MCM Consulting Group, Inc.

Clinton County 2018 Hazard Mitigation Plan

Clinton County Department of Emergency Services

Certification of Annual Review Meetings

YEAR	DATE OF MEETING	PUBLIC OUTREACH ADDRESSED? *	SIGNATURE
2019			
2020			
2021			
2022			
2023			

**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 Clinton 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 Clinton County and all of its twenty-nine municipalities. The Clinton County Department of Emergency Services was charged by the County Board of Commissioners to prepare the 2018 plan. The 2011 HMP has been utilized and maintained during the 5-year life cycle.

The Clinton 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 Clinton County as a sub-grantee. The Clinton County Commissioners assigned the Clinton County Department of Emergency Services 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 Clinton County. This updated HMP will provide another solid foundation for the Clinton 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 Clinton County Multi-Jurisdictional Hazard Mitigation Plan serves as a framework for saving lives, protecting assets and preserving the economic viability of the twenty-nine municipalities in Clinton County. The HMP outlines actions designed to address and reduce the impact of a full range of natural hazards facing Clinton County, including drought, earthquakes, flooding, tornados, hurricanes/tropical storms and severe winter weather. Human caused hazards such as transportation accidents, hazardous materials spills and fires are also addressed.

A multi-jurisdictional planning approach was utilized for the Clinton 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 National Fire Incident Reporting System 5.0: Complete Reference Guide. January 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

The following document produced by the National Fire Protection Association (NFPA) provided additional guidance for updating this plan:

- NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs. 2011

2. Community Profile

2.1. Geography and Environment

Clinton County covers approximately 902 square miles and is situated in north central Pennsylvania. The county is bordered by Cameron and Clearfield Counties in the west and by Potter County to the north, Lycoming County to the east, Union County to the southeast, and Centre County to the south. Clinton County lies within two physiographic provinces of Pennsylvania—the Appalachian Plateaus and the Ridge and Valley Province. The division between the two provinces is marked by the Allegheny Front, which trends along a northeast-southwest axis, northwest of the town of Lock Haven. There is a total of 891 square miles of land and 11 square miles of water.

Clinton County presents a wide range of topographic features. The surface ranges from almost level on plateaus and in valleys, to rolling and hilly in other areas. Elevations in the county range from a high of 2,330 feet near State Camp to the northwest to a low of 530 feet at the Susquehanna River near Avis.

The climate in Clinton County is temperate, being characterized by moderately hot summers and moderately severe winters. In winter, the average temperature is 28.6˚F and the average daily minimum temperature is 19.9˚F. In summer, the average temperature is 69.8˚F and the average daily maximum temperature is 82.4˚F. The average amount of snowfall each winter is 27.01 inches.

River and stream valleys dominate the landscape of Clinton County. The West Branch of the Susquehanna River is the primary feature and runs through the entire county. Its major tributaries include Sinnemahoning Creek, Kettle Creek, Young Woman's Creek, Hyner Run, Queen's Run, Chatham Run, McElhattan Creek, Fishing Creek, Bald Eagle Creek, and Beech Creek.

Clinton County is comprised of 15 watersheds:

- Antes Creek
- Bald Eagle Creek
- Beech Creek
- Chatham Run
- First Fork Sinnemahoning Creek
- Fishing Creek/Cedar Run
- Kettle Creek
- Penns Creek
- Pine Creek
- Reeds Run
- Sinnemahoning Creek
- West Branch Susquehanna River
- White Deer Creek

- White Deer Hole Creek
- Young Womans Creek

2.2. Community Facts

In 1839, Clinton County became the fifty-fifth county in Pennsylvania when it was created from parts of Centre and Lycoming Counties. The county is named after the famous New York canal builder, Dewitt Clinton. The county seat is the City of Lock Haven, which is home to Lock Haven State University.

The following cities, boroughs and townships are located in Clinton County:

- Cities: Lock Haven
- Boroughs: Avis, Beech Creek, Flemington, Loganton, Mill Hall, Renovo, South Renovo.
- Townships: Allison, Bald Eagle, Beech Creek, Castanea, Chapman, Colebrook, Crawford, Dunnstable, East Keating, Gallagher, Greene, Grugan, Lamar, Leidy, Logan, Noyes, Pine Creek, Porter, Wayne, West Keating, Woodward.

Clinton County's leading industries are education, healthcare, social services, manufacturing, and retail trade. The primary employment providers within Clinton County are displayed below in *Table 1 - Top Employers.*

Table 1 - Top Employers

Clinton County Top Employers	
Company	**Industry**
First Quality Products Inc	Healthcare Products Manufacturer
Keystone Central School District	Education
First Quality Tissue LLC	Tissue Products Manufacturer
PA State System of Higher Education	Education
Keane Frac LP	Hydraulic Equipment Supplier
Truck-Lite Co LLC	Truck Lighting Supplier
Wal-Mart Associates Inc	Retail Services
Lock Haven Hospital	Healthcare
Local Government	Government
Nutek Disposables Inc	Sanitary Paper Product Supplier
Source: Pennsylvania Department of Labor & Industry	

The wealth of natural resources found in the county has been instrumental in shaping the diversity of communities within its borders. Agriculture, mining, and the network of rivers have played a large role in the economic development in Clinton County. Clinton County has relied heavily on the agricultural and lumber industries. Other industries that have played an important historic role in the county are textile manufacturing and railroads. A number of textile mills were located in Clinton County, including silk mills in Lock Haven and the Woolrich Woolens Mill in Pine Creek Township. The

Borough of Renovo was home to a major railroad car repair facility – the Berwick Forge and Fabricating Railcar Plant. The Piper Aircraft Plant, home of the Piper Cub, was located in Lock Haven until the early 1980's, and paper product manufacturing remains an important component of the county's economic base.

2.3. Population and Demographics

Clinton County recorded a population of 39,238 during the 2010 U.S. Census, ranking the county in the 56th position among Pennsylvania's sixty-seven counties. The population in this county is declining slightly according to the U.S. Census Bureau whom estimated the population to be 39,233 in July of 2016, or -.02% from the April 1, 2010 population census. The median income of households in Clinton County is $45,078. This is approximately $8,500 less than the national median household income (U.S. Census, 2014).

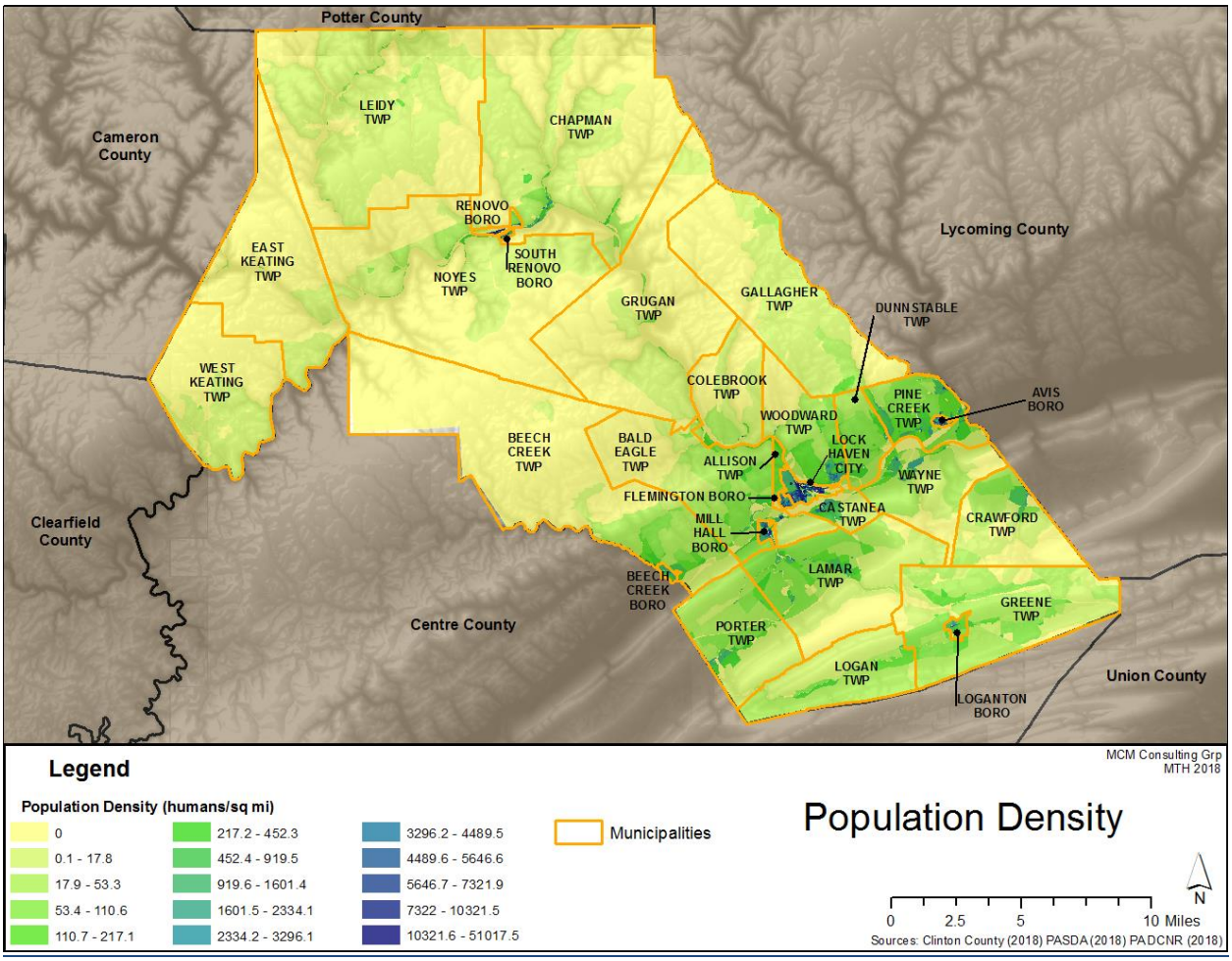
The populations per municipality are identified in *Table 2 - Municipal Population* below.

Table 2 - Municipal Population

Clinton County Municipality Populations			
Municipality	**Population**	**Municipality**	**Population**
Allison Township	193	Lamar Township	2,517
Avis Borough	1,484	Leidy Township	180
Bald Eagle Township	2,065	Lock Haven City	9,772
Beech Creek Borough	701	Logan township	817
Beech Creek Township	1,015	Loganton Borough	468
Castanea Township	1,185	Mill Hall Borough	1,613
Chapman Township	848	Noyes Township	357
Colebrook Township	199	Pine Creek Township	3,215
Crawford Township	939	Porter Township	1,460
Dunnstable Township	1,008	Renovo Borough	1,228
East Keating Township	11	South Renovo Borough	439
Flemington Borough	1,330	Wayne Township	1,666
Gallagher Township	381	West Keating Township	29
Greene Township	1,695	Woodward Township	2,372
Grugan Township	51		
Source: US Decennial Census			

The median age in Clinton County is 38.5 years old (according to the 2010 United States Census Bureau). More than 64% of the county's total population is under the age of 45, according to the 2010 census data. A total of 10,745 (70.9%) owner-occupied housing units were identified during the 2010 census. The total number of residents living in rental units is 9,778.

Figure 1 - Population Density Map



2.4. Land Use and Development

Clinton County is composed of 29 municipalities, which includes:

- 21 townships
- 7 boroughs
- 1 city

The majority of acreage in Clinton County is forested while approximately 9.8% (or 56,626 acres) of the acreage is agriculture. The land use in the county consists of three main regions; Northern Half, Southern Half, and South-Central River Corridor (which includes the city of Lock Haven). The Northern two-thirds consists primarily of forestland and provides recreational opportunity and wildlife habitat along the Allegheny Plateau. The Southern one-third consists primarily of farmland in the Ridge and Valley Province. The South-Central River Corridor consists of the manufacturing and business districts along with residential areas.

2.5. Data Sources

- Clinton County Comprehensive Plan
- Clinton County Planning Commission
- United States Census Bureau (2010, 2014)
- United States Department of Agriculture
- Natural Resources Conservation Service
- Pennsylvania State Data Center
- Clinton County Conservation District
- Pennsylvania Department of Environmental Protection
- Clinton County Geographic Information Systems (GIS)
- Pennsylvania Spatial Data Access (PASDA)
- National Oceanic and Atmospheric Administration
- Pennsylvania Department of Conservation and Natural Resources
- Clinton County Today - Summary of Indicators
- Pennsylvania Department of Labor and Industry
- Clinton County Greenways and Open Spaces Plan
- Clinton County Conservation District Strategic Plan
- Soil Survey of Clinton County

