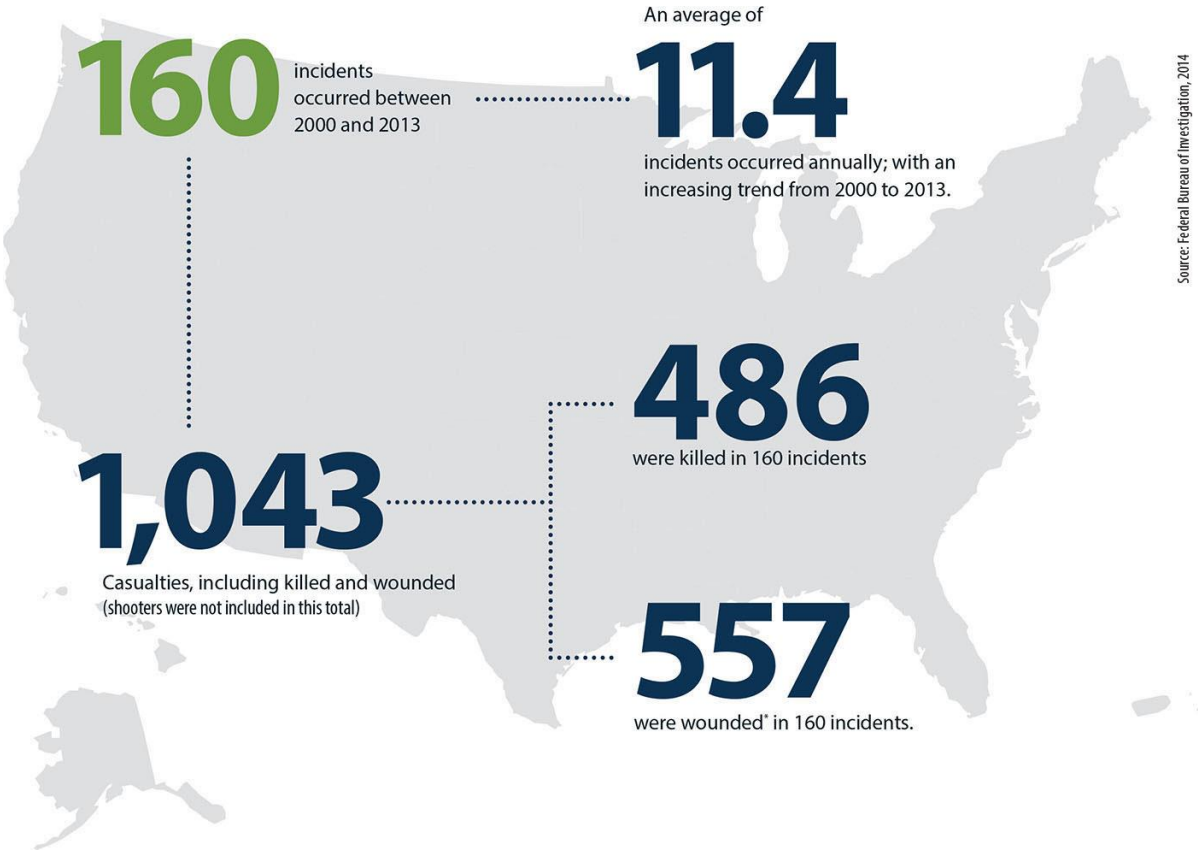
Knowledge Center reports of terrorist activity in Bradford County as of January 2019 can be found in *Table 55 - Terrorist Activity History*; however, these incidents are not all inclusive of the history of terrorism in the county.

Table 55 - Terrorist Activity History

Terrorist Activity History ***(Knowledge Center, 2019; Bradford County, 2013)***			
Title	**Location**	**Location Type**	**Date**
Bomb Threat	Bradford County Courthouse	County Government	12/15/2005
Bomb Threat	Northern Tier Counseling	Healthcare	03/08/2006
Bomb Threat	Litchfield School	Education	03/29/2006
Bomb Threat	Smoker's Choice	Business	12/14/2006
Bomb Threat	Walmart	Business	08/04/2007
Bomb Threat	Sayre High School	Education	12/12/2007
Bomb Threat	Gamelands	State Government	05/03/2009
Bomb Threat	S. Center Street	Residential	07/10/2009
Bomb Threat	Penntroy and Old Agway Alley	Unknown	08/27/2010
Bomb Threat	Troy Dandy		03/10/2012
Bomb Threat	Bradford County Courthouse	County Government	12/06/2012
Terroristic Threats	Wyalusing Township		12/20/2012

Terrorist Activity History *(Knowledge Center, 2019; Bradford County, 2013)*			
Title	**Location**	**Location Type**	**Date**
Bomb Threat	Cargill	Industry	02/26/2013
SNS Exercise	Bradford		03/05/2013
Barricaded Gunman	Bradford		05/13/2013

Figure 52 - Active Shooter Incidents 2000-2013 (FBI, 2014)



4.3.20.4 Future Occurrence

The likelihood of Bradford County being a primary target for a major international terrorist attack is somewhat small. More likely terrorist activity in Bradford County are bomb threats or other incidents at schools. Bradford County has seven public school districts, seven private schools, and four institutions of higher education. Despite the lack of recent events reported in *Table 55 - Terrorist Activity History,* bomb threats at schools are typically experienced at least once a year across the county. In the early months of 2019, three School Resource Officers (SRO's) have been employed across schools in Bradford County to help increase preparedness for incidents at schools.

4.3.20.5 Vulnerability Assessment

Agriculture consists of over 44% of land covered in Bradford County. Considering the widespread farming taking place in the county and despite the lack of past occurrences, Bradford County should be prepared to handle Agri-terrorism incidents. It is important to note that the use and exposure to biological agents can remain unknown for several days until the infected person(s), livestock, or crops begin to experience symptoms. Often such agents are contagious and the infected person must be quarantined, livestock culled, and/or crops destroyed.

The probability of terrorist activity is more difficult to quantify than some other hazards. Instead of considering likelihood of occurrence, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in a community, planning efforts can be put in place to reduce the risk of attack. Planning should work towards identifying potentially at-risk critical facilities and systems in the community, prioritizing those assets and locations, and identify their vulnerabilities relative to known potential threats.

All communities in Bradford County are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities with schools and government infrastructure like the county seat of Towanda Borough should be considered more likely to attract terrorist activity. Site-specific assessments should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist, and vulnerabilities, including:

Inherent vulnerability:

- Visibility – How aware is the public of the existence of the facility?
- Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
- Accessibility – How accessible is the place to the public?
- Asset mobility – is the asset's location fixed or mobile?
- Presence of hazardous materials – Are flammable, explosive, biological, chemical, and/or radiological materials present on site? If so, are they well secured?
- Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- Occupancy – What is the potential for mass casualties based on the maximum number of individuals on-site at a given time?

Tactical vulnerability:

Site Perimeter:

- Site planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
- Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?

Building Envelope:

- Structural Engineering – Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological, and radiological contaminants?

Facility Interior:

- Architectural and Interior Space Planning – Does security screening cover all public and private areas?
- Mechanical Engineering – Are utilities and HVAC systems protected and/or backed up with redundant systems?
- Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lightning sufficient?
- Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant, and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

4.3.21. Transportation Accidents

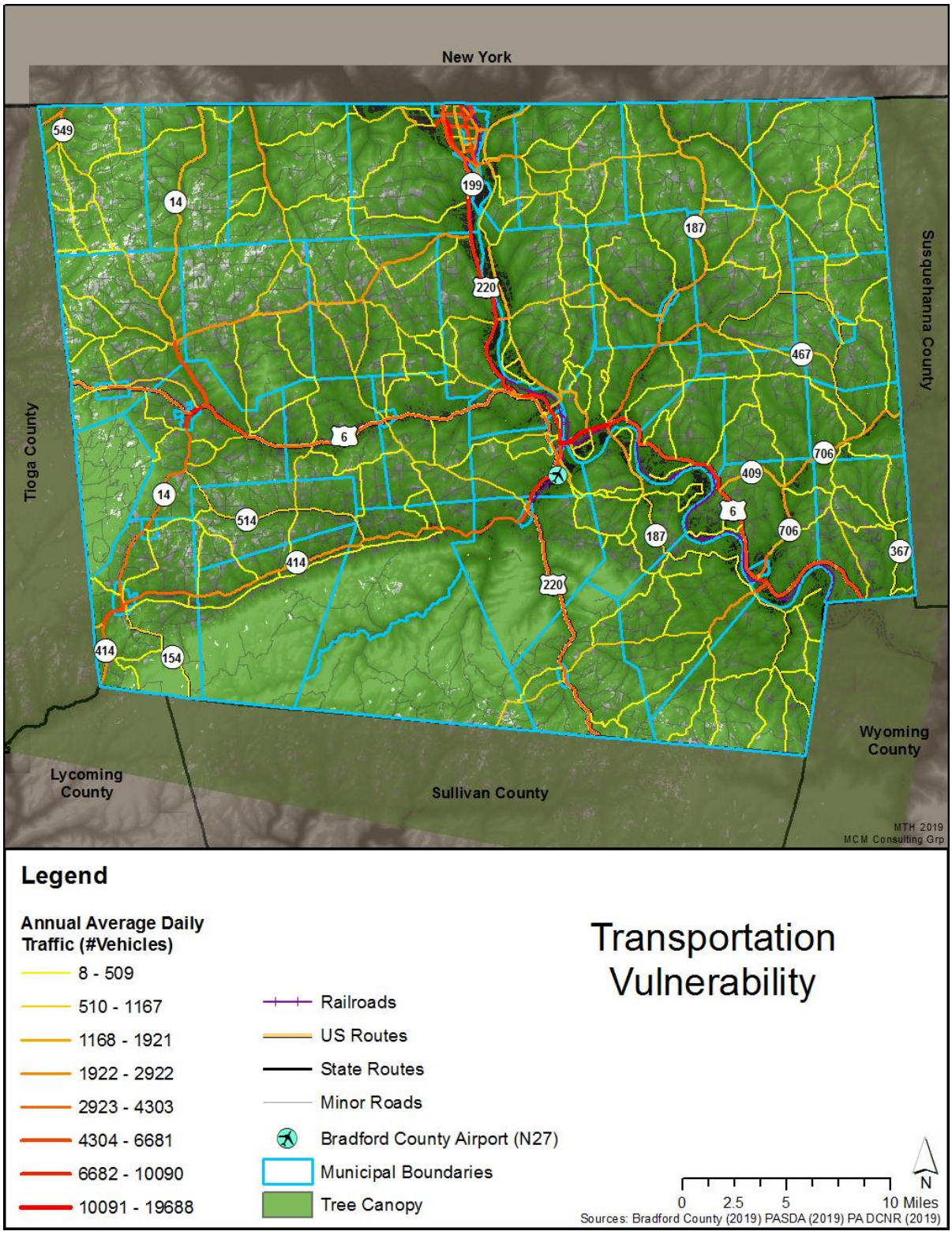
4.3.21.1 Location and Extent

Transportation accidents are a daily occurrence across Pennsylvania and include incidents involving road, air and rail travel. Bradford County is served by US Route 6, 220 as well as State Routes 14, 187, 414, 549, 706, and there are approximately 900 miles of Pennsylvania Department of Transportation (PennDOT) maintained roads within the county. U.S. Transportation accidents are directly impacted by hazardous weather events such as winter weather, heavy rainfall, and extreme temperatures. Bradford County serves as a major transportation corridor and is heavily traveled by various motorists. Hazardous materials are transported through Bradford County on a daily basis *Figure 53 - Major Transportation Routes* shows the major transportation systems in Bradford County along with the annual average daily traffic volume by number of vehicles.

The Bradford County Airport (N27) in Towanda Township is the only airport in the County. For location details, see *Figure 53 - Major Transportation Routes*.

The Lehigh Secondary Rail Line runs through Bradford County roughly following the Susquehanna River and is owned by Norfolk Southern Railway. The Towanda-Monroeton Shippers Lifeline Railroad is a short line that runs between Monroeton and Towanda and is owned by Shaffer & Zadrusky.

Figure 53 - Major Transportation Routes



4.3.21.2 Range and Magnitude

Transportation accidents can result in death or serious injury and extensive property loss or damage. In the United States, over 37,000 people die in road crashes annually (ASIRT, 2017). Inclement weather and higher traffic volume and speed increase the risk for automobile accidents. Road and railway accidents in particular have a potential to result in hazardous material releases. Accidents involving hazardous materials can pose an environmental hazard and potentially contaminate the air, water and or soil. Hazardous material release is covered in more detail in *Section 4.3.17 Environmental Hazards*.

Aviation incidents most often occur near landing or take-off sites; the five-mile radius around the Bradford County Airport is considered a high-risk area for aircraft incidents.

4.3.21.3 Past Occurrence

The most serious transportation concerns in Bradford County involves U.S. Route 6, U.S. Route 220 and State Routes 14 and 414 as they are the most highly traveled highways in the county.

Table 59 - PennDOT Bradford County Crash Report shows crash statistics recorded by the Pennsylvania Department of Transportation for Bradford County between 2008 and 2017. Over this ten-year period, incidents spiked in 2011 at 848 crashed in the year and are recently down to 571 in 2017. This information was gathered from PennDOT Crash Information Tool (crashinfo.penndot.gov) where there is more detailed information available. *Table 58 – Highway Transportation Incidents* shows the accidents and relevant incidents that were recorded in the Bradford County Knowledge Center from November 2012 to January 2019.

According to previous Hazard Mitigation Plans in Bradford County, from 1977 to 1999 there were three recorded rail incidents that occurred within the county. Between the three incidents, eight cars carrying hazardous materials were derailed and leaked hazardous substances (*Hazards Vulnerability Analysis for Bradford County, 2000*). No further details were available for these three incidents. According to data from the Federal Railroad Administration Office of Safety Analysis, from January 1997 to December 2018, there were nine casualties due to railway accidents in Bradford County, including two fatalities. Both fatalities were individuals trespassing on railroad tracks (FRA, 2019).

According to the National Transportation Safety Board, Bradford County has experienced three aviation accidents between 1969 and March 2019 resulting in two fatalities. More information can be seen in *Table 56 - Aircraft Incidents*, and by looking up the accident number in the National Transportation Safety Board Aviation Accident Database. One other incident occurred involving an ultralight on June 5, 2001 in Sayre: an Interplane Sky Boy (a type of ultralight) rolled over after takeoff and impacted the runway, resulting in one serious injury.

Table 56 - Aircraft Incidents

Aircraft Incidents *(National Transportation Safety Board, 2019)*					
Accident Number	**Date**	**Location**	**Injury Severity**	**Make**	**Description**
ERA17FA248	07/19/2017	Towanda, PA (N27)	Fatal(1)	Aircraft MFG & DVLPMT CO CH601XLi SLSA	Personal flight, crashed during descent, aircraft sustained substantial damage
ERA09CA425	07/27/2009	Towanda, PA (N27)	3 Minor Injuries	Cessna 177	Personal flight, crashed during takeoff, aircraft sustained substantial damage
NYC98FA164	08/08/1998	Towanda, PA (N27)	Fatal(1) & 1 Minor Injury	Cessna 150L	Personal flight, crashed during climb, aircraft was destroyed

Table 57 - Railroad Casualties

Railroad Casualties *(Federal Railroad Administration, 2019)*					
Date	**Rail-road**	**Incident Number**	**Type of Person**	**Condition**	**Description**
03/09/2015	LRWY	15030901	Non-trespasser	Fracture, lower leg	Highway-rail collision/impact
03/29/2013	LRWY	LRWY13088	Contractor (MOW & Struct. (No Signal)	Dental related	Struck by thrown or propelled object
04/06/2012	NS	100638	Trespasser	Fracture, lower leg	Other (describe in narrative)
03/26/2004	NS	P030417379	RR Emp on duty (Transport, Train and Engine)	Sprain/strain, neck	Collision/impact - auto, truck, bus, van, etc.
06/05/1999	CSX	69931010	Trespasser	Fatality	Struck by on-track equipment
07/11/1997	CR	448	RR Emp on duty (Transport, Train and Engine)	Cut/abrasion, skull	Slipped, fell, stumbled, etc. due to object, a ballast.
10/07/1997	CR	583	Trespasser	Fatality	Struck by on-track equipment
12/12/1997	CR	734	Non-trespasser	Sprain/strain, neck	Pushed/shoved into/against
12/12/1997	CR	735	Non-trespasser	Sprain/strain, neck	Pushed/shoved into/against

Table 58 – Highway Transportation Incidents

Transportation Incidents *(Knowledge Center, 2019)*		
Description	**Location**	**Date**
Motor Vehicle Accident	Wyalusing Township	11/05/2012
Motor Vehicle Accident	Athens Township	11/13/2012
Motor Vehicle Accident	Troy Township	11/16/2012
Motor Vehicle Accident	Terry Township	11/17/2012
Motor Vehicle Accident	Canton Township	11/19/2012
Motor Vehicle Accident	North Towanda Township	11/20/2012
Road Closure	North Towanda Township	11/20/2012
Motor Vehicle Accident	Sheshequin Township	11/27/2012
Motor Vehicle Accident	Albany Township	11/27/2012
Motor Vehicle Accident	Terry Township	11/28/2012
Debris in the Roadway	North Towanda Township	11/28/2012
Motor Vehicle Accident	Sheshequin Township	11/29/2012
Motor Vehicle Accident	Athens Borough	12/11/2012
Motor Vehicle Accident	Standing Stone Township	12/13/2012
Motor Vehicle Accident	Terry Township	12/19/2012
Motor Vehicle Accident	Wysox Township	12/21/2012
Motor Vehicle Accident	Burlington Township	01/04/2013
Motor Vehicle Accident	Canton Township	01/04/2013
Motor Vehicle Accident	W Burlington Township	01/09/2013
Motor Vehicle Accident	North Towanda Township	01/17/2013
Motor Vehicle Accident	North Towanda Township	01/17/2013
Motor Vehicle Accident	South Waverly Borough	01/17/2013
Motor Vehicle Accident w/ Injuries	Towanda Borough	01/18/2013
Motor Vehicle Accident	Athens Township	01/22/2013
Motor Vehicle Accident	Troy Township	01/24/2013
Motor Vehicle Accident	Terry Township	01/28/2013
Motor Vehicle Accident	Pike Township	01/28/2013
Motor Vehicle Accident	Stevens Township	01/28/2013
Motor Vehicle Accident	Athens Township	01/28/2013
Disabled Vehicle	Pike Township	01/30/2013
Water Rescue	Burlington Township	01/30/2013
Motor Vehicle Accident	Albany Township	02/01/2013
Motor Vehicle Accident	Athens Township	02/01/2013
Motor Vehicle Accident	W Burlington Township	02/01/2013
Motor Vehicle Accident	Windham Township	02/13/2013
Motor Vehicle Accident - Route 6	Wyalusing Township	02/20/2013
Motor Vehicle Accident	Bradford County	02/21/2013
Road Closure	Bradford County	02/27/2013
Motor Vehicle Accident with Fatality – Two Vehicles	Bradford County	03/01/2013
Motor Vehicle Accident with Fatality – Two Vehicles	Bradford County	03/01/2013
Motor Vehicle Accident	Wyalusing Township	03/08/2013

Transportation Incidents *(Knowledge Center, 2019)*		
Description	**Location**	**Date**
Motor Vehicle Accident - Route 220	Bradford County	03/09/2013
Motor Vehicle Accident – One Truck	Bradford County	03/11/2013
Motor Vehicle Accident – Two Vehicles	Bradford County	03/13/2013
Motor Vehicle Accident – Two Vehicles	Bradford County	03/14/2013
Motor Vehicle Accident	Bradford County	03/14/2013
Motor Vehicle Accident	Bradford County	03/14/2013
Motor Vehicle Accident	Bradford County	03/14/2013
Motor Vehicle Accident – One Car	Bradford County	03/15/2013
Truck Rollover	Bradford County	03/19/2013
Road Closure Due to Shooting	Bradford County	04/02/2013
Motor Vehicle Accident	Bradford County	04/02/2013
Motor Vehicle Accident	Bradford County	04/02/2013
Truck Rollover	Bradford County	04/06/2013
Motor Vehicle Accident – Two Cars	Bradford County	04/11/2013
Route 154 Closed	Canton Township	04/23/2013
Route 414 Motor Vehicle Accident	Canton Township	04/24/2013
Berry Rd. Closed	Springfield Township	04/24/2013
Motor Vehicle Accident – Two Cars	Bradford County	04/25/2013
Motor Vehicle Accident – One Car	Bradford County	04/26/2013
Route 220 Partial Closing	Ulster Township	04/30/2013
Jacobs Rd. Closed	Windham Township	04/30/2013
Motorcycle Accident	Bradford County	05/03/2013
Multi-Vehicle Accident	Bradford County	05/04/2013
Motor Vehicle Accident – Two Cars	Bradford County	05/05/2013
SR2027 Crane Rollover	Towanda Township	05/07/2013
Motor Vehicle Accident – Two Cars	Bradford County	05/25/2013
Ambulance Accident	Bradford County	05/29/2013
Motor Vehicle Accident – Two Cars	Towanda Borough	05/31/2013
Pedestrian Struck by Motor Vehicle	Canton Township	05/31/2013
Motorcycle Accident	Canton Township	06/02/2013
Road Closure	Bradford County	06/11/2013
Road Closure	Leroy Township	06/17/2013
Motor Vehicle Accident	Smithfield Township	06/20/2013
Motor Vehicle Accident – Two Cars	Bradford County	06/22/2013
Road Closure Milan Rd.	Bradford County	06/23/2013
Motorcycle Accident	Terry Township	06/23/2013
Road Closure	Athens Borough	06/24/2013
Road Closure – Manchester Rd.	Orwell Township	06/26/2013
Road Closure	Windham Township	07/09/2013
Road Closure	Overton Township	07/23/2013
Motor Vehicle Accident	Wysox Township	08/02/2013
Motor Vehicle Accident	Burlington Borough	08/02/2013
Motor Vehicle Accident - Route 706	Wyalusing Township	08/08/2013