Figure 2 - Clinton County Base Map

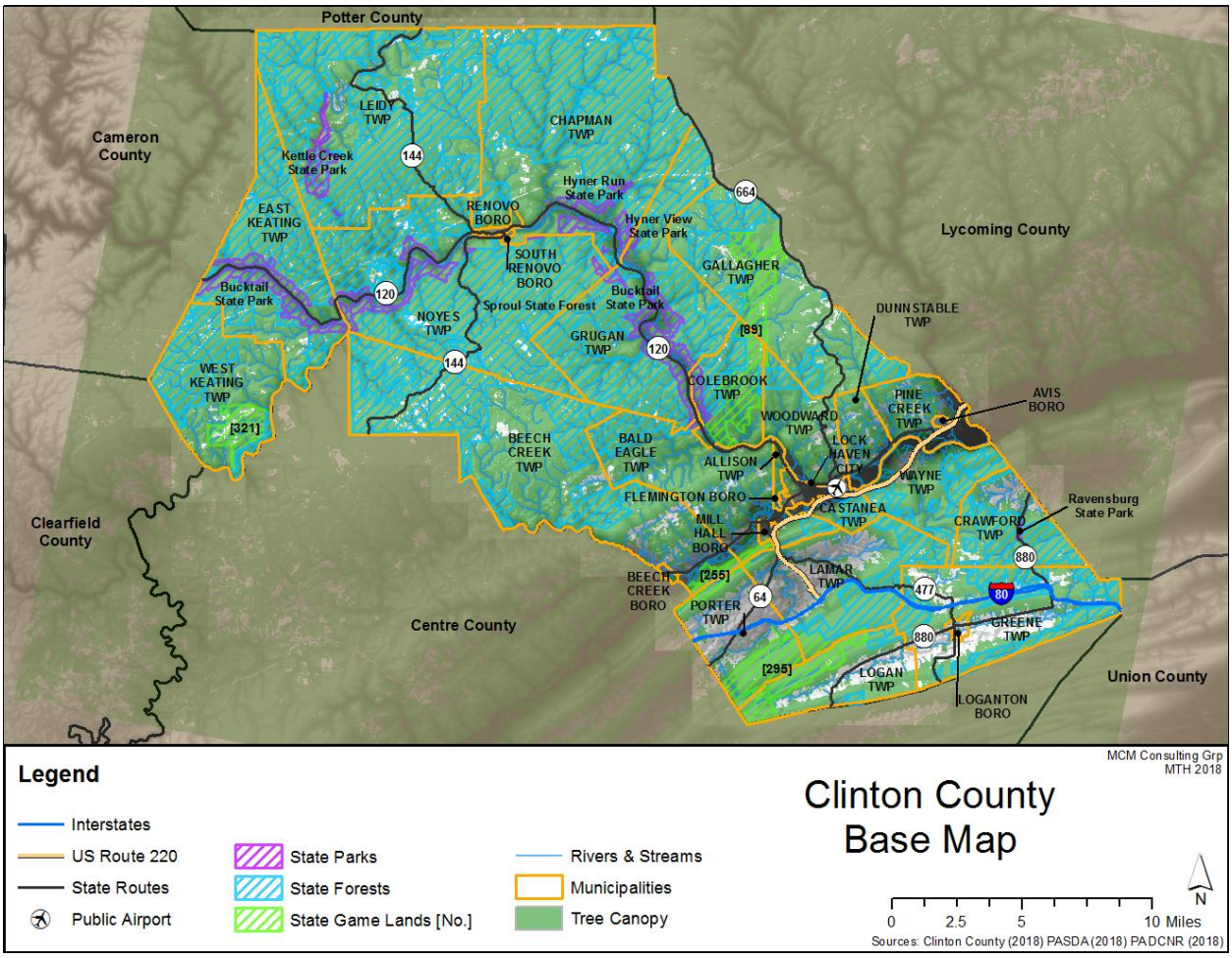


Figure 3 - Land Use/Land Cover Map

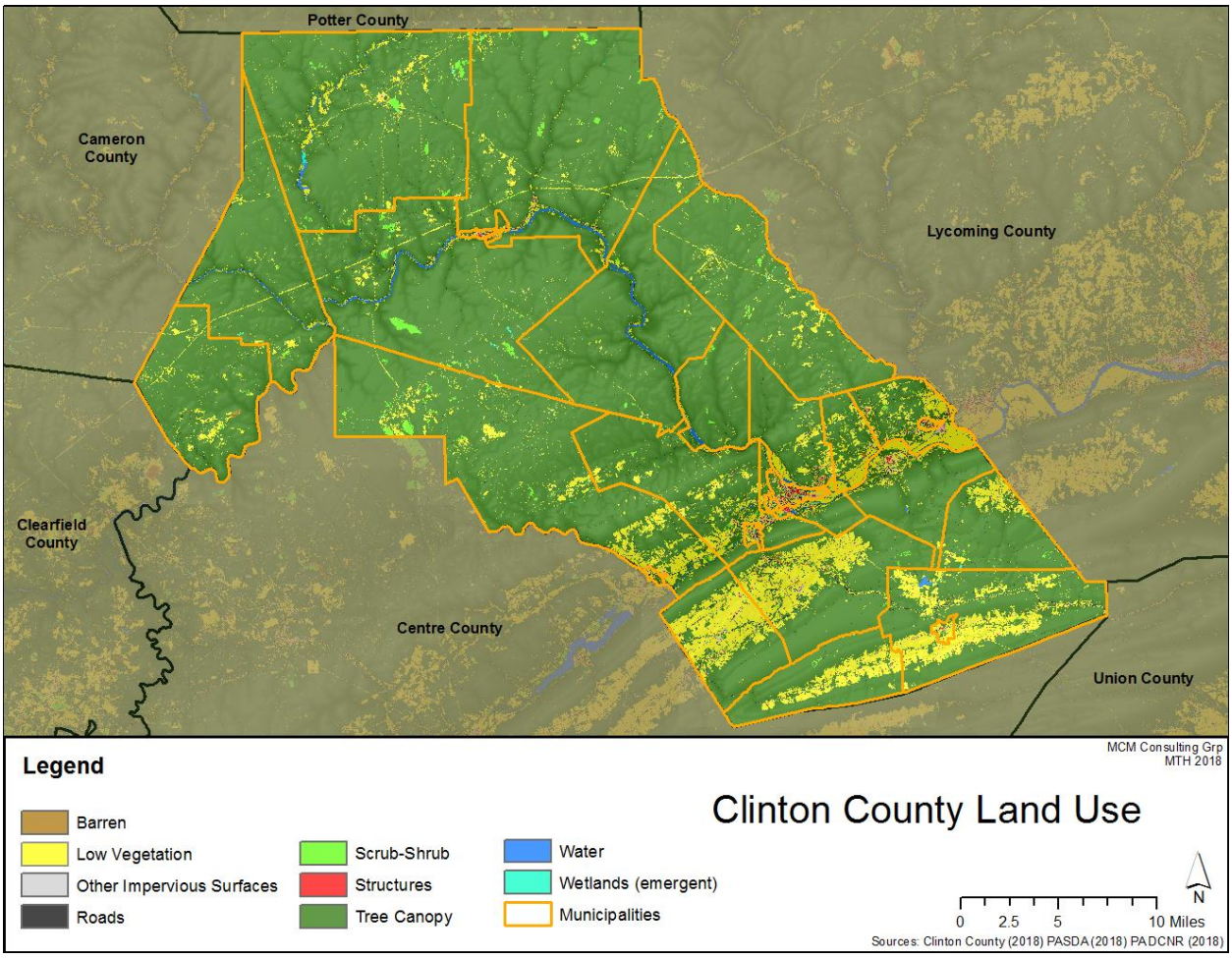


Figure 4 - Recreation Features

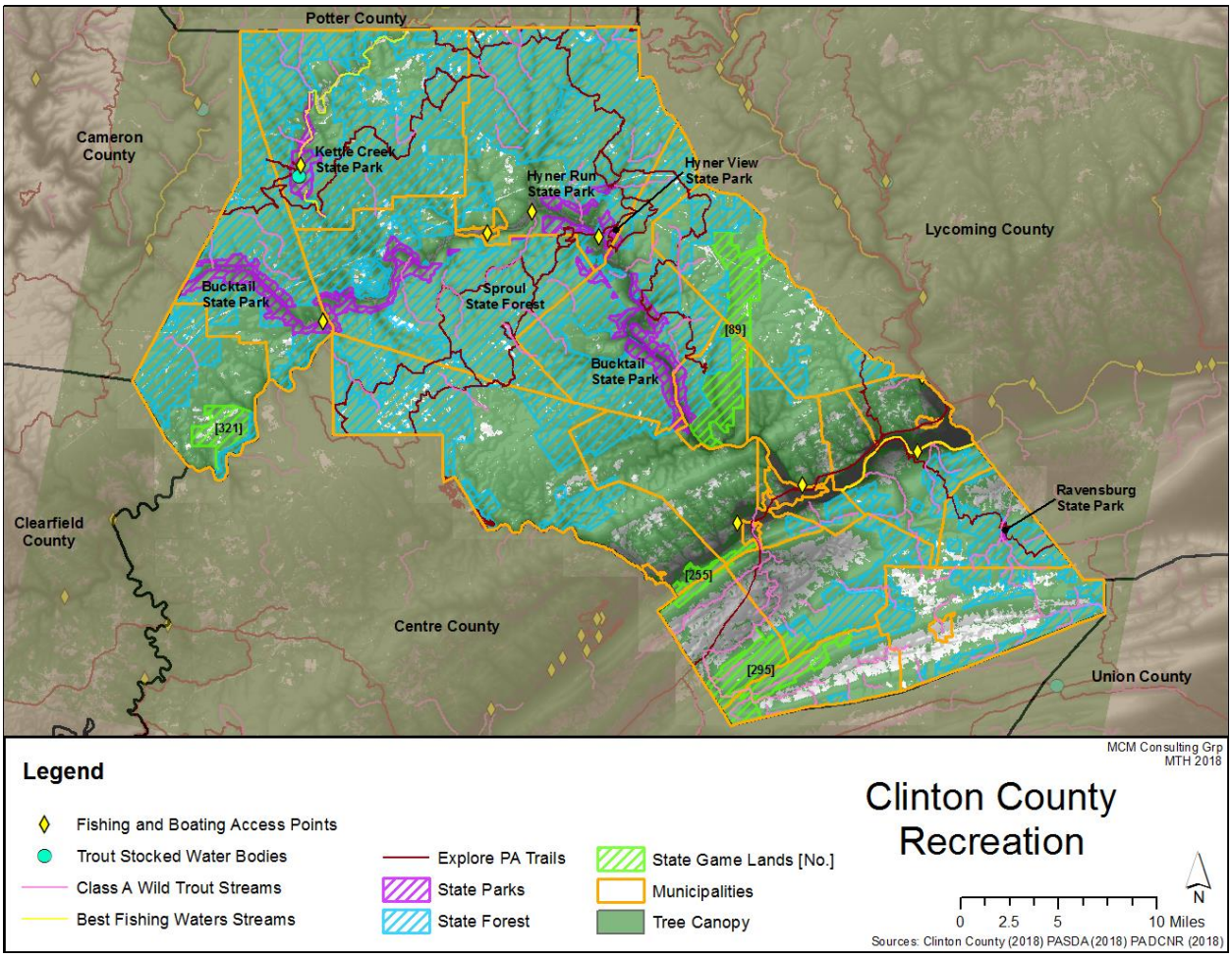
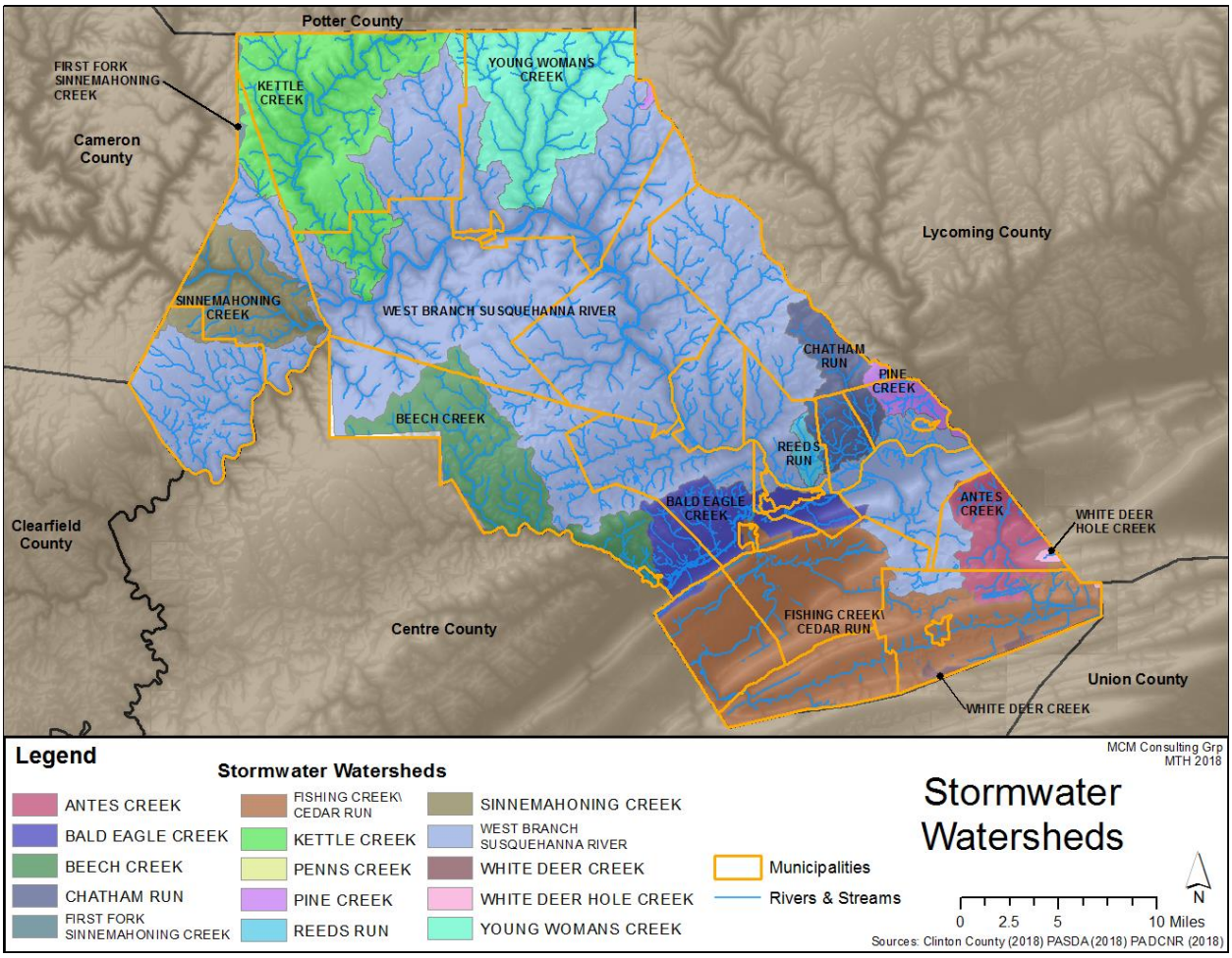


Figure 5 - Hydrologic Features



3. Planning Process

3.1. Update Process and Participation Summary

The Clinton County Hazard Mitigation Plan update began October 11, 2017. The Clinton County Commissioners were able to secure a hazard mitigation grant to start the process. The Clinton County Department of Emergency Services was identified as the lead agency for the Clinton County Hazard Mitigation Plan update. The planning process involved a variety of key decision makers and stakeholders within Clinton County. Clinton 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 Clinton County Department of Emergency Services, 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 Clinton County Department of Emergency Services in coordinating and leading public involvement meetings, local planning team meetings, analysis and the writing of the HMP. The Clinton 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 Clinton 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. Clinton 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 Clinton County Board of Commissioners.
- Plan submission to FEMA and PEMA.

The 2018 Clinton County HMP was completed April 18, 2018. The 2018 plan follows an outline developed by PEMA which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. The 2018 HMP format is consistent with the PEMA recommended format. The 2018 Clinton 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 2018 Clinton County Hazard Mitigation Plan update was led by the Clinton County Steering committee. The Clinton 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 3 - Steering Committee* outlines the individuals that comprised this team.

Table 3 - Steering Committee

Clinton County Hazard Mitigation Plan Update Steering Committee		
Name	**Organization**	**Position**
Kevin Fanning	Clinton County DES	Director
Bill Frantz	Clinton County DES	EMA Coordinator
Katie de Silva	Clinton County Planning	Director
Jim Watson	Clinton County GIS	Director
Grant McCuley	Clinton County DES	Intern
Scott Koser	Clinton County Conservation Dist.	Watershed Specialist
Michael Rearick	MCM Consulting Group, Inc.	Project Manager
Robert Anderson	MCM Consulting Group, Inc.	Senior Consultant
Corbin Snyder	MCM Consulting Group, Inc.	Project Coordinator

In order to represent the county, the Clinton County Steering committee developed a diversified list of potential Local Planning Team (LPT) members. Members that participated in the 2011 hazard mitigation plan were highly encouraged to join the 2018 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: Clinton County Commissioners, Clinton County Planning Commission, Clinton County Conservation District, Lock Haven University, Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Parks, DCNR Bureau of Forestry, PennDOT, Pennsylvania State Police, Clinton County School Districts, Clinton County Fire Chiefs, Clinton County Ambulance, Clinton County Sheriff and all 29 municipalities. The invitations for membership of the LPT were disseminated by the Clinton County Department of Emergency Services 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 4 - Local Planning Team* served on the 2018 Clinton 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 4 - Local Planning Team

Clinton County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Kevin Fanning	Clinton County Department of Emergency Services	Director
Bill Frantz	Clinton County Department of Emergency Services	EMA Coordinator
Katie de Silva	Clinton County Planning Commission	Director
Robert Smeltz	Clinton County	County Commissioner
Paul Conklin	Clinton County	County Commissioner
Elmer Christian	Avis Borough	Elected or Appointed Official
Lew Summers	Bald Eagle Township	Elected or Appointed Official
Marissa Morgan	Bald Eagle Township	Elected or Appointed Official
Melvin Coakley	Beech Creek Borough	Elected or Appointed Official
Denise Bittner	Beech Creek Township	Elected or Appointed Official
Elizabeth Whitty	Chapman Township	Elected or Appointed Official
Charles Rossell	Chapman Township	Elected or Appointed Official
Paulene Simcox	Colebrook Township	Elected or Appointed Official
Marguerite Miller	East Keating Township	Elected or Appointed Official
Gary Mellott	Flemington Borough	Elected or Appointed Official
Chris Scaff	Greene Township	Elected or Appointed Official
Karl Weber	Grugan Township	Elected or Appointed Official
Jan Maney	Lamar Township	Elected or Appointed Official

Clinton County Hazard Mitigation Plan Update Local Planning Team		
Name	**Organization**	**Position**
Bill Garbrick	Lamar Township	Elected or Appointed Official
Nevin Courter	Lamar Township	Elected or Appointed Official
Danielle Cross	Leidy Township	Elected or Appointed Official
David Flack	Leidy Township	Elected or Appointed Official
Steve Stevenson	Lock Haven City	Elected or Appointed Official
Jason Dershem	Lock Haven City	Elected or Appointed Official
Brad Anderson	Lock Haven Hospital	Elected or Appointed Official
Marchal Rote	Lock Haven University	Facilities Coordinator
Chris Scaff	Logan Township	Elected or Appointed Official
Chris Scaff	Loganton Borough	Elected or Appointed Official
Michael Rearick	MCM Consulting Group, Inc.	Project Manager
Corbin Snyder	MCM Consulting Group, Inc.	Project Coordinator
Anthony Walker	Mill Hall Borough	Elected or Appointed Official
Brad Rote	Mill Hall Borough	Elected or Appointed Official
Dennis Greenawaly	Pine Creek Township	Elected or Appointed Official
Elmer Christian	Pine Creek Township	Elected or Appointed Official
Carol Colucci	Porter Township	Elected or Appointed Official
Ann Taratella	Renovo Borough	Elected or Appointed Official
Marsha Davis	Renovo Borough	Elected or Appointed Official
James Palmer	South Renovo Borough	Elected or Appointed Official
Ryan Harkinson	South Renovo Borough	Elected or Appointed Official
Darlene Macklem	Wayne Township	Elected or Appointed Official
Brad Rote	Wayne Township	Elected or Appointed Official
Jan Maney	West Keating 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. *A final public meeting was held* on April 18, 2018 to present the draft plan and invite public comments. The meeting was advertised in the local newspaper and also made available digitally on the Clinton County web site at: www.clintoncountypa.com/departments/emergency_services/des/

The public comment period remained open until May 16, 2018. All public comments were to be submitted in writing to Bill Frantz at the Clinton County Department of Emergency Services. No public comments were received.

Table 5 - HMP Process Timeline lists the meetings held during the HMP planning process, which organizations and municipalities attended and the topic that was dis-

cussed 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 April 18, 2018 to present the draft plan and invite public comments. The meeting was advertised in the local newspaper and also made available digitally on the Clinton County web site at: www.clintoncountypa.com/departments/emergency_services/des/

The public comment period remained open until May 16, 2018. All public comments were to be submitted in writing to Bill Frantz at the Clinton County Department of Emergency Services. No public comments were received.

Table 5 - HMP Process Timeline

Clinton County HMP Process - Timeline		
Date	**Meeting**	**Description**
10/11/17	Clinton 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.
11/16/17	Local Planning Team Initial Meeting	Defined hazard mitigation planning and identified roles and responsibilities. Discussed the 2011 hazard mitigation plan and defined a timeline to complete the update.
02/01/18	Public Meeting	Conducted a public meeting to review the draft risk assessment section of the Clinton County Hazard Mitigation Plan update.
01/31/18 02/01/18 02/02/18	Meeting with Municipal Officials	Educated county and local elected officials on the hazard mitigation planning process. Presented the findings of the hazard vulnerability analysis and risk assessment. Sought input for mitigation projects throughout the county. Distributed Hazard Mitigation Project Opportunity Forms.
04/18/18	Clinton 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

Clinton 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 Clinton 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. 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 Clinton County Department of Emergency

Services 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 Clinton County Department of Emergency Services.

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 2011 mitigation opportunity forms that were included in the current HMP were provided to the municipalities for review and amendment. These opportunities are located in Appendix F. The previous mitigation actions were provided and reviewed at update meetings. New 2018 municipal project opportunity forms are included as well, 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.

Clinton County invited all contiguous counties to review the 2018 draft hazard mitigation plan. A letter was sent to the emergency management coordinator in the contiguous counties on April 20, 2018. The counties that were notified were: Cameron County, Centre County, Clearfield County, Lycoming County, Potter County and Union County. No response was received from any counties. Copies of these letters are included in Appendix C.

3.5. Multi-Jurisdictional Planning

Clinton 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 6 - Worksheets, Surveys and Forms Participation* reflects the municipality participation by completing worksheets, surveys and forms.

Table 6 - 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**
Allison Township			
Avis Borough	X	X	X
Bald Eagle Township	X	X	X
Beech Creek Borough	X	X	X
Beech Creek Township	X	X	X
Castanea Township			
Chapman Township	X	X	X
Colebrook Township	X	X	None
Crawford Township	X	X	None
Dunnstable Township	X	X	None
East Keating Township	X	X	X
Flemington Borough	X	X	X
Gallagher Township			
Greene Township	X	X	X
Grugan Township	X	X	None
Lamar Township	X	X	X
Leidy Township	X	X	X
Lock Haven City	X	X	X
Lock Haven University	X	X	X
Logan Township	X	X	X
Loganton Borough	X	X	X
Mill Hall Borough	X	X	X
Noyes Township	X	X	X
Pine Creek Township	X	X	X
Porter Township	X	X	X
Renovo Borough	X	X	X
South Renovo Borough	X	X	X
Wayne Township	X	X	None
West Keating Township	X	X	None
Woodward Township	X	X	X

Twenty-eight municipalities within Clinton County have adopted the 2011 Clinton County Hazard Mitigation Plan as the municipal hazard mitigation plan. The only municipality that has an independent plan is Lock Haven City. The Clinton County Local Planning Team goal is 100% participation by municipalities in adopting the 2018 Clinton 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 manmade 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 Clinton County risk assessment provides in-depth knowledge of the hazards and vulnerabilities that affect Clinton 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 Clinton County Emergency Operations Plan (EOP), local EOPs and other public and private emergency management plans.

The Clinton 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 Clinton County Local Planning Team reviewed and assessed the change in risk for all natural and manmade hazards identified in the 2011 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Pennsylvania Hazard Mitigation Plan but not included in the 2011 Clinton County Hazard Mitigation Plan that could impact Clinton County. The team utilized the Hazard Identi-

fication and Risk Evaluation worksheet that was provided by the Pennsylvania Emergency Management Agency.

The Clinton County Steering Committee met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. Twenty-four municipalities returned a completed worksheet. 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 Clinton 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 7 - Presidential & Gubernatorial Disaster Declarations presents a list of all Presidential and Governor's Disaster Declarations that have affected Clinton County from 1972 through 2014, according to the Pennsylvania Emergency Management Agency.

Table 7 - Presidential & Gubernatorial Disaster Declarations

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
September, 1955	Drought	Gubernatorial Declaration
January, 1966	Heavy snow	Gubernatorial Declaration
February, 1972	Heavy snow	Gubernatorial Declaration
June, 1972	Flood (Agnes)	Presidential Disaster Declaration
February, 1974	Truckers strike	Gubernatorial Declaration
September, 1975	Flood (Eloise)	Presidential Disaster Declaration
January, 1978	Heavy snow	Gubernatorial Declaration
February, 1978	Blizzard	Gubernatorial Declaration
March, 1993	Blizzard	Presidential Emergency Declaration
January, 1994	Severe winter storms	Presidential Disaster Declaration
September, 1995	Drought	Gubernatorial Declaration
January, 1996	Severe winter storms	Presidential Disaster Declaration
January, 1996	Flooding	Presidential Disaster Declaration
December, 1998	Drought	Gubernatorial Declaration
July, 1999	Drought	Gubernatorial Declaration

Presidential Disaster Declarations and Gubernatorial Declarations and Proclamations		
Date	**Hazard Event**	**Action**
September, 1999	Hurricane Floyd	Presidential Disaster Declaration
February, 2003	Severe winter storm	Presidential Emergency Declaration
September, 2003	Hurricane Isabel/Henri	Presidential Disaster Declaration
September, 2004	Tropical Depression Ivan	Presidential Disaster Declaration
September, 2005	Hurricane Katrina – to render mutual aid and to receive and house evacuees	Presidential Emergency Declaration
September, 2005	Hurricane Katrina	Gubernatorial Proclamation of Emergency
June, 2006	Flooding	Presidential Proclamation of Emergency
September, 2006	Tropical depression Ernesto	Gubernatorial Proclamation of Emergency
February, 2007	severe winter storm	Gubernatorial Proclamation of Emergency
February, 2007	Waive the regulations regarding hours of service limitations for drivers of commercial vehicles	Gubernatorial Proclamation of Emergency
April, 2007	Severe storm	Gubernatorial Declaration
April, 2007	Severe winter storm	Gubernatorial Proclamation of Emergency
February, 2010	severe winter storm	Gubernatorial Proclamation of Emergency
January, 2011	Severe winter storm	Gubernatorial Proclamation of Emergency
September, 2011	Severe storms and flooding (Lee/Irene)	Gubernatorial Proclamation of Emergency
September, 2011	Remnants of Tropical Storm Lee	Presidential Proclamation of Emergency
April, 2012	Spring winter storms	Gubernatorial Proclamation of Emergency
October, 2012	Hurricane Sandy	Gubernatorial Proclamation of Emergency
October, 2012	Hurricane Sandy	Presidential Proclamation of Emergency
June, 2013	High winds, thunderstorms, heavy rain, tornado, flooding	Gubernatorial Proclamation of Emergency
June, 2013	Severe storms, tornadoes and flooding	Presidential Proclamation of Emergency
January, 2014	Extended prolonged cold	Gubernatorial Proclamation of Emergency
January, 2014	Driver hours waived due to prolonged and continued severe winter weather	Gubernatorial Proclamation of Emergency
February, 2014	Severe winter weather	Gubernatorial Proclamation of Emergency
February, 2014	Severe winter storm	Presidential Proclamation of Emergency

4.2.2. Summary of Hazards

The Clinton County Local Planning Team (LPT) was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2018 HMP Update. Following a review of the hazards considered in the 2011 HMP and the standard list of hazards, the Local Planning Team decided that the 2018 plan should identify, profile and analyze seventeen hazards. These seventeen hazards include all of the hazards profiled in the 2011 plan. The list below contains the hazards that have the potential to impact Clinton County as identified through previous risk assessments, the Clinton County Hazards Vulnerability Analysis and input from those that participated in the 2018 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 particular 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).

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, Nor'easter

Hurricanes, tropical storms and nor'easters 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 (June through November). (FEMA, 1997).

Invasive Species

An invasive species is a species that is not indigenous to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease, or pathogen. Infestations may not necessarily impact human health, but can create a nuisance or agricultural hardships by destroying crops, defoliating populations of native plant and tree species, or interfering with ecological systems (Governor's Invasive Species Council of Pennsylvania, 2009).

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 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).

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, Wind Storm

A wind storm 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. 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 water spout 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).

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 Manmade Hazards

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).

Disorientation

Large numbers of people are attracted to Pennsylvania's rural areas for recreational purposes such as hiking, camping, hunting and fishing. As a result, people can become lost or trapped in remote and rugged wilderness areas. Search and rescue may be required for people who suffer from medical problems or injuries and those who become accidentally or intentionally disoriented. Search and rescue efforts are focused in and around state forest and state park lands (DCNR, 2009).

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 so as 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).

Opioid Epidemic

The opioid epidemic is the 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 pain-killers, 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 recreation-al 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.

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.

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).

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 events, for example (Clinton County, PA, 2005).
- 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 on these hazards is expected to intensify over time as temperatures continue to rise, so it is prudent to be aware of how climate change is impacting natural hazards.

The most obvious change is in regard to extreme temperature. As average atmospheric temperatures rise, extreme high temperatures become more threatening, with record high temperatures outnumbering record low temperatures 2:1 in recent years (Meehl et al., 2009). As climate change intensifies, it is expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated. Less immediately apparent, climate change could increase the prevalence of the West Nile Virus (Section 4.3.6). 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 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. Along with the prospect of decreased annual precipitation, the risk of hydrological and agricultural drought is expected to increase (Sheffield & Wood, 2008). Correspondingly this will impact wildfires (Section 4.3.9). 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 Clinton 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 4.3.2). 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, increasing the risk of flooding and dam and levee failures. Similarly, winter storms are expected to become more intense, if possibly less frequent (Section 4.3.10). Climate change is also expected to result in more intense hurricanes and tropical storms (Section 4.3.3). 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 is capable of fueling 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).

Climate change is contributing to the introduction of new invasive species (Section 4.3.4). As maximum and minimum seasonal temperatures change, non-native species are able to 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.

This type of sudden global change is novel to humanity. Despite the myriad of well thought out research, there is still much uncertainty surrounding the future of the Earth. All signs point to the intensification of the hazards mentioned above, especially if human society and individuals do not make swift and significant changes to reduce emissions and species losses.

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 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 Clinton 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 of time without rainfall that has an adverse effect on streams, lakes, and groundwater levels, potentially impacting agriculture.

4.3.1.2 Range of Magnitude

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

Table 8 - 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 9 - 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 PA 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. [PEMA, 409 Plan]

4.3.1.3 Past Occurrence

Table 10 - Drought Event History shows declared drought status for Clinton County from 1980 to November 2017 as reported by the Pennsylvania Department of Environmental Protection (PA DEP) and the table also includes past disaster declarations impacting Clinton County due to drought events. *Figure 6 - Palmer Drought Severity Index History* shows that Clinton County has experienced severe drought (PDSI ≤ -3) between five and ten percent of the time from 1895-1995, which gives a good idea of how often the county has been affected by drought events (see *Figure 6 - Palmer Drought Severity Index History*).

The worst drought event on record for Clinton County 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.

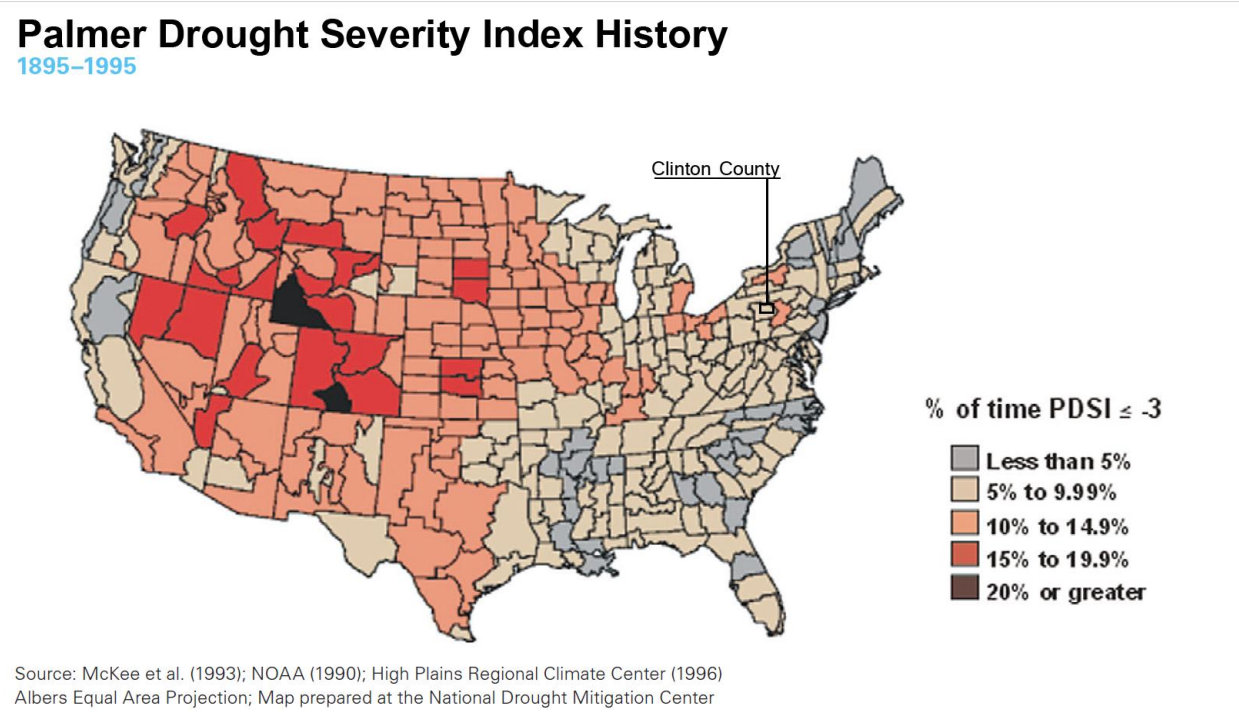
Another devastating drought occurred throughout the year in 1999, culminating with the governor of Pennsylvania declaring a drought emergency for most of the Commonwealth on July 21, 1999. Corn crop losses alone were estimated to be approximately $100 million with total crop losses estimated at over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

Table 10 - Drought Event History

Drought Event History ***(PA DEP, 2018)***			
Start Date	**End Date**	**Drought Status**	**Event Duration**
11/18/80	04/20/82	Emergency	1 year, 5 months, 2 days
04/26/85	12/19/85	Watch	7 months, 23 days
07/07/88	08/24/88	Watch	5 months, 5 days
08/24/88	12/12/88	Warning	
03/03/89	05/15/89	Watch	2 months, 12 days
06/28/91	07/24/91	Warning	1 year, 2 months, 14 days
07/24/91	04/20/92	Emergency	
04/20/92	06/23/92	Warning	
06/23/92	09/11/92	Watch	
09/01/95	09/20/95	Warning	3 months, 17 days
09/20/95	11/08/95	Emergency	
11/08/95	12/18/95	Warning	
07/17/97	11/13/97	Watch	3 months, 27 days
12/03/98	01/15/99	Warning	1 year, 5 months, 2 days
01/15/99	03/15/99	Emergency	
03/15/99	06/10/99	Watch	
06/10/99	07/20/99	Warning	
07/20/99	09/30/99	Emergency**	
09/30/99	02/25/00	Warning	
02/25/00	05/05/00	Watch	
08/08/01	05/13/02	Watch	9 months, 5 days
09/05/02	11/07/02	Watch	2 months, 2 days
04/11/06	06/30/06	Watch	2 months, 19 days
08/06/07	10/05/07	Watch	6 months, 9 days
10/05/07	01/11/08	Warning	
01/11/08	02/15/08	Watch	
11/07/08	01/26/09	Watch	2 months, 19 days

Drought Event History *(PA DEP, 2018)*			
Start Date	**End Date**	**Drought Status**	**Event Duration**
09/16/10	11/10/10	Watch	1 months, 25 days
08/05/11	09/02/11	Watch	28 days
03/24/15	07/10/15	Watch	3 months, 16 days
08/02/16	02/08/17	Watch	6 months, 6 days
**Gubernatorial Disaster Declaration			

Figure 6 - Palmer Drought Severity Index History

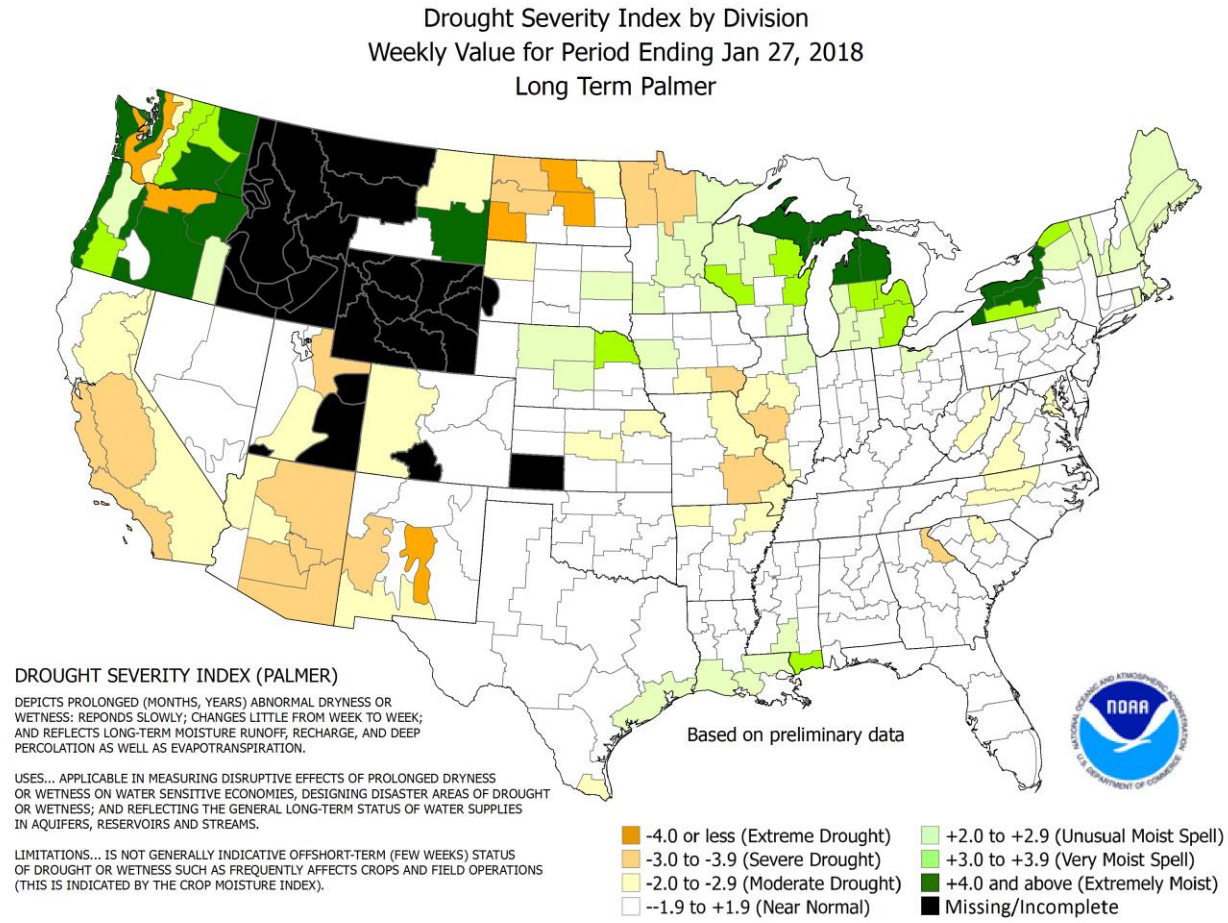


4.3.1.4 Future Occurrence

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. Clinton County has experienced severe drought between five and ten percent of the time between 1895 and 1995 (*Figure 6 - Palmer Drought Severity Index History)*, which can be used to make a rough estimate of the future probability of drought in Clinton County, although it does not account for uncertainty introduced by climate change. *Figure 7 - Recent Drought Severity Index* shows a recent Palmer Drought Severity Index reading for the continental United States and as of January 27, 2018 Clinton County

and the surrounding region are considered in near normal conditions, with a PDSI between -1.9 and 1.9.

Figure 7 - Recent Drought Severity Index



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 469 farms in Clinton County, at an average size of 112 acres. Clinton County ranks thirty-second of the sixty-seven counties

in the Commonwealth for agricultural production, totaling $60,558,000 dollars (USDA, 2012). The majority of this production comes from livestock, poultry and their products (~$48 million). The remaining agricultural production comes from crops, including nursery and greenhouse crops (~$12 million).

Water supplies are also vulnerable to the effects of drought. Public water service areas cover 4.4% of the county, including the majority of Renovo, South Renovo, Beech Creek, Mill Hall, Avis, Loganton, and Flemington Boroughs as well as Lock Haven City and portions of Pine Creek, Wayne, Porter, Castanea, and Woodward Townships *(See Figure 8 - Drought Vulnerability).* The majority of the county however 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 Clinton County residents who use private domestic wells are vulnerable to drought events. *Table 11 - Domestic Water Wells* shows the number of wells in each municipality in Clinton 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 Clinton County, it is not comprehensive due to the voluntary nature of the data submission. Not all wells were reported including a location designation.

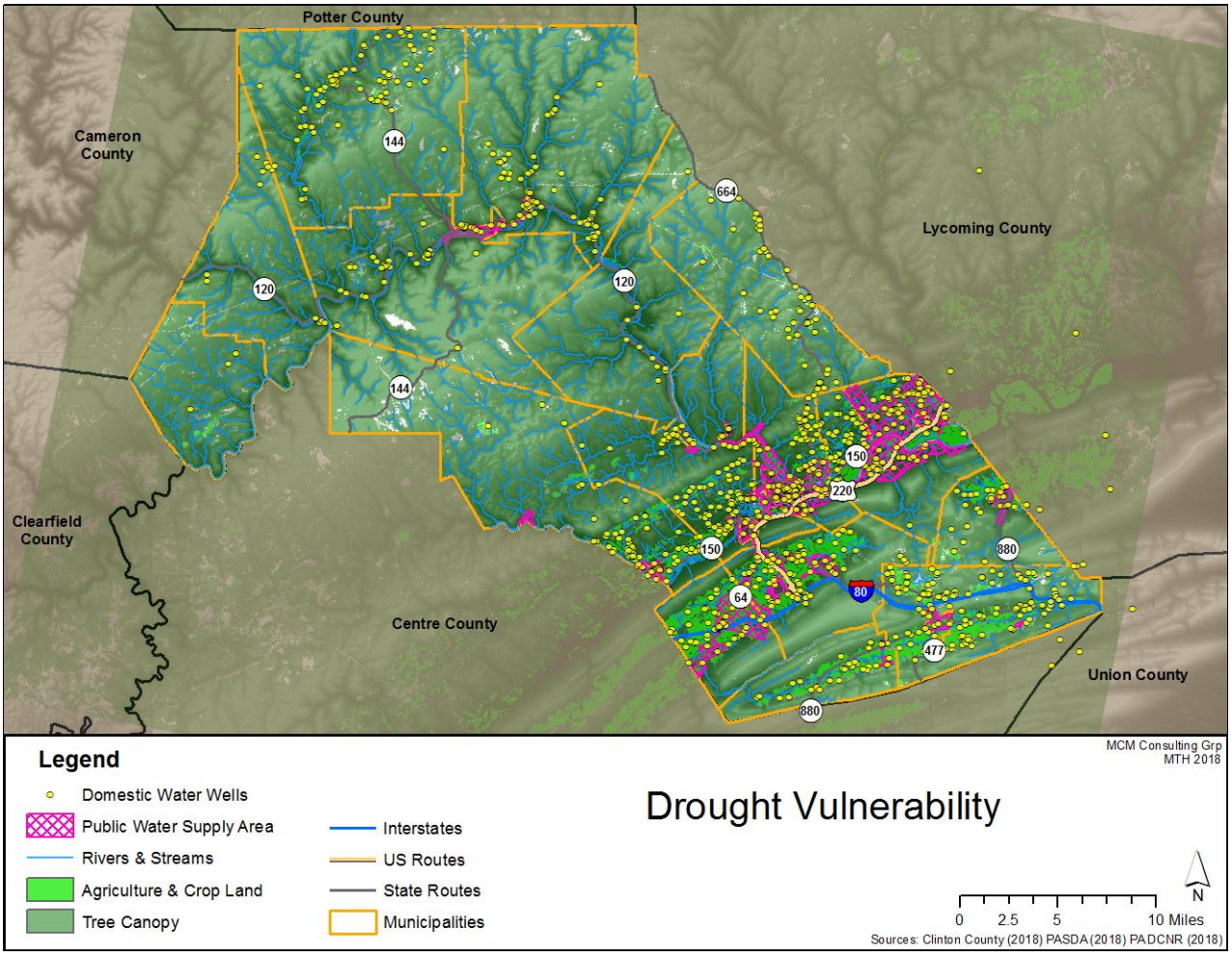
The EPA provides a guide published in October 2017 for water utilities to aid in drought response and recovery. The guide outlines what goes into a good drought response plan, and how to manage water supply and demand during a drought, outlines best practices for communication and partnerships with other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

Table 11 - Domestic Water Wells

Domestic Water Wells ***(PAGWIS, 2018)***			
Municipality	**Domestic Water Wells**	**Municipality**	**Domestic Water Wells**
Allison Township	19	Lamar Township	199
Avis Borough	26	Leidy Township	215
Bald Eagle Township	191	Lock Haven City	155
Beech Creek Borough	68	Logan Township	60
Beech Creek Township	109	Loganton Borough	10
Castanea Township	70	Mill Hall Borough	8
Chapman Township	148	Noyes Township	76
Colebrook Township	26	Pine Creek Township	165
Crawford Township	92	Porter Township	156
Dunnstable Township	133	Renovo Borough	13

Domestic Water Wells *(PAGWIS, 2018)*			
Municipality	**Domestic Water Wells**	**Municipality**	**Domestic Water Wells**
East Keating Township	25	South Renovo Borough	0
Flemington Borough	4	Wayne Township	61
Gallagher Township	189	West Keating Township	18
Greene Township	282	Woodward Township	140
Grugan Township	17	Undesignated	209
		Total	**2884**

Figure 8 - Drought Vulnerability



4.3.2. Flood, Flash Flood and Ice Jams

4.2.3.1 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 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. Flash floods are the most common type of flooding in Clinton 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 4.2.3.4. 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 9 - 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 Clinton 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 12 - Flood Hazard High Risk Zones*. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Clinton County with vulnerable structures and critical facilities identified using the most current DFIRM data for Clinton 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.

The major waterways that flow through Clinton County are the West Branch of the Susquehanna River, Young Woman's Creek, Beech Creek, Fishing Creek, Bald Eagle Creek, Pine Creek and Kettle Creek (See *Figure 21 - Flood Vulnerability*). There are flood control dams on Bald Eagle, Kettle, Sinnemahoning and Little Pine Creeks. More detailed discussion of the impact of dams and levees have on flooding can be found in sections 4.3.11 and 4.3.14 respectively.

Lock Haven University main campus in Lock Haven has several facilities in the 100-year floodplain, including the Hursh Nevel Maintenance Building, Parsons Student Union, Health Professions Building, Recreation Center, along with a storage building. A detailed flood hazard map of Lock Haven can be found below in *Figure 10 - Lock Haven University Flood Hazard Map*. Flooding from the 1972 flood associated with Hurricane Agnes gave impetus to the Lock Haven Flood Protection project. The project was authorized by the Water Resources Development Act of 1986 to construct flood control measures along the West Branch Susquehanna River and the Bald Eagle Creek in Lock Haven. Construction of the Lock Haven Flood Protection Project began in 1991 and was completed in 1994. The plan of protection for Lock Haven consists of a levee system with associated interior drainage and utility modifications. The protection plan provides approximately 31,000 feet of levee, with aesthetic and recreation features addressed along that portion of the levee system along the West Branch Susquehanna River bordering Lock Haven.