Transportation Incidents *(Knowledge Center, 2019)*		
Description	**Location**	**Date**
Motor Vehicle Accident	Standing Stone Township	08/10/2013
Camptown Post Office Drive-In	Bradford County	08/10/2013
Road Closure	Sayre Borough	08/12/2013
N. Thomas Ave, Spill of Unknown Substance	Athens Township	08/15/2013
Motor Vehicle Accident	Standing Stone Township	08/21/2013
Milan Rd. Closed	Smithfield Township	08/21/2013
Road Closure	Sayre Borough	08/23/2013
Road Closure	Bradford County	08/26/2013
Motor Vehicle Accident / Gas Leak	South Waverly Borough	09/02/2013
Motor Vehicle Accident	Troy Township	09/03/2013
Motor Vehicle Accident	Bradford County	09/04/2013
Road Closure	Orwell Township	09/06/2013
Motor Vehicle Accident	Bradford County	09/10/2013
Accident at Gas Well Pad	Wilmot Township	09/11/2013
Industrial Accident	Monroe Township	09/19/2013
Road Closure	Ulster Township	09/30/2013
Production Fluid Spill	Bradford County	10/02/2013
Route 220 Motor Vehicle Accident	Albany Township	10/04/2013
Fatal Motor Vehicle Accident	Overton Township	10/07/2013
Truck Roll Over	Wyalusing Township	10/15/2013
Route 6 Motor Vehicle Accident	Columbia Township	11/04/2013
Tractor Trailer Accident into Building	Wilmot Township	12/02/2013
Tanker Truck Rollover	Wyalusing Township	12/09/2013
Omni School Bus Accident	Wysox Township	12/19/2013
Motor Vehicle Accident, Crane	Bradford County	12/21/2013
Tanker Rollover	Standing Stone Township	01/03/2014
Motor Vehicle Accident	Bradford County	01/09/2014
Motor Vehicle Accident	Towanda Township	01/17/2014
Motor Vehicle Accident	Athens Township	01/30/2014
Aircraft Emergency	Towanda Township	02/10/2014
Motor Vehicle Accident	North Towanda Township	02/10/2014
Motor Vehicle Accident	Standing Stone Township	02/14/2014
Motor Vehicle Accident	Bradford County	02/15/2014
Motor Vehicle Accident	Bradford County	02/15/2014
Motor Vehicle Accident Involving a School Bus – Three Vehicles	Bradford County	03/05/2014
Road Closure	Warren Township	04/01/2014
Motor Vehicle Accident	Athens Township	04/14/2014
Motor Vehicle Accident – Train vs. Pick-up	Bradford County	04/21/2014
Road Closure	Smithfield Township	05/05/2014
Motor Vehicle Accident	Bradford County	05/07/2014
Motor Vehicle Accident/ Road Closure	Bradford County	05/11/2014
Road Closure	Towanda Township	05/14/2014

Transportation Incidents *(Knowledge Center, 2019)*		
Description	**Location**	**Date**
Road Closure	Orwell Township	06/02/2014
Motor Vehicle Accident - Route 6	Wyalusing Township	06/09/2014
Road Closure	Wyalusing Township	06/16/2014
Road Closure	Tuscarora Township	06/16/2014
Motor Vehicle Accident – Route 6	Troy Township	06/23/2014
Motor Vehicle Accident with Fatality – Rt. 414	Franklin Township	06/26/2014
Road Closure	Bradford County	07/04/2014
Traffic Accident	Sheshequin Township	07/05/2014
Motor Vehicle Accident	Monroe Township	07/17/2014
Motor Vehicle Accident	Wyalusing Township	07/17/2014
Motor Vehicle Accident	Wilmot Township	07/20/2014
ATV Accident	Troy Township	08/17/2014
Motor Vehicle Accident	Burlington Township	08/24/2014
Road Closure	Sayre Borough	08/25/2014
Motor Vehicle Accident – Car vs. Pedestrian	Bradford County	09/03/2014
Motor Vehicle Accident	Orwell Township	09/25/2014
Motor Vehicle Accident	Franklin Township	10/06/2014
Bridge Closure	Troy Borough	10/13/2014
Motor Vehicle Accident – Train vs. Car	Bradford County	10/14/2014
Rollover Motor Vehicle Accident	Sheshequin Township	10/20/2014
Motor Vehicle Accident	Standing Stone Township	10/20/2014
Motor Vehicle Accident	Ulster Township	10/23/2014
Motor Vehicle Accident	Warren Township	10/25/2014
Motor Vehicle Accident	Bradford County	11/24/2014
Water Truck Roll Over	Bradford County	12/08/2014
Motor Vehicle Accident, Head-On – Route 220	Towanda Borough	12/18/2014
Motor Vehicle Accident	Bradford County	01/09/2015
Tractor Trailer Roll-Over	Bradford County	01/20/2015
Fuel Truck Roll-Over	Columbia Township	02/11/2015
Motor Vehicle Accident – Vehicle vs. Pedestrian	Sayre Borough	02/15/2015
Road Closure	Asylum Township	02/18/2015
Road Closure, Fatal Accident	Wysox Township	02/25/2015
Motor Vehicle Accident with Fatality	Terry Township	02/26/2015
Motor Vehicle Accident	Wysox Township	03/03/2015
Motor Vehicle Accident – Train and Vehicle	Ulster Township	03/09/2015
School Bus Accident	Smithfield Township	03/11/2015
Train Derailment	Ulster Township	04/06/2015
Tractor Trailer into a House	Canton Township	04/21/2015
Motor Vehicle Accident -ATV	Windham Township	05/30/2015
Motor Vehicle Accident with Fatality	Standing Stone Township	06/09/2015
Motor Vehicle Accident	Ulster Township	07/17/2015
Motor Vehicle Accident	McNett Township	08/22/2015
Motor Vehicle Accident with Fatality	Wyalusing Township	08/29/2015

Transportation Incidents *(Knowledge Center, 2019)*		
Description	**Location**	**Date**
Motor Vehicle Accident with Fatality	Wysox Township	09/14/2015
Bus Accident	Leroy Township	09/18/2015
Motor Vehicle Accident	Ulster Township	10/27/2015
Police Pursuit	Bradford County	12/26/2015
Motor Vehicle Accident with Entrapment	Towanda Borough	02/10/2016
Motor Vehicle Accident - Route 414	Bradford County	02/16/2016
Motor Vehicle Accident - Ambulance	South Creek Township	02/16/2016
Schrader Creek Rd. Closure	Bradford County	03/19/2016
Motor Vehicle Accident	Springfield Township	04/03/2016
518 Powell St.	Sayre Borough	04/21/2016
Motor Vehicle Accident with Fire Fighter Injury	Albany Township	04/23/2016
Motor Vehicle Accident – Route 6	Standing Stone Township	05/31/2016
Motor Vehicle Accident – Route 6	Burlington Township	06/08/2016
Bridge Replacement on Route 467	Orwell Township	06/13/2016
Motor Vehicle Accident with Injuries and Pole Damage	Bradford County	06/18/2016
Motor Vehicle Accident with Entrapment	Bradford County	06/18/2016
Motor Vehicle Accident - Roadway Closed	Bradford County	06/19/2016
Motor Vehicle Accident - Rollover	Bradford County	06/19/2016
Motor Vehicle Accident - Route 6	Wysox Township	07/10/2016
Motor Vehicle Accident with Fatality	Burlington Township	07/19/2016
Motor Vehicle Accident - Route 220	Ulster Township	08/08/2016
School Bus Accident	Bradford County	09/22/2016
Route 220 Closure	Bradford County	09/23/2016
Bridge Replacement - Rt 467	Pike Township	09/26/2016
Motor Vehicle Accident - Entrapment	Bradford County	09/27/2016
Tractor Accident	Bradford County	10/15/2016
Motor Vehicle Accident - Towanda Township	Bradford County	10/29/2016
Disabled Tractor Trailer	Bradford County	11/03/2016
Tractor Trailer Accident	Union Township	11/16/2016
Multiple Motor Vehicle Accidents – Weather-related	Bradford County	12/06/2016
Motor Vehicle Accident	Bradford County	12/06/2016
Motor Vehicle Accident with Fatality	Bradford County	12/10/2016
Motor Vehicle Accident	Bradford County	12/21/2016
Road Closure	Windham Township	01/12/2017
ATV Crash	West Burlington Township	02/20/2017
Ambulance Rollover	Wilmot Township	03/10/2017
Fatal Skid Steer Accident	Bradford County	03/17/2017
Motor Vehicle Accident – Route 14	Canton Township	03/19/2017
Disabled Vehicle - Route 14	Canton Borough	03/20/2017
Motor Vehicle Accident	Union Township – Tioga County	03/20/2017
Motor Vehicle Accident Serious Injury and Entrapment	Bradford County	04/16/2017
Motor Vehicle Accident with Injuries - Route 220	Bradford County	04/17/2017

Transportation Incidents *(Knowledge Center, 2019)*		
Description	**Location**	**Date**
Fatal Motor Vehicle Accident	South Creek Township	05/20/2017
Motor Vehicle Accident – Route 187	Orwell Township	05/24/2017
Industrial accident	Bradford County	06/05/2017
S. Keystone Ave & Lincoln St.	Sayre Borough	06/12/2017
Motor Vehicle Accident - Car into Pond	Bradford County	06/15/2017
Motorcycle Motor Vehicle Accident with Fatality – Route 187	Terry Township	06/22/2017
Motor Vehicle Accident	Towanda Township	06/30/2017
Mower Rollover	Wyalusing Township	07/02/2017
Motor Vehicle Accident with Fatality	Troy Township	07/11/2017
Golf Cart Rollover	Asylum Township	07/12/2017
Motor Vehicle Accident	Bradford County	07/16/2017
Airplane Crash	Monroe Township	07/19/2017
Truck Rollover with Hazardous Materials	Bradford County	08/04/2017
Motor Vehicle Accident – Car vs. Pedestrian	Bradford County	08/16/2017
Motorcycle Accident - SR 6	Bradford County	08/17/2017
Motor Vehicle Accident with Confinement	Bradford County	08/19/2017
Spring Hill Road Closure – Route 706	Bradford County	08/19/2017
Motor Vehicle Accident with Township Truck	Bradford County	09/14/2017
Motor Vehicle Accident with Injuries and Road Closure	Bradford County	09/27/2017
Motor Vehicle Accident with Serious Injury/State Highway	Bradford County	10/01/2017
Motor Vehicle Accident with Road Closure	Bradford County	10/14/2017
Road Closure	Bradford County	10/30/2017
Motor Vehicle Accident Rollover/Road Closure	Bradford County	10/30/2017
Springbrook Drive – Route 14	Canton	10/30/2017
Motor Vehicle Accident with Injuries	Bradford County	11/06/2017
Motor Vehicle Accident with Juvenile Injury – Car vs. Pedestrian	Bradford County	11/08/2017
Motor Vehicle Accident - Route 6	Standing Stone Township	01/05/2018
Motor Vehicle Accident	Wysox Township	01/30/2018
Motor Vehicle Accident	Smithfield Township	02/22/2018
Milan Rd. Closure	Bradford County	03/07/2018
Road Closure	Bradford County	03/07/2018
School Bus Accident	Ridgebury Township	03/15/2018
Motor Vehicle Accident with Entrapment	Ridgebury Township	03/24/2018
Motor Vehicle Accident with Fatality - Berwick Turnpike	Smithfield Township	04/02/2018
Motor Vehicle Accident	Bradford County	04/03/2018
Motor Vehicle Accident with Entrapment	Bradford County	04/21/2018
Tri-axle Water Truck Rollover	Bradford County	04/26/2018
Motorcycle Crash	Bradford County	05/01/2018
Tri-axle Truck Rollover	Bradford County	05/02/2018
Motorcycle Accident	Athens Borough	05/10/2018

Transportation Incidents *(Knowledge Center, 2019)*		
Description	**Location**	**Date**
Motor Vehicle Accident with Entrapment	Monroe Township	07/03/2018
Motor Vehicle Accident	Bradford County	07/09/2018
Car in water	Burlington Township	07/25/2018
Motor Vehicle Accident with Injuries	Springfield Township	09/06/2018
Car into a Building	Towanda Borough	09/10/2018
Route 220 South of New Albany Borough	Albany Township	09/10/2018
Tractor Trailer Rollover	Terry Township	09/12/2018
Roadway Closure due to Flooding	South Creek Township	09/18/2018
Tractor Trailer Rollover	Bradford County	09/25/2018
Car vs. Tractor Trailer, Fuel Spilled	Bradford County	09/27/2018
Tractor Trailer Hauling Cars on Fire	Bradford County	10/01/2018
Disabled Tractor Trailers	Bradford County	10/11/2018
Tractor Overturned	Wilmot Township	10/29/2018
State Route 187	Wilmot Township	11/07/2018
Motor Vehicle Accident	Bradford County	12/11/2018

Table 59 - PennDOT Bradford County Crash Report

PennDOT Bradford County Crash Report *(PennDOT, 2019)*										
Year --->	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Total Crashes	**633**	**586**	**771**	**848**	**776**	**662**	**650**	**605**	**553**	**571**
Pedestrian Crashes	6	7	7	10	8	9	8	7	3	2
Motorcyclist Crashes	21	16	23	13	26	14	20	20	16	21
Bicyclist Crashes	3	3	3	1	3	1	6	0	0	3
Alcohol-Related Crashes	88	74	108	91	109	84	83	73	66	48
Impaired Driver Crashes	93	80	112	106	123	96	94	83	81	58[1]
Speeding Crashes	11	15	10	7	17	7	13	13	13	19
Distracted Driver Crashes	67	71	84	115	88	83	68	74	74	73
Heavy Truck Crashes	29	27	78	121	63	47	54	26	34	25
Aggressive Driving Crashes	25	26	35	28	21	12	25	18	21	27
Crashes Involving a 65+ Year Old Driver	60	74	93	99	103	79	104	80	83	82
Crashes Involving a 65-74-Year-Old Driver	31	46	47	71	61	46	63	58	52	42
Crashes Involving a 75+ Year Old Driver	31	30	48	32	46	39	47	27	33	50
Local Road (only) Crashes	118	87	120	104	131	103	114	107	91	87
Work Zone Crashes	5	6	10	5	10	5	0	1	6	3
Winter Condition Crashes	172	93	104	145	97	150	107	103	74	77

PennDOT Bradford County Crash Report *(PennDOT, 2019)*										
Year --->	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Crashes Involving a 16-17-Year-Old Driver	54	49	49	44	45	38	37	37	33	43
Crashes Involving a 16-Year-Old Driver	14	14	14	12	11	10	9	10	10	9
Crashes Involving a 17-Year-Old Driver	41	35	36	34	34	28	28	27	24	35
Drowsy/Asleep Driver Crashes	9	10	23	26	26	15	16	17	14	14
Vehicle Failure Related Crashes (any factor)	31	29	44	47	41	28	26	33	20	25

4.3.21.4 Future Occurrence

Automobile accidents occur frequently, and typically occur more frequently than rail or aviation accidents. The most traveled roadways in Bradford County are U.S. Route 6 and 220, and State Routes 14 and 414 (see *Figure 53 - Major Transportation Routes*). Additionally, these roadways are also the most traveled by heavy freight vehicles which can often carry hazardous materials.

The average rate of aviation accidents occurs at a rate of one per 1.2 million flights; with the chances of dying in a plane crash at 1 in 11 million. The likelihood of an aviation incident in Bradford County is considered low; however, past events show that they are not impossible. While they are also infrequent, railroad accidents are considered more likely to affect larger areas of population and/or the environment.

The probability of transportation accidents is characterized as highly likely as defined by the risk factor methodology probability criteria. An overall risk factor of 2.8 has been determined by the local planning team using this methodology.

4.3.21.5 Vulnerability Assessment

The combination of high traffic volume and severe winter weather in the county increase the chances of traffic accidents occurring. Vulnerability for highway accidents falls within a ¼ mile of Interstate and US highways. Bradford County is also prone to aviation incidents in municipalities in close proximity to the Bradford County Airport. The major railways in Bradford County run in close proximity to the Susquehanna River, meaning if a rail incident caused a hazardous material spill, the spill could enter the Susquehanna River and the environmental impact could be far reaching.

Table 60 - Transportation Vulnerability shows the number of highway and airport transportation vulnerable addressable structures and critical facilities by municipality. Highways used for this analysis include US Route 6, 220 as well as State Routes 14, 154, 187, 199, 367, 409, 414, 467, 514, 549, 706. Those cells without any entries have no critical facilities or addressable structures according to this analysis.

Table 60 - Transportation Vulnerability

Transportation Vulnerability *(Bradford Co GIS, 2019)*				
Municipality	**1/4 Mile of Major Roads**		**5 Miles of Bradford Airport**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
Alba Borough	70			
Albany Township	143			
Armenia Township				
Asylum Township	221	3	505	3
Athens Borough	1,513	12		
Athens Township	600	6		
Burlington Borough	70	1		
Burlington Township	90		47	
Canton Borough	996	11		
Canton Township	554	7		
Columbia Township	157	1		
Franklin Township	179	1	11	
Granville Township	165	1		
Herrick Township	2			
Leraysville Borough	129	3		
Leroy Township	179	1		
Litchfield Township				
Monroe Borough	260	2	265	2
Monroe Township	294	1	575	2
New Albany Borough	188	1		
North Towanda Township	598	14	669	16
Orwell Township	214	3		
Overton Township				
Pike Township	77	1		
Ridgebury Township				
Rome Borough	224	2		
Rome Township	159			
Sayre Borough	1,541	13		
Sheshequin Township			64	
Smithfield Township				
South Creek Township	341	2		
South Waverly Borough	83			
Springfield Township	1			
Standing Stone Township	69	1	87	
Stevens Township	137	1		
Sylvania Borough	101			
Terry Township	128			
Towanda Borough	1,684	15	1,775	17
Towanda Township	282	3	588	4

Transportation Vulnerability *(Bradford Co GIS, 2019)*				
Municipality	**1/4 Mile of Major Roads**		**5 Miles of Bradford Airport**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
Troy Borough	713	13		
Troy Township	491	10		
Tuscarora Township	197			
Ulster Township	351	3		
Warren Township	149			
Wells Township	1			
West Burlington Township	87	4		
Wilmot Township	121	2		
Windham Township	139	1		
Wyalusing Borough	443	7		
Wyalusing Township	435	7		
Wysox Township	619	4	818	6
Total	**15,195**	**157**	**5,404**	**50**

4.3.22. Urban Fire and Explosions

4.3.22.1 Location and Extent

An urban fire involves a structure or property within an urban or developed area. A primary concern is a major urban fire involving large buildings and/or multiple properties. Minor to significant property damage, loss of life, and residential or business displacement are the effects of a major urban fire. Urban fires spread easily from building to building in denser areas. In areas with a significant proportion of building over fifty-years of age, urban fires are a significant threat.

Explosions are extremely rapid releases of energy that usually generate high temperatures and often lead to fire. Careful management of flammable and explosive hazardous materials could reduce the risk of severe explosions.

Urban fires and explosions are often a result of other hazards, particularly storms, lightning strikes, drought, transportation accidents, hazardous materials releases, utility emergencies, criminal activity (arson), and terrorism. In denser populated areas, fires can easily spread from building to building.

4.3.22.2 Range of Magnitude

Bradford County is a rural county. Of the fifty-one municipalities in Bradford County, fourteen are boroughs. There are twenty-seven fire departments providing fire coverage to the county, *Table 61 - Fire Coverage Providers by Municipality* shows the breakdown.

Table 61 - Fire Coverage Providers by Municipality

Fire Coverage Providers by Municipality (Bradford County Data Resource Book, 2012)	
Municipality	**Fire Coverage Provider/s**
Alba Borough	Canton Fire Department
Albany Township	New Albany Volunteer Fire Department Dushore Volunteer Fire Department
Armenia Township	Troy Volunteer Fire Department
Asylum Township	Wysox Volunteer Fire Department
Athens Borough	Athens Borough Fire Department
Athens Township	Athens Township Volunteer Fire Department
Burlington Borough	Troy Fire Department
Burlington Township	Troy Fire Department East Smithfield Fire Department North Towanda Fire Department Franklindale Fire Department
West Burlington Twp.	Troy Fire Department East Smithfield Fire Department
Canton Borough	Canton Fire Department
Canton Township	Canton Volunteer Fire Company
Columbia Township	Troy Volunteer Fire Company
Franklin Township	Franklin Township Volunteer Fire Company
Granville Township	Troy Fire Department
Herrick Township	Herrickville Volunteer Fire Department
LeRaysville Borough	LeRaysville-Pike Volunteer Fire Company
LeRoy Township	Canton Volunteer Fire Department
Litchfield Township	Litchfield Volunteer Fire Department
Monroe Borough	Monroe Hose Company
Monroe Township	Monroe Hose Fire Company
New Albany Borough	New Albany Volunteer Fire Company
Orwell Township	Herrick Township Volunteer Fire Department LeRaysville-Pike Volunteer Fire Department Vigilante Volunteer Fire Department
Overton Township	New Albany Volunteer Fire Company
Pike Township	LeRaysville-Pike Volunteer Fire Department
Ridgebury Township	Ridgebury Volunteer Fire Company
Rome Borough	Vigilante Engine Company
Rome Township	Vigilante Engine Company
Sayre Borough	Sayre Borough Volunteer Fire Department
Sheshequin Township	Ulster Sheshequin Fire Company
Smithfield Township	Smithfield Township Volunteer Fire Department

Fire Coverage Providers by Municipality *(Bradford County Data Resource Book, 2012)*	
Municipality	**Fire Coverage Provider/s**
South Creek Township	South Creek Volunteer Fire Company
South Waverly Borough	South Waverly Volunteer Fire Department
Springfield Township	Oscoluwa Engine Hose Smithfield Township Volunteer Fire Department Ridgebury Township Volunteer Fire Company
Standing Stone Township	Wysox Volunteer Fire Company
Stevens Township	LeRaysville-Pike Volunteer Fire Company
Sylvania Borough	Troy Volunteer Fire Department
Terry Township	Wyalusing Volunteer Fire Department New Albany volunteer Fire Department Wilmot Volunteer Fire Department
Towanda Borough	Towanda Fire Department
Towanda Township	Towanda Fire Department
North Towanda Township	North Towanda Fire and Rescue
Troy Borough	Troy Volunteer Fire Department
Troy Township	Troy Volunteer Fire Department
Tuscarora Township	Wyalusing Valley Volunteer Fire Company Laceyville Goodwill Company
Ulster Township	Ulster Sheshequin Fire Company
Warren Township	Warren Township Volunteer Fire Company
Wells Township	Millerton Fire Department Big Elm Fire Department
Wilmot Township	Wilmot Fire Company
Windham Township	Windham Township Volunteer Fire Company
Wyalusing Borough	Wyalusing Valley Volunteer Fire Department
Wyalusing Township	Wyalusing Valley Volunteer Fire Department
Wysox Township	Wysox Volunteer Fire Department

Severe urban fires result in extensive damage to residential, commercial, and/or public property. Damages range from minor smoke and/or water damage to the destruction of buildings. Following a fire or explosion, people can be displaced for several months to years depending on the magnitude of the event. Urban fires and explosions can also cause injuries and death.