Figure 9 - Flooding and Floodplain Diagram

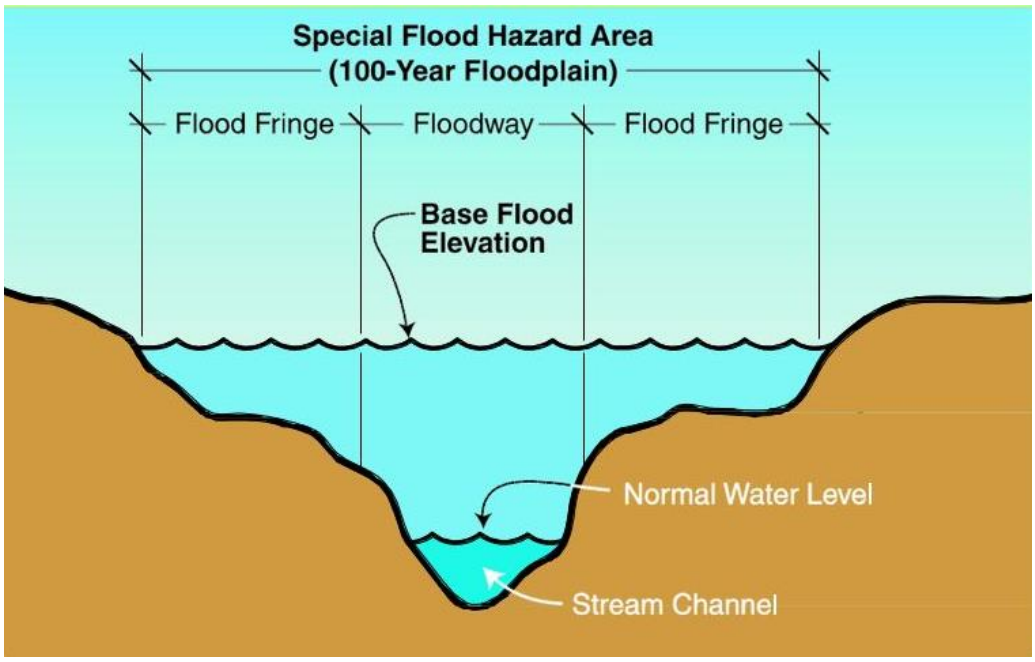
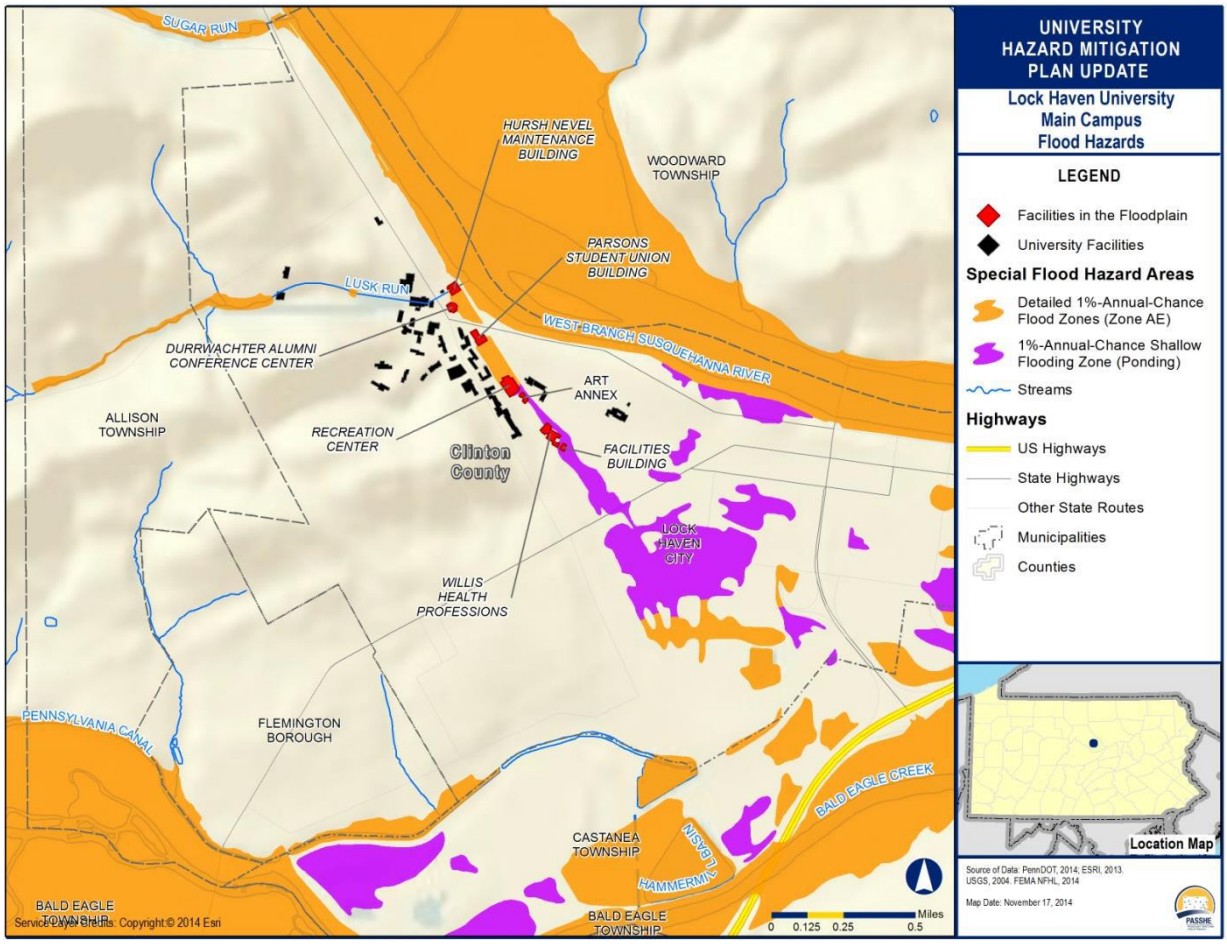


Table 12 - Flood Hazard High Risk Zones

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.
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.

Figure 10 - Lock Haven University Flood Hazard Map



4.2.3.2 Range of Magnitude

The chief flooding concern for many parts of Clinton County is the West Branch Susquehanna River. Flooding of the West Branch creates backwater effects which compound flooding problems for many tributaries. A second major concern is Bald Eagle Creek. Floods on Bald Eagle Creek are usually the result of high flows on Bald Eagle Creek and backwater effects of the West Branch Susquehanna River. Floods along the West Branch Susquehanna River and Bald Eagle Creek can have long durations.

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 Clinton 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.

In winter months, local flooding could be exacerbated by ice jams in rivers. Ice jam floods occur on rivers that are totally or partially frozen. A rise in stream level will break up a totally frozen river and create ice flows that can pile up on channel obstructions such as shallow riffles, log jams, or bridge piers. The jammed ice creates a dam across the channel over which the water and ice mixture continues to flow, allowing for more jamming to occur.

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 Clinton 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 Clinton 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.

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.

4.2.3.3 Past Occurrence

Clinton County has experienced numerous flooding, flash flooding and ice jam flooding events in the past. The flooding and flash flooding was caused by a variety of heavy storms, tropical storms and other issues. A summary of flood event history for Clinton County is found in *Figure 17 - Hurricane Lee September 2011 – Overtopping* at Hall's Run Reservoir

Figure 18 - Hurricane Lee September 2011 – Aftermath at Hall's Run Reservoir

Figure 19 - Hurricane Lee September 2011 – Brewery Run Road Before

Figure 20 - Hurricane Lee September 2011 – Brewery Run Road After

Table 14 - Flood Event History for Clinton County – property damage that is reported as "-" was not reported.

Since 1847, flood flows in the West Branch Susquehanna River at the Jay Street Bridge in the City of Lock Haven have exceeded 90,000 cubic feet per second (cfs) eighteen times. The highest cresting flood on record occurred on St. Patrick's Day in 1936 and had a discharge of 238,000 cfs at the Jay Street Bridge. Historical flood crests of the West Branch Susquehanna River in Lock Haven can be found in *Table 13 - Historical Flood Crests in Lock Haven*.

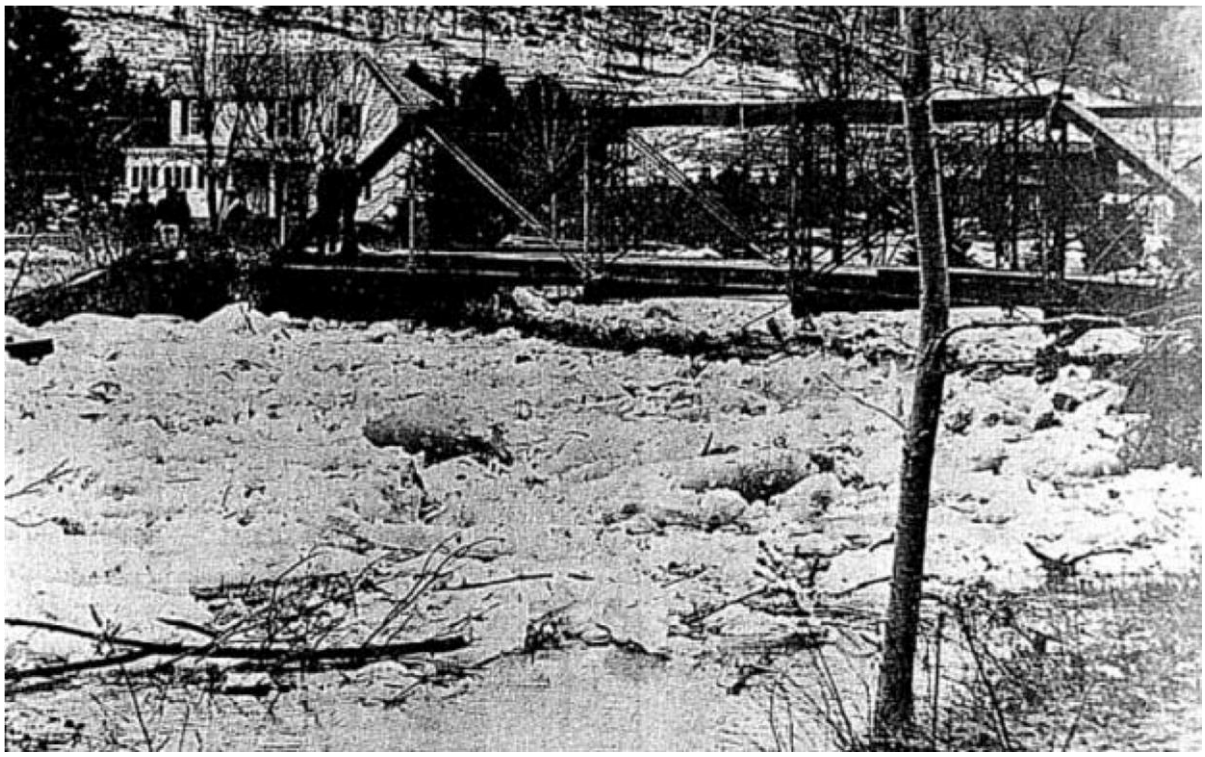
There are stormwater management plans for the Chatham Run and Fishing Creek/ Cedar Run watersheds from 2006, which include inventories of existing storm drainage and flooding problems in the watersheds. There were an identified thirty-eight obstructions in the Chatham Run watershed, and 103 in the Fishing Creek watershed (Clinton County Conservation District, 2006).

Table 13 - Historical Flood Crests in Lock Haven

Historical Flood Crests in Lock Haven *(Lock Haven University HMP, 2016)*			
Crest Height (ft)	**Date**	**Crest Height (ft)**	**Date**
29.80	6/1/1889	26.10	3/10/1964
26.40	3/24/1898	26.80	2/21/1972
23.70	3/1/1902	31.30	6/23/1972
24.20	3/4/1904	22.92	9/26/1975
24.20	11/4/1904	22.38	2/15/1984
25.10	3/4/1923	20.00	4/2/1993
22.80	2/26/1926	18.30	11/28/1993
32.30	3/18/1936	17.82	3/25/1994
21.70	4/1/1940	25.86	1/20/1996
23.10	12/31/1942	28.13	9/18/2004
26.85	5/28/1946	24.10	12/2/2010
27.61	11/26/1950		

A photo of an ice jam flood that occurred in 1964 in Clinton County is shown below *Figure 11 - Ice Jam Flooding, Clinton County 1964*, however additional information about the event is limited.

Figure 11 - Ice Jam Flooding, Clinton County 1964



Hurricane Agnes in June of 1972 caused what is considered the worst flooding on record for Clinton County. Agnes occurred just after an earlier rainfall event had saturated the ground in much of Pennsylvania and the storm brought as much as 18 inches of rain to some locations in Pennsylvania, with Clinton County receiving 10-12 inches. This event produced severe surface water runoff conditions which caused abnormally high flows in local streams and tributaries. Most communities along the Susquehanna River, including Clinton County experienced severe flooding. The USGS gage at Lock Haven recorded a peak river stage of 31.3 feet on June 23rd, with an estimated discharge of 190,000 cfs at the Jay Street Bridge, which was reduced by 60,000 by upstream flood control reservoirs. The greatest damage was seen at the Hammermill Paper Company and Piper Aircraft.

Numerous other streams in Clinton County reached historical crests causing flooding in nearly all communities within the county. The town of North Bend sustained significant damages, specifically near the mouth of Young Womans Creek and Hyner Run. Water entered the basement and first floor of many residential and commercial structures. Bank erosion was a common problem and channels had to be cleared of debris following the storm. The event caused the failure of a levee near Farrandsville in Colebrook Township. Total damage in the region from the 1972 flood was approximated at $50,000,000, and it was estimated that Pennsylvania as a whole incurred over $2.8 billion (1972) in economic losses along with 48 deaths. President Richard Nixon de-

clared Pennsylvania to be a disaster area due to the event, the flood had an estimated frequency of occurrence of 130-years.

Tropical Storm Lee in September 2011 caused some flooding in Clinton County (see Figures 17 – 20). The Hall's Run Reservoir which provides water to South Renovo Borough was badly damaged, costing $120,806 to repair. Additionally, the flooding damaged road infrastructure along Brewery Run, costing $36,000.

Figure 12 - Flooding from Hurricane Agnes, Clinton County 1972

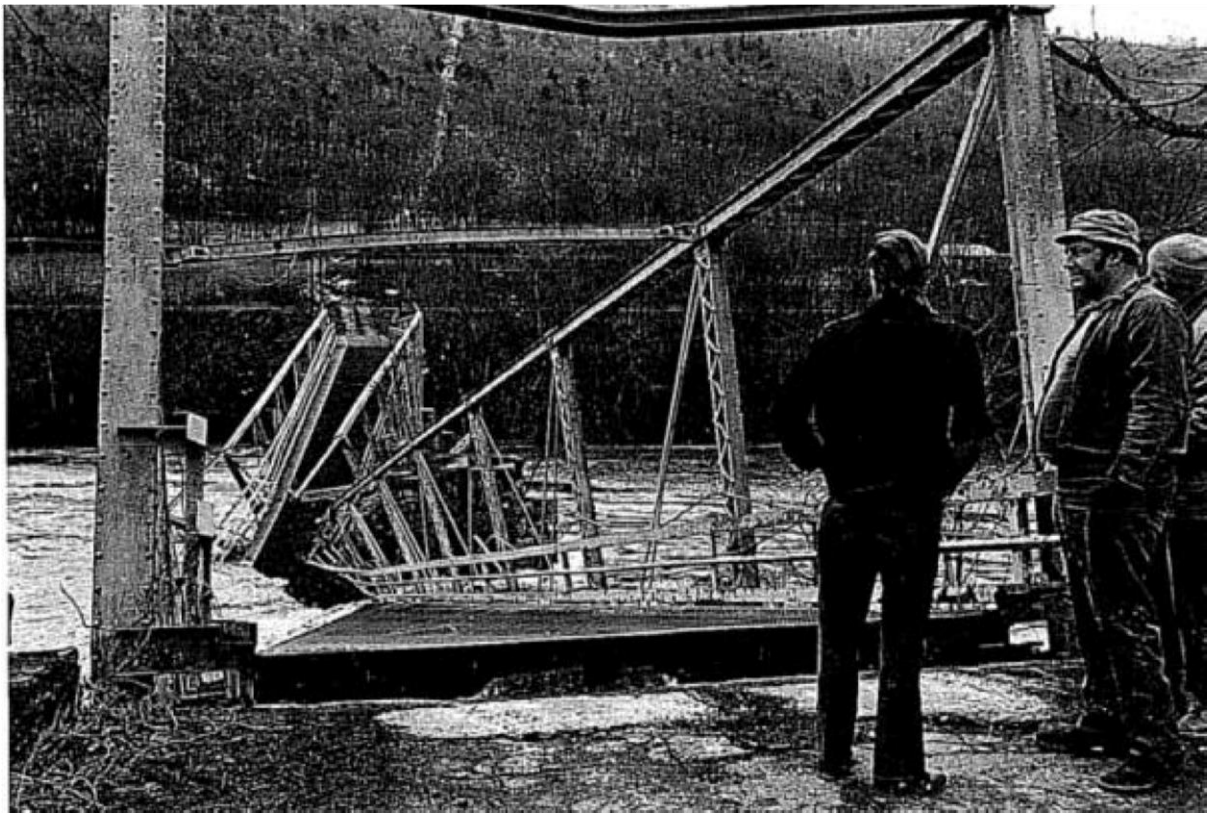


Figure 13 - Downtown Lock Haven during Hurricane Agnes, Clinton County 1972

Figure 14 - Flooding from Tropical Depression Ivan, Clinton County 2004

Figure 15 - Cars being swept away in Renovo Borough during Tropical Depression Ivan, Clinton County 2004

Figure 16 - Rescuers pulling flood victims to safety during Tropical Depression Ivan, Clinton County 2004

Figure 17 - Hurricane Lee September 2011 – Overtopping at Hall's Run Reservoir

Figure 18 - Hurricane Lee September 2011 – Aftermath at Hall's Run Reservoir

Figure 19 - Hurricane Lee September 2011 – Brewery Run Road Before

Figure 20 - Hurricane Lee September 2011 – Brewery Run Road After

Table 14 - Flood Event History for Clinton County

Flood Event History for Clinton County ***(NOAA NCEI, 2018; 2012 HMP; 2016 LHU HMP)***			
Location	**Date**	**Property Damage ($USD)**	**Description**
Clinton County	04/02/70	$21,000	
Countywide	06/21/72	$7,500,000	Flooding Associated with Hurricane Agnes
Clinton County	06/28/73	$15,000	
Clinton County	09/23/75	$15,000	
Clinton County	01/26/76	$ -	
Clinton County	01/24/79	$15,000	
Clinton County	02/23/79	$15,000	
Clinton County	02/02/82	$2,000	
Clinton County	06/28/83	$25,000	
Clinton County	02/14/84	$1,700,000	
Clinton County	03/14/86	$15,000	
Countywide	03/29/93	$ -	
Clinton County	04/10/93	$4,000	
Countywide	11/28/93	$ -	
Several Counties	11/28/93	$ -	
Beech Creek	03/25/94	$ -	
Clinton County	08/18/94	$50,000	
Countywide	08/18/94	$ -	
Countywide	08/18/94	$500,000	
Countywide	08/25/94	$ -	
Countywide	08/25/94	$ -	
Countywide	08/25/94	$ -	
Countywide	08/25/94	$ -	
Countywide	01/20/95	$ -	
Countywide	10/21/95	$ -	
Countywide	01/19/96	$ -	

Flood Event History for Clinton County *(NOAA NCEI, 2018; 2012 HMP; 2016 LHU HMP)*			
Location	**Date**	**Property Damage ($USD)**	**Description**
Western Section	11/08/96	$ -	Minor road flooding occurred due to heavy rainfall.
Southeast	12/01/96	$ -	
Countywide	01/08/98	$ -	
Mill Hall	08/02/00	$ -	Roads were flooded. A carport was destroyed.
Countywide	03/26/02	$ -	A low-pressure system over the Ohio Valley spread a large area of moderate to heavy rain across central Pennsylvania during Tuesday, March 26th. Total rainfall amounts averaged slightly in excess of 2 inches from this system. In Clinton and Lycoming counties, many roads were flooded as several small creeks exceeded bank full.
Countywide	05/13/02	$ -	Rising waters in Bald Eagle Creek at Beech Creek Station caused the river gauge to reach its flood stage of 11.0 feet briefly between 9 and 10 pm.
Mill Hall	05/30/02	$ -	Heavy rains caused significant runoff from area hills onto area roads, causing several to be flooded and closed.
Countywide	11/19/03	$ -	Heavy rain caused Bald Eagle Creek at Beech Creek Station to exceed flood stage. The creek rose above the flood stage of 11.0 feet at 21:00 EST on the 19th, crested at 11.34 feet at 23:00 EST on the 19th, then fell back below flood stage at 05:00 EST on the 20th.
Countywide	12/11/03	$ -	Heavy rainfall caused Bald Eagle Creek at Beech Creek to exceed flood stage. The creek rose above its flood stage of 11.0 feet at 9:00 AM EST on the 11th, crested at 11.74 feet at 12:30 PM EST on the 11th, then fell back below flood stage at 10:15 PM EST on the 11th.
Countywide	07/27/04	$ -	Heavy rain caused flooding on Bald Eagle Creek at Beech Creek Station. The creek rose above flood stage of 11 feet at 16:00 EST on the 27th, crested at 11.3 feet at 19:00 EST, then fell back below flood stage at 04:15 EST on the 28th.
Countywide	09/08/04	$ -	
Southern Clinton	09/09/04	$ -	Heavy rain caused flooding along the Bald Eagle Creek at Beech Creek Station. The creek rose above flood stage of 11.0 feet at 09:00 EST on the 9th, crested at 12.68 feet at 14:45 EST on the 9th, then fell back below flood stage at 22:30 EST on the 9th.
Countywide	09/17/04	$ -	Heavy rain caused the Bald Eagle Creek at Beech Creek Station to exceed its flood stage of 11 feet. The river rose above flood stage at 20:45 EST on the 17th, crested at 15.96 feet at 11:45 EST on the 18th, and fell below flood stage at 11:45 EST on the 19th.
Northern Clinton	09/18/04	$ -	Heavy rain associated with Hurricane Ivan caused the West Branch of the Susquehanna River at Renovo to exceed its flood stage of 16 feet. The river rose above flood stage at 02:15 EST on the 18th, crested at 21.14 feet at 10:16 EST on the 18th, and fell below flood stage at 20:30 EST on the 18th.

Flood Event History for Clinton County *(NOAA NCEI, 2018; 2012 HMP; 2016 LHU HMP)*			
Location	**Date**	**Property Damage ($USD)**	**Description**
Southern Clinton	09/28/04	$ -	Heavy rain associated with Hurricane Ivan caused the Bald Eagle Creek at Beech Creek Station to exceed its flood stage of 11 feet. The creek rose above flood stage at 02:30 EST on the 28th, crested at 11.6 feet at 07:00 EST on the 28th and fell back below flood stage just after 07:00 EST on the 28th.
Countywide	11/29/05	$ -	Heavy rain caused Bald Eagle Creek at Beech Creek Station to flood. The creek exceeded flood stage of 11 feet at 21:00 EST on the 29th, crested at 11.73 feet at 05:00 EST on the 30th, then fell back below flood stage at 11:45 EST on the 30th.
Lock Haven	11/16/06	$ -	A strong cold front crossing the region triggered widespread severe weather and flash flooding across Central Pennsylvania during the afternoon of November 16, 2006. Heavy rain caused flash flooding throughout Clinton County. Flooding was reported in downtown Lock Haven, with Hyner River Road closed due to stream flooding. There was a mud slide reported on Route 120 in East Keating Township which closed the road.
Cooks Run, Parvin	03/05/08	$ -	Heavy rain produced widespread urban, small stream and river flooding over much of Central Pennsylvania during the late evening hours of March fourth into the morning of March fifth. Heavy rain caused flooding and numerous road closings throughout the county. Fishing Creek, Bald Eagle Creek and several other smaller mountain streams all flooded and caused road closures. Fishing Creek along 477 was high enough to impact several homes.
Swissdale, Beech Creek	07/23/09	$40,000	Slow moving thunderstorms along a nearly stationary cold front produced locally heavy rainfall in a short duration, resulting in flash flooding across portions of the Lower Susquehanna Valley. Rainfall amounts ranged from three to six inches in less than three hours with the highest amounts over eastern Cumberland, eastern Franklin and northern York Counties. Heavy rain produced flash flooding throughout south-central Clinton County. Numerous small streams were flooded causing road and bridge closures in Woolrich, McElhatten and Avis. Flash flooding caused a washout along Coudersport Pike/Route 664 and Middle Hill Road in Woodward Township. Lusk Run, Fairport Road and Orner Road were flooded in Bald Eagle Township. Flooding was also reported on Spong Hollow Road in Dunnstable Township and on Little Plum Road, Gravel Hill Road, Owl Hollow Road, Park Avenue, Sulfur Run Road and Steward Road in Pine Creek Township. Chatham Run was out of its banks at Gravel Hill Road. Heavy rain produced flash flooding throughout south-central Clinton County. The flash flooding persisted into the late evening on the 23rd and transitioned into areal county flooding.

Flood Event History for Clinton County ***(NOAA NCEI, 2018; 2012 HMP; 2016 LHU HMP)***			
Location	**Date**	**Property Damage ($USD)**	**Description**
Keating, Tamarack	12/01/10	$200,000	Widespread heavy rainfall of 2 to 4 inches produced extensive flooding across Central Pennsylvania for the first three days of December 2010. The heavy rain fell in two distinct periods with the first round of 1-2 inches falling by the evening of November 30th. The second period of heavy rain fell overnight into the afternoon on December 1st. The initial rainfall on the 30th resulted in antecedent conditions that proved to be very favorable for significant flooding. The flooding continued to worsen through the morning of the 1st and reached a pinnacle during the afternoon and evening on the 2nd before stream levels and flood waters slowly receded into the morning of the 3nd. Cold season hydrologic conditions (non-receptive or partially frozen soils) contributed to enhanced runoff and poor drainage. Moderate to major flood stages were observed at several river points in the West Branch Susquehanna, Juniata and the headwaters of the Allegheny river basins. The Bald Eagle Creek at Beech Creek Station recorded the third highest crest ever at 14.57 feet. The Clarion River at Ridgway and Johnsonburg recorded the fourth and fifth highest crests ever at 19.21 and 9.72 feet. No injuries or fatalities occurred as a result of the flooding despite numerous water rescues, evacuations and flooded roads. The Kettle Creek at Cross Forks was out of its banks and flooded nearby areas. The West Branch Susquehanna River at Lock Haven crested over moderate flood stage just above 24 feet. As a precaution, emergency crews in Lock Haven closed the Jay Street Bridge with flood gates sealing off the Susquehanna River.
South Renovo	September 2011	$120,806	Tropical Storm Lee caused significant damage to Hall's Run Reservoir, which provides water to South Renovo Borough

Flood Event History for Clinton County *(NOAA NCEI, 2018; 2012 HMP; 2016 LHU HMP)*			
Location	**Date**	**Property Damage ($USD)**	**Description**
Beech Creek, Flemington	06/27/13	$2,100,000	A MCV and broader mid-level trough crossed the central Appalachians and triggered strong to severe thunderstorms from the central ridges into the Susquehanna River Valley during the afternoon and evening. Very high boundary layer moisture and humidity contributed to heavy rainfall/flash flooding and precipitation loading within consolidating convection. While the deep layer flow and shear were somewhat modest, ambient vertical vorticity just ahead of the MCV and low LCLs aided in the development of two weak, short-lived (EF1) tornadoes in Centre and Perry Counties. Deep moisture (PWAT) values around two inches along with relatively slow, south-to-north training cells and bands produced significant flash flooding, particularly in DuBois and Beech Creek which sustained extensive flood damages due localized 4-6+ inch rainfall amounts. Both towns were declared a State of Emergency. The Bald Eagle Creek at Beech Creek Station surged nearly 8 feet in 4 hours and crested just below major flood stage. The creek officially crested at 13.75 feet which was the sixth highest crest on record. The flash flooding extended northeast along Route 150 into Mill Hall. The heavy rains and flood waters inundated the Beech Creek area, which resulted in a State of Emergency and Disaster Declaration due to numerous roads closed/damaged and covered in debris from flood waters. Many of the road closures and damage was confined in Beech Creek Township. More than 30 miles of roadway, including drainage culverts and bridges, were affected by the flooding. One home in the Beech Creek area was destroyed and another sustained major damage. An additional 14 homes also sustained minor damage. Flood-related damages totaled over 10 million dollars. An 86-year-old man was swept away by rising flood waters along Bald Eagle Creek while trying to rescue his ATV. His body was found two days later on Saturday, June 29, 2013 by kayakers. The Bald Eagle Creek at Beech Creek Station surged nearly 8 feet in 4 hours and crested just below major flood stage. The creek officially crested at 13.75 feet which was the sixth highest crest on record.

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 November 30th 2017, there are

seventy-five repetitive loss properties and no severe repetitive loss properties in Clinton County. This is an increase from 2010 when there was only one repetitive loss property.

All municipalities in Clinton County participate in the NFIP. Information on each participating municipality is located in *Table 16 - Municipal NFIP Policies & Vulnerability*, where NFIP data on non-participating municipalities appears as "-".

Table 15 - Repetitive Loss Properties

Repetitive Loss Properties ***(PEMA, 2017)***						
Comm. Name	**Comm. No.**	**Building Payments**	**Contents Payments**	**Total Payments**	**Losses**	**Properties**
Allison Township	421534	$4,312	$371	$4,683	2	1 Residential
Bald Eagle Township	420319	$301,869	$103,649	$405,518	33	4 Residential 4 Non-Res
Beech Creek Township	420321	$16,751	$4,163	$20,914	5	2 Residential
Castanea Township	420322	$77,946	$124,905	$202,851	7	2 Residential 1 Non-Res
Colebrook Township	420324	$200,751	$54,853	$255,603	7	3 Residential
Dunnstable Township	420325	$448,617	$53,131	$501,748	11	5 Residential
Lamar Township	420327	$369,683	$132,231	$501,914	24	12 Residential
Lock Haven City	420328	$3,529	$2,009	$5,538	2	1 Residential
Mill Hall Borough	420330	$104,453	$13,385	$117,838	22	9 Residential
Noyes Township	420331	$97,881	$18,541	$116,423	9	4 Residential
Pine Creek Township	420332	$377,903	$27,310	$405,213	19	9 Residential
Porter Township	420333	$32,219	$8,487	$40,706	6	2 Residential
Renovo Borough	420334	$264,216	$52,052	$316,269	28	10 Residential 1 Non-Res
Wayne Township	420336	$46,103	$10,000	$56,103	2	1 Residential
Woodward Township	420337	$135,477	$27,844	$163,321	8	4 Residential
Totals	**-**	**$2,481,711**	**$632,931**	**$3,114,641**	**185**	**69 Residential 6 Non-Res**

Table 16 - Municipal NFIP Policies & Vulnerability

Municipal NFIP Policies & Vulnerability ***(PEMA, 2018, Clinton GIS, 2018)***

Municipality	Losses	Active Contracts	Addressable Structures in SFHA	Critical Facilities in SFHA
Allison Township	4	1	5	0
Avis Borough	7	16	69	0
Bald Eagle Township	136	73	376	4
Beech Creek Borough	12	5	21	0
Beech Creek Township	18	8	78	0
Castanea Township	19	8	57	3
Chapman Township	8	18	193	2
Colebrook Township	19	8	31	0
Crawford Township	1	4	28	0
Dunnstable Township	38	19	52	0
East Keating Township	0	2	19	0
Flemington Borough	2	6	10	0
Gallagher Township	-	-	3	0
Greene Township	1	0	11	0
Grugan Township	0	2	39	0
Lamar Township	94	52	199	0
Leidy Township	8	3	180	0
Lock Haven City	141	52	200	6
Logan Township	2	2	43	1
Loganton Borough	0	1	4	0
Mill Hall Borough	142	78	267	2
Noyes Township	21	11	95	1
Pine Creek Township	88	75	333	9
Porter Township	26	37	187	0
Renovo Borough	81	42	186	5
South Renovo Borough	0	2	0	0
Wayne Township	13	11	58	1
West Keating Township	-	-	6	0
Woodward Township	29	19	161	0
Totals	**910**	**555**	**2911**	**34**

4.2.3.4 Future Occurrence

Table 17 - Flood Probability Summary

Flood Probability Summary (PEMA)	
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. Clinton County will certainly be impacted by flooding events in the future - Clinton 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 17 - Flood Probability Summary*.

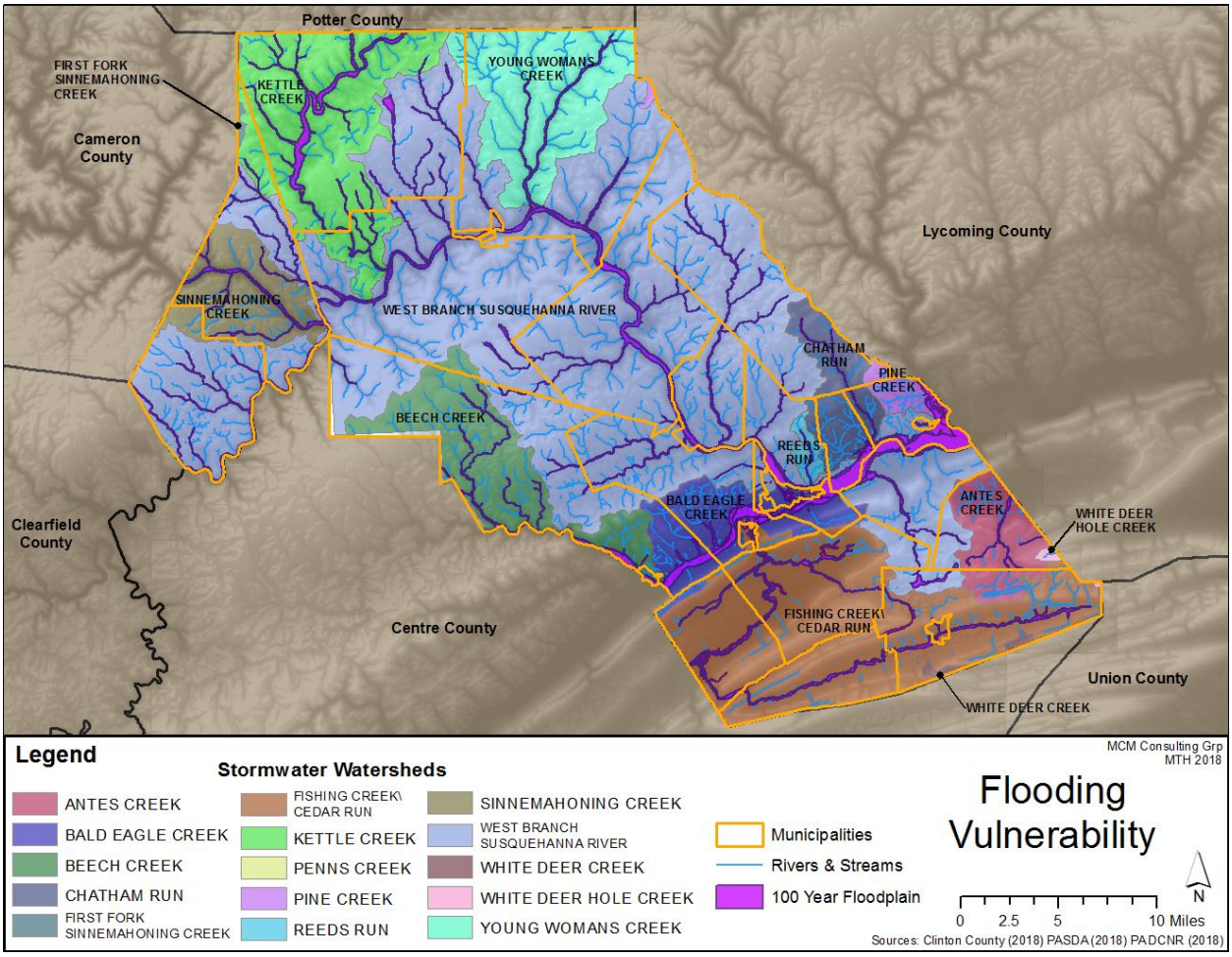
4.2.3.5 Vulnerability Assessment

Clinton 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 16 - Municipal NFIP Policies & Vulnerability* identifies how many structures and critical facilities 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. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Clinton County with vulnerable structures and critical facilities identified. A list of critical facilities located in the special flood hazard area is located in Appendix D as well.

Building at most risk of experiencing flooding on the Lock Haven University Campus include:

- Nursh-Nevel Building
- Parsons union Building (PUB)
- Student Recreational Center
- Willis Health Professions (HP) Building
- Facilities Building
- East Campus Complex

Figure 21 - Flood Vulnerability



4.3.3. Hurricane, Tropical Storms, Nor'easter

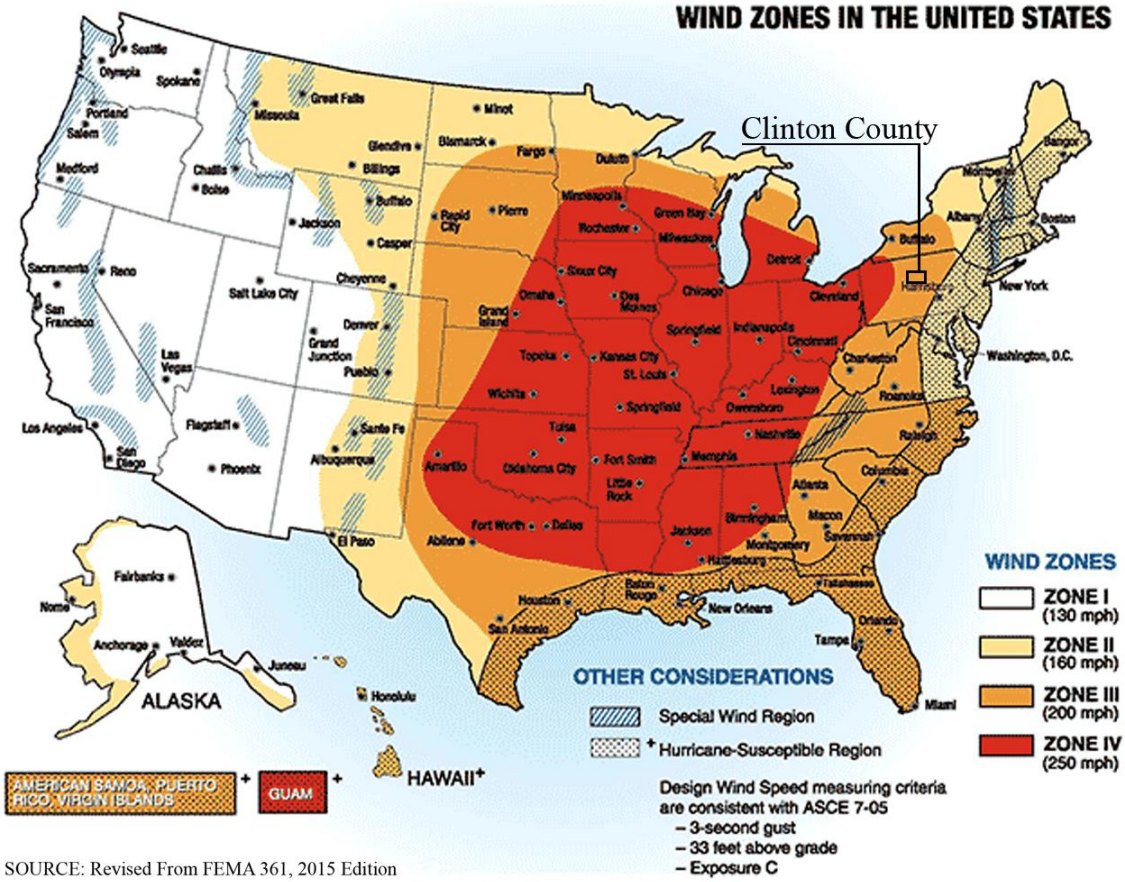
4.3.3.1 Location and Extent

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 Clinton 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.

Clinton County is located around two hundred miles inland of the East Coast of the United States and is located inland of the region designated by FEMA as being Hurricane-Susceptible (see *Figure 22 - Wind Zones*). However, tropical storms can track inland potentially causing heavy rainfall and strong winds in Clinton County. All communities within Clinton County are equally subject to the impacts of hurricanes and tropical storms that track near the county. Areas in Clinton County which are subject to flooding, wind and winter storm damage are particularly vulnerable.

Figure 22 - Wind Zones



SOURCE: Revised From FEMA 361, 2015 Edition

4.3.3.2 Range of Magnitude

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 18 - 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 Clinton County). Categories 3, 4, and 5 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 4.3.2.5.

4.3.3.3 Past Occurrence

Table 19 - History of Coastal Storms lists all coastal storms that have impacted Clinton County from 1970 to December 2017. Although impacts of tropical storms are commonly felt in the Commonwealth, it is rare that a hurricane would track through Clinton County.

Hurricane Agnes was the most severe coastal storm event recorded in Clinton 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.

In 2004 Tropical Storm Ivan caused extensive flooding as well, also resulting in a Presidential Disaster Declaration for the region. Damage estimates from Tropical Storm Ivan were reported at $2,550,304 for Clinton County. This amount includes residential, commercial and infrastructure damages. As of February 10, 2005, Federal Assistance to Clinton County totaled $339,807. The Ivan event produced flooding somewhat less than 100-year event crests.

Table 19 - History of Coastal Storms

History of Coastal Storms Impacting Clinton County (NCEI, 2018)	
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

4.3.3.4 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 20 - Annual Probability of Wind Speeds* shows the annual probability of winds that reach the strength of tropical storms and hurricanes in Clinton County and the surrounding areas based on a sample period of forty-six years. NOAA's Hurricane Research Division estimates that Clinton County will experience impacts from a named tropical storm or hurricane less than once every ten years, with a probability less than 10% annually (*Figure 23 - Mean Occurrence of Named Storms 1944-1997*). However according to FEMA, there is a high probability each year that Clinton County will experience winds from coastal storms that could cause minimal to moderate damages (*Table 20 - Annual Probability of Wind Speeds)*. The probability of winds exceeding 118 mph is less than .1% annually.