Economic consequences related to urban fires and explosions could be:

- Lost wages due to temporary or permanent closure of businesses;
- Destruction and damage to business and personal assets;
- Loss of tax base;
- Recovery costs;

- Lost investments on destroyed property.

Secondary effects of urban fire and explosion events relates to the ability of public, private, and non-profit entities to provide post-incident relief.

4.3.22.3 Past Occurrence

Bradford County has not had any Presidential or Gubernatorial disaster emergency declarations or proclamations for urban fires and explosions, nor has received Small Business Administration Loan Assistance for fires. *Table 62 - Fires and Explosions in Bradford County* lists all the structure fires and explosions within Bradford County as identified on Knowledge Center between October 26, 2012 and January 18, 2019.

Table 62 - Fires and Explosions in Bradford County

Fires and Explosions in Bradford County ***(Knowledge Center, 2019)***		
Date	**Municipality/Location**	**Event**
11/09/2012	North Towanda Township	Dumpster fire
11/14/2012	Rome Township	Barn fire
11/19/2012	Athens Township	Structure fire
11/26/2012	Rome Township	Oven fire
11/28/2012	Wyalusing Township	Automatic fire alarm
11/29/2012	Orwell Township	Structure fire
12/12/2012	Athens Township	Industrial fire
12/13/2012	North Towanda Township	Automatic fire alarm
12/15/2012	Canton Township	Structure fire
12/20/2012	Sayre Borough	Automatic fire alarm
12/21/2012	Athens Township	Automatic fire alarm
01/10/2013	Athens Borough	Automatic fire alarm
01/15/2015	Granville Township	Structure fire
01/23/2013	Sheshequin Township	Structure fire
01/27/2013	Smithfield Township	Structure fire
01/30/2013	North Towanda Township	Structure fire
01/30/2013	Rome Township	Structure fire
01/31/2013	Troy Borough	Structure fire
02/11/2013	Bradford County	Structure fire
02/13/2013	South Creek Township	Structure fire
02/19/2013	Bradford County	Structure fire
02/22/2013	Bradford County	Structure fire
02/26/2013	Bradford County	Structure fire
03/11/2013	Bradford County	Structure fire
03/12/2013	Bradford County	Structure fire

Fires and Explosions in Bradford County ***(Knowledge Center, 2019)***		
Date	**Municipality/Location**	**Event**
03/14/2013	Bradford County	Structure fire
03/15/2013	Bradford County	Chimney fire
03/19/2013	Towanda Township	Structure fire
03/19/2013	Bradford County	Garage fire
04/02/2013	Sayre Borough	Stove fire
04/03/2013	Bradford County	Structure fire
04/09/2013	Memorial Personal Care Home	Smoke in structure
05/07/2013	Litchfield Township	Structure fire
05/16/2013	Bradford County	Garage fire w/injuries
06/02/2013	Bradford County	Structure fire
06/05/2013	Herrick Township	Motor home fire
06/05/2013	Bradford County	Structure fire
06/14/2013	Bradford County	Electrical fire
06/23/2013	Athens area	Structure fire
06/29/2013	NASCO Cabinetry	Structure fire
09/16/2013	Wyalusing Borough	Garage fire
09/28/2013	Columbia Township	Structure fire
11/03/2013	Leroy Township	Structure fire
11/07/2013	Ulster Township	2nd- Alarm structure fire
01/13/2014	Leroy Township	Structure fire
01/13/2014	Ridgebury Township	Structure fire
01/27/2014	Standing Stone Township	Pole barn fire
02/01/2014	Terry Township	Structure fire
02/06/2014	Ridgebury Township	Structure fire
02/12/2014	Athens Borough	Structure fire
02/12/2014	Bradford County	Automatic fire alarm
02/28/2014	Franklin Township	Structure fire
03/06/2014	Bradford County	Structure fire
03/07/2014	GTP	Explosion
03/21/2014	Bradford County	Structure fire
03/29/2014	Bradford County	Structure fire
04/25/2014	Standing Stone Township	Structure fire
04/29/2014	Terry Township	Structure fire
05/23/2014	Bradford County	Fire in a basement
06/12/2014	Stevens Township	Structure fire
07/08/2014	Athens Township	Trailer fire

Fires and Explosions in Bradford County ***(Knowledge Center, 2019)***		
Date	**Municipality/Location**	**Event**
07/18/2014	Bradford County	Garage and apartment fire
08/11/2014	Troy Borough	Structure fire
08/25/2014	Smithfield Township	Garage fire
10/03/2014	Sheshequin Township	Silo fire
11/03/2014	Stevens Township	Fire with firefighter injury
11/12/2014	Bradford County	Industrial structure fire
11/25/2014	Bradford County	Structure fire
11/29/2014	Bradford County	Structure fire
12/10/2014	Bradford County	Trailer fire
12/13/2014	Towanda Borough	Structure fire
12/15/2014	Bradford County	Chimney fire
12/18/2014	Bradford County	Structure fire
12/21/2014	Bradford County	Chimney fire with firefighter injury
01/05/2015	Springfield Township	Structure fire
02/10/2015	South Creek Township	Structure fire
02/12/2015	Bradford County	Structure fire
02/15/2015	Litchfield Township	Structure fire
02/19/2015	Troy Township	Structure fire
02/21/2015	Troy Township	Structure fire
02/21/2015	Ulster Township	Structure fire
02/21/2015	Ulster Township	Structure fire
02/21/2015	Albany Borough	Structure fire
02/22/2015	Franklin Township	Structure fire
02/25/2015	Bradford County	House trailer fire
03/02/2015	Towanda Borough	Structure fire
03/02/2015	Granville Township	Trailer fire
03/08/2015	Warren Township	Trailer fire
03/12/2015	Litchfield Township	Structure fire
03/12/2015	Monroe Township	Structure fire
03/23/2015	Athens Borough	Structure fire
04/05/2015	Windham Township	Structure fire
04/19/2015	Athens Borough	Fatal garage fire
05/19/2015	Bradford County	Industrial fire
05/24/2015	Litchfield Township	Structure fire
06/23/2015	Canton Township	Structure fire
06/26/2015	Athens Township	Structure fire

Fires and Explosions in Bradford County ***(Knowledge Center, 2019)***		
Date	**Municipality/Location**	**Event**
08/08/2015	West Burlington Township	Fire
09/17/2015	Smithfield Township	Structure fire
10/18/2015	Troy Township	Structure fire
11/04/2015	Sayre Borough	Structure fire
11/15/2015	Bradford County	Structure fire
11/15/2015	Bradford County	Structure fire
11/22/2015	Bradford County	Structure fire
12/17/2015	Asylum Township	Fire
12/18/2015	Asylum Township	Fire
12/23/2015	Monroe Borough	Structure fire
01/10/2016	Union Township	Structure fire
01/19/2016	South Creek Township	Structure fire
01/20/2016	Ridgebury Township	Barn fire
01/28/2016	South Creek Township	Structure fire
01/29/2016	Bradford County	Structure fire
01/31/2016	Springfield Township	Structure fire
02/12/2016	Smithfield Township	Chimney fire
02/20/2016	Smithfield Township	Barn fire
02/29/2016	Monroe Township	Fire
03/20/2016	Monroe Township	Structure fire
03/20/2016	Towanda Borough	Structure fire
03/21/2016	Springfield Township	Chimney fire
04/11/2016	Towanda Borough	Structure fire
05/16/2016	Orwell Township	School fire
06/18/2016	Bradford County	Structure fire
06/21/2016	Sayre Borough	Structure fire
06/25/2016	Franklin Township	Structure fire
07/17/2016	Sayre Borough	Fire
07/26/2016	Sayre Borough	Structure fire
08/08/2016	Bradford County	Structure fire
08/12/2016	Towanda Borough	Structure fire
08/25/2016	Bradford County	Duct work fire
09/19/2016	Bradford County	Structure fire
10/27/2016	Smithfield Township	Structure fire
11/12/2016	Bradford County	Structure fire
11/14/20916	Athens Township	Structure fire

Fires and Explosions in Bradford County ***(Knowledge Center, 2019)***		
Date	**Municipality/Location**	**Event**
11/21/2016	Wilmot Township	Structure fire
12/14/2016	Sheshequin Township	Structure fire
12/18/2016	Ridgebury Township	Structure fire
12/21/2016	Terry Township	Structure fire
12/24/2016	Towanda Borough	Structure fire on N. Main Street
12/31/2016	Rome Township	Structure fire
01/04/2017	Athens Township	Fire
02/03/2017	Sayre Borough	Structure fire
02/04/2017	Orwell Township	Structure fire
02/06/2017	Canton Township	Structure fire
02/06/2017	Granville Township	Barn fire
02/20/2017	Bradford County	Gas line explosion
02/20/2017	Rome Borough	Structure fire
02/20/2017	Orwell Township	Structure fire
03/14/2017	South Waverly Borough	Structure fire
03/15/2017	Springfield Township	Structure fire
03/17/2017	GTP Plant	Structure fire
03/23/2017	West Burlington Township	Chimney fire
04/25/2017	Athens Township	Chimney fire
04/30/2017	Asylum Township	Structure fire
05/08/2017	GTP	Structure fire
06/01/2017	Ulster Township	Structure fire
06/07/2017	Columbia Township	Structure fire
06/18/2017	Herrick Township	Structure fire
09/23/2017	Athens Township	Commercial structure fire
10/01/2017	Bradford County	Smoke in an apartment building
10/07/2017	Ulster Township	Fire
10/16/2017	Wyalusing Township	Structure fire
11/08/2017	Canton Township	Structure fire
11/13/2017	Sheshequin Township	Structure fire
12/30/2017	Sheshequin Township	Structure fire
01/04/2018	Columbia Township	Structure fire
01/06/2018	Jeld-Wen, Wysox Township	Structure fire
01/26/2018	Wysox Township	Structure fire
01/31/2018	Bradford County	Barn fire
02/28/2018	Asylum Township	Structure fire

Fires and Explosions in Bradford County *(Knowledge Center, 2019)*		
Date	**Municipality/Location**	**Event**
03/06/2018	Canton Township	Barn fire
03/16/2018	Smithfield Township	Structure fire
03/19/2018	Wilmot Township	Vehicle fire in a structure
03/25/2018	Franklin Township	Gas pad explosion
04/08/2018	Granville Township	Structure fire
04/21/2018	Leroy Township	Structure fire
04/23/2018	Franklin Township	Structure fire
05/02/2018	Bradford County	Brush fire and working structure fire
05/05/2018	Windham Township	Garage fire
05/08/2018	Wyalusing Township	Structure fire
05/20/2018	Franklin Township	Structure fire
06/11/2018	Wyalusing Township	Structure fire
06/15/2018	Columbia Township	Structure fire
06/23/2018	Bradford County	Structure fire
06/25/2018	Bradford County	Structure fire
06/26/2018	Stevens Township	Structure fire
07/11/2018	Tuscarora Township	Structure fire
07/17/2018	Bradford County	Structure fire
07/20/2018	Pike Township	Structure fire
07/30/2018	Smithfield Township	Structure fire
07/30/2018	West Burlington Township	Structure fire
08/27/2018	Towanda Borough	Structure fire
08/27/2018	Athens Township	Structure fire
08/29/2018	Sayre Borough	Structure fire
09/03/2018	Franklin Township	Structure fire
09/09/2018	Rome Township	Structure fire
10/02/2018	Litchfield Township	Structure fire (rekindled 10/03/2018)
10/18/2018	Bradford County	Possible structure fire
10/30/2018	Smithfield Township	Structure fire
11/01/2018	Franklin Township	Chimney fire
11/01/2018	Canton Borough	Apartment fire
11/10/2018	Ulster Township	Structure fire
11/11/2018	Rome Township	Garage fire
12/10/2018	Troy Township	Structure fire
12/14/2018	Litchfield Township	Structure fire
12/22/2018	Bradford County	Structure fire

Fires and Explosions in Bradford County *(Knowledge Center, 2019)*		
Date	**Municipality/Location**	**Event**
12/27/2018	Bradford County	Structure fire
01/09/2019	Franklin Township	Structure fire
01/16/2019	South Creek Township	Structure fire

Ulster Township had two fires in one day approximately 4-hours apart on February 21, 2015. That same day there was another structure fire in Albany Borough.

4.3.22.4 Future Occurrence

It is difficult to predict urban fires or explosions. Bradford County is likely to experience an urban fire or explosion; however, minor events are more likely to happen than major fires or explosions.

4.3.22.5 Vulnerability Assessment

Forty-three of the fifty-one municipal governments in Bradford County enforce the Commonwealth of Pennsylvania's statewide Uniform Construction Code. These forty-three municipalities entered into an agreement with the Code Inspections, Inc. through with the Eastern and Western Council of Governments.

Urban fires are a significant threat in denser areas with a significant proportion of buildings over fifty years of age. Bradford County Comprehensive Plan Update adopted August 2016 reports; with compiled data from the U.S. Census Bureau and information from the Bradford County Housing Market report prepared in 2014 reflects the Marcellus Shale and economic trends:

- Since 2000, Bradford County added over 1,400 housing units.
- An estimated 19% of the total housing units are vacant (prevalence of seasonal homes accounting for nearly 12%).
- Housing units constructed:
    - 34% prior to 1940
    - 35% between 1940 to 1980
    - 31% after 1980

The Bradford County Comprehensive Plan Update also reports there are five municipalities within the county with over 2,000 residents. The U.S. Census published this data in the 2012-2016 American Community Survey 5-Year Estimates. These municipalities are:

- Sayre Borough 5,467
- Athens Township 5,145
- Athens Borough 3,287
- Towanda Borough 2,848

- Ridgebury Township 2,097

The three boroughs listed are at a higher risk for urban fire and explosion hazards due to the density and proximity of buildings.

4.3.23. Utility Interruptions

4.3.23.1 Location and Extent

Utility interruptions in Bradford County focus primarily on power failures; which are often a secondary impact of another hazard event. For example, severe thunderstorms high winds or winter storms could bring down power lines and cause widespread disruptions to electric service. Strong heat waves may result in rolling blackouts where power may not be available for an extended period. Traffic accidents or wind damage may cause local outages.

Utility interruptions can occur throughout the county and may include communications failures and water supply issues.

4.3.23.2 Range of Magnitude

Bradford County is a rural county, with fifty-one municipalities. Most severe power failures or outages are regional events. A loss of electricity can have numerous impacts including, but not limited to food spoilage, loss of heat or air conditioning, basement flooding (i.e. sump pump failure), lack of indoor lighting, loss of water supply (i.e. well pump failure) and lack of phone or Internet service. These issues are often more of a nuisance than a hazard but can cause damage or harm depending on the population affected and the severity of the outage. Utility interruptions can affect those with medical conditions and/or the very young or very old (i.e. those on home oxygen, CPAP machines, etc.). A possible worst-case scenario would be a power outage lasting several days.

Communication failures occur locally and across the entire county. The worst-case scenario for a communications failure is the loss of 911 phone lines. With the loss of 911 phone lines, those in need of emergency help are unable to quickly get assistance.

4.3.23.3 Past Occurrence

Bradford County has minor outages of electric and phone service annually. Fires, transportation accidents and severe weather conditions can also cause localized outages to phone and power supply.

Table 63 - Utility Outages

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
11/21/2012	Odor of gas	Canton Township
11/30/2012	Power outage	Canton Borough
12/06/2012	Electrical fire	Warren Township

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
02/11/2013	Oder investigation	Sayre Borough
03/18/2013	Gas leak in a residence	Bradford County
04/09/2013	Frontier phone outage	Bradford County
04/17/2013	Phone outage	Bradford County
05/14/2013	Phone outage	Bradford County
05/14/2013	Power outage	Bradford County
05/16/2013	Phone outage	Bradford County
05/19/2013	Phone outage	Bradford County
05/22/2013	Frontier phone outage	Towanda area
06/19/2013	Phone outage	Bradford County
06/25/2013	Phone outage	Bradford County
07/23/2013	Live wires down	Wyalusing Borough
07/26/2013	Power outage	Wysox Township
07/26/2013	Phone outage	Wysox Township
07/28/2013	Phone outage	Towanda Borough
07/30/2013	Phone outage	Towanda Borough
08/06/2013	Power outage	Sayre Borough
08/19/2013	Water main break	Troy Borough
08/26/2013	Phone outage	Towanda area
08/31/2013	Phone outage	Overton Township
09/03/2013	Wires down	Springfield Township
09/14/2013	Phone outage	Stevens Township
09/22/2013	Water system	Towanda Borough
09/26/2013	Phone outage	Bradford County
10/03/2013	Phone outage	Tuscarora Township
10/11/2013	Boil water advisory	Troy Borough
10/13/2013	Verizon phone issues	Bradford County
10/23/2013	Phone outage	Towanda area
11/05/2013	Water main repair	Troy Brough
11/16/2013	Issues dialing 911	Ridgebury Township
12/16/2013	Power outage	Ridgebury Towns

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
01/05/2014	Phone outage	Columbia Township
01/07/2014	Phone outage	Columbia Township
01/07/2014	Phone outage	Monroe Township
01/07/2014	Power outage	Columbia Township
01/11/2014	Phone outage	Columbia Township
01/20/2014	Power outage	Ridgebury Township
01/26/2014	Phone outage	Canton area
01/27/2014	Power outage	Stevens Township
02/07/2014	Water main break	Guthrie Health
02/13/2014	Gas line leak	Bradford County
03/23/2014	Medical gas shutdown	Sayre Borough
03/30/2014	Power outage	Bradford County
03/31/2014	Phone outage	Bradford County
03/31/2014	Power outage	Bradford County
04/07/2014	Phone outage	Leraysville Borough
04/15/2014	Power outage	South Waverly Borough
05/01/2014	Phone outage	Bradford County
05/14/2014	Phone outage	Bradford County
06/13/2014	Phone outage	Columbia Township
06/14/2014	Phone outage	Windham Township
06/19/2014	First Energy power outage	Bradford County
07/13/2014	Power outage	Bradford County
07/14/2014	Phone outage	Austinville
07/18/2014	Power outage	Wysox Township
07/24/2014	Natural gas odor	Windham Township
08/04/2014	Power outage	Athens Township
08/06/2014	Phone outage	Bradford County
08/13/2014	Phone outage	Bradford County
08/19/2014	Phone outage	Leraysville Borough
08/21/2014	Phone outage	Stevens Township
09/23/2014	Contaminated water	Windham Township

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
09/30/2014	Phone outage	Bradford County
10/03/2014	Phone outage	Sayre Borough
10/04/2014	Power outage	Towanda area
10/17/2014	Power outage	Troy Borough
11/06/2014	Water main break	Bradford County
11/06/2014	Water loss	Troy Borough
11/22/2014	Phone outage	Bradford County
12/14/2014	Power outage	Bradford County
01/08/2015	Power outage	Bradford County
01/14/2015	Water main break	Towanda Borough
01/14/2015	Water main break	Bradford County
01/20/2015	Gas leak	Sayre Borough
01/25/2015	Phone outage	Overton Township
02/09/2015	Power outage	Franklin Township
02/19/2015	Phone outage	Bradford County
02/19/2015	Water line break	Sayre Borough
02/25/2015	Frozen water lines	Bradford County
02/25/2015	Power outage	Rome Township
03/03/2015	Water main leak	North Towanda Township
03/20/2015	Power Outage	New Albany Borough
03/26/2015	Power outage/brown out	Sayre Borough
04/06/2015	Power outage	Athens Borough
04/06/2015	Phone outage	Bradford County
04/21/2015	Phone outage	Bradford County
04/24/2015	Power outage	Canton, Granville, Leroy areas
05/19/2015	Phone outage	Towanda Borough
05/27/2015	Water main break	Troy Borough
06/05/2015	Phone outage	Austinville area
06/08/2015	Phone outage	265 and 268 exchange
06/08/2015	Phone outage	Rome Township
06/23/2015	Frontier Phone outage	Bradford County

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
06/23/2015	Long-distance phone outage repair	Sayre Borough
06/26/2015	Phone outage	Rome Township
06/27/2015	Phone outage	Windham Township
06/29/2015	NC-RPH PACS system outage	Sayre Borough
07/05/2015	Water line break	Sayre Borough
07/07/2015	Phone outage	Towanda Borough
07/10/2015	Power outage	Bradford County
07/16/2015	Phone outage	Towanda area
07/18/2015	Phone outage	Bradford County
08/09/2015	Phone outage	Rome area
08/10/2015	Phone lines down	Bradford County
08/31/2015	Phone outage	Towanda area
09/26/2015	Paging system complications	Sayre Borough
10/13/2015	Wysox Substation Repairs	Wysox Township
10/21/2015	Phone outage	Towanda area
10/30/2015	Phone outage	Bradford County
11/02/2015	Power outage	Towanda Township
11/10/2015	Planned electric outage	Bradford County jail
11/05/2015	Water line leak	Troy Borough
11/17/2015	Phone outage	Herrickville area
12/27/2015	Power outage	Bradford County
12/31/2015	Phone outage	Wysox Township
01/10/2016	Power outage	Wysox Township, Sayre Borough
01/10/2016	Phone outage	Bradford County
01/26/2016	911 cell tower failure	Bradford County
02/01/2016	Domestic water break	Sayre Borough
02/03/2016	Phone outage	Bradford County
02/16/2016	Phone outage	Towanda area
02/24/2016	Phone outage	Wyalusing Township
03/18/2016	Boil water advisory	North Towanda Township
04/03/2016	Phone outage	Wyalusing Township

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
04/03/2016	Power outage	Bradford County
05/04/2016	911 trunk line outage	Bradford County
05/30/2016	Phone outage	Towanda area
06/01/2016	Frontier Phone outage	Tuscarora Township
06/16/2016	Power outage	Bradford County
07/18/2016	Phone outage	Troy area
08/18/2016	Planned power outage	W. Sayre Substation
08/23/2016	Planned power outage	Sayre Substation
08/25/2016	Frontier phone outage	Bradford County
09/02/2016	Frontier phone outage	Bradford County
09/12/2016	Phone outage	Windham Township
09/22/2016	Power interruption	Towanda Borough
10/15/2016	Water main break	Towanda Borough
10/24/2016	Power outage	North Towanda Township
10/25/2016	Natural gas leak	Springfield Township
10/26/2016	Phone outage	East Troy area
10/30/2016	Phone outage	Tuscarora Township
11/13/2016	Phone outage	Bradford County
11/19/2016	Power outage NC Hospital -RPH	Sayre Borough
12/20/2016	Phone system issues	Sayre Borough
02/22/2017	Phone outage	Columbia Township
03/01/2017	Phone outage	Columbia Township
03/06/2017	Phone outage	Warren Township
03/19/2017	Phone outage	Towanda area
03/20/2017	Phone outage	Leroy Township
04/07/2017	Phone outage	Towanda area
04/11/2017	Phone outage	Burlington Township
04/12/2017	Phone outage	Columbia Township
04/12/2017	Power outage	Athens Borough
04/15/2017	Power outage	North Towanda Township
04/17/2017	Phone outage	Bradford County

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
04/27/2017	Water main break	Bradford County
05/01/2017	911 Phone outage	Burlington Township
05/05/2017	Phone outage	Towanda area
05/05/2017	Phone outage	Warren Township
06/01/2017	Phone outage	Stevens Township
06/03/2017	Phone outage	Bradford County
06/23/2017	Planned power outage	NC-RPH Hospital, Sayre Borough
06/25/2017	Compressor station	Stevens Township
07/02/2017	Phone outage	Wyalusing area
07/10/2017	Phone outage	Columbia Township
07/19/2017	Power issues	RPH Guthrie, Sayre Borough
07/20/2017	Phone outage	Tuscarora Township
07/24/2017	Phone outage	Warren Township
07/24/2017	Phone outage	Windham Township
08/08/2017	Utility emergency	Columbia Township
08/17/2017	Phone outage	Standing Stone Township
08/18/2017	Planned power outage	NC-RPH, Sayre Borough
08/22/2017	Phone outage	Columbia Township
08/24/2017	Phone outage	Tuscarora Township
10/01/2017	Phone outage	Troy Township
10/06/2017	Planned power outage	NC-RPH, Sayre Borough
10/09/2017	Phone outage	Wysox Township
10/24/2017	Phone outage	Tuscarora Township
11/04/2017	Phone outage	Robert Packer Hospital
11/04/2017	Phone outage	Bradford County
11/12/2017	Water main break	Towanda Borough
11/14/2017	Planned power outage	Bradford County
11/16/2017	Planned water outage	NC-RPH, Sayre Borough
11/28/2017	Frontier phone outage	Bradford County
11/29/2017	Phone outage	Troy Township
12/03/2017	Phone outage	Bradford County

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
12/12/2017	Power outage	Wysox Township
12/12/2017	Network outage	RPH/Troy/Towanda areas
12/13/2017	Phone outage	Warren Township
12/29/2017	Power and phone outages	Bradford County
01/03/2018	Phone outage	Wysox Township
01/13/2018	Phone outage	Troy Township
02/08/2018	Phone outage	Bradford County
02/26/2018	Phone outage	Monroe Township
04/07/2018	Water outage	NC-RPH, Sayre Borough
04/09/2018	Phone outage	Bradford County
04/16/2018	Phone outage	Warren Township
04/16/2018	Phone outage	Bradford County
04/16/2018	Power outage	Asylum Township
04/19/2018	Planned water outage	NC-RPH, Sayre Borough
04/27/2018	Power outage	Bradford County
05/04/2018	Phone outage	Bradford County
05/10/2018	Phone outage	Bradford County
05/17/2018	Phone outage	Warren Township
05/21/2018	Phone outage	Tuscarora Township
06/01/2018	Phone outage at Warren Center	Warren Township
06/03/2018	Phone outage at Warren Center	Warren Township
06/05/2018	Phone outage	Warren Township
06/06/2018	Phone outage	Tuscarora Township
06/14/2018	Phone outage	Monroe Township
06/22/2018	Phone outage	Bradford County
06/29/2018	Phone outage	Bradford County
07/06/2018	Phone outage	Warren Township
07/14/2018	Phone outage	Troy Township
07/18/2018	Frontier power outage	Bradford County
07/19/2018	Phone outage	Warren Township
07/23/2018	Phone outage	Warren Township

Utility Outages *(Knowledge Center, 2019)*		
Date	**Event**	**Location**
07/27/2018	Phone outage	Bradford County
07/30/2018	Frontier phone outage	Wyalusing area
08/03/2018	Phone outage	Tuscarora Township
08/11/2018	Phone outage	Asylum Township
08/12/2018	Frontier phone outage	Troy Township
08/12/2018	Phone outage	Asylum Township
08/14/2018	Phone outage	Troy Township
08/16/2018	Frontier phone outage	Bradford County
08/17/2018	Phone outage	Bradford County
08/22/2018	Phone outage	Tuscarora Township
09/02/2018	Phone outage	Albany Township
09/04/2018	Frontier outage	Bradford County
09/10/2018	Phone outage	Stevens and Warren townships
09/11/2018	Power issues	NC-RPH, Sayre Borough
09/15/2018	Phone outage	Asylum Township
09/15/2018	Phone outage	Burlington Township
10/21/2018	Phone outage	Warren Township
10/23/2018	Phone outage	Tuscarora Township
10/23/2018	Power outage	Bradford County
10/28/2018	Frontier outage	Bradford County
11/01/2018	Frontier outage	Bradford County
11/01/2018	Phone outage	Warren Township
11/02/2018	Phone outage	Stevens and Troy townships
11/03/2018	Planned water outage	NC-RPH, Sayre Borough
11/06/2018	Frontier outage	Tuscarora Township
12/02/2018	Power outage	Bradford County
12/02/2018	Phone outage	Asylum Township
01/08/2019	Phone outage	Monroe Township
01/10/2019	Phone outage	Warren Township

Most events listed above are phone outages. Of Bradford County's fifty-one municipalities; those not identified in the Knowledge Center events log are: Alba, Burlington, Monroe, Rome, and Sylvania boroughs; Armenia, Herrick, Litchfield, Orwell, Pike, Sheshequin, Smithfield, South Creek, Terry, Ulster, Wells, West Burlington, and Wilmot townships.

The worst events noted were:

- Phone services interrupted for 13 days in Troy Township on January 13, 2018 to January 26, 2018.
- 9-1-1 phone service interrupted for four days in Burlington Township from May 1, 2017 to May 5, 2017.
- Power services interrupted for nine days in Franklin Township from February 9, 2015 to February 18, 2015.
- A boil water advisory for six days in Troy Borough from October 11, 2013 to October 17, 2013.

4.3.23.4 Future Occurrence

It is difficult to predict when and where utility interruptions will occur. Minor utility interruption events (i.e. short outages) may occur several times a year for any given area within the county; while major (i.e. widespread, long-term outages) events take place once every few years. Interruptions to utilities such as power and telephone are likely occurrences during severe weather, and residents should expect them during these types of events.

4.3.23.5 Vulnerability Assessment

All fifty-one municipalities are vulnerable to utility interruptions. Critical facilities such as emergency medical facilities, retirement homes and senior centers (see Appendix E) are particularly vulnerable to power outages. While many of these facilities use back-up generators, loss of electricity may result in hot or cold temperatures for which elderly populations are vulnerable to.

Interruptions to telephone communications (landline and/or cellular) may cause a delay in summoning emergency services. Loss of Internet connection, at the most, causes interruptions to businesses and irritation to the general population. However, as more and more homes/businesses switch to Internet based phone services, the loss of Internet affects communications.

Water supply interruptions may result in either short- or long-term boil water advisories.

4.4. Hazard Vulnerability Summary

4.4.1. Methodology

Ranking hazards helps communities set goals and priorities for mitigation based on their vulnerabilities. A risk factor (RF) is a tool used to measure the degree of risk for identified hazards in a particular planning area. The RF can also assist local community officials in ranking and prioritizing hazards that pose the most significant threat to a planning area based on a variety of factors deemed important by the planning team and other stakeholders involved in the hazard mitigation planning process. The RF system relies mainly on historical data, local knowledge, general consensus from the planning team and information collected through development of the hazard profiles included in Section 4.3. 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 were obtained by assigning varying degrees of risk to five categories for each of the hazards profiled in the HMP update. Those categories include *probability*, *impact*, *spatial extent*, *warning time and duration*. Each degree of risk was assigned a value ranging from one to four. The weighting factor agreed upon by the planning team is shown in *Table 64 - Risk Factor Approach Summary*. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the following example equation:

Risk Factor Value =
[(Probability x .30) + (Impact x .30) +(Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

Table 64 - Risk Factor Approach Summary summarizes each of the five categories used for calculating a RF for each hazard. According to the weighting scheme applied, the highest possible RF value is 4.0.

Table 64 - Risk Factor Approach Summary

Summary of Risk Factor Approach Used to Rank Hazard Risk.					
RISK ASSESSMENT CATEGORY	**DEGREE OF RISK**				**WEIGHT VALUE**
	LEVEL	**CRITERIA**		**INDEX**	
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 & 10% ANNUAL PROBABILITY		2	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY		3	
	HIGHLY LIKELY	100% 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% OF AREA AFFECTED		2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED		3	
	LARGE	BETWEEN 50 & 100% 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	*(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	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	*(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)*	1	10%
	LESS THAN 24 HRS	SELF-DEFINED		2	
	LESS THAN 1 WEEK	SELF-DEFINED		3	
	MORE THAN 1 WEEK	SELF-DEFINED		4	

4.4.2. Ranking Results

Using the methodology described in Section 4.4.1, *Table 65 - Risk Factor Assessment Hazard Ranking* lists the Risk Factor calculated for each of the twenty-three potential hazards identified in the 2020 HMP. *It should be noted that the tornado hazard and windstorm hazard were ranked individually instead of together, and flash flooding and flooding are also ranked individually*. Hazards identified as *high* risk have risk factors greater than 2.5. Risk Factors ranging from 2.0 to 2.4 were deemed *moderate* risk hazards. Hazards with Risk Factors 1.9 and less are considered *low* risk. Hazards that appear with a light blue background are natural hazards, while those with beige backgrounds are manmade hazards.

Table 65 - Risk Factor Assessment Hazard Ranking

Risk Factor Assessment Hazard Ranking							
Hazard Risk	**Hazard**	**Probability**	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**Risk Factor**
High	Emergency Response Organizations	4	4	4	1	4	**3.7**
	Addiction	4	3	4	1	4	**3.4**
	Invasive Species	4	3	4	1	4	**3.4**
	Flash Flooding	4	3	3	4	3	**3.4**
	Winter Storm	4	2	4	1	3	**3**
	Environmental Hazards	3	2	4	4	3	**3**
	Utility Interruption	4	2	3	4	2	**3**
	Pandemic, Epidemic, Infectious Disease	3	3	3	1	4	**2.9**
	Transportation Accidents	4	3	1	4	1	**2.8**
	Urban Fire and Explosions	4	2	2	4	2	**2.8**
	Flooding	2	3	4	1	4	**2.8**
	Extreme Temperatures	3	2	4	1	3	**2.7**
	Drought	2	2	4	1	4	**2.5**
	Radon Exposure	3	1	4	1	4	**2.5**
	Windstorm	3	2	3	1	3	**2.5**
	Terrorism	3	2	2	4	2	**2.5**

Risk Factor Assessment Hazard Ranking							
Hazard Risk	**Hazard**	**Probability**	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**Risk Factor**
Moderate	Hurricane/ Tropical Storm	2	2	4	1	3	**2.4**
	Earthquakes	1	2	4	4	1	**2.2**
	Civil Disturbance	2	2	1	4	2	**2**
Low	Landslides	3	1	1	1	4	**1.9**
	Tornado	1	3	1	4	1	**1.9**
	Nuclear Incidents	1	1	4	1	4	**1.9**
	Levee Failure	1	2	2	1	4	**1.8**
	Wildfire	2	1	1	4	2	**1.7**
	Dam Failure	1	1	2	4	3	**1.7**

Based on these results, there are sixteen *high* risk hazards, three *moderate* risk hazards and six *low* risk hazards in Bradford County. Mitigation actions were developed for all high, moderate and low risk hazards (see Section 6.4). The threat posed to life and property for moderate and high-risk hazards is considered significant enough to warrant the need for establishing hazard-specific mitigation actions. Mitigation actions related to future public outreach and emergency service activities are identified to address low risk hazard events.

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. *Table 66 - Countywide Risk Factor by Hazard* shows the different municipalities in Bradford County and whether their risk is greater than (>), less than (<), or equal to (=) the risk factor assigned to the county as a whole. This table was developed by the consultant based on the findings in the hazard profiles located in sections 4.3.1 through 4.3.23.

Table 66 - Countywide Risk Factor by Hazard

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk																
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR																
JURISDICTION	Emergency Response Organizations (M)	Addiction (M)	Invasive Species (N)	Flash Flooding (N)	Winter Storm (N)	Environmental Hazards (M)	Utility Interruption (M)	Pandemic, Epidemic, Infectious Disease (N)	Transportation Accidents (M)	Urban Fire and Explosions (M)	Flooding (N)	Extreme Temperatures (N)	Drought (N)	Radon Exposure (N)	Windstorm (N)	Terrorism (M)
	3.7	***3.4***	***3.4***	***3.4***	***3***	***3***	***3***	***2.9***	***2.8***	***2.8***	***2.8***	***2.7***	***2.5***	***2.5***	***2.5***	***2.5***
Alba Borough	<	=	=	=	=	=	=	=	=	=	=	=	=	=	=	<
Albany Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Armenia Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Asylum Township	=	<	=	<	=	=	<	>	<	=	***N/A***	>	>	>	=	>
Athens Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	<	=
Athens Township	=	=	=	>	=	=	=	=	>	=	>	=	=	=	=	=
Burlington Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Burlington Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Canton Borough	<	<	=	=	>	>	>	<	>	<	>	>	=	<	>	<
Canton Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Columbia Township	=	=	=	=	<	<	=	<	<	<	>	=	=	=	=	=
Franklin Township	>	=	=	=	<	=	=	=	=	=	>	=	=	=	>	=
Granville Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Herrick Township	=	=	=	=	=	=	=	<	=	<	=	=	=	=	=	=
Leraysville Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Leroy Township	=	=	<	=	=	=	=	=	=	<	***N/A***	=	=	=	=	<
Litchfield Township	=	=	=	<	<	>	=	=	<	>	=	=	=	=	<	>
Monroe Borough	=	=	=	=	=	=	=	=	=	=	>	=	=	=	>	=
Monroe Township	=	=	=	=	=	=	=	=	=	=	=	=	<	<	>	=
New Albany Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
North Towanda Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Orwell Township	=	=	=	=	=	=	=	<	=	<	=	=	=	=	=	=
Overton Township	=	<	=	=	=	=	=	<	<	<	=	=	=	=	=	<
Pike Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Ridgebury Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Rome Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Rome Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk

IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR

JURISDICTION	Emergency Response Organizations (M)	Addiction (M)	Invasive Species (N)	Flash Flooding (N)	Winter Storm (N)	Environmental Hazards (M)	Utility Interruption (M)	Pandemic, Epidemic, Infectious Disease (N)	Transportation Accidents (M)	Urban Fire and Explosions (M)	Flooding (N)	Extreme Temperatures (N)	Drought (N)	Radon Exposure (N)	Windstorm (N)	Terrorism (M)
	3.7	***3.4***	***3.4***	***3.4***	***3***	***3***	***3***	***2.9***	***2.8***	***2.8***	***2.8***	***2.7***	***2.5***	***2.5***	***2.5***	***2.5***
Sayre Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Sheshequin Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Smithfield Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
South Creek Township	=	=	=	=	=	=	=	=	>	***N/A***	>	=	=	=	***N/A***	<
South Waverly Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Springfield Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Standing Stone Township	***N/A***	=	=	=	=	=	=	=	=	<	<	=	=	=	=	<
Stevens Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Sylvania Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Terry Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Towanda Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Towanda Township	>	<	<	<	<	<	<	<	>	<	>	>	<	>	>	<
Troy Borough	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Troy Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Tuscarora Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Ulster Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Warren Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Wells Township	=	=	<	=	>	=	=	<	=	=	=	<	=	=	>	=
West Burlington Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Wilmot Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Windham Township	=	=	<	>	=	=	>	>	=	=	>	=	=	>	=	<
Wyalusing Borough	=	=	=	=	=	=	=	=	=	<	=	=	=	<	=	<
Wyalusing Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=
Wysox Township	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=	=

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Hurricane/ Tropical Storm (N)	Earthquakes (N)	Civil Disturbance (M)	Landslides (N)	Tornado (N)	Nuclear Incidents (M)	Levee Failure (M)	Wildfire (N)	Dam Failure (M)
	2.4	***2.2***	***2***	***1.9***	***1.9***	***1.9***	***1.8***	***1.7***	***1.7***
Alba Borough	>	=	<	=	=	=	=	=	=
Albany Township	=	=	=	=	=	=	=	=	=
Armenia Township	=	=	=	=	=	=	=	=	=
Asylum Township	>	>	=	=	<	>	>	>	>
Athens Borough	=	=	=	=	=	=	=	=	=
Athens Township	=	=	=	>	=	=	<	=	=
Burlington Borough	=	=	=	=	=	=	=	=	=
Burlington Township	=	=	=	=	=	=	=	=	=
Canton Borough	>	<	=	<	=	<	<	<	<
Canton Township	=	=	=	=	=	=	=	=	=
Columbia Township	***N/A***	<	<	<	=	<	<	<	<
Franklin Township	=	>	=	>	>	=	=	=	=
Granville Township	=	=	=	=	=	=	=	=	=
Herrick Township	=	=	<	=	=	<	<	<	<
Leraysville Borough	=	=	=	=	=	=	=	=	=
Leroy Township	=	=	=	=	=	=	=	=	=
Litchfield Township	>	>	>	=	<	>	>	<	>
Monroe Borough	=	=	=	=	=	=	>	=	=
Monroe Township	>	=	=	=	=	=	=	=	=
New Albany Borough	=	=	=	=	=	=	=	=	=
North Towanda Township	=	=	=	=	=	=	=	=	=
Orwell Township	=	=	<	=	=	<	<	<	<
Overton Township	=	<	<	<	=	<	<	=	<

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Hurricane/ Tropical Storm (N)	Earthquakes (N)	Civil Disturbance (M)	Landslides (N)	Tornado (N)	Nuclear Incidents (M)	Levee Failure (M)	Wildfire (N)	Dam Failure (M)
	2.4	***2.2***	***2***	***1.9***	***1.9***	***1.9***	***1.8***	***1.7***	***1.7***
Pike Township	=	=	=	=	=	=	=	=	=
Pike Township	=	=	=	=	=	=	=	=	=
Ridgebury Township	=	=	=	=	=	=	=	=	=
Rome Borough	=	=	=	=	=	=	=	=	=
Rome Township	=	=	=	=	=	=	=	=	=
Sayre Borough	=	=	=	=	=	=	=	=	=
Sheshequin Township	=	=	=	=	=	=	=	=	=
Smithfield Township	=	=	=	=	=	=	=	=	=
South Creek Township	=	=	<	=	=	=	=	=	>
South Waverly Borough	=	=	=	=	=	=	=	=	=
Springfield Township	=	=	=	=	=	=	=	=	=
Standing Stone Township	=	=	<	<	=	<	<	=	<
Stevens Township	=	=	=	=	=	=	=	=	=
Sylvania Borough	=	=	=	=	=	=	=	=	=
Terry Township	=	=	=	=	=	=	<	=	<
Towanda Borough	=	=	=	=	=	=	=	=	=
Towanda Township	<	<	<	<	<	<	<	>	<
Troy Borough	=	=	=	=	=	=	=	=	=
Troy Township	=	=	=	=	=	=	=	=	=
Tuscarora Township	=	=	=	=	=	=	=	=	=
Ulster Township	=	=	=	=	=	=	=	=	=
Warren Township	=	=	=	=	=	=	=	=	=
Wells Township	=	=	=	=	=	<	<	>	=

Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk									
IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR									
JURISDICTION	Hurricane/ Tropical Storm (N)	Earthquakes (N)	Civil Disturbance (M)	Landslides (N)	Tornado (N)	Nuclear Incidents (M)	Levee Failure (M)	Wildfire (N)	Dam Failure (M)
	2.4	***2.2***	***2***	***1.9***	***1.9***	***1.9***	***1.8***	***1.7***	***1.7***
West Burlington Township	=	=	=	=	=	=	=	=	=
Wilmot Township	=	=	=	=	=	=	=	=	=
Wilmot Township	=	=	=	=	=	=	=	=	=
Windham Township	<	=	=	<	<	<	<	>	=
Wyalusing Borough	=	<	=	<	>	<	<	<	<
Wyalusing Township	=	=	=	=	=	=	=	=	=
Wysox Township	=	=	=	=	=	=	=	=	=

4.4.3. Potential Loss Estimates

Based on various kinds of available data, potential loss estimates were established for one-hundred-year flooding events. Estimates provided in this section are based on PEMA's Digital Flood Insurance Rate Maps (DFIRMs) and Bradford County structure and assessment data. Estimates are considered *potential* in that they generally represent losses that could occur in a countywide hazard scenario. In events that are localized, losses may be lower, while regional events could yield higher losses.

Potential loss estimates have four basic components, including:

- Replacement Value: Current cost of returning an asset to its pre-damaged condition, using present-day cost of labor and materials.
- Content Loss: Value of building's contents, typically measured as a percentage of the building replacement value.
- Functional Loss: The value of a building's use or function that would be lost if it were damaged or closed.

- Displacement Cost: The dollar amount required for relocation of the function (business or service) to another structure following a hazard event.

The parcel data used in this plan includes building values provided in the county tax assessment database. These values are representative of replacement value alone; content loss, functional loss, and displacement cost are not included.

Flooding Loss Estimation:

Flash flooding is a high-risk natural hazard in Bradford County. The estimation of potential loss in this assessment focuses on the monetary damage that could result from flooding. The potential property loss was determined for each municipality and for the entire county.