Figure 23 - Mean Occurrence of Named Storms 1944-1997

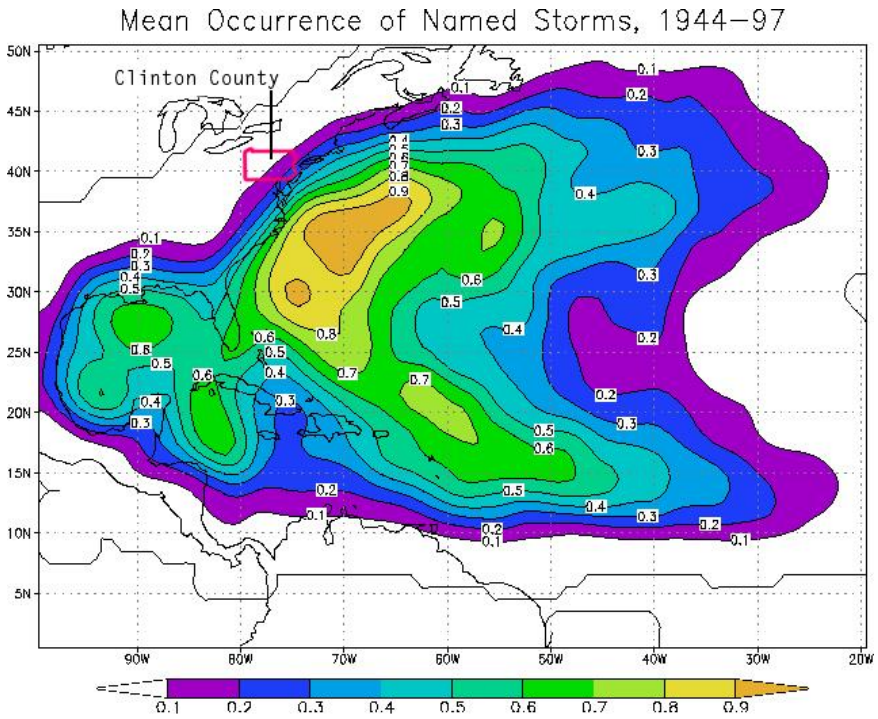


Table 20 - Annual Probability of Wind Speeds

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 4 and 5 hurricanes in the

Atlantic, and the hurricane season may be elongating. Clinton 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 future.

4.3.3.5 Vulnerability Assessment

While Clinton County is located outside of the East Coast region acutely susceptible to hurricanes, tropical storms tracking nearby 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 4.3.2.5 and discussion of wind related vulnerability is addressed in Section 4.3.8.5.

4.3.4. Invasive Species

4.3.4.1 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 phenomena 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 21 - Prevalent Invasive Species* lists invasive species that have been found in Clinton County.

4.3.4.2 Range of Magnitude

Some invasive species are not considered agricultural pests, do not harm humans and do not 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 Clinton 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 Clinton County and the surrounding region. The Emerald Ash Borer has already become established in Clinton County and the surrounding region, and there is a high mortality rate for trees associated with this pest. Hardwood forests in the county have been 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.

4.3.4.3 Past Occurrence

Invasive species have been entering Pennsylvania since the arrival of European settlers. There are large swatches of public forested land in Clinton County, including the Sproul State Forest. Members of the Clinton County DCNR Bureau of Forestry have identified several problematic species that are widespread in Clinton County as of February 2018, including:

- Japanese Knotweed
- Garlic Mustard

- Japanese Stiltgrass
- Multiflora Rose
- Autumn Olive
- Mile-A-Minute Vine
- Japanese Barberry

Because these species are so established and widespread, they are not often actively treated unless they are in a project area that is receiving attention otherwise. In the past these species have been cut back to slow their spread and treated with Foliar Herbicide when they re-sprout. In order to combat mile-a-minute vines, forest managers attempted a biological control by releasing beetles that naturally prey on the vine. The beetle has slowed the spread of the vine but does not remove it from an area.

There are several invasive pests that have moved through Clinton 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 Clinton County and the surrounding region. Once a species is established in an area and it causes a change in the ecology, it is quite difficult if somewhat futile to turn back the clock on the prevalence of the species, however Clinton County can work towards 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 21 - Prevalent Invasive Species lists all non-native species that are established in Clinton County. While all species listed here are not native to Clinton County, those species highlighted in yellow pose a larger ecological threat than others (see 4.3.5.5. Vulnerability Assessment for additional discussion). For some species such as the Asian Long-horned Beetle, the Sirex Woodwasp and the Spotted Lanternfly, Clinton 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 22 - Vulnerable Species*).

Table 21 - Prevalent Invasive Species

Prevalent Invasive Species (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Common Name	**Scientific Name**	**Type**
Asiatic Clam	*Corbicula fluminea*	Aquatic Animal
Common Carp	*Cyprinus carpio*	Aquatic Animal
Marsh Thistle	*Cirsium palustre*	Aquatic Plant
Marshpepper Knotweed, Smartweed	*Persicaria hydropiper*	Aquatic Plant
Watercress	*Nasturtium officinale*	Aquatic Plant
Beech Bark Disease Complex	multiple sp.	Disease
Butternut Canker	*Sirococcus clavigignenti juglandacearum*	Disease
Chestnut Blight	*Cryphonectria parasitica*	Disease
Dogwood Anthracnose	*Discula destructiva*	Disease
Elongate Hemlock Scale	*Fiorina externa*	Disease
Oak Wilt	*Ceratocystis fagacearum*	Disease
White Pine Blister Rust	*Cronartium ribicola*	Disease
Emerald Ash Borer	*Agrilus planipennis*	Insect
European Bark Beetle (H. Opacus)	*Hylastes opacus*	Insect
Gypsy Moth	*Lymantria dispar dispar*	Insect
Hemlock Woolly Adelgid	*Adelges tsugae*	Insect
Japanese Beetle	*Popillia japonica*	Insect
Larch Sawfly	*Pristiphora erichsonii*	Insect
Pine False Webworm	*Acantholyda erythrocephala*	Insect
Pine Shoot Beetle	*Coleoptera: Cuculionidae*	Insect
Alkali Grass, Spreading Alkali Grass	*Puccinellia distans*	Plant
Autumn Olive	*Elaeagnus umbellata*	Plant
Bishop's Goutweed	*Aegopodium podagraria*	Plant
Bush Honeysuckles (Exotic)	*Lonicera spp.*	Plant
Canada Thistle	*Cirsium arvense*	Plant
Climbing Nightshade	*Solanum dulcamara*	Plant
Common Reed	*Phragmites sp.*	Plant

Prevalent Invasive Species (EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)		
Common Name	**Scientific Name**	**Type**
Common Yarrow	*Achillea millefolium*	Plant
Garlic Mustard	*Alliaria petiolata*	Plant
Glossy Buckthorn	*Frangula alnus*	Plant
Japanese Barberry	*Berberis thunbergii*	Plant
Japanese Knotweed	*Reynoutria japonica*	Plant
Japanese Stiltgrass, Nepalese Browntop	*Microstegium vimineum*	Plant
Lesser Burdock	*Arctium minus*	Plant
Mile-A-Minute Vine	*Persicaria perfoliata*	Plant
Multiflora Rose	*Rosa multiflora*	Plant
Oriental Bittersweets	*Celastrus spp.*	Plant
Poison Hemlock	*Conium maculatum*	Plant
Purple Loosestrife	*Lythrum salicaria*	Plant
Reed Canarygrass	*Phalaris arundinacea*	Plant
Sweetflag, Calamus	*Acorus calamus*	Plant
Touch-Me-Not Bittercress	*Cardamine impatiens*	Plant
Tree-Of-Heaven	*Ailanthus altissima*	Plant
True Forget-Me-Not	*Myosotis scorpioides*	Plant

4.3.4.4 Future Occurrence

According to PISC (the Pennsylvania Invasive Species Council), 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 are able to 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 of 2010. 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 Clinton County but have not yet been detected inside the county (see *Table 22 - 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. 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). Species highlighted in yellow were identified as priority species for prevention (see 4.3.4.5. vulnerability assessment for more additional discussion).

Table 22 - Vulnerable Species

Vulnerable Species *(EDDMaps, 2018; PA DCNR, 2018; USDA FS, 2018; iMapInvasives, 2018)*		
Common Name	**Scientific Name**	**Type**
Eurasian water-milfoil	Myriophyllum spicatum	Aquatic Plant
Dutch Elm Disease	Ophiostoma novo-ulmi	Disease
Oak Pit Sclae A. Minus	Asterolecanium minus	Disease
Oystershell Scale	Lepidosaphes ulmi	Disease
Asian long-horned beetle	Anoplophora glabripennis	Insect
Birch Leafminer	Fenusa pusilla	Insect
Birch Leafminer	Fenusa pusilla	Insect
Chestnut Gall Wasp	Dryocosmus kiriphilus	Insect
Eastern Spruce Gall Adelgid	Adelges abietis	Insect
European Spruce Needleminer	Epinotia nanana	Insect
Imported Willow Leaf Beetle	Plagiodera versicolora	Insect
Larch Casebearer	Coleophora laricella	Insect
Mimosa Webworm	Homadaula anisocentra	Insect
Norway Maple Aphid	Periphyllus lyropictus	Insect
Pear Sawfly	Caliroa cerasi	Insect
Sirex Woodwasp	Sirex noctillio	Insect
Smaller European Elm Bark Beetle	Scolytus multistriatus	Insect
Spotted Lanternfly (lycorma)	Lycroma delicatula	Insect

4.3.4.5 Vulnerability Assessment

Clinton 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 in Clinton 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 Clinton 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: 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. Members of the Clinton County DCNR Bureau of Forestry have identified priority species that are currently less widespread, as they are able to have a more significant impact on these species. As of February 2018, priority species for management in Clinton County include:

- Poison Hemlock
- Common Phragmites Reed
- Glossy Buckthorn

Furthermore, it is best to take action before a species can become established in the County, so management should be aware of invasive species found nearby Clinton County but are not yet present in the County (priority species in *Table 22 - Vulnerable Species*). Public outreach and education is 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. Clinton 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.

4.3.5. Landslides

4.3.5.1 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 Clinton 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. The visible effects of landslides can be seen cut into the steep hillsides along roadways in Clinton County. Many roads have lane restrictions, reduced weight limits and warning signs designating these areas to be vulnerable to landslides despite costly repairs.

During the update process a Countywide Risk Factor of 1.9 was calculated. It was determined using the methodology that the impact from a landslide event would be minor resulting in a few injuries, minor property damage, and minimal disruption. The spatial extent to being affected would be moderate resulting in between 11 and 25% affected. Figure twenty shows the municipalities and their risk to landslide. The municipalities with a combo-high risk are West Keating, Porter, Lamar, Crawford, Logan, Loganton, and Greene Townships.

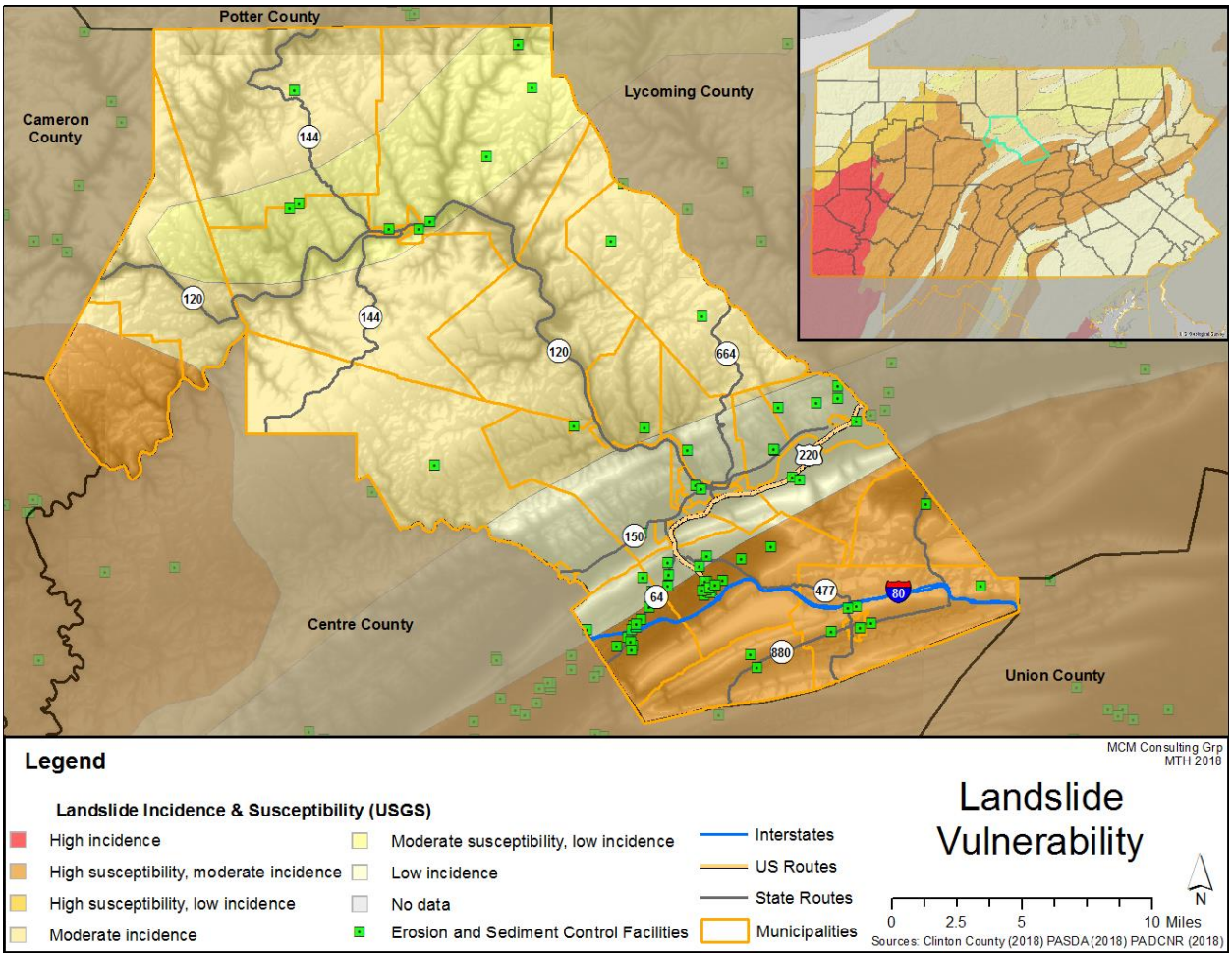
4.3.5.2 Range and Magnitude

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 Clinton County. Most reported deaths due to landslides have occurred when rockfalls or other slides along highways have involved vehicles. 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 $10 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 identifies the vast majority of Clinton County as falling into a high incidence zone for landslides as more than 15 percent of the land area in Clinton County has incidents of landslides (*Figure 24 - Landslide Susceptibility*). These areas are geologically prone to giving way after significant precipitation events.

Figure 24 - Landslide Susceptibility



4.3.5.3 Past Occurrence

No comprehensive list of landslide incidents in Clinton County is available, as there is no formal reporting system in place. The County Department of Emergency Services identified Route 120 from the City of Lock Haven to Renovo Borough as having past occurrences. There have been numerous occurrences of debris on the roadway.

An example of landslides in Clinton County is one site which has been the subject of a mitigation project implemented by the Pennsylvania Department of Transportation. This site is located in a steep cut of the Susquehanna River above SR 120 known as the Ice Mine Cut. The Ice Mine Cut project was performed in 1997 to move a potential hazard back away from SR 120 in Bald Eagle Township. This site had for years deposited debris onto SR 120. The mitigation project cut the hillside back a reasonably safe distance from the roadway and deposited all the material excavated from the site up and out of the potential slide area. While this area continues to deposit material down slope, a buffer was created back from the roadway, drastically reducing the risk to motorists. This site is also significant due to the fact that it is the primary maintained roadway access to the western portion of Clinton County. A population of nearly 10,000 people resides north of the site, so a road closure at this location would effectively isolate the Renovo area from State Police and Advanced Life Support coverage.

4.3.5.4 Future Occurrence

It is quite likely that Clinton County will experience landslides and their impacts in the future. 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.

4.3.5.5 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 close 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.

Much of Pennsylvania has landslide susceptible areas in the form of loose soil and both natural and human-made steep slopes. Most highways have sections cut in rock or soil that can fail. Vulnerable areas are primarily located in the Ridge and Valley Physiographic Province spanning central Pennsylvania and encroaching into the

northeastern section of the state. This landslide susceptibility area, characterized as Combo-High landslide hazard zone with high susceptibility and moderate instance of landslides by the USGS, was used to identify vulnerable jurisdictions and critical facilities. The exact vulnerability of a jurisdiction will depend on the geology and topography.

The Pennsylvania HMP states that there are four state owned critical facilities in Clinton County that are vulnerable to landslides, however the specific identity of the facilities is unclear (PA HMP 2013). In terms of estimated jurisdictional losses, there are approximately 14,661 buildings in Clinton County vulnerable to landslides and $2,871,184,000 in dollar value of exposure (building and contents) (PA HMP 2013).

Construction projects in Clinton County should be wary of erosion and the potential for landslides. The Clinton County Emergency Management Department identified several general factors that can be indicators of a landslide prone area:

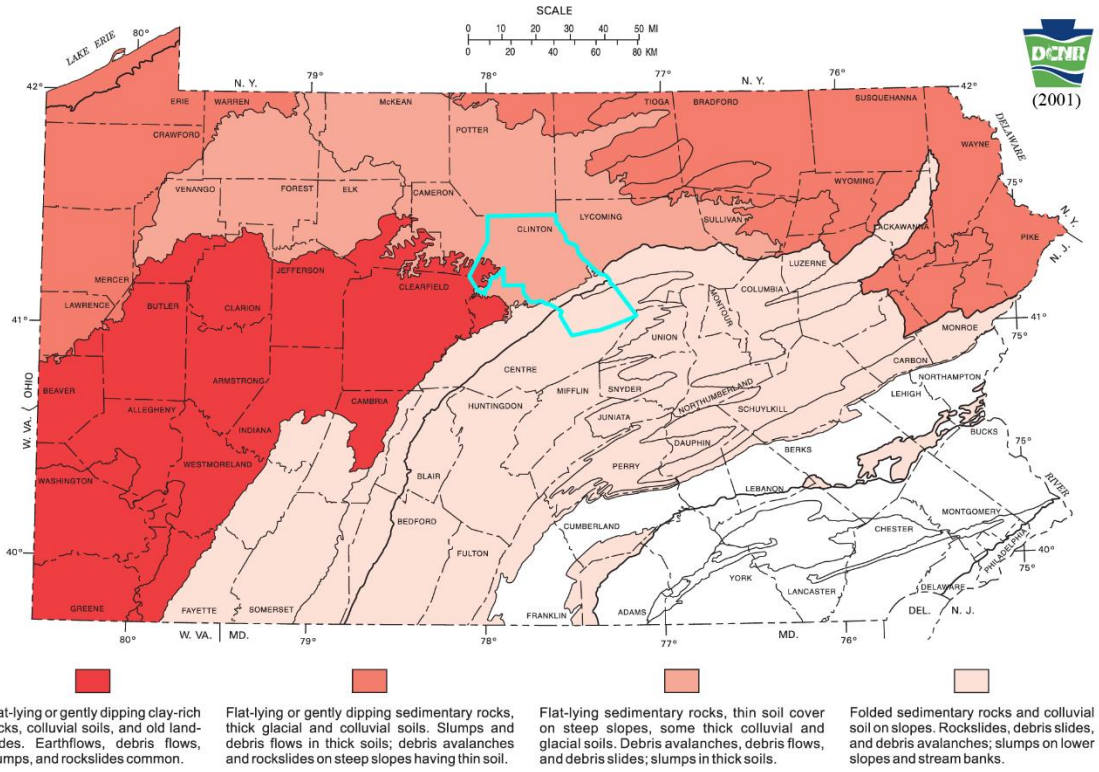
- On or close to steep hills
- Areas of steep road cuts or excavations
- Steep areas where surface run-off is channeled
- Fan shaped areas of sediment and rock accumulations
- Evidence of past sliding such as tilted utility lines, tilted trees, cracks in the ground and irregularly surfaced ground.