MCM Consulting Group worked towards conducting a county wide flood study using the Hazards U.S. Multi-Hazard (HAZUS-MH) software that is provided by the Federal Emergency Management Agency. This software is a standardized loss estimation software deriving economic loss, building damage, content damage and other economic impacts that can be used in local flood mitigation planning activities.

Unfortunately, estimation of potential losses for Bradford County was unavailable at the time of this report due to errors encountered with the HAZUS software (version 4.2 with service pack 1). The software was unable to process stream reaches for the Susquehanna River despite efforts with HAZUS support. For stream reaches that successfully processed, no reports were available due to the software crashing. Efforts with FEMA's HAZUS support were not able to solve these fatal errors. In order to improve estimation of potential losses due to flooding in Bradford County, it is recommended that the county conduct a new HAZUS analysis when an updated version of the software becomes available.

In lieu of this analysis, MCM Consulting Group conducted a flooding loss estimate by analyzing structures located within the FEMA designated 100-year floodplain along with the assessed price of the parcels where those structures were located. The results were broken down by municipality and by assessed land use type, including residential, commercial and "other" designations which consists of industrial, agriculture, service, transportation, communication, utility, natural resources and other land uses. The reported losses should be considered minimum estimates of replacement value. Total residential estimated loss is $26.6 million, commercial estimated loss is $6.1 million, and other use estimated loss is $8.7 million. These results appear summarized by watershed below in *Table 67 - Estimated Property Losses by Watershed*, and summarized by municipality in section 4.3.4.3 *Table 16 - Repetitive Loss Properties*.

Table 67 - Estimated Property Losses by Watershed

Estimated Property Losses by Watershed (PEMA, 2018; Bradford Co. 2019)			
Watershed	**Use Type**	**Vulnerable Structures**	**Assessed Value**
Chemung River	Commercial Other Residential	125 57 453	$2,210,700 $1,830,700 $8,994,402
Mehoopany Creek	Other Commercial Other	1 18 31	$0 $1,023,900 $811,400
Sugar Creek	Commercial Other Residential	18 31 79	$1,023,900 $811,400 $2,219,800
Susquehanna River	Commercial Other Residential	20 192 162	$601,750 $2,913,900 $4,315,550
Tioga River	Other Residential Commercial	1 1 37	$146,850 $37,250 $1,162,100
Towanda Creek	Commercial Other Residential	37 72 298	$1,162,100 $1,005,550 $7,570,250
Wappasening Creek	Commercial Other Residential	9 29 44	$54,500 $656,400 $1,089,900
Wyalusing Creek	Commercial Other Residential	20 23 24	$832,750 $499,950 $683,800
Wysox Creek	Commercial Other Residential	52 39 77	$261,300 $869,000 $1,648,170
Total	**Commercial** **Other** **Residential** **Overall Total**	**281** **445** **1138** **1864**	**$6,147,000** **$8,733,750** **$26,559,122** **$41,439,872**

4.4.4. Future Development and Vulnerability

Risk and vulnerability to natural and human-caused hazard events are not static. Risk will increase or decrease as counties and municipalities see changes in land use and development as well as changes in population. Bradford County is expected to experience a variety of factors that will, in some areas, increase vulnerability to hazards while in other areas, vulnerability may stay static or even be reduced.

As of the 2018 Bradford Comprehensive Plan, land use in Bradford County was 44.2% Agriculture, 16.3% Residential, 8.7% Public/Semi-Public Use (including State Game

Lands, State Forests and State Parks), 0.8% Industrial, 0.7% Commercial, 24.2% Undeveloped Land, and 2.5% Water. Developed land (including agriculture) comprises almost three quarters (73.4%) of land area in Bradford County. Forest and agriculture are the reported leading use of land in Bradford, however natural gas exploration and extraction has increased dramatically in the last fifteen years. Bradford County has the second most active natural gas wells among states in the Commonwealth, and the extraction operations have an impact on the landscape and the County overall. This results in more extraction wells and local pipelines to transport the extracted gas. The increase has economic ramifications, but also can have marked negative effects on environmental health (See section 4.3.17). Natural gas hydraulic fracturing has been correlated with increases in seismicity as well (See section 4.3.2).

Total population in Bradford County decreased by approximately three percent from 2010 to 2017. The estimated population of Bradford County as of July 2017 was 60,853, lower from the 2016 estimate by 955 people. A full history of population trends in Bradford County can be found in *Table 68 - Countywide Population Trends*.

Recent estimates suggest that 19% of the total housing units in Bradford County are vacant, however that includes seasonal homes which account for 12% all housing units. Bradford County has experienced a significant increase in rental rates between 2005 and 2018. According to Fair Market Rental Rate figures, rental rates in Bradford County increased by 82% for efficiency units, 59% for two-bedroom, and 79% for three-bedroom units from 2005 to 2018. The coming and prevalence of the natural gas industry is considered the primary driving force behind this increase. Median value of Bradford County owner occupied housing units from 2013-2017 is estimated at $145,600.

Table 68 - Countywide Population Trends

Countywide Population Trends *(US Census, 2018; Bradford Comprehensive Plan, 2018)*			
Year	**Population**	**# Change (from previous row)**	**% Change (from previous row)**
2017	60,853	-955	-1.57%
2016	61,808	-814	-1.30%
2010	62,622	-139	-0.22%
2000	62,761	1,794	2.94%
1990	60,967	-1,952	-3.10%
1980	62,919	4,957	8.55%
1970	57,962	3,037	5.53%
1960	54,925	3,203	6.19%
1950	51,722	1,107	2.19%
1940	50,615	-	-

5. Capability Assessment

5.1. Update Process Summary

The capability assessment is an evaluation of Bradford County's governmental structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations and ordinances and resource availability. Each category is evaluated for its strengths and weaknesses in responding to, preparing for and mitigating the effects of the profiled hazards. A capability assessment is an integral part of the hazard mitigation planning process. Here, the county and municipalities identify, review and analyze what they are currently doing to reduce losses and identify the framework necessary to implement new mitigation actions. This information will help the county and municipalities evaluate alternative mitigation actions and address shortfalls in the mitigation plan.

A capabilities assessment survey was provided to the municipalities during the planning process at meetings held with Bradford County officials. These meetings were designed to seek input from key county and municipal stakeholders on legal, fiscal, technical and administrative capabilities of all jurisdictions. As such, the capabilities assessment helps guide the implementation of mitigation projects and will help evaluate the effectiveness of existing mitigation measures, policies, plans, practices and programs.

Throughout the planning process, the mitigation local planning team considered the county's fifty-one municipalities. Pennsylvania municipalities have their own governing bodies, pass and enforce their own ordinances and regulations, purchase equipment and manage their own resources, including critical infrastructure. These capability assessments, therefore, consider the various characteristics and capabilities of municipalities under study.

The evaluation of the following categories – political framework, legal jurisdiction, fiscal status, policies and programs and regulations and ordinances – allows the mitigation planning team to determine the viability of certain mitigation actions. The capability assessment analyzes what Bradford County and its municipalities have the capacity to do and provides an understanding of what must be changed to mitigate loss.

Bradford County has a number of resources it can access to implement hazard mitigation initiatives including emergency response measures, local planning and regulatory tools, administrative assistance and technical expertise, fiscal capabilities and participation in local, regional, state and federal programs. The presence of these resources enables community resiliency through actions taken before, during and after a hazardous event. While the capability assessment serves as a good instrument for identifying local capabilities, it also provides a means for recognizing gaps and weaknesses that can be resolved through future mitigation actions. The results of this assessment lend critical information for developing an effective mitigation strategy.

5.2. Capability Assessment Findings

All participating municipalities completed and submitted a capability assessment survey. The results of the survey were collected, aggregated and analyzed.

5.2.1. Planning and Regulatory Capability

Municipalities have the authority to govern more restrictively than state and county minimum requirements; as long as they are in compliance with all criteria established in the Pennsylvania Municipalities Planning Code (MPC) and their respective municipal codes. Municipalities can develop their own policies and programs and implement their own rules and regulations to protect and serve their local residents. Local policies and programs are typically identified in a comprehensive plan, implemented through a local ordinance and enforced by the governmental body or its appointee.

Municipalities regulate land use via the adoption and enforcement of zoning, subdivision and land development, building codes, building permits, floodplain management and/or storm water management ordinances. When effectively prepared and administered, these regulations can lead to an opportunity for hazard mitigation. For example, the National Flood Insurance Program (NFIP) established minimum floodplain management criteria. Adoption of the Pennsylvania Floodplain Management Act (Act 166 of 1978) established higher standards. A municipality must adopt and enforce these minimum criteria to be eligible for participation in the NFIP. Municipalities have the option of adopting a single-purpose ordinance or incorporating these provisions into their zoning, subdivision and land development, or building codes; thereby mitigating the potential impacts of local flooding. This capability assessment details the existing Bradford County and municipal legal capabilities to mitigate the profiled hazards. It identifies the county's and the municipalities' existing planning documents and their hazard mitigation potential. Hazard mitigation recommendations are, in part, based on the information contained in the assessment.

Building Codes

Building codes are important in mitigation because they are developed for a region of the country in respect to the hazards existing in that area. Consequently, structures that are built according to applicable codes are inherently resistant to many hazards, such as strong winds, floods and earthquakes; and can help mitigate regional hazards, such as wildfires. In 2003, Pennsylvania implemented the Uniform Construction Code (UCC) (Act 45), a comprehensive building code that establishes minimum regulations for most new construction, including additions and renovations to existing structures.

The code applies to almost all buildings, excluding manufactured and industrialized housing (which are covered by other laws), agricultural buildings and certain utility and

miscellaneous buildings. The UCC has many advantages. It requires builders to use materials and methods that have been professionally evaluated for quality and safety, as well as inspections to ensure compliance.

The initial election period, during which all of Pennsylvania's 2,565 municipalities were allowed to decide whether the UCC would be administered and enforced locally, officially closed on August 7, 2004. The codes adopted for use under the UCC are the 2003 International Codes issued by the International Code Council (ICC). Supplements to the 2003 codes have been adopted for use over the years since.

If a municipality has "opted in", all UCC enforcement is local, except where municipal (or third party) code officials lack the certification necessary to approve plans and inspect commercial construction for compliance with UCC accessibility requirements. If a municipality has "opted out", the PA Department of Labor and Industry is responsible for all commercial code enforcement in that municipality; and all residential construction is inspected by independent third-party agencies selected by the owner. The department also has sole jurisdiction for all state-owned buildings no matter where they are located. Historical buildings may be exempt from such inspections and Act 45 provides quasi-exclusion from UCC requirements.

The municipalities in Bradford County adhere to the standards of the Pennsylvania Uniform Construction Code (Act 45). All municipalities have opted in on building code enforcement.

Zoning Ordinance

Article VI of the Municipalities Planning Code (MPC) authorizes municipalities to prepare and enact zoning to regulate land use. Its regulations can apply to the permitted use of land; the height and bulk of structures; the percentage of a lot that may be occupied by buildings and other impervious surfaces; yard setbacks; the density of development; the height and size of signs; the parking regulations. A zoning ordinance has two parts, including the zoning map that delineates zoning districts and the text that sets forth the regulations that apply to each district. Sixteen of the fifty-one municipalities provide their own zoning enforcement. Additionally, one municipality has an airport zoning overlay surrounding the county airport.

Subdivision Ordinance

Subdivision and land development ordinances include regulations to control the layout of streets, the planning of lots and the provision of utilities and other site improvements. The objectives of a subdivision and land development ordinance are to: coordinate street patterns; assure adequate utilities and other improvements are provided in a manner that will not pollute streams, wells and/or soils; reduce traffic congestion; and provide sound design standards as a guide to developers, the elected officials, planning commis-

sions and other municipal officials. Article V of the Municipality Planning Code authorizes municipalities to prepare and enact a subdivision and land development ordinance. Subdivision and land development ordinances provide for the division and improvement of land. All municipalities in Bradford County utilize some form of land use and land development regulation. The Bradford County Subdivision and Land Development Ordinance provides regulatory guidance for forty-five of the fifty-one municipalities. The remaining six municipalities have their own subdivision and land development ordinance.

Stormwater Management Plan/Stormwater Ordinance

The proper management of storm water runoff can improve conditions and decrease the chance of flooding. Pennsylvania's Storm Water Management Act (Act 167) confers on counties the responsibility for development of watershed plans. The Act specifies that counties must complete their watershed storm water plans within two years following the promulgation of these guidelines by the DEP, which may grant an extension of time to any county for the preparation and adoption of plans. Counties must prepare the watershed plans in consultation with municipalities and residents. This is to be accomplished through the establishment of a Watershed Plan Advisory Committee. The counties must also establish a mechanism to periodically review and revise watershed plans so they are current. Plan revisions must be done every five years or sooner, if necessary.

Municipalities have an obligation to implement the criteria and standards developed in each watershed storm water management plan by amending or adopting laws and regulation for land use and development. The implementation of storm water management criteria and standards at the local level are necessary since municipalities are responsible for local land use decisions and planning. The degree of detail in the ordinances depends on the extent of existing and projected development. The watershed storm water management plan is designed to aid the municipality in setting standards for the land uses it has proposed. Municipalities within rapidly developing watersheds will benefit from the watershed storm water management plan and will use the information for sound land use considerations. A major goal of the watershed plan and the attendant municipal regulations is to prevent future drainage problems and avoid the aggravation of existing problems. Bradford County has one approved Act 167 Stormwater Management Plan in place for Wysox Creek.

Comprehensive Plan

A comprehensive plan is a policy document that states objectives and guides the future growth and physical development of a municipality. The comprehensive plan is a blueprint for housing, transportation, community facilities, utilities and land use. It examines how the past led to the present and charts the community's future path. The Pennsylvania Municipalities Planning Code (MPC Act 247 of 1968, as reauthorized and amended) requires counties to prepare and maintain a county comprehensive plan. In addition, the MPC requires counties to update the comprehensive plan every ten years.

With regard to hazard mitigation planning, Section 301.a(2) of the Municipality Planning Code requires comprehensive plans to include a plan for land use, which, among other provisions, suggests that the plan give consideration to floodplains and other areas of special hazards and other similar uses. The MPC also requires comprehensive plans to include a plan for community facilities and services and recommends giving consideration to storm drainage and floodplain management.

Bradford County has recently updated their comprehensive plan and officially adopted it on August 9, 2018.

Article III of the MPC enables municipalities to prepare a comprehensive plan; however, development of a comprehensive plan is voluntary. Twenty municipalities in Bradford County have adopted their own comprehensive plan. The remaining thirty-one fall under the county plan.

Capital Improvements Plan

The capital improvements plan is a multi-year policy guide that identifies needed capital projects and is used to coordinate the financing and timing of public improvements. Capital improvements relate to streets, storm water systems, water distribution, sewage treatment and other major public facilities. A capital improvements plan should be prepared by the respective county's planning department and should include a capital budget. This budget identifies the highest priority projects recommended for funding in the next annual budget. The capital improvements plan is dynamic and can be tailored to specific circumstances. There are currently no municipalities within Bradford County that have an identified capital improvement plan.

Participation in the National Flood Insurance Program (NFIP)

Floodplain management is the operation of programs or activities that may consist of both corrective and preventive measures for reducing flood damage, including but not limited to such things as emergency preparedness plans, flood control works and flood plain management regulations. The Pennsylvania Floodplain Management Act (Act 166) requires every municipality identified by the Federal Emergency Management Agency (FEMA) to participate in the National Flood Insurance Program (NFIP) and permits all municipalities to adopt floodplain management regulations. It is in the interest of all property owners in the floodplain to keep development and land usage within the scope of the floodplain regulations for their community. This helps keep insurance rates low and makes sure that the risk of flood damage is not increased by property development.

The Pennsylvania DCED provides communities, based on their CFR, Title 44, Section 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP along with the Pennsylvania Flood

Plain Management Act (Act 166). These suggested or model ordinances contain provisions that are more restrictive than state and federal requirements. Suggested provisions include, but are not limited to:

1. Prohibiting manufactured homes in the floodway.
2. Prohibiting manufactured homes within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
3. Special requirements for recreational vehicles within the special flood hazard area.
4. Special requirement for accessory structures.
5. Prohibiting new construction and development within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
6. Providing the County Conservation District an opportunity to review and comment on all applications and plans for any proposed construction or development in any identified floodplain area.

Act 166 mandates municipal participation in and compliance with the NFIP. It also establishes higher regulatory standards for new or substantially improved structures which are used for the production or storage of dangerous materials (as defined by Act 166) by prohibiting them in the floodway. Additionally, Act 166 establishes the requirement that a Special Permit be obtained prior to any construction or expansion of any manufactured home park, hospital, nursing home, jail and prison if said structure is located within a special flood hazard area.

The NFIP's Community Rating System (CRS) provides discounts on flood insurance premiums in those communities that establish floodplain management programs that go beyond NFIP minimum requirements. Under the CRS, communities receive credit for more restrictive regulations; acquisition, relocation, or flood-proofing of flood-prone buildings; preservation of open space; and other measures that reduce flood damages or protect the natural resources and functions of floodplains.

The CRS was implemented in 1990 to recognize and encourage community floodplain management activities that exceed the minimum NFIP standards. Section 541 of the 1994 Act amends Section 1315 of the 1968 Act to codify the Community Rating System in the NFIP. The section also expands the CRS goals to specifically include incentives to reduce the risk of flood-related erosion and to encourage measures that protect natural and beneficial floodplain functions. These goals have been incorporated into the CRS and communities now receive credit toward premium reductions for activities that contribute to them.

Under the Community Rating System, flood insurance premium rates are adjusted to reflect the reduced flood risk resulting from community activities that meet a minimum of three of the following CRS goals:

1. Reduce flood losses
2. Protect public health and safety
3. Reduce damage to property

4. Prevent increases in flood damage from new construction
5. Reduce the risk of erosion damage
6. Protect natural and beneficial floodplain functions
7. Facilitate accurate insurance rating
8. Promote the awareness of flood insurance

There are ten Community Rating System classes. Class 1 requires the most credit points and gives the largest premium reduction; Class 10 receives no premium reduction. CRS premium discounts on flood insurance range from five percent for Class 9 communities up to 45 percent for Class 1 communities. The CRS recognizes 18 credible activities, organized under four categories: Public Information, Mapping and Regulations, Flood Damage Reduction and Flood Preparedness.

FEMA Region III makes available to communities, an ordinance review checklist which lists required provisions for floodplain management ordinances. This checklist helps communities develop an effective floodplain management ordinance that meets federal requirements for participation in the NFIP. The Pennsylvania Department of Community and Economic Development (DCED) provides communities, based on their 44 CFR 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP and the Pennsylvania Flood Plain Management Act (Act 166). Act 166 mandates municipal participation in and compliance with the NFIP. It also establishes higher regulatory standards for hazardous materials and high-risk land uses. As new Digital Flood Insurance Rate Maps (DFIRMs) are published, the Pennsylvania State NFIP Coordinator at DCED works with communities to ensure the timely and successful adoption of an updated floodplain management ordinance by reviewing and providing feedback on existing and draft ordinances.

All fifty-one municipalities that reside in Bradford County have floodplain regulations in place that meet requirements set forth by the NFIP. Currently, no municipalities have completed or started to complete the CRS program. Additional research will be conducted on the CRS program and mitigation actions will be developed in support of the CRS.

5.2.2. Administrative and Technical Capability

There are fourteen boroughs and thirty-seven townships within Bradford County. Each of these municipalities conducts its daily operations and provides various community services according to local needs and limitations. Some of these municipalities have formed cooperative agreements and work jointly with their neighboring municipalities to provide services such as police protection, fire and emergency response, infrastructure maintenance and water supply management. Others choose to operate on their own. Municipalities vary in staff size, resource availability, fiscal status, service provision, constituent population, overall size and vulnerability to the profiled hazards.

County Planning Department

In Pennsylvania, planning responsibilities traditionally have been delegated to each county and local municipality through the Municipalities Planning Code (MPC). A planning agency acts as an advisor to the governing body on matters of community growth and development. A governing body may appoint individuals to serve as legal or engineering advisors to the planning agency. In addition to the duties and responsibilities authorized by Article II of the MPC, a governing body may, by ordinance, delegate approval authority to a planning agency for subdivision and land development applications. A governing body has considerable flexibility, not only as to which powers and duties are assigned to a planning agency, but also as to what form an agency will possess. A governing body can create a planning commission, a planning department, or both. The Bradford County Planning Commission assists all municipalities in the county as needed. The county employs a county planner on an annual basis.

Municipal Engineer

A municipal engineer performs duties as directed in the areas of construction, reconstruction, maintenance and repair of streets, roads, pavements, sanitary sewers, bridges, culverts and other engineering work. The municipal engineer prepares plans, specifications and estimates of the work undertaken by the township. All municipalities within Bradford County have a contracted municipal engineer.

Personnel Skilled in GIS or FEMA HAZUS Software

A geographic information system (GIS) is an integrated, computer-based system designed to capture, store, edit, analyze and display geographic information. Some examples of uses for GIS technology in local government are land records management, land use planning, infrastructure management and natural resources planning. A GIS automates existing operations such as map production and maintenance, saving a great deal of time and money. The GIS also includes information about map features such as the capacity of a municipal water supply or the acres of public land. GIS data is managed, maintained and developed by the Bradford County GIS Department. There are currently no members of the Bradford County GIS Department that have completed Basic HAZUS-MH.

Emergency Management Coordinator

Emergency Management is a comprehensive, integrated program of mitigation, preparedness, response and recovery for emergencies/disasters of any kind. No public or private entity is immune to disasters and no single segment of society can meet the complex needs of a major emergency or disaster on its own.

A municipal emergency management coordinator is responsible for emergency management – preparedness, response, recovery and mitigation within his/her respective authority having jurisdiction (AHJ). The responsibilities of the emergency management coordinator are outlined in PA Title 35 §7503:

- Prepare and maintain a current disaster emergency management plan
- Establish, equip and staff an emergency operations center
- Provide individuals and organizational training programs
- Organize and coordinate all locally available manpower, materials, supplies, equipment and services necessary for disaster emergency readiness, response and recovery
- Adopt and implement precautionary measures to mitigate the anticipated effects of a disaster
- Cooperate and coordinate with any public and private agency or entity
- Provide prompt information regarding local disaster emergencies to appropriate Commonwealth and local officials or 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

Title 35 requires Bradford County and its municipalities to have an emergency management coordinator.

The Bradford County Department of Public Safety coordinates countywide emergency management efforts. Each municipality has a designated local emergency management coordinator who possesses a unique knowledge of the impact hazard events have on their community.

The Emergency Management Services Code (PA Title 35) requires that all municipalities in the Commonwealth have a local emergency operations plan (EOP) which is updated every two years. All fifty-one municipalities have adopted the county EOP. The notification and resource section of the plan was developed individually by each municipality.

Political Capability

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to mitigate hazard events. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development. In many cases, mitigation may not generate interest among local officials when compared with competing priorities. Therefore, the local political climate must be considered when designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing the adoption or implementation of specific actions.

The capability assessment survey was used to capture information on each jurisdiction's political capability. Survey respondents were asked to identify examples of political ca-

pability, such as guiding development away from hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum state or federal requirements (i.e. building codes, floodplain management ordinances, etc.). These examples were used to guide respondents in scoring their community on a scale of "unwilling" (0) to "very willing" (5) to adopt policies and programs that reduce hazard vulnerabilities. Of the municipalities that responded, none of the municipalities completed this section with a numerical response.

Self-Assessment

In addition to the inventory and analysis of specific local capabilities, the *Capability Assessment Survey* required each local jurisdiction to conduct its own self-assessment of its capability to effectively implement hazard mitigation activities. As part of this process, county and municipal officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. In response to the survey questionnaire, local officials classified each of the capabilities as either "L = limited" "M = moderate" or "H = high." *Table 69 – Capability Self-Assessment Matrix* summarizes the results of the self-assessment survey. All municipalities returned this section of the assessment completed.

Table 69 - Capability Self-Assessment Matrix

Bradford County Capability Self-Assessment Matrix				
Municipality Name	**Capability Category**			
	Planning and Regulatory Capability	**Administrative and Technical Capability**	**Fiscal Capability**	**Community Political Capability**
Alba Borough	L	L	L	L
Albany Township	L	L	L	L
Armenia Township	M	M	M	M
Asylum Township	M	M	M	M
Athens Borough	H	H	H	H
Athens Township	L	L	L	L
Burlington Borough	Not completed by municipality			
Burlington Township	L	L	L	L
Canton Borough	M	M	L	M
Canton Township	Not completed by municipality			
Columbia Township	M	M	M	M
Franklin Township	L	L	L	L
Granville Township	L	L	L	L

Bradford County Capability Self-Assessment Matrix				
Municipality Name	**Capability Category**			
	Planning and Regulatory Capability	**Administrative and Technical Capability**	**Fiscal Capability**	**Community Political Capability**
Herrick Township	L	L	L	L
LeRaysville Borough	L	L	L	L
Leroy Township	M	L	L	L
Litchfield Township	H	H	H	H
Monroe Borough	L	L	L	L
Monroe Township	L	L	L	L
New Albany Borough	M	M	L	H
North Towanda Township	M	M	M	M
Orwell Township	Not completed by municipality			
Overton Township	L	L	M	L
Pike Township	M	L	M	M
Ridgebury Township	L	M	L	M
Rome Borough	L	L	L	L
Rome Township	L	L	L	L
Sayre Borough	M	M	L	M
Sheshequin Township	Not completed by municipality			
Smithfield Township	M	M	M	M
South Creek Township	L	M	L	M
South Waverly Borough	M	M	M	M
Springfield Township	L	L	L	L
Standing Stone Township	L	L	L	L
Stevens Township	M	M	L	M
Sylvania Borough	L	L	L	L
Terry Township	M	M	M	M
Towanda Borough	H	H	L	M
Towanda Township	M	L	M	L
Troy Borough	M	M	L	L
Troy Township	H	H	H	H
Tuscarora Township	L	M	M	L
Ulster Township	L	L	L	L

Bradford County Capability Self-Assessment Matrix				
Municipality Name	Capability Category			
	Planning and Regulatory Capability	Administrative and Technical Capability	Fiscal Capability	Community Political Capability
Warren Township	M	L	M	M
Wells Township	L	L	L	L
West Burlington Township	M	M	M	M
Wilmot Township	L	L	L	M
Windham Township	L	L	L	L
Wyalusing Borough	L	M	M	M
Wyalusing Township	L	L	L	L
Wysox Township	M	M	M	M

Existing Limitations

Funding has been identified as the largest limitation for a municipality to complete mitigation activities. The acquisition of grants is the best way to augment this process for the municipalities. The county and municipalities representatives will need to rely on regional, state and federal partnerships for future financial assistance. Development of intra-county regional partnerships and intra-municipality regional partnerships will bolster this process.

5.2.3. Financial Capability

Fiscal capability is significant to the implementation of hazard mitigation activities. Every jurisdiction must operate within the constraints of limited financial resources. The following information pertains to various financial assistance programs relevant to hazard mitigation.

State and Federal Grants

During the 1960s and 1970s, state and federal grants-in-aid were available to finance a large number of municipal programs, including streets, water and sewer facilities, airports, parks and playgrounds. During the early 1980s, there was a significant change in federal policy, based on rising deficits and a political philosophy that encouraged states and local governments to raise their own revenues for capital programs. The result has been a growing interest in “creative financing.”

Capital Improvement Financing

Because most capital investments involve the outlay of substantial funds, local governments can seldom pay for these facilities through annual appropriations in the annual operating budget. Therefore, numerous techniques have evolved to enable local government to pay for capital improvements over a time period exceeding one year. Public finance literature and state laws governing local government finance classify techniques that are used to finance capital improvements. The techniques include: revenue bonds; lease-purchase, authorities and special district; current revenue (pay-as-you-go); reserve funds; and tax increment financing. Most municipalities have very limited local tax funds for capital projects. Grants and other funding is always a priority.

Indebtedness through General Obligation Bonds

Some projects may be financed with general obligation bonds. With this method, the jurisdiction's taxing power is pledged to pay interest and principal to retire debt. General obligation bonds can be sold to finance permanent types of improvements, such as schools, municipal buildings, parks and recreation facilities. Voter approval may be required.

Municipal Authorities

Municipal authorities are most often used when major capital investments are required. In addition to sewage treatment, municipal authorities have been formed for water supply, airports, bus transit systems, swimming pools and other purposes. Joint authorities have the power to receive grants, borrow money and operate revenue generating programs. Municipal authorities are authorized to sell bonds, acquire property, sign contracts and take similar actions. Authorities are governed by authority board members, who are appointed by the elected officials of the member municipalities.

Sewer Authorities

Sewer authorities include multi-purpose authorities with sewer projects. They sell bonds to finance acquisition of existing systems or for construction, extension, or system improvement. Sewer authority operating revenues originate from user fees. The fee frequently is based on the amount of water consumed and payment is enforced by the ability to terminate service or by the imposition of liens against real estate. In areas with no public water supply, flat rate charges are calculated on average use per dwelling unit.

Water Authorities

Water authorities are multi-purpose authorities with water projects, many of which operate both water and sewer systems. The financing of water systems for lease back to the municipality is among the principal activities of the local government facilities' financing authorities. An operating water authority issues bonds to purchase existing facilities or to construct, extend, or improve a system. The primary source of revenue is user fees

based on metered usage. The cost of construction or extending water supply lines can be funded by special assessments against abutting property owners. Tapping fees also help fund water system capital costs. Water utilities are also directly operated by municipal governments and by privately owned public utilities regulated by the Pennsylvania Public Utility Commission. The Pennsylvania Department of Environmental Protection has a program to assist with consolidating small water systems to make system upgrades more cost effective.

Circuit Riding Program (Engineer)

The Circuit Riding Program is an example of intergovernmental cooperation. This program offers municipalities the ability to join together to accomplish a common goal. The circuit rider is a municipal engineer who serves several small municipalities simultaneously. These are municipalities that may be too small to hire a professional engineer for their own operations yet need the skills and expertise the engineer offers. Municipalities can jointly obtain what no one municipality could obtain on its own.

5.2.4. Education and Outreach

Bradford County conducts an education and outreach program. The Bradford County Department of Public Safety conducts public outreach at public events to update the citizens and visitors of the county on natural and human-caused hazards. Code Red is a tool that Bradford County utilizes to disseminate important information to the public regarding hazards. The county conservation district also conducts outreach on various activities and projects in the county. Many of these projects are related to or directly impact hazard mitigation projects.

Educational activities that directly impact hazard mitigation in Bradford County predominantly revolve around the first responders. Providing fire, medical and search and rescue training and education enhances the response and recovery capabilities of response agencies in the county. Additional training is always a goal within Bradford County.

Education and outreach on the NFIP are necessary. With new regulations in flood-plain management, updated digital flood insurance rate maps and new rate for insurance policies, education and outreach on the NFIP would assist the program. The Bradford County Local Planning Team will identify actions necessary to complete this.

5.2.5. Plan Integration

There are numerous existing regulatory and planning mechanisms in place at the state, county and municipal level of government which support hazard mitigation planning efforts. These tools include the 2018 Commonwealth of Pennsylvania Standard All-Hazard Mitigation Plan, local floodplain management ordinances, the Bradford County Comprehensive Plan, Bradford County Emergency Operations Plan, local emergency operation plans, local zoning ordinances, local subdivision and land development ordinances.

Information from several of these documents has been incorporated into this plan and mitigation actions have been developed to further integrate these planning mechanisms into the hazard mitigation planning process. In particular, information on identified development constraints and potential future growth areas was incorporated from the Bradford County Comprehensive Plan so that vulnerability pertaining to future development could be established. Floodplain management ordinance information was used to aid in the establishment of local capabilities in addition to participation in The National Flood Insurance Program (NFIP).

The Bradford County Comprehensive Plan, the Bradford County Emergency Operations Plan, and various municipal regulatory tools as identified in the capability assessment section of this plan, require alignment with this updated hazard mitigation plan. This plan is very limited on the amount of hazard mitigation principals that are incorporated into the plan. Discussions on specific hazard areas within municipalities that may be used for future development must be addressed. Municipalities should also identify mitigation projects that could decrease the impact of hazards in these specific areas in the annual municipal capital improvement plan.

Bradford County Comprehensive Plan

Article III of the Pennsylvania Municipalities Planning code (Act 247 of 1968, as reenacted and amended) requires all Pennsylvania counties (except Philadelphia) to adopt a comprehensive plan and update it at least every 10 years. The Bradford County Commissioners adopted the updated Bradford County Comprehensive Plan in 2018.

The Bradford County Planning Commission is responsible for maintaining and updating the Bradford County Comprehensive Plan and many other regulatory tools. Technical assistance on community planning matters is provided to the Bradford County Board of Commissioners through the Bradford County Planning Commission. The planning commission administers the Bradford County Comprehensive Plan. The planning commission also performs technical reviews of municipal subdivision and land development plans, municipal floodplain ordinances and other community planning and development matters.

Bradford County Emergency Operations Plan

The Pennsylvania Emergency Management Services Code, 35 PA C.S. Sections 7701-7707, as amended, requires each county and municipality to prepare, maintain and keep current an Emergency Operations Plan (EOP). Bradford County Office of Emergency Services is responsible for preparing and maintaining the county's EOP, which applies to both the county and municipal emergency management operations and procedures.

The EOP is reviewed at least biennially. Whenever portions of the plan are implemented in an emergency event or training exercise, a review is performed, and changes are made where necessary. These changes are then distributed to the county's municipalities.

The complete risk assessment section, mitigation actions and mitigation project opportunities identified in the Bradford County Hazard Mitigation Plan will assist with decreasing hazard specific risk and vulnerability. Understanding the risks and vulnerability in the county and municipalities will allow for emergency management and other response agencies to better direct planning, response and recovery aspects.

DPS will consider the Bradford County Hazard Mitigation Plan during its biennial review of the county EOP. Recommended changes to the HMP will then be coordinated with the hazard mitigation local planning team.

Plan Interrelationships

Ensuring consistency between these planning mechanisms is critical. In fact, Section 301 (4.1) of the Pennsylvania Municipalities Planning Code requires that comprehensive plans include a discussion of the interrelationships among their various plan components, "which may include an estimate of the environmental, energy conservation, fiscal, economic development and social consequences on the environment."

To that end, Bradford County and its municipalities must ensure that the components of the hazard mitigation plan are integrated into existing community planning mechanisms and are generally consistent with goals, policies and recommended actions. Bradford County and the hazard mitigation planning team will utilize the existing maintenance schedule of each plan to incorporate the goals, policies and recommended actions as each plan is updated.

6. Mitigation Strategy

6.1. Update Process Summary

Mitigation goals are general guidelines that explain what the county wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results. Mitigation objectives describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date. There were six goals and twenty-one objectives identified in the 2015 hazard mitigation plan. The 2020 Bradford County Hazard Mitigation Plan Update has six goals and seventeen objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. These changes are noted in *Table 70 - 2015 Mitigation Goals and* Objectives. A list of these goals and objectives as well as a review summary based on comments received from stakeholders who participated in the HMP update process is included in *Table 70 - 2015 Mitigation Goals and Objectives*. These reviews are based on the 5-Year hazard mitigation plan review worksheet, which includes a survey on existing goals and objectives, completed by the local planning team. Municipal officials then provided feedback on the changes to the goals and objectives via a mitigation strategy update meeting. Copies of these meetings and all documentation associated with the meetings are located in Appendix C.

Actions provide more detailed descriptions of specific work tasks to help the county and its municipalities achieve prescribed goals and objectives. There were fifty-one actions identified in the 2015 mitigation strategy. A review of the 2015 mitigation actions was completed by the local planning team. The results of this review are identified in *Table 71 – 2015 Mitigation Actions Review* Actions were evaluated by the local planning team with the intent of carrying over any actions that were not started or continuous for the next five years.

Table 70 - 2015 Mitigation Goals and Objectives

Bradford County 2015 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 1	Keep current the knowledge of the impacts of flooding and other natural and man-made disasters to structures, critical facilities, infrastructure and businesses.	Roll forward. Understand and mitigate the natural and human caused hazards that could impact structures, critical facilities and businesses.
Objective 1.1	Conduct hazard specific seminars, summits and conferences to educate officials	Move to goal 3.

Bradford County 2015 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 1.2	Increase advance warning capabilities	Add maintain
Objective 1.3	Conduct vulnerability assessments based on identified hazards	Roll forward
GOAL 2	Improve emergency response capabilities among state, county and local emergency management personnel and all emergency disciplines to protect public health and safety within the county.	Roll forward
Objective 2.1	Conduct a training, exercise and equipment needs assessment with municipalities and first responders	Change to: "Coordinate training, exercise and equipment needs assessment with municipalities and emergency disciplines"
Objective 2.2	Complete training programs to enhance response capabilities for first responders	Remove
Objective 2.3	Enhance damage assessment capabilities at the county and municipal level	Remove
Objective 2.4	Conduct exercises in accordance with the Homeland Security Exercise and Evaluation Program	Change to: "Enhance interagency cooperation, coordination, communication and planning within the county"
GOAL 3	Encourage intergovernmental cooperation and planning within the county in order to prevent or reduce the impact of natural and man-made hazards.	Add in "coordination, communication, cooperation and planning…"
Objective 3.1	Update the county comprehensive plan.	Remove
Objective 3.2	Develop and implement regulations and ordinances.	Develop implement and maintain regulations, ordinances, policies, procedures and checklists.
Objective 3.3	Review and update mitigation, response and recovery plans.	Review, update, maintain and exercise comprehensive mitigation response and recovery plans.
Objective 3.4	Encourage local officials to incorporate the hazard mitigation goals, objectives and actions into local planning efforts.	Roll forward. Change to: "Encourage local officials to attend the public officials conference"
GOAL 4	Expand spatial information resources to support hazard mitigation processes.	Roll forward
Objective 4.1	Develop GIS data on the location of occurrences for high and moderate hazards.	Roll forward
Objective 4.2	Update existing GIS layers.	Update existing and develop new GIS capabilities.

Bradford County 2015 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 4.3	Develop flooding specific GIS data that can be used during the mitigation, response and recovery phases of emergency management.	Develop hazard specific GIS data that can be used during the mitigation, response and recovery phases of emergency management.
GOAL 5	Expand and support the technical or material acquisitions to support hazard mitigation	Expand and enhance public education to support hazard mitigation activities.
Objective 5.1	Acquire, elevate, demolish or demolish/reconstruct properties, repetitive loss properties and severe repetitive loss properties.	Roll forward
Objective 5.2	Research and acquire grant funding to complete flooding mitigation project opportunities.	Research and acquire funding to complete mitigation project opportunities.
Objective 5.3	Protect infrastructure and critical facilities from identified hazards.	Roll forward.
GOAL 6	Expand and enhance public information activities to support hazard mitigation strategies	Expand and enhance public education to support hazard mitigation activities.
Objective 6.1	Publicize and advertise the Bradford County Hazard Mitigation Plan	Ensure public awareness of jurisdictional plans as required.
Objective 6.2	Develop a public awareness action plan	Enhance public outreach to educate residents on how to prepare, respond and recover from hazards.
Objective 6.3	Educate the public on how to prepare and respond to hazards and disasters	Remove
Objective 6.4	Utilize multi-media resources to disseminate hazard mitigation information	Remove

Table 71 – 2015 Mitigation Actions Review

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1.1.1 Conduct annual municipal flood summits to educate municipal officials on hazard mitigation opportunities for a flooding hazard.			X			Flash flood task force initiative EMA Outreach Needs to be more frequent
1.1.2 Research individual municipal officials training through the Department of Community and Economic Development (DCED) floodplain Outreach Program that provides technical assistance for Community Assisted Visits (CAVs) contracted through the Conservation District.			X			Grants and Conservation Dist.
1.1.3 Provide detailed local municipal flood hazard mapping upon the issuance of updated digital flood insurance rate map data.			X			Planning EMA Outreach Athens Township flood maps from 1980 are in the process of being updated. We have a public hearing next week.
1.1.4 Contact the Department of Environmental Protection and determine specific tactics to educate municipal officials on radon in Bradford County.			X			EMA Outreach

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1.1.5 Contact the local Department of Health office and develop a strategy to educate local officials on pandemic and infectious disease issues.			X			EMA Outreach
1.2.1 Encourage NOAA alert radio use by homeowners, critical facilities and special needs facilities.			X			EMA -storm warning program -outreach
1.2.2 Research upgrades for the county emergency notification system that would enhance early warning capabilities.			X			Code Red is program of choice and program in place Code Red
1.2.3 Seek funding resources to install signage throughout the county for the indication of flood elevations and flood zones.	X					Conservation Dist.
1.3.1 Conduct a commodity flow study to determine hazardous materials that are transported through Bradford County.				X		Commodity Flow Plan update 2019
1.3.2 Conduct an inventory of dams or impoundments of water that are not identified in the dam failure hazard.			X			
1.3.3 Conduct assessments to determine vulnerability of critical facilities to high and moderate risk hazards.			X			

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
1.3.4 Determine the emergency generator capabilities of critical facilities and special needs facilities in all municipalities of Bradford County.	X					Roll forward to the 2020 HMP
1.3.5 Develop and maintain a database to track wind damage by municipality during the next 5-year period to assist with determining wind and tornado vulnerability.		X				NWS
1.3.6 Centralize stream erosion hazard information in relationship to homes, businesses, and infrastructure that has been collected through watershed groups and the Conservation District.			X			Conservation Dist.
2.1.1 Conduct a training and exercise needs assessment with municipalities and first responders to determine specific training that would enhance mitigation capabilities to profiled hazards.				X		Tactical Team TRN Local FD/EMS TRN
2.2.1 Conduct hazardous material training to enhance response capabilities to transportation and fixed facility hazardous material incidents.	X					Fire Service/Manufacturing TRN

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
2.3.1 Enhance the county damage assessment team capabilities and encourage the development of municipal damage assessment teams to augment the county team.			X			Damage assessment team Identified weakness during flood events of 2017/2018
2.3.2 Conduct annual damage assessment training for damage assessment teams and local officials.			X			EMA -5-2019 Local officials participate county DAT's don't
2.4.1 Conduct exercises for all emergency disciplines to better protect public health and safety within the county.			X			EMA -Cert Exercise 5-19
2.4.2 Conduct exercises to test the capabilities of municipalities to respond to large scale, long duration utility outages.	X					
3.1.1 Seek funding to complete an update of the Bradford Comprehensive Plan				X		Planning Adopted Aug. 2018 – Next Update 2027 → 2028
3.1.2 Incorporate risk assessment and hazard mitigation principles into the Bradford County Comprehensive Plan update.				X		

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
3.2.1 Enforce the Uniform Construction Codes and incorporate higher standards for hazard resistance at the municipal level.			X			COG's It is my understanding that municipalities opt-in or opt-out of UCC enforcement, so I am not sure if the word "Enforce" should be there? Municipalities that opt-out put the burden of compliance on their residents. Done at Local Level
3.2.2 Regulate new development in known hazard areas, especially the special flood hazard area.			X			COG's Not all municipalities belong to the COGs, so this is not a 'catch-all' way to get to everyone. I think the County Conventions would be a better tool for this. Done at Local Level
3.2.3 Maintain and enhance the county storm water management plan and encourage municipal participation.	X					Planning/COG's Not all municipalities belong to the COGs, so this is not a 'catch-all' way to get to everyone. I think the County Conventions would be a better tool for this.
3.2.4 Ensure the zoning ordinance encourages higher densities outside of known hazard areas.	X					Not all municipalities follow the County zoning ordinance. Several have their own Zoning Ordinances, but that could be encouraged to those who have their own Comp Plans and Zoning Ord. The word "Ensure" might need to be changed? No Countywide zoning done at local level only – will include in reviews
3.2.5 Encourage municipalities to participate in the National flood Insurance Program, Community Rating System.			X			Awareness and compliance program delivered – first half 2019 Buy out mitigation underway

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
3.3.1 Review high risk dam emergency plans annually and participate in exercises as required.			X			
3.3.2 Encourage the municipalities to adopt the county emergency operations plan as the municipal emergency operations plan.				X		...with the added language about requiring the municipal adoption to be by resolution and requiring the municipal NARM to be included as a criteria for eligibility – and require the annual updated NARM to be submitted. Should be a component of the county plan; tailored to their needs.
3.4.1 Hold an annual coordination meeting of the Bradford County Hazard Mitigation Committee, local elected officials, State and Federal Agencies, and other appropriate agencies; organizations and individuals for the purpose of reviewing the County Plan progress and recommending and modifications.	X					
3.4.2 Incorporate hazard mitigation objectives into applicable plans that support the hazard mitigation planning process.			X			
4.1.1 Develop GIS layers identifying the damage from profiled hazards during the next planning cycle.			X			

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
4.1.2 Develop a GIS layer for large impoundments of water that support gas exploration.			X			
4.2.1 Update and maintain the critical infrastructure and special needs GIS layers on a regular basis.			X			
4.2.2 Maintain the special flood hazard area GIS layer and disseminate to the municipalities.			X			
4.2.3 Update all GIS layers used for hazard mitigation planning purposes annually.			X			
4.3.1 Develop a GIS layer that identifies locations of flash flooding throughout the county with input from municipalities.			X			GIS On-going
4.3.2 Conduct an inventory, in cooperation with local municipalities, of all non-mapped flood prone hazard areas for the purpose of developing a flood prone hazard map.			X			GIS
5.1.1 Purchase repetitive loss and severe repetitive loss properties through mitigation grant opportunities.			X			

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
5.2.1 Seek funding to enhance existing stream flow monitoring system installed by the Conservation District and Watershed Groups to provide a Countywide Flood Warning System.		X				Flash flood task force Flash flood task force
5.2.2 Disseminate information on grant funding through the flood mitigation assistance program and assist with the application process.		X				Grants
5.2.3 Research hazard mitigation annual granting programs and compare against the mitigation strategy for Bradford County to determine funding capabilities.			X			
5.3.1 Install emergency generators at critical facilities and special needs facilities.	X					
5.3.2 Conduct a maintenance program for all levees or dikes in Bradford County.	X					Locally owned and operated
6.1.1 Place the county hazard mitigation plan on the county website and provide outreach identifying how to access the plan.			X			

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
6.1.2 Conduct public announcements with risk and mitigation strategy information to increase the public knowledge of hazard mitigation efforts.			X			
6.2.1 Develop a public awareness action plan that would include development of informational brochures to provide to new home builders/buyers, educational materials and programs for use in schools, regular news releases and public workshops/forums.			X			
6.3.1 Conduct National Flood Insurance Program community workshops to provide information and incentives for property owners to acquire flood insurance.			X			
6.3.2 Develop a brochure to educate the public about the dangers or radon, the impacts of radon and mitigation efforts to remove radon.	X					
6.4.1 Develop public service announcements to utilize prior to storms during the winter season.			X			

2015 Bradford County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
6.4.2 Develop a strategy to utilize social media for hazard mitigation information dissemination.			X			

6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the local planning team, a list of six goals and seventeen corresponding objectives was developed. *Table 72 - 2020 Goals and Objectives* details the mitigation goals and objectives established for the 2020 Bradford County Hazard Mitigation Plan.