Table 23 - Landslide Vulnerable Structures

Landslide Vulnerable Structures	
Municipality	**Addressable Structures**
Allison Township	96
Avis Borough	620
Bald Eagle Township	1,126
Beech Creek Borough	314
Beech Creek Township	774
Castanea Township	582
Chapman Township	914
Colebrook t Township	111
Crawford Township	427
Dunnstable Township	455
East Keating Township	197
Flemington Borough	604
Gallagher Township	452
Greene Township	880
Grugan Township	164
Lamar Township	1,184
Leidy Township	899
Lock Haven City	2,565
Logan Township	403
Loganton Borough	220
Mill Hall Borough	707
Noyes Township	430

Pine Creek Township	1,580
Porter Township	772
Renovo Borough	610
South Renovo Borough	231
Wayne Township	669
West Keating Township	187
Woodward Township	1,220
TOTAL	**19,393**

Figure 25 - 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.

4.3.6. Pandemic and Infectious Disease

4.3.6.1 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 Clinton 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 PA Department of Health Influenza Pandemic Response Plan states that "an influenza pandemic is inevitable and will probably give little warning" (PA Department of Health, 2005). For this reason, influenza is a primary concern regarding pandemic and infectious disease in Clinton County.

Studies after the 2009 H1N1 influenza pandemic disproportionately impacted people younger than twenty-four (CIDRAP, 2010). Universities such as the Lock Haven University main campus and other large 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 Clinton 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 Clinton 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).

4.3.6.2 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 4.3.6.5.

Lock Haven University is a relatively high-risk location due to the higher population density and prominent young adult population. The Sieg Conference Center is a small venue where activities and events are held on a regular basis, but it is not a full time daily use educational facility.

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.

4.3.6.3 Past Occurrence

Pandemic & Epidemic

Table 24 - 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 flu outbreak to impact Clinton 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).

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 was detected in forty one of sixty-seven counties in the Commonwealth in 2016, with sixteen human cases (PA West Nile Virus Control Program, 2017). West Nile Virus has been detected in Clinton County in fourteen out of the last seventeen years with one human case (See *Table 25 - West Nile Occurrences*). Cases of Lyme disease are consistently reported in Clinton County with a recent spike in cases throughout the Commonwealth – reported cases are summarized in

Table 26 - Lyme Disease Reported Cases.

Table 25 - West Nile Occurrences

West Nile Occurrences *(PAWNVCP, 2018)*

Year	Positive Detection	Human Cases	Deaths	Year	Positive Detec-tion	Hu-man Cases	Deaths
2001				2010	✓		
2002	✓			2011	✓		
2003	✓	2	0	2012	✓		
2004	✓			2013	✓		
2005	✓			2014	✓		
2006	✓			2015	✓		
2007				2016	✓		
2008	✓			2017	✓	1	0
2009				**Totals**	**14 of 17**	3	0

Table 26 - 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	4
1982	0	2001	3
1983	0	2002	7
1984	0	2003	13
1985	0	2004	13
1986	0	2005	8
1987	0	2006	8
1988	0	2007	7
1989	8	2008	19
1990	4	2009	42
1991	14	2010	28
1992	5	2011	42
1993	4	2012	30
1994	7	2013	37

1995	<4	2014	60
1996	0	2015	57
1997	<4	2016	46
1998	0	**Total**	**~474**

4.3.6.4 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 plan 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 in an effort 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.

Lock Haven University will investigate and consider joining the CHSN network to gain a more accurate assessment of the student population health concerns across the country and help identify and establish preventative health measures that are specific to LHU.

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).

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 kills many insects including ticks, so fewer fires yields more ticks (Templeton, 2017).

4.3.6.5 Vulnerability Assessment

Pandemic & Epidemic

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 26 - 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 Clinton County such as schools and medical facilities are found in the Lock Haven, Mill Hall and Renovo areas.

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.

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 (see *Table 27 - Points of Distribution*). 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 University faculty, staff and students. Dispensing of medications/vaccines is a core function of the Strategic National Stockpile plan, and preparedness of an Open POD. LHU is a PA DOH approved Open and/or closed POD location with the capacity to pro-

vide medication to upwards of 300 individuals. While Open PODs play an important role in epidemic response, the students, staff and faculty at LHU could be more vulnerable to pandemics as Open PODs attract a high density of infected peoples.

Table 27 - Points of Distribution

Points of Distribution *(Clinton County GIS, 2018)*			
Name	**Description**	**Address**	**Municipality**
Susqueview Home	SPECIAL POP	22 CREE DR, LOCK HAVEN	Lock Haven City
Lock Haven Hospital	HOSPITAL (NC-H-5)	24 CREE DR, LOCK HAVEN	Lock Haven City
Bucktail HS	POD (NC-POD-4)	1300 BUCKTAIL AVE, RENOVO	Chapman Township
Bucktail Medical Center	HOSPITAL (NC-H-4)	1001 PINE ST, RENOVO	South Renovo Borough
Zimmerli Gymnasium	POD (NC-POD-3)	65 SUSQUEHANNA AVE, LOCK HAVEN	Lock Haven City
Clinton County Prison	SPECIAL POP	60 PINE MOUNTAIN RD, MCELHATTAN	Wayne Township

The U.S. Department of Health and Humans Services and the Centers for Disease Control and Prevention have developed the following checklist as a framework to assist colleges and universities to develop and/or improve plants to prepare for and respond to an influenza pandemic:

1. Coordination

- Identify a pandemic coordinator and response team (including campus health services and mental health staff, student housing personnel, security, communications staff, physical plant staff, food services director, academic staff, and student representatives)
- Define roles and responsibilities for preparedness, response, and recovery planning.

2. Accountability

- Delineate accountability and responsibility as well as resources for key stakeholders engaged in planning and executing specific components of the operational plan.
- Assure that the plan includes timelines, deliverables, and performance measures.

3. Scenario-Driven

- Incorporate scenarios that address college/university functioning based upon having various levels of illness in students and employees and different types of community containment interventions.
- Plan for different outbreak scenarios including variations of severity of illness, mode of transmission, and rates of infection in the community. Consider social

distancing options such as cancellation of classes, sporting events and/or other public events, closure of campus, student housing, and/or public transportation, self-isolation and/or assessment of the suitability of student housing for quarantine of exposed and/or ill students.
- Contingency plans for students who depend on student housing and food services (e.g., international students and other students who live too far away to travel home).
- Contingency plans for maintaining research laboratories, particularly those using animals.
- Stockpiling non-perishable food and equipment that may be needed in the case of an influenza pandemic.

4. Legal Implications

- Work with state and local public health and other local authorities to identify legal authority, decision-makers, trigger points, and thresholds to institute community containment measures such as closing (and re-opening) the college/university.
- Identify and review the college/university's legal responsibilities and authorities for executing infection control measures, including case identification, reporting information about ill students and employees, isolation, movement restriction, and provision of healthcare on campus.

5. Consistency

- Ensure that pandemic influenza planning is consistent with any existing college/university emergency operations plan and is coordinated with the pandemic plan of the community and of the state higher education agency.

6. Cooperation

- Work with the local health department to discuss an operational plan for surge capacity for healthcare and other mental health and social services to meet the needs of the college/university and community during and after a pandemic.

7. Communications

- Establish an emergency communication plan and revise regularly.
- This plan should identify key contacts with local and state public health officials as well as the state's higher education officials (including back-ups) and the chain of communications, including alternate mechanisms.

8. Incident Command

- Test the linkages between the college/university's Incident Command System and the Incident Command Systems of the local and/or state health department and the state's higher education agency.

9. Practice

- Implement an exercise/drill to test your plan, and revise it regularly.

- Participate in exercises of the community's pandemic plan.

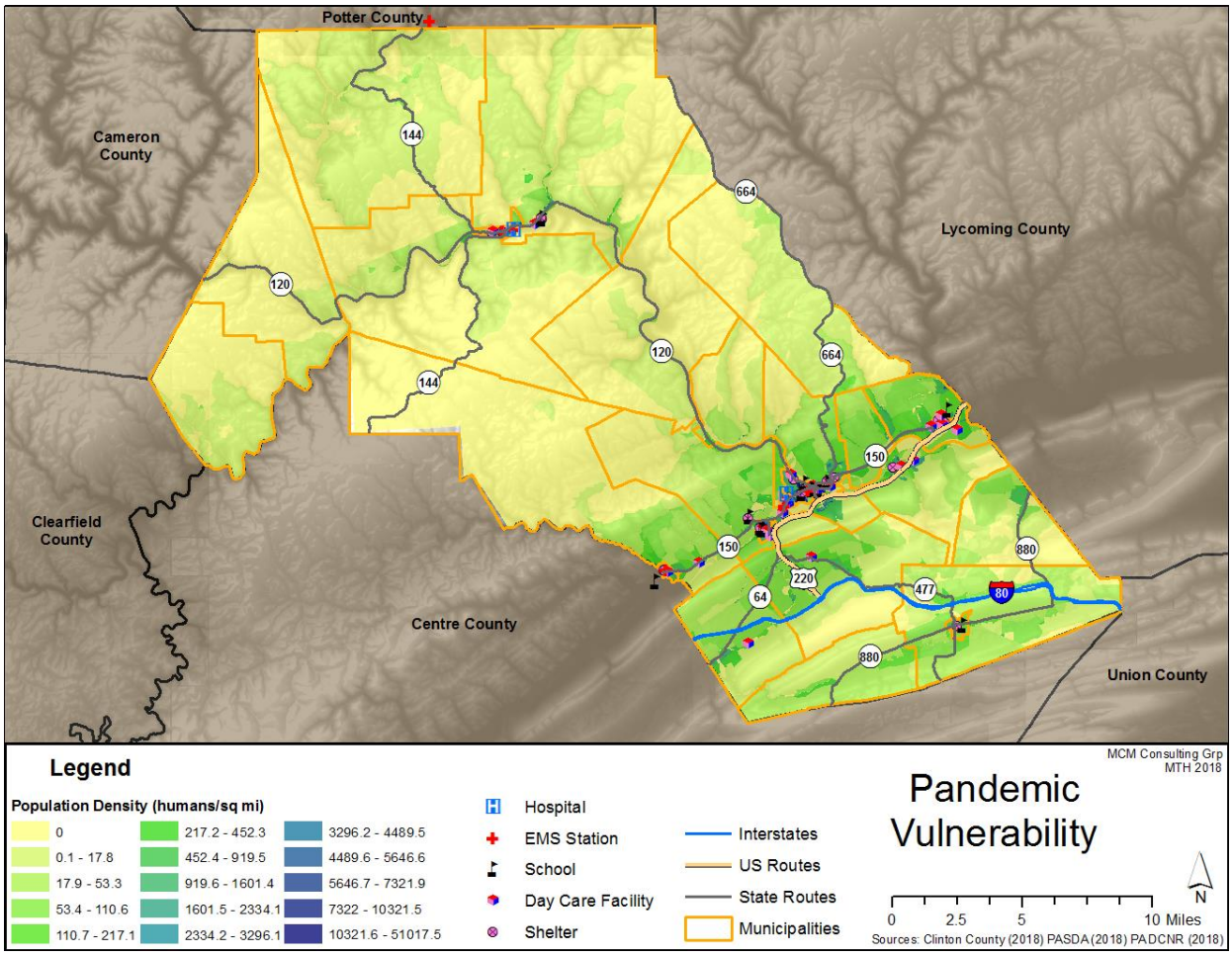
10. Recovery

- Develop a recovery plan to deal with consequences of the pandemic (e.g., loss of students, loss of staff, financial, and operational disruption).

11. Share

- Share what you have learned from developing your preparedness and response plan with other colleges/universities to improve community response efforts.

Figure 26 - Pandemic & Infectious Disease Vulnerability



4.3.7. Radon Exposure

4.3.7.1 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 55 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 (southeast of Clinton 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 neighboring 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.

4.3.7.2 Range of Magnitude

According to 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 28 - 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 to consider fixing a home if the radon level is between 2 pCi/L and 4 pCi/L.

Table 28 - Radon Risk

Radon Risk (EPA, 2017)			
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
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	

Radon Risk (EPA, 2017)			
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**
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.*			

4.3.7.3 Past Occurrence

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 Clinton 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. That being said, any homes with high radon levels are problematic, and there are many reported homes in Clinton 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 29 - Radon Level Test Results* shows there are nine zip codes in Clinton County where sufficient tests were reported for the PA DEP to report their findings. Many reported zip codes in Clinton 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 8.4 pCi/L. Two prevalent zip codes in Clinton County are 17745, containing Lock Haven and much of the surrounding area which has an average reported basement reading of 9.3 pCi/L, and 17751, containing Mill Hall Borough and much of the surrounding area which has an average reported basement reading of 9.1 pCi/L.

According to LHU officials, radon was discovered in the soil on the main campus and tests were conducted on a few buildings on campus several years ago. Radon was encountered in the crawl space of the Bentley Dining Hall and a radon reduction fan was installed. No testing has been conducted since the installation.

Table 29 - Radon Level Test Results

Radon Level Test Results *(PA DEP, 2018)*					
Zip Code	**Municipalities**	**Location**	**Number of Tests**	**Max Result pCi/L**	**Avg Result pCi/L**
16822	Beech Creek Borough, Parts of Beech Creek Township & Bald Eagle Township	BASEMENT	106	88.6	8.7
17721	Most of Avis Borough & Part of Pine Creek Township	BASEMENT	81	38.6	3.8
17740	Parts of Crawford Township, Pine Creek Township & Wayne Township	BASEMENT	656	301	13
		FIRST FLOOR	125	109.8	3.7
17745	Woodward Township, Dunnstable Township, Lock Haven, Flemington Borough, Parts of Castanea Township, Gallagher Township, Wayne Township & Pine Creek Township	BASEMENT	1747	193.8	9.3
		FIRST FLOOR	207	126.4	4.6
17747	Loganton Borough, Logan Township, Greene Township, Parts of Lamar Township, Wayne Township & Crawford Township	BASEMENT	113	93.9	9
17748	Parts of Wayne Township	BASEMENT	66	33.3	6.4
17751	Mill Hall Borough, Most of Lamar Township, Porter Township, Bald Eagle Township, Parts of Grugan Township, Beech Creek Township & Castanea Township	BASEMENT	517	238.6	9.1
		FIRST FLOOR	71	70.1	3.7
17764	Renovo Borough, South Renovo Borough, Parts of Noyes Township, Leidy Township, Chapman Township & East Keating Township	BASEMENT	61	49.2	5.9
17779	Part of Pine Creek Township	BASEMENT	134	131.8	10

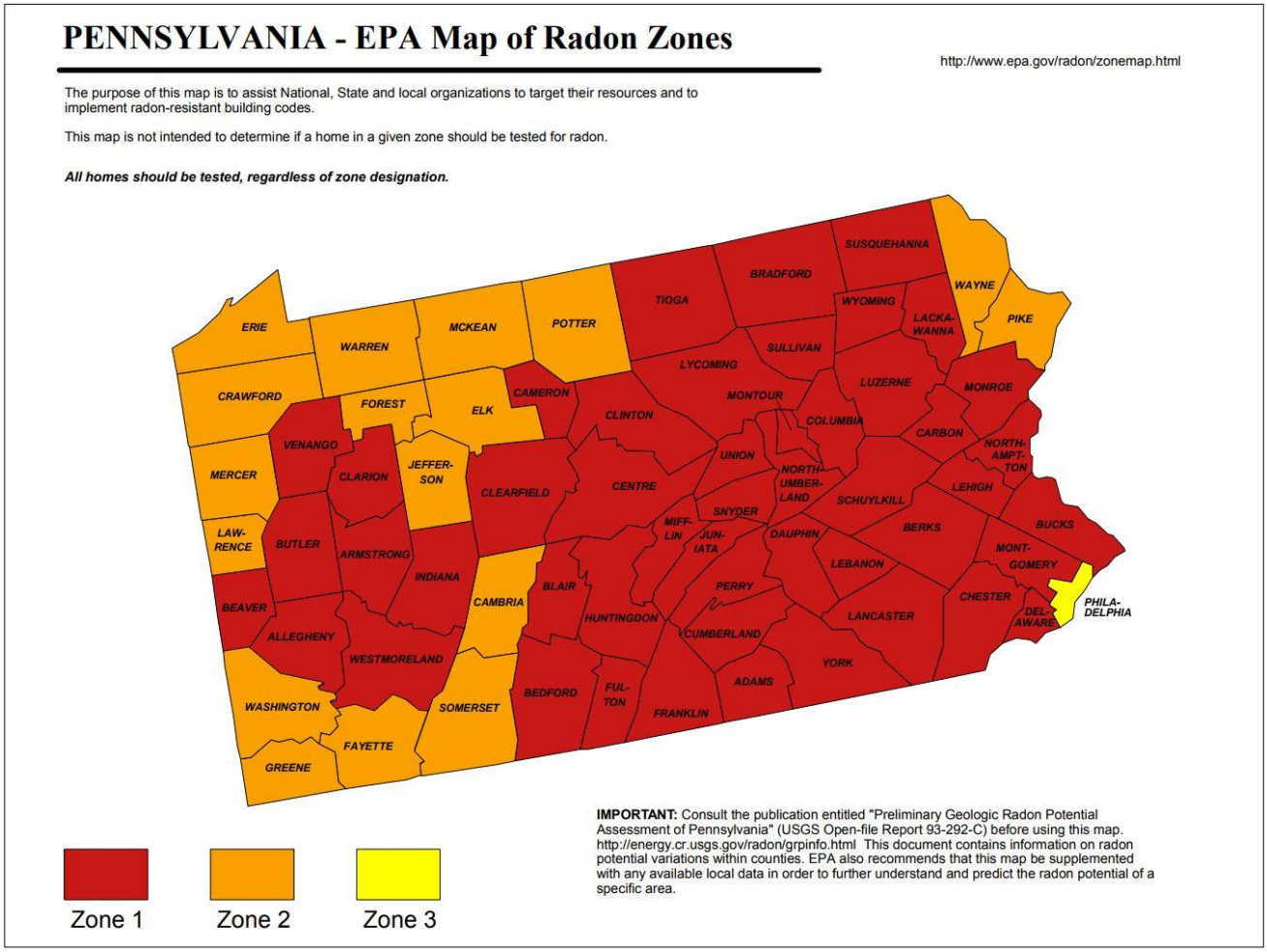
4.3.7.4 Future Occurrence

Radon exposure is inevitable given the geologic and geomorphic conditions in Clinton 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 27 - Radon Zones*. Each zone reflects the

average short-term measurement of radon that can be expected in a building without radon controls. Clinton 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 27 - Radon Zones



4.3.7.5 Vulnerability Assessment

Clinton 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 consistently found to be above the EPA action level of 4 piC/L. Homeowners across Clinton 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.

4.3.8. Tornados and Windstorms

4.3.8.1 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 67 years, records show that 826 tornados have been reported in all 67 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, formerly NCDC), 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." This is the reason that one house will be completely demolished by a tornado and the house next to it might be untouched. The width of tornados can vary greatly, from 100 feet wide to over a mile, and the forward motion of tornados can range from speeds between 0 and 50 miles per hour.

Windstorms may be caused by thunderstorms, hurricanes and tornadoes, but the most frequent cause of windstorms in Western 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 40 mph or greater, lasting for at least one hour, or simply winds of 58 mph or greater 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 100 mph. Wind shear is defined as a difference in wind speed and direction over a relatively short distance in the atmosphere.

4.3.8.2 Range of Magnitude

Figure 28 - Microburst

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

Each year, tornados account for $1.1 billion in damages and cause over 80 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 100 mph to more than 250 mph. In addition, a tornado's speed of forward motion can range from 0 to 50 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 missiles.

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, as shown in, based upon the estimated maximum winds occurring within the wind vortex *(Table 30 - 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 30 - Enhanced Fujita Scale* shows F-Scale categories with corresponding EF-Scale wind speeds.

Figure 22 - Wind Zones in Section 4.3.3 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. Because Clinton County falls

within Zone III, design wind speeds for shelters and critical facilities should be able to withstand a 3-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 EF5 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 Clinton County:

- Power failures lasting 4 hours or longer
- Loss of communications networks lasting 4 hours or more
- Residents requiring evacuation or provision of supplies or temporary shelter
- Severe crop loss and or damage

Table 30 - 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.

Enhanced Fujita Scale			
EF-Scale Number	**Wind Speed (MPH)**	**F-Scale Number**	**Description of Potential Damage**
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.