Table 72 - 2020 Goals and Objectives

Bradford County 2020 Goals and Objectives	
GOAL 1	**Increase planning and emergency response efforts.**
Objective 1.1	Understand and mitigate the natural and human caused hazards that could impact structures, critical facilities and businesses.
Objective 1.2	Increase and maintain advanced warning capabilities.
Objective 1.3	Conduct vulnerability assessments based on identified hazards.
GOAL 2	**Improve emergency response capabilities among state, county and local emergency management personnel and all emergency disciplines to protect public health and safety with the county.**
Objective 2.1	Coordinate training, exercise and equipment needs assessment with municipalities and emergency disciplines.
Objective 2.2	Enhance interagency cooperation, coordination, communication and planning within the county.

Bradford County 2020 Goals and Objectives	
GOAL 3	**Encourage intergovernmental coordination, communication, cooperation and planning with the county in order to prevent or reduce the impacts of natural and human-caused hazards.**
Objective 3.1	Develop, implement and maintain regulations, policies, procedures and checklists.
Objective 3.2	Review, update, maintain and exercise comprehensive mitigation response and recovery plans.
Objective 3.3	Encourage local officials to incorporate the hazard mitigation goals, objectives and actions into local planning efforts.
Objective 3.4	Encourage local officials to attend the public officials conference.
GOAL 4	**Expand spatial information resources to support hazard mitigation processes.**
Objective 4.1	Develop GIS data on the location of occurrences for high and moderate hazards.
Objective 4.2	Update existing and develop new GIS capabilities.
Objective 4.3	Develop hazard specific GIS data that can be used during the mitigation, response and recovery phases of emergency management.
GOAL 5	**Develop and complete project opportunities to support hazard mitigation activities.**
Objective 5.1	Acquire, elevate, demolish or demolish/reconstruct properties, repetitive loss properties and severe repetitive loss properties.
Objective 5.2	Research and acquire funding to complete mitigation project opportunities.
Objective 5.3	Protect infrastructure and critical facilities from identified hazards.
GOAL 6	**Expand and enhance public education to support hazard mitigation activities.**
Objective 6.1	Ensure public awareness of jurisdictional plans as required.
Objective 6.2	Enhance public outreach to educate residents on how to prepare, respond and recover from hazards.

6.3. Identification and Analysis of Mitigation Techniques

This section includes an overview of alternative mitigation actions based on the goals and objectives identified in Section 6.2. There are four general mitigation strategy techniques to reducing hazard risks:

- Local plans and regulations

- Structure and infrastructure
- Natural systems protection
- Education and awareness

Local Plans and Regulations: These actions include government authorities, policies or codes that influence the way land and buildings are developed and built. The following are some examples:

- Comprehensive plans
- Land use ordinances
- Subdivision regulations
- Development review
- Building codes and enforcement
- National Flood Insurance Program and Community Rating System
- Capital improvement programs
- Open space preservation
- Stormwater management regulations and master plans

The local plans and regulations technique will protect and reduce the impact of specific hazards on new and existing buildings by improving building code standards and regulating new and renovation construction. The improved building codes will decrease the impact of risk hazards. Subdivision and land development enhancements will also augment this process. Ensuring that municipalities participate in the National Flood Insurance Program and encourage participation in the Community Rating System will decrease the impact as well.

Structure and infrastructure implementation: These actions involve modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. The following are examples:

- Acquisitions and elevations of structures in flood prone areas
- Utility undergrounding
- Structural retrofits
- Floodwalls and retaining walls
- Detention and retention structures
- Culverts
- Safe rooms

Structure and infrastructure implementation is a technique that removes or diverts the hazard from structures or protects the structure from a specific hazard. The new or renovated structures are therefore protected or have a reduced impact of hazards.

Natural Resource Protection: These are actions that minimize damage and losses and also preserve or restore the functions of natural systems. They include the following:

- Erosion and sediment control

- Stream corridor restoration
- Forest management
- Conservation easements
- Wetland restoration and preservation

Natural resource protection techniques allow for the natural resource to be used to protect or lessen the impact on new or renovated structures through the management of these resources. Utilization and implementation of the examples above will protect new and existing buildings and infrastructure.

Education and Awareness: These are actions to inform and educate citizens, elected officials and property owners about hazards and potential ways to mitigate them and may also include participation in national programs. Examples of these techniques include the following:

- Radio and television spots
- Websites with maps and information
- Real estate disclosure
- Provide information and training
- NFIP outreach
- StormReady
- Firewise Communities

The education and awareness technique will protect and reduce the impact of specific hazards on new and existing buildings through education of citizens and property owners on the impacts that specific hazards could have on new or renovated structures. This information will allow the owner to make appropriate changes or enhancements that will lessen or eliminate the impact of hazards.

Table *73 - Mitigation Strategy Technique Matrix* provides a matrix identifying the mitigation techniques used for all low, moderate and high-risk hazards in the county. The specific actions associated with these techniques are included in *Table 74 - 2020 Mitigation Action Plan*.

Table 73 - Mitigation Strategy Technique Matrix

Bradford County Mitigation Strategy Technique Matrix				
HAZARD	**MITIGATION TECHNIQUE**			
	Local Plans and Regulations	**Structural and Infra-structure**	**Natural Systems Protection**	**Education and Awareness**
Emergency Response Organi-zations	X			X
Addiction	X			X
Invasive Species	X		X	X
Flash Flooding	X	X	X	X
Winter Storm	X	X		X
Environmental Hazards	X	X		X
Utility Interruption	X	X		X
Pandemic, Epidemic, Infec-tious Disease	X		X	X
Transportation Accidents	X	X		X
Urban Fire and Explosions	X	X		X
Flooding	X	X	X	X
Extreme Temperatures	X	X		X
Drought	X	X	X	X
Radon Exposure	X	X		X
Windstorm	X	X		X
Terrorism	X			X
Hurricane/ Tropical Storm	X	X		X
Earthquakes	X			X
Civil Disturbance	X			X
Landslides	X	X	X	X
Tornado	X	X		X
Nuclear Incidents	X	X		X
Levee Failure	X	X		X
Wildfire	X	X		X
Dam Failure	X	X		X

6.4. Mitigation Action Plan

The Bradford County Hazard Mitigation Local Planning Team (LPT) immediately began work on the mitigation strategy section of the 2020 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2020 HMP mitigation strategy section. A review of the previous goals, objectives, actions and project opportunities documented in the 2015 HMP was conducted. The next step the LPT completed was the brainstorming of possible new actions based on new identified risks. The LPT compiled all this information for presentations to the municipalities.

MCM Consulting Group, Inc. completed municipality meetings at various time periods at the Bradford County Department of Public Safety, Bradford County Conservation District and Troy Township Municipal Building. During all these meetings, an overview of mitigation strategy was presented, and the municipalities were informed that they needed to have at least one hazard-related mitigation action for their municipality. All municipalities were invited to attend these meetings.

The municipalities were notified of draft mitigation actions and encouraged to provide new mitigation actions that could be incorporated into the plan. Municipalities were provided copies of their previously submitted mitigation opportunity forms and asked to determine if the projects were still valid. Municipalities were solicited for new project opportunities as well. All agendas, sign in sheets and other support information from these meetings is included in Appendix C.

Mitigation measures for the 2020 Bradford County HMP are listed in the mitigation action plan. *Table 74 - 2020 Mitigation Action Plan* is the 2020 Bradford County Mitigation Action Plan. This plan outlines mitigation actions and projects that comprise a strategy for Bradford County. The action plan includes actions, a benefit and cost prioritization, a schedule for implementation, any funding sources to complete the action and a responsible agency or department. All benefit and cost analysis were completed using the Pennsylvania Emergency Management Agency recommended analysis tool. The completed analysis is located in Appendix H. *Table 75 - Municipal Hazard Mitigation Actions Checklist* is a matrix that identifies the county and/or municipalities responsible for mitigation actions in the new mitigation action plan.

Table 74 - 2020 Mitigation Action Plan

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.1.1	Education and awareness	Conduct annual municipal flood summits to educate municipal officials on hazard mitigation opportunities for a flooding hazard.	Flooding	**X**			2019 - 2023	Local	Bradford County DPS
1.1.2	Education and awareness	Research individual municipal officials training through the Department of Community and Economic Development (DCED) floodplain Outreach Program that provides technical assistance for Community Assisted Visits (CAVs) contracted through the Conservation District.	Flooding		**X**		2019 - 2023	Local	Bradford County Conservation District
1.1.3	Local plans and regulations	Provide detailed local municipal flood hazard mapping upon the issuance of updated digital flood insurance rate map data.	Flooding		**X**		2019 - 2023	Local	Bradford County GIS

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.1.4	Education and awareness	Contact the Department of Environmental Protection and determine specific tactics to educate municipal officials on radon in Bradford County.	Radon		**X**		2019 - 2023	Local	Bradford County DPS and Bradford County DEP
1.1.5	Local plans and regulations	Contact the local Department of Health office and develop a strategy to educate local officials on pandemic and infectious disease issues.	Pandemic, Epidemic and Infectious Disease		**X**		2019 - 2023	Local	Bradford County DPS /and Department of Health
1.2.1	Education and awareness	Encourage NOAA alert radio use by homeowners, critical facilities and special needs facilities.	All Hazards	**X**			2019 - 2023	Local	Bradford County DPS and Facility Owners
1.2.2	Local plans and regulations	Research upgrades for the county emergency notification system that would enhance early warning capabilities.	All Hazards		**X**		2019 - 2023	Local	Bradford County DPS

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.2.3	Local plans and regulations	Seek funding resources to install signage throughout the county for the indication of flood elevations and flood zones.	Flooding		**X**		2019 - 2023	Local	Bradford County Conservation District
1.3.1	Local plans and regulations	Conduct a commodity flow study to determine hazardous materials that are transported through Bradford County.	Transportation Accidents and Environmental Hazard		**X**		2019 - 2023	Local	Bradford County LEPC
1.3.2	Structure and infrastructure	Conduct an inventory of dams or impoundments of water that are not identified in the dam failure hazard.	Dam Failure		**X**		2019 - 2023	PDM and HMGP	Bradford County DPS and GIS
1.3.3	Structure and infrastructure	Conduct assessments to determine vulnerability of critical facilities to high and moderate risk hazards.	All Hazards		**X**		2019 - 2023	PDM and HMGP	Bradford County DPS and Facility Owners
1.3.4	Local plans and regulations	Determine the emergency generator capabilities of critical facilities and special needs facilities in all municipalities of Bradford County.	All Hazards		**X**		2019 - 2023	Local	Bradford County DPS and Facility Owners

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.3.5	Local plans and regulations	Develop and maintain a database to track wind damage by municipality during the next 5-year period to assist with determining wind and tornado vulnerability.	Wind-storms, Tornado	**X**			2019 - 2023	Local	National Weather Service
1.3.6	Education and awareness	Centralize stream erosion hazard information in relationship to homes, businesses, and infrastructure that has been collected through watershed groups and the Conservation District.	Flooding		**X**		2019 - 2023	Local	Bradford County Conservation District
2.1.1	Education and awareness	Conduct a training and exercise needs assessment with municipalities and first responders to determine specific training that would enhance mitigation capabilities to profiled hazards.	Emergency Services	**X**			2019 - 2023	Local	Bradford County DPS

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.1.2	Education and awareness	Bradford County will conduct programs and training to enhance school safety in the school districts within the county.	All-Hazards		**X**			Local	Bradford County DPS and school districts
2.1.3	Education and awareness	Conduct flood insurance workshops and seminars throughout the county to enhance participation in the national flood insurance program	Flooding		**X**			Local	Bradford County DPS
2.2.1	Education and awareness	Conduct hazardous material training to enhance response capabilities to transportation and fixed facility hazardous material incidents.	Transportation Accidents, Environmental Hazards and Emergency Services		**X**		2019 - 2023	Local	Bradford County DPS
2.2.2	Education and awareness	Outreach and planning will continue to enhance the voluntary organization participation in preparation for emergency and disaster recovery in Bradford County.	All-Hazards		**X**			Local	Bradford County DPS and school districts

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.3.1	Education and awareness	Enhance the county damage assessment team capabilities and encourage the development of municipal damage assessment teams to augment the county team.	All Hazards		**X**		2019 - 2023	Local	Bradford County DPS
2.3.2	Education and awareness	Conduct annual damage assessment training for damage assessment teams and local officials.	All Hazards		**X**		2019 - 2023	Local	Bradford County DPS
2.4.1	Education and awareness	Conduct exercises for all emergency disciplines to better protect public health and safety within the county.	All-Hazards	**X**			2019 - 2023	Local	Bradford County DPS
2.4.2	Education and awareness	Conduct exercises to test the capabilities of municipalities to respond to large scale, long duration utility outages.	All-Hazards		**X**		2019 - 2023	Local	Bradford County DPS and municipalities
3.1.1	Education and awareness	Seek funding to complete an update of the Bradford Comprehensive Plan	All Hazards		**X**		2019 - 2023	Local	Bradford County Planning

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
3.1.2	Local plans and infrastructure	Incorporate risk assessment and hazard mitigation principles into the Bradford County Comprehensive Plan update.	All Hazards		**X**		2019 - 2023	Local	Bradford County DPS and Bradford County Planning
3.2.1	Local plans and infrastructure	Enforce the Uniform Construction Codes and incorporate higher standards for hazard resistance at the municipal level.	All Hazards		**X**		2019 - 2023	Local	Bradford County Municipalities
3.2.2	Structure and infrastructure	Regulate new development in known hazard areas, especially the special flood hazard area.	All Hazards		**X**		2019 - 2023	Local	Bradford County Municipalities
3.2.3	Local plans and regulations	Maintain and enhance the county storm water management plan and encourage municipal participation.	Flooding		**X**		2020 - 2022	Local	Bradford County DPS
3.2.4	Local plans and infrastructure	Ensure the zoning ordinance encourages higher densities outside of known hazard areas.	Flooding		**X**		2019 - 2023	Local	Bradford County Municipalities

Bradford County 2020 Mitigation Action Plan									
Action Number	**Mitigation Actions**			**Prioritization**			**Implementation**		
	Category	**Description/ Action Items**	**Hazard Vulnerability**	**High**	**Medium**	**Low**	**Schedule**	**Funding**	**Responsibility**
3.2.5	Local plans and regulations	Encourage municipalities to participate in the National flood Insurance Program, Community Rating System.	All-Hazards			**X**	2019 - 2023	FMA or Local	Bradford County DPS and Bradford County Planning
3.3.1	Education and outreach	Review high risk dam emergency plans annually and participate in exercises as required.	All=Hazards		**X**		2019 - 2023	Local	Bradford County DPS
3.3.2	Education and awareness	Encourage municipalities to adopt the county emergency operations plan as the municipal emergency operations plan.	All-Hazards		**X**		2019 - 2023	Local	Bradford County DPS

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
3.4.1	Education and awareness	Hold an annual coordination meeting of the Bradford County Hazard Mitigation Committee, local elected officials, State and Federal Agencies, and other appropriate agencies; organizations and individuals for the purpose of reviewing the County Plan progress and recommending and modifications.	All Hazards	**X**			2019 - 2023	Local	Bradford County DPS and Bradford County Planning
3.4.2	Education and awareness	Incorporate hazard mitigation objectives into applicable plans that support the hazard mitigation planning process.	All-Hazards	**X**			2019 - 2023	Local	Bradford County DPS and Bradford County Planning
4.1.1	Education and awareness	Develop GIS layers identifying the damage from profiled hazards during the next planning cycle.	All Hazards		**X**		2019 - 2023	Local	Bradford County GIS
4.1.2	Education and awareness	Develop a GIS layer for large impoundments of water that support gas exploration.	Environmental Hazard			**X**	2019 - 2023	Local	Bradford County GIS

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
4.2.1	Education and awareness	Update and maintain the critical infrastructure and special needs GIS layers on a regular basis.	All Hazards	**X**			2019 - 2023	Local	Bradford County GIS
4.2.2	Education and awareness	Maintain the special flood hazard area GIS layer and disseminate to the municipalities.	Flooding	**X**			2019 - 2023	Local	Bradford County GIS
4.2.3	Education and awareness	Update all GIS layers used for hazard mitigation planning purposes annually.	All Hazards	**X**			2019 - 2023	Local	Bradford County GIS
4.3.1	Education and awareness	Develop a GIS layer that identifies locations of flash flooding throughout the county with input from municipalities.	Flash Flooding	**X**			2019 - 2023	Local	Bradford County GIS
4.3.2	Local plans and regulations	Conduct an inventory, in cooperation with local municipalities, of all non-mapped flood prone hazard areas for the purpose of developing a flood prone hazard map.	Flooding	**X**			2019 - 2023	Local	Bradford County DPS and Bradford County GIS

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
5.1.1	Local plans and regulations	Purchase repetitive loss and severe repetitive loss properties through mitigation grant opportunities	All-Hazards	**X**			2019 - 2023	Local	Bradford County DPS
5.2.1	Education and awareness	Seek funding to enhance existing stream flow monitoring system installed by the Conservation District and Watershed Groups to provide a Countywide Flood Warning System.	Flooding	**X**			2019 - 2023	Local	Bradford County DPS
5.2.2	Education and awareness	Disseminate information on grant funding through the flood mitigation assistance program and assist with the application process.	Flooding		**X**		2019 - 2023	FMA, PDM and Local	Bradford County DPS
5.2.3	Local plans and regulations	Research hazard mitigation annual granting programs and compare against the mitigation strategy for Bradford County to determine funding capabilities.	All Hazards		**X**		2019 - 2023	Local	Bradford County Municipalities

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
5.3.1	Structural and Infrastructure	Install emergency generators at critical facilities and special needs facilities.	All-Hazards		**X**		2019 - 2023	Local	Bradford County Municipalities
5.3.2	Local plans and regulations	Conduct a maintenance program for all levees or dikes in Bradford County.	Flooding		**X**		2019 - 2023	Local	Applicable Bradford County Municipalities
6.1.1	Education and awareness	Place the county hazard mitigation plan on the county website and provide outreach identifying how to access the plan.	All-Hazards		**X**		2019 - 2023	Local	Bradford County DPS
6.1.2	Education and awareness	Conduct public announcements with risk and mitigation strategy information to increase the public knowledge of hazard mitigation efforts.	All Hazards		**X**		2019 - 2023	PDM, FMA or Local	Bradford County DPS and Bradford County Planning

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
6.2.1	Education and awareness	Develop a public awareness action plan that would include development of informational brochures to provide to new home builders/buyers, educational materials and programs for use in schools, regular news releases and public workshops/forums.	All Hazards	**X**			2019 - 2023	Local	Bradford County DPS and Bradford County Planning
6.2.2	Education and awareness	Conduct National Flood Insurance Program community workshops to provide information and incentives for property owners to acquire flood insurance.	Flooding		**X**		2019 - 2023	Local	Bradford County DPS and Bradford County Planning
6.2.3	Education and awareness	Develop a brochure to educate the public about the dangers or radon, the impacts of radon and mitigation efforts to remove radon.	Radon	**X**			2019 - 2023	Local	Bradford County DPS and Bradford County Planning

Bradford County 2020 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
6.2.4	Education and awareness	Develop public service announcements to utilize prior to storms during the winter season.	Winter Storms		**X**		2019 - 2023	Local	Bradford County DPS
6.2.5	Education and awareness	Develop a strategy to utilize social media for hazard mitigation information dissemination.	All Hazards		**X**		2019 - 2023	Local	Bradford County DPS
6.2.6	Education and awareness	Bradford County Emergency Management Agency will conduct outreach to the public on the benefits of a community emergency response team (CERT).	All-Hazards		**X**		2019 - 2023	Local	Bradford County DPS
6.2.7	Education and awareness	Bradford County Department of Public Safety will continue community and first responder outreach to enhance the understanding of the role and capabilities of the department of public safety.	Emergency Services		**X**		2019 - 2023	Local	Bradford County DPS

Funding acronym definitions:

CERT: Community Emergency Response Team

FMA: Flood Mitigation Assistance Grant Program, administered by the Federal Emergency Management Agency

HMGP: Hazard Mitigation Grant Program, administered by the Federal Emergency Management Agency

PDM: Pre-Disaster Mitigation Grant, administered by the Federal Emergency Management Agency

EMPG: Emergency Management Performance Grant, administered by the Federal Emergency Management Agency

HSGP: Homeland Security Grant Program, administered by the Federal Emergency Management Agency

HMEP: Hazardous Material Emergency Planning Grant, administered by the Pennsylvania Emergency Management Agency

HMRF: Hazardous Material Response Fund, administered by the Pennsylvania Emergency Management Agency

Table 75 - Municipal Hazard Mitigation Actions Checklist

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.1.1**	**1.1.2**	**1.1.3**	**1.1.4**	**1.1.5**	**1.2.1**	**1.2.2**	**1.2.3**	**1.3.1**	**1.3.2**
Alba Borough	X	X	X			X		X		X
Albany Township	X	X	X			X		X		X
Armenia Township	X	X	X			X		X		X
Asylum Township	X	X	X			X		X		X
Athens Borough	X	X	X			X		X		X
Athens Township	X	X	X			X		X		X
Burlington Borough	X	X	X			X		X		X
Burlington Township	X	X	X			X		X		X
Canton Borough	X	X	X			X		X		X
Canton Township	X	X	X			X		X		X
Columbia Township	X	X	X			X		X		X
Franklin Township	X	X	X			X		X		X
Granville Township	X	X	X			X		X		X
Herrick Township	X	X	X			X		X		X
LeRaysville Borough	X	X	X			X		X		X
Leroy Township	X	X	X			X		X		X
Litchfield Township	X	X	X			X		X		X
Monroe Borough	X	X	X			X		X		X
Monroe Township	X	X	X			X		X		X
New Albany Borough	X	X	X			X		X		X
North Towanda Township	X	X	X			X		X		X

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.1.1**	**1.1.2**	**1.1.3**	**1.1.4**	**1.1.5**	**1.2.1**	**1.2.2**	**1.2.3**	**1.3.1**	**1.3.2**
Orwell Township	X		X			X		X		X
Overton Township	X		X			X		X		X
Pike Township	X		X			X		X		X
Ridgebury Township	X		X			X		X		X
Rome Borough	X		X			X		X		X
Rome Township	X		X			X		X		X
Sayre Borough	X		X			X		X		X
Sheshequin Township	X		X			X		X		X
Smithfield Township	X		X			X		X		X
South Creek Township	X		X			X		X		X
South Waverly Borough	X		X			X		X		X
Springfield Township	X		X			X		X		X
Standing Stone Township	X		X			X		X		X
Stevens Township	X		X			X		X		X
Sylvania Borough	X		X			X		X		X
Terry Township	X		X			X		X		X
Towanda Borough	X		X			X		X		X
Towanda Township	X		X			X		X		X
Troy Borough	X		X			X		X		X
Troy Township	X		X			X		X		X
Tuscarora Township	X		X			X		X		X
Ulster Township	X		X			X		X		X
Warren Township	X		X			X		X		X
Wells Township	X		X			X		X		X
West Burlington Township	X		X			X		X		X
Wilmot Township	X		X			X		X		X
Windham Township	X		X			X		X		X
Wyalusing Borough	X		X			X				X
Wyalusing Township	X		X			X				X
Wysox Township	X		X			X				X
Bradford County	X	X	X	X	X	X	X	X	X	X

Municipality	**1.3.3**	**1.3.4**	**1.3.5**	**1.3.6**	**2.1.1**	**2.1.2**	**2.1.3**	**2.2.1**	**2.2.2**	**2.3.1**
Alba Borough	X	X	X	X			X		X	
Albany Township	X	X	X	X			X		X	
Armenia Township	X	X	X	X			X		X	
Asylum Township	X	X	X	X			X		X	

Municipality	1.3.3	1.3.4	1.3.5	1.3.6	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.3.1
Athens Borough	X	X	X	X			X		X	
Athens Township	X	X	X	X			X		X	
Burlington Borough	X	X	X	X			X		X	
Burlington Township	X	X	X	X			X		X	
Canton Borough	X	X	X	X			X		X	
Canton Township	X	X	X	X			X		X	
Columbia Township	X	X	X	X			X		X	
Franklin Township	X	X	X	X			X		X	
Granville Township	X	X	X	X			X		X	
Herrick Township	X	X	X	X			X		X	
LeRaysville Borough	X	X	X	X			X		X	
Leroy Township	X	X	X	X			X		X	
Litchfield Township	X	X	X	X			X		X	
Monroe Borough	X	X	X	X			X		X	
Monroe Township	X	X	X	X			X		X	
New Albany Borough	X	X	X	X			X		X	
North Towanda Township	X	X	X	X			X		X	
Orwell Township	X	X	X	X			X		X	
Overton Township	X	X	X	X			X		X	
Pike Township	X	X	X	X			X		X	
Ridgebury Township	X	X	X	X			X		X	
Rome Borough	X	X	X	X			X		X	
Rome Township	X	X	X	X			X		X	
Sayre Borough	X	X	X	X			X		X	
Sheshequin Township	X	X	X	X			X		X	
Smithfield Township	X	X	X	X			X		X	
South Creek Township	X	X	X	X			X		X	
South Waverly Borough	X	X	X	X			X		X	
Springfield Township	X	X	X	X			X		X	
Standing Stone Township	X	X	X	X			X		X	
Stevens Township	X	X	X	X			X		X	
Sylvania Borough	X	X	X	X			X		X	
Terry Township	X	X	X	X			X		X	
Towanda Borough	X	X	X	X			X		X	
Towanda Township	X	X	X	X			X		X	
Troy Borough	X	X	X	X			X		X	
Troy Township	X	X	X	X			X		X	
Tuscarora Township	X	X	X	X			X		X	
Ulster Township	X	X	X	X			X		X	
Warren Township	X	X	X	X			X		X	

Municipality	1.3.3	1.3.4	1.3.5	1.3.6	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.3.1
Wells Township	X	X	X	X			X		X	
West Burlington Township	X	X	X	X			X		X	
Wilmot Township	X	X	X	X			X		X	
Windham Township	X	X	X	X			X		X	
Wyalusing Borough	X	X	X	X			X		X	
Wyalusing Township	X	X	X	X			X		X	
Wysox Township	X	X	X	X			X		X	
Bradford County	X	X	X	X	X	X	X	X	X	X

Municipality	2.3.2	2.4.1	2.4.2	3.1.1	3.1.2	3.2.1	3.2.2	3.2.3	3.2.4	3.2.5
Alba Borough			X			X	X		X	
Albany Township			X			X	X		X	
Armenia Township			X			X	X		X	
Asylum Township			X			X	X		X	
Athens Borough			X			X	X		X	
Athens Township			X			X	X		X	
Burlington Borough			X			X	X		X	
Burlington Township			X			X	X		X	
Canton Borough			X			X	X		X	
Canton Township			X			X	X		X	
Columbia Township			X			X	X		X	
Franklin Township			X			X	X		X	
Granville Township			X			X	X		X	
Herrick Township			X			X	X		X	
LeRaysville Borough			X			X	X		X	
Leroy Township			X			X	X		X	
Litchfield Township			X			X	X		X	
Monroe Borough			X			X	X		X	
Monroe Township			X			X	X		X	
New Albany Borough			X			X	X		X	
North Towanda Township			X			X	X		X	
Orwell Township			X			X	X		X	
Overton Township			X			X	X		X	
Pike Township			X			X	X		X	
Ridgebury Township			X			X	X		X	
Rome Borough			X			X	X		X	
Rome Township			X			X	X		X	
Sayre Borough			X			X	X		X	
Sheshequin Township			X			X	X		X	

Municipality	2.3.2	2.4.1	2.4.2	3.1.1	3.1.2	3.2.1	3.2.2	3.2.3	3.2.4	3.2.5
Smithfield Township			X			X	X		X	
South Creek Township			X			X	X		X	
South Waverly Borough			X			X	X		X	
Springfield Township			X			X	X		X	
Standing Stone Township			X			X	X		X	
Stevens Township			X			X	X		X	
Sylvania Borough			X			X	X		X	
Terry Township			X			X	X		X	
Towanda Borough			X			X	X		X	
Towanda Township			X			X	X		X	
Troy Borough			X			X	X		X	
Troy Township			X			X	X		X	
Tuscarora Township			X			X	X		X	
Ulster Township			X			X	X		X	
Warren Township			X			X	X		X	
Wells Township			X			X	X		X	
West Burlington Township			X			X	X		X	
Wilmot Township			X			X	X		X	
Windham Township			X			X	X		X	
Wyalusing Borough			X			X	X		X	
Wyalusing Township			X			X	X		X	
Wysox Township			X			X	X		X	
Bradford County	X	X	X	X	X		X	X		X

Municipality	3.3.1	3.3.2	3.4.1	3.4.2	4.1.1	4.1.2	4.2.1	4.2.2	4.2.3	4.3.1
Alba Borough	X		X	X						X
Albany Township	X		X	X						X
Armenia Township	X		X	X						X
Asylum Township	X		X	X						X
Athens Borough	X		X	X						X
Athens Township	X		X	X						X
Burlington Borough	X		X	X						X
Burlington Township	X		X	X						X
Canton Borough	X		X	X						X
Canton Township	X		X	X						X
Columbia Township	X		X	X						X
Franklin Township	X		X	X						X
Granville Township	X		X	X						X
Herrick Township	X		X	X						X

Municipality	3.3.1	3.3.2	3.4.1	3.4.2	4.1.1	4.1.2	4.2.1	4.2.2	4.2.3	4.3.1
LeRaysville Borough	X		X	X						X
Leroy Township	X		X	X						X
Litchfield Township	X		X	X						X
Monroe Borough	X		X	X						X
Monroe Township	X		X	X						X
New Albany Borough	X		X	X						X
North Towanda Township	X		X	X						X
Orwell Township	X		X	X						X
Overton Township	X		X	X						X
Pike Township	X		X	X						X
Ridgebury Township	X		X	X						X
Rome Borough	X		X	X						X
Rome Township	X		X	X						X
Sayre Borough	X		X	X						X
Sheshequin Township	X		X	X						X
Smithfield Township	X		X	X						X
South Creek Township	X		X	X						X
South Waverly Borough	X		X	X						X
Springfield Township	X		X	X						X
Standing Stone Township	X		X	X						X
Stevens Township	X		X	X						X
Sylvania Borough	X		X	X						X
Terry Township	X		X	X						X
Towanda Borough	X		X	X						X
Towanda Township	X		X	X						X
Troy Borough	X		X	X						X
Troy Township	X		X	X						X
Tuscarora Township	X		X	X						X
Ulster Township	X		X	X						X
Warren Township	X		X	X						X
Wells Township	X		X	X						X
West Burlington Township	X		X	X						X
Wilmot Township	X		X	X						X
Windham Township	X		X	X						X
Wyalusing Borough	X		X	X						X
Wyalusing Township	X		X	X						X
Wysox Township	X		X	X						X
Bradford County	X	X	X	X	X	X	X	X	X	X

Municipality	4.3.2	5.1.1	5.2.1	5.2.2	5.2.3	5.3.1	5.3.2	6.1.1	6.1.2	6.2.1
Alba Borough	X					X				
Albany Township	X					X				
Armenia Township	X					X				
Asylum Township	X	X				X				
Athens Borough	X	X				X				
Athens Township	X	X				X				
Burlington Borough	X	X				X				
Burlington Township	X					X				
Canton Borough	X					X				
Canton Township	X					X				
Columbia Township	X	X				X				
Franklin Township	X					X				
Granville Township	X	X				X				
Herrick Township	X					X				
LeRaysville Borough	X					X				
Leroy Township	X					X				
Litchfield Township	X					X				
Monroe Borough	X	X				X				
Monroe Township	X	X				X				
New Albany Borough	X					X				
North Towanda Township	X	X				X				
Orwell Township	X	X				X				
Overton Township	X					X				
Pike Township	X					X				
Ridgebury Township	X	X				X				
Rome Borough	X	X				X				
Rome Township	X					X				
Sayre Borough	X	X				X				
Sheshequin Township	X	X				X				
Smithfield Township	X					X				
South Creek Township	X					X				
South Waverly Borough	X					X				
Springfield Township	X					X				
Standing Stone Township	X					X				
Stevens Township	X	X				X				
Sylvania Borough	X	X				X				
Terry Township	X	X				X				
Towanda Borough	X					X				
Towanda Township	X	X				X				
Troy Borough	X	X				X				

Municipality	4.3.2	5.1.1	5.2.1	5.2.2	5.2.3	5.3.1	5.3.2	6.1.1	6.1.2	6.2.1
Troy Township	X					X				
Tuscarora Township	X					X				
Ulster Township	X	X				X				
Warren Township	X	X				X				
Wells Township	X					X				
West Burlington Township	X					X				
Wilmot Township	X	X				X				
Windham Township	X	X				X				
Wyalusing Borough	X	X				X				
Wyalusing Township	X	X				X				
Wysox Township	X	X				X				
Bradford County	X		X	X	X	X		X	X	X

Municipality	6.2.2	6.2.3	6.2.4	6.2.5	6.2.6	6.2.7
Alba Borough	X					
Albany Township	X					
Armenia Township	X					
Asylum Township	X					
Athens Borough	X					
Athens Township	X					
Burlington Borough	X					
Burlington Township	X					
Canton Borough	X					
Canton Township	X					
Columbia Township	X					
Franklin Township	X					
Granville Township	X					
Herrick Township	X					
LeRaysville Borough	X					
Leroy Township	X					
Litchfield Township	X					
Monroe Borough	X					
Monroe Township	X					
New Albany Borough	X					
North Towanda Township	X					
Orwell Township	X					
Overton Township	X					
Pike Township	X					
Ridgebury Township	X					

Municipality	6.2.2	6.2.3	6.2.4	6.2.5	6.2.6	6.2.7
Rome Borough	X					
Rome Township	X					
Sayre Borough	X					
Sheshequin Township	X					
Smithfield Township	X					
South Creek Township	X					
South Waverly Borough	X					
Springfield Township	X					
Standing Stone Township	X					
Stevens Township	X					
Sylvania Borough	X					
Terry Township	X					
Towanda Borough	X					
Towanda Township	X					
Troy Borough	X					
Troy Township	X					
Tuscarora Township	X					
Ulster Township	X					
Warren Township	X					
Wells Township	X					
West Burlington Township	X					
Wilmot Township	X					
Windham Township	X					
Wyalusing Borough	X					
Wyalusing Township	X					
Wysox Township	X					
Bradford County	X	X	X	X	X	X

National Flood Insurance Program (NFIP) Related Mitigation Actions

The Federal Emergency Management Agency (FEMA) requires that every participating jurisdiction that either participates in the NFIP or has identified Special Flood Hazard Areas (SFHAs) have at least one specific action in its mitigation action plan that relates to continued compliance with the NFIP. The following actions comply with this requirement: 1.1.1; 1.1.2; 1.1.3; 1.2.3; 2.1.3; 3.2.5; 4.2.2; 4.3.1 and 6.2.2

Evaluate and Prioritize Mitigation Actions

Mitigation Action Evaluation:

Evaluating mitigation actions involves judging each action against certain criteria to determine whether or not it can be executed. The feasibility of each mitigation action is

evaluated using the ten evaluation criteria set forth in the mitigation action evaluation methodology as outlined in the Commonwealth of Pennsylvania's All-Hazard Mitigation Planning, Standard Operating Guide. The methodology solicits input on whether each action is highly effective or feasible and ineffective or not feasible for the criteria. These criteria are listed below and aid in determining the feasibility of implementing one action over another.

- Life Safety: Will the action be effective in promoting public safety?
- Property Protection: Will the action be effective in protecting public or private property?
- Technical: How effective will the action be in avoiding or reducing future losses?
- Political: Does the action have public and political support?
- Legal: Does the community have the authority to implement the proposed measure?
- Environmental: Will the action provide environmental benefits and will it comply with local, state and federal environmental regulations?
- Social: Will the action be acceptable by the community or will it cause any one segment of the population to be treated unfairly?
- Administrative: Is there adequate staffing and funding available to implement the action in a timely manner?
- Local Champion: Is there local support for the action to help ensure its completion?
- Other Community Objectives: Does the action address any current or future community objectives either through municipal planning or community goals?

To evaluate the mitigation actions, each action is identified as highly effective or feasible; ineffective or not favorable and no cost or benefit. For each criterion, the prioritization methodology assigns a "+" if the action was highly effective or feasible, a "-" if the action was ineffective or not feasible, and a "N" if no cost or benefit could be associated with the suggested action or the action was not applicable to the criteria.

Mitigation Action Prioritization:

Actions should be compared with one another to determine a ranking or priority by applying the multi-objective mitigation action prioritization criteria. Scores are assigned to each criterion using the following weighted, multi-objective mitigation action prioritization criteria:

- Effectiveness (weight: 20% of score): The extent to which an action reduces the vulnerability of people and property.
- Efficiency (weight: 30% of score): The extent to which time, effort, and cost is well used as a means of reducing vulnerability.

- Multi-Hazard Mitigation (weight: 20% of score): The action reduces vulnerability for more than one hazard.
- Addresses High Risk Hazard (weight: 15% of score): The action reduces vulnerability for people and property from a hazard(s) identified as high risk.
- Addresses Critical Communications/Critical Infrastructure (weight: 15% of score): The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.

Scores of 1, 2, or 3 are assigned for each multi-objective mitigation action prioritization criterion where 1 is a low score and 3 is a high score. Actions are prioritized using the cumulative score assigned to each. Each mitigation action is given a priority ranking (Low, Medium, and High) based on the following:

- Low Priority: 1.0 – 1.8
- Medium Priority: 1.9 – 2.4
- High Priority: 2.5 – 3.0

The cumulative results of the prioritization of mitigation actions is identified in the mitigation action evaluation and prioritization tool. The results for the mitigation action evaluation and prioritization are located in Appendix H of this plan.

7. Plan Maintenance

7.1. Update Process Summary

Monitoring, evaluating and updating this plan, is critical to maintaining its value and success in Bradford County's hazard mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis. The 2020 HMP update establishes a review of the plan within ninety days of a disaster event in addition to continuing with an annual plan evaluation. This HMP update also defines the municipalities' role in updating and evaluating the plan. Finally, the 2020 HMP Update encourages continued public involvement and how this plan may be integrated into other planning mechanisms in the county.

7.2. Monitoring, Evaluating and Updating the Plan

Hazard mitigation planning in Bradford County is a responsibility of all levels of government (i.e., county and local), as well as the citizens of the county. The Bradford County Local Planning Team will be responsible for maintaining this multi-jurisdictional HMP. The local planning team will meet annually and following each emergency declaration to review the plan. Every municipality that has adopted this plan will also be afforded the opportunity to provide updated information or information specific to hazards encountered during an emergency or disaster. Each review process will ensure that the hazard vulnerability data and risk analysis reflect current conditions of the county, that the capabilities assessment accurately reflects local capabilities and that the hazard mitigation strategies are updated based on the county's damage assessment reports and local mitigation project priorities. The HMP must be updated on a five-year cycle. An updated HMP must be completed and approved by the end of the five-year period. The monitoring, evaluating and updating of the plan every five years will rely heavily on the outcomes of the annual HMP Planning Team meetings.

The Bradford County Local Planning Team will complete a hazard mitigation progress report to evaluate the status and accuracy of the Multi-Jurisdictional HMP and record the local planning team's review process. The Bradford County Department of Public Safety will maintain a copy of these records and place them in Appendix J of this plan and will provide PEMA and FEMA with copies of the annual updates. Bradford County will continue to work with all municipalities regarding hazard mitigation projects, especially those municipalities that did not submit projects for inclusion in this plan.

7.3. Continued Public Involvement

The Bradford County Department of Public Safety will ensure that the 2020 Bradford County Hazard Mitigation Plan is posted and maintained on the Bradford County website and will continue to encourage public review and comment on the plan. The Bradford County website that the plan will be located at is as follows: www.bradfordcountypa.org/2019-bradford-county-hazard-mitigation/

The public will have access to the 2020 HMP through their local municipal office, the Bradford County Planning Department, or the Bradford County Department of Public Safety. Information on upcoming events related to the HMP or solicitation for comments will be announced via newsletters, newspapers, mailings, social media and the county website.

The citizens of Bradford County are encouraged to submit their comments to elected officials and/or members of the Bradford County HMP Local Planning Team. To promote public participation, the Bradford County Local Planning Team will post a public comment form as well as the hazard mitigation project opportunity form on the county's website. These forms will offer the public various opportunities to supply their comments and observations. All comments received will be maintained and considered by the Bradford County Hazard Mitigation Planning Team.

8. Plan Adoption

8.1. Resolutions

In accordance with federal and state requirements, the governing bodies of each participating jurisdiction must review and adopt by resolution, the 2020 Bradford County Hazard Mitigation Plan. Copies of the adopting resolutions are included in this plan in Appendix K. FEMA Region III in Philadelphia is the final approval authority for the Hazard Mitigation Plan. PEMA also reviews the plan before submission to FEMA.

9. Appendices

APPENDIX A: References
APPENDIX B: FEMA Local Mitigation Review Tool
APPENDIX C: Meetings and Support Documents
APPENDIX D: Municipal Flood Maps
APPENDIX E: Critical and Special Needs Facilities
APPENDIX F: 2020 HAZUS Reports
APPENDIX G: 2020 Mitigation Project Opportunities
APPENDIX H: 2020 Mitigation Action Evaluation & Prioritization
APPENDIX I: Dam Failure Profile
APPENDIX J: Annual Review Documentation
APPENDIX K: Bradford County & Municipal Adoption Resolutions