4.3.8.3 Past Occurrence

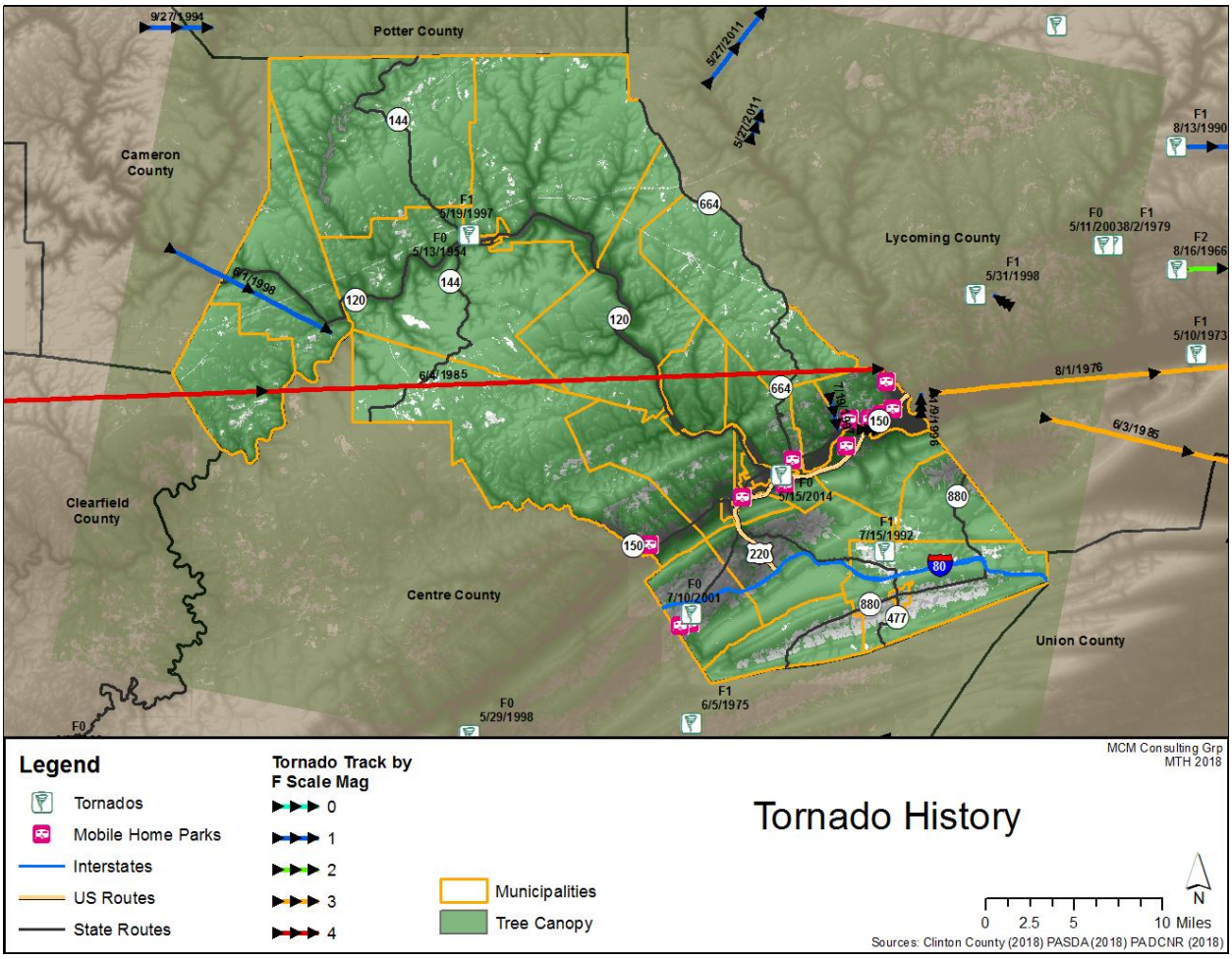
Clinton County has experienced ten tornados since 1954 (see *Table 31 - Tornado History*). One of the deadliest tornado events in Pennsylvania occurred on May 31 1985, with a total of 21 tornados in the Ohio and Northwest Pennsylvania region. These tornados resulted in 76 deaths (none of which occurred in Clinton County), upwards of 1000 injuries, and hundreds of millions of dollars in property damage. Clinton County experienced two F4 tornados during this event, causing an estimated $5-$50 million in damages.

Aside from tornados and hurricanes, Clinton County has 227 severe wind reports from 138 severe wind events from 1950 to 2018 causing a total of ~$520,000 dollars in property damage (NOAA NCEI, 2018). Most often these are the result of intense thunderstorms, which may fell trees, damaging power lines and cause power outages for upwards of four days in some areas. A severe thunderstorm on October 20, 2016 produced straight line winds estimated at 95 to 100 mph in Clinton County. The high winds knocked down trees onto a home in Lamer Township, causing one fatality (NOAA NCEI, 2018).

Table 31 - Tornado History

Tornado History *(NOAA NCEI, 2018)*					
Location	**Date**	**Fujita**	**Width (Yards)**	**Length (Miles)**	**Total Damage**
Clinton Co.	5/13/1954	F0	10	0.8	$500-$5,000
Clinton Co.	5/31/1985	F4	3330	69	$5M-$50M
Clinton Co.	7/15/1992	F1	73	1	$5K-$50K
Clinton Co.	11/8/1996	F1	150	3	$25K
Avis	11/8/1996	F1	150	1	$100K
Renovo	5/19/1997	F1	50	5	-
Woolrich	7/18/1997	F1	880	3.5	-
Keating	5/31/1998	F1	50	5	-
Lamar	7/10/2001	F0	30	0.1	-
Lock Haven	5/15/2014	F0	100	0.32	$5,000.00

Figure 29 - Tornado History



4.3.8.4 Future Occurrence

It is possible for a disastrous tornado to hit Clinton 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 100 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 1998, most of Clinton County lies within an area that has experienced six to fifteen EF4 or EF5 tornados per 3,700 square miles. There is an estimated 1.3% to 3.4% chance that the planning area will be affected by a Category EF4 or EF5 tornado each year. 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 50 knots indicates that annual chance of a windstorm is higher.

According to FEMA (See Section 4.3.3 *Table 20 - Annual Probability of Wind Speeds*), there is high probability (~92%) each year that Clinton County will experience winds of 45-77 mph, however there is under a 10% chance of winds of 78-118 mph.

4.3.8.5 Vulnerability Assessment

Tornados can occur at any time of the year, though they're 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. Because of the abundance of forested areas in Clinton, numerous hikers and hunters visit Clinton County annually. In the event of a tornado or severe storm, these tourists and hunters have limited emergency notification measures.

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 wind storms. While many severe storms can cause exterior damage to structures, tornados can also completely destroy structures, along with their surrounding infrastructure, abruptly halting operations. Severe storms and their secondary effects often accompanying tornados and can be just as threatening to the critical facilities within the county. 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. Mobile homes are also particularly vulnerable to tornados and windstorms.

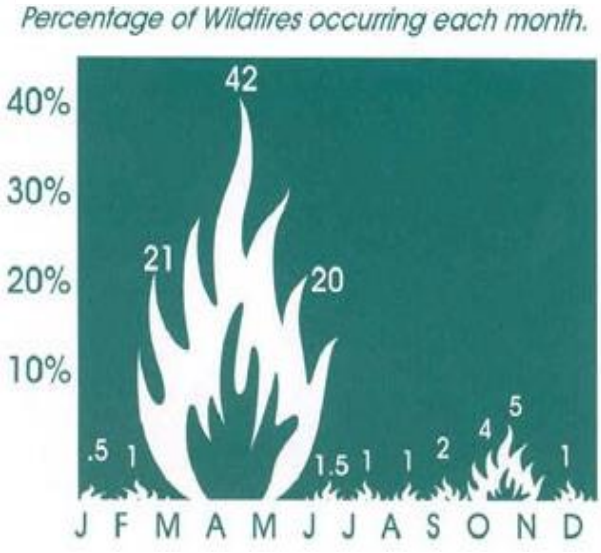
The local economy can also be crippled by tornados and windstorms and their secondary effects when buildings and supporting infrastructure are destroyed in the storm. Power outages can create work stoppages while transportation accidents and road closings can limit the transportation of goods and services. 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.

4.3.9. Wildfire

4.3.9.1 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 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 PA 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 are fuel for fires. *Figure 30 - Seasonal Wildfire Percentage* shows the wildfire percentage occurrence during each month occurring in Pennsylvania.

Figure 30 - Seasonal Wildfire Percentage



Clinton County is located in the Sproul District (District 10) and has significant expanses of natural forests, including much of the Sproul State Forest, several State

Parks (Ravensburg, Kettle Creek, Hyner Run, Bucktail & Hyner View) as well as several State Game Lands (Numbers 89, 255, 295 & 321). Natural gas extraction wells, storage facilities and pipelines can also be sources for fire activity in Clinton County. These features can often be in forested regions, meaning they have significant potential for starting wildfires (see *Figure 37 - Pipelines in Clinton County* for pipeline locations).

4.3.9.2 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, 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 32 - Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

Table 32 - 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.

Wildland Fire Assessment System *(U.S. Forest Service)*	
Rank	**Description**
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.

4.3.9.3 Past Occurrences

Between 2002 and December 2017, there were one hundred twenty-three fire events reported to the Knowledge Center, DCNR and the PEIRS voluntary reporting system - these reported fires are primarily urban fires and some brush fires as well as a few vehicle fires. The Knowledge Center provides data from 2013 – December 2017, and it should be noted that wildfires in natural lands may be reported less frequently to the Knowledge Center and thus could be under-represented in later years in *Table 34 - Fire Occurrence*. Data from 2003 to 2009 comes from the 2011 HMP, and lists wildfires reported by the PA DCNR and PEIRS reporting system. Data covering the years of 2010 – 2012 was not readily available. This list should be treated as a sample of fire history in Clinton County and not an all-inclusive database.

A significant fire occurred at a gas storage well (the Greenlick Field) owned by Dominion Transmission Inc. in Leidy Township on Sunday September 14, 2008. The fire burned for nearly two weeks, with responders from the Clinton County Department of Emergency Services, the Kettle Creek Hose Company, the volunteer fire department of Renovo PA, the PA Department of Environmental Conservation, as well as the Susquehanna River Basin Commission. The fire was contained and did not spread to the surrounding forest, and eventually Wildcat specialists from Texas arrived at the scene to help extinguish the blaze.

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* 33 - PA Prescribed Burns *(PA DCNR, 2017)* shows prescribed burn data for Pennsylvania from 2010 to 2015. No data on prescribed burns was available for 2016 or 2017.

Table 33 - PA Prescribed Burns

PA 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

Table 34 - Fire Occurrence

Fire Occurrence *(Knowledge Center, 2018; PA DCNR, 2011; PEIRS, 2011)*		
Location	**Description**	**Date**
Clinton Co.	Structure Fire	12/11/17
Clinton Co.	Structure Fire Printer LANE	11/20/17
Clinton Co.	House Fire	09/29/17
Clinton Co.	Fallon Hotel Fire	09/21/17
Avis Borough	Firefighter Injury (non-life threatening)	07/24/17
Pine Creek Township	Barn Fire	07/10/17
Clinton Co.	Structure Fire 3rd alarm	04/29/17
Clinton Co.	Second Alarm Barn Fire	04/05/17
Lamar Township	Structure Fire Lamar Township	02/06/17
Clinton Co.	commercial structure fire	12/16/16
Clinton Co.	Structure Fire	12/02/16
Clinton Co.	Tractor Trailer Fire	10/13/16
Clinton Co.	Structure Fire	08/10/16
Clinton Co.	Structure Fire	08/09/16
Clinton Co.	Lock Haven Structure Fire	06/01/16
Clinton Co.	House Fire	05/27/16
Clinton Co.	Tractor Trailer Fire	04/16/16
Gallagher Township	Wildfire with Patient	03/31/16
Clinton Co.	Tractor Trailer fire	03/07/16
Logan Township	Structure Fire	03/02/16
Porter Township	Tire Fire	05/23/15
Clinton Co.	Firefighter Injury	05/04/15
Clinton Co.	Firefighter minor injury	04/06/15

Fire Occurrence *(Knowledge Center, 2018; PA DCNR, 2011; PEIRS, 2011)*		
Location	**Description**	**Date**
Clinton Co.	Mobile Home Fire	03/30/15
Lamar Township	Barn Fire	03/13/15
Clinton Co.	Structure Fire	02/07/15
Lock Haven City	Residential Structure Fire	11/19/14
Lock Haven City	Structure Fire - Clinton County	06/27/14
Greene Township	Structure Fire Greene Twp.	05/13/14
Clinton Co.	Structure Fire	04/26/14
Clinton Co.	Firefighter Injury	04/13/14
Clinton Co.	Structure Fire	03/09/14
Clinton Co.	Structure Fire	03/05/14
Clinton Co.	Structure Fire	03/01/14
Clinton Co.	Structure Fire	02/24/14
Clinton Co.	Structure Fire	02/02/14
Clinton Co.	Tri-Axel Fire	01/28/14
Clinton Co.	Residential Structure Fire	01/21/14
Lock Haven City	Structure Fire--Multi Family Dwelling	12/22/13
Clinton Co.	Structure Fire	12/05/13
Lock Haven City	Reported Fire In Susqueview Home	11/28/13
Lamar Township	Residential Structure Fire	11/14/13
Clinton Co.	Structure Fire	11/12/13
Bald Eagle Township	Outdoor Fire	11/10/13
Greene Township	Structure Fire	10/08/13
Clinton Co.	Residential Structure Fire	09/17/13
Dunnstable Township	Outdoor Debris/Log Fire	08/22/13
Clinton Co.	Structure Fire	05/31/13
Wayne Township	Structure Fire--Clinton County Landfill	05/22/13
Clinton Co.	Wild Fire	05/05/13
Beech Creek Township	Wild Fire	04/06/13
Clinton Co.	Wild Fire	04/06/13
Clinton Co.	Well Involved Residential Structre Fire	03/30/13
Colebrook Township	Wild Fire	03/30/13
Lock Haven City	Residential Structure Fire	03/30/13
Castanea Township	Structure Fire-Industrial	03/23/13
Chapman Township	Structure Fire	03/23/13
Clinton Co.	Industrial Fire	03/05/13
Dunnstable Township	firefighter injury	02/26/13
Chapman Township		2009
Chapman Township		2009
Crawford Township	5 Acres Burned	2008
Bald Eagle Township	10 Acres Burned	2008
Lock Haven City	0.2 Acres Burned	2008
Countywide		2008
Gallagher Township	4 Acres Burned	2008

Fire Occurrence *(Knowledge Center, 2018; PA DCNR, 2011; PEIRS, 2011)*		
Location	**Description**	**Date**
Chapman Township	2 Acres Burned	2008
Leidy Township	56.4 Acres Burned	2008
Wayne Township	0.1 Acres Burned	2007
Wayne Township	2 Acres Burned	2007
East Keating Township	0.1 Acres Burned	2007
Chapman Township	1 Acre Burned	2007
Chapman Township	4.5 Acres Burned	2007
Leidy Township	0.1 Acres Burned	2007
Porter Township	1.5 Acres Burned	2006
Lock Haven City		2006
Colebrook Township		2006
Lamar Township	11 Acres Burned	2006
Lamar Township	2.1 Acres Burned	2006
Greene Township	65 Acres Burned	2006
Lamar Township	11.1 Acres Burned	2006
Crawford Township	0.25 Acres Burned	2006
Woodward Township	0.4 Acres Burned	2006
Beech Creek Township	2.2 Acres Burned	2006
Gallagher Township	5.7 Acres Burned	2006
Noyes Township	8 Acres Burned	2006
Noyes Township	0.7 Acres Burned	2006
Noyes Township	348 Acres Burned	2006
Noyes Township	1329 Acres Burned	2006
Leidy Township	5 Acres Burned	2006
Leidy Township	917.8 Acres Burned	2006
Leidy Township	15 Acres Burned	2006
Logan Township	4.5 Acres Burned	2005
Lamar Township	3.5 Acres Burned	2005
Logan Township	1.5 Acres Burned	2005
Logan Township	1.5 Acres Burned	2005
Logan Township	1.5 Acres Burned	2005
Logan Township	0.5 Acres Burned	2005
Logan Township	0.01 Acres Burned	2005
Logan Township	0.01 Acres Burned	2005
Lamar Township	1.5 Acres Burned	2005
Lamar Township	0.1 Acres Burned	2005
Mill Hall Borough	2.1 Acres Burned	2005
Lamar Township	2.5 Acres Burned	2005
Crawford Township	50 Acres Burned	2005
Bald Eagle Township	12.8 Acres Burned	2005
Beech Creek Township	30.9 Acres Burned	2005
Dunnstable Township	0.8 Acres Burned	2005
Chapman Township	0.1 Acres Burned	2005

Fire Occurrence (Knowledge Center, 2018; PA DCNR, 2011; PEIRS, 2011)		
Location	**Description**	**Date**
Gallagher Township	0.4 Acres Burned	2005
Greene Township		2005
Leidy Township	0.1 Acres Burned	2005
Crawford Township	3 Acres Burned	2004
Colebrook Township	2.5 Acres Burned	2004
Leidy Township	1.72 Acres Burned	2004
Colebrook Township	0.1 Acres Burned	2003
Noyes Township	1.5 Acres Burned	2003
Renovo Borough	1 Acre Burned	2003
Chapman Township	4 Acres Burned	2003
Greene Township	1 Acre Burned	2002
Lamar Township	0.5 Acres Burned	2002
Crawford Township	6.8 Acres Burned	2002
Beech Creek Township	2 Acres Burned	2002
Grugan Township	5 Acres Burned	2002
Noyes Township	1 Acre Burned	2002
Leidy Township	1 Acre Burned	2002
Chapman Township	1 Acre Burned	2002

4.3.9.4 Future Occurrence

Annual occurrences of urban and wildfires in Clinton 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 dry 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.

4.3.9.5 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. Wildfires are most common in the spring (March–May) and fall (October–November) months. During spring and fall months, the lack of leaves on the trees allows the sunlight to heat and dry the existing leaves on the ground, increasing the risk of forest fires. 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.

Table 36 - 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.

There are twenty fire departments that cover Clinton County. *Table 35 - Fire Departments* shows which municipalities have fire departments. Each fire department conducts its own schedule of in house training sessions for their members.

Table 35 - Fire Departments

Fire Departments *(Clinton County GIS, 2018)*			
Name	**Station No.**	**Municipality**	**Address**
Avis Fire Co.	8	Avis Borough	1 E Central Ave
Beech Creek - Blanchard Fire Co.	9	Beech Creek Borough	38 Locust St
Castanea Fire Co.	3	Castanea Township	111 Mcelhattan Ave
Chapman Township Fire Co.	27	Chapman Township	79 Park Ave
Nippenose Valley	L6	Crawford Township	4453 Pine Mountain Rd
Goodwill Hose Co.	7	Flemington Borough	126 High St
Haneyville Fire Co.	18	Gallagher Township	15351 Coudersport Pike
Lamar Township Fire Co.	11	Lamar Township	91 Firehouse Dr
Citizens Hose Co.	6	Lock Haven City	415 Bellefonte Ave
Hope Hose Co.	2	Lock Haven City	120 E Church St
Hand In Hand Hose Co.	1	Lock Haven City	1 N Henderson St
Sugar Valley Volunteer Fire Co	13	Loganton Borough	24 W Anthony St
Mill Hall Volunteer Fire Co.	4	Mill Hall Borough	9 E Peale Ave
Woolrich Fire Co.	12	Pine Creek Township	26 Cemetery St
Nittany Valley Fire Co.	17	Porter Township	5101 Nittany Valley Dr
Renovo Fire Dept.	29	Renovo Borough	230 11Th St
Citizens Fire Co.	28	South Renovo Borough	415 Fourth St
Kettle Creek Hose Co.	26	Stewardson Township	75 Firehouse Ln
Wayne Township Fire Co.	10	Wayne Township	317 Linwood Dr
Dunnstown Fire Co.	5	Woodward Township	119 Woodward Ave

Table 36 - Buildings in High Wildfire Hazard Areas

Buildings in High Wildfire Hazard Areas (Clinton Co. GIS, 2018; Radeloff et al. 2016)				
Municipalities	**Wild Urban Interface & Intermix**		**State Forests, Parks & Game Lands**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
Allison Township	1	2	0	0
Avis Borough	615	0	0	0
Bald Eagle Township	498	1	17	0
Beech Creek Borough	304	7	0	0
Beech Creek Township	138	1	89	0
Castanea Township	559	2	5	0
Chapman Township	386	7	135	0
Colebrook Township	33		16	0
Crawford Township	255	1	11	1
Dunnstable Township	127	0	0	0
East Keating Township	48	0	35	0
Flemington Borough	619	4	0	0
Gallagher Township	1	0	17	0
Greene Township	19	0	22	1
Grugan Township	6	0	87	0
Lamar Township	476	2	9	0
Leidy Township	310	0	64	0
Lock Haven City	2,509	16	0	0
Logan Township	36	0	1	0
Loganton Borough	175	2	0	0
Mill Hall Borough	712	4	0	0
Noyes Township	136	0	104	1
Pine Creek Township	992	1	0	0
Porter Township	316	3	2	0
Renovo Borough	552	6	0	0
South Renovo Borough	232	4	0	0
Wayne Township	402	5	1	0
West Keating Township	20	0	29	0
Woodward Township	862	2	0	0
Totals	**11,339**	**70**	**644**	**3**

Figure 31 - Wildfire Vulnerability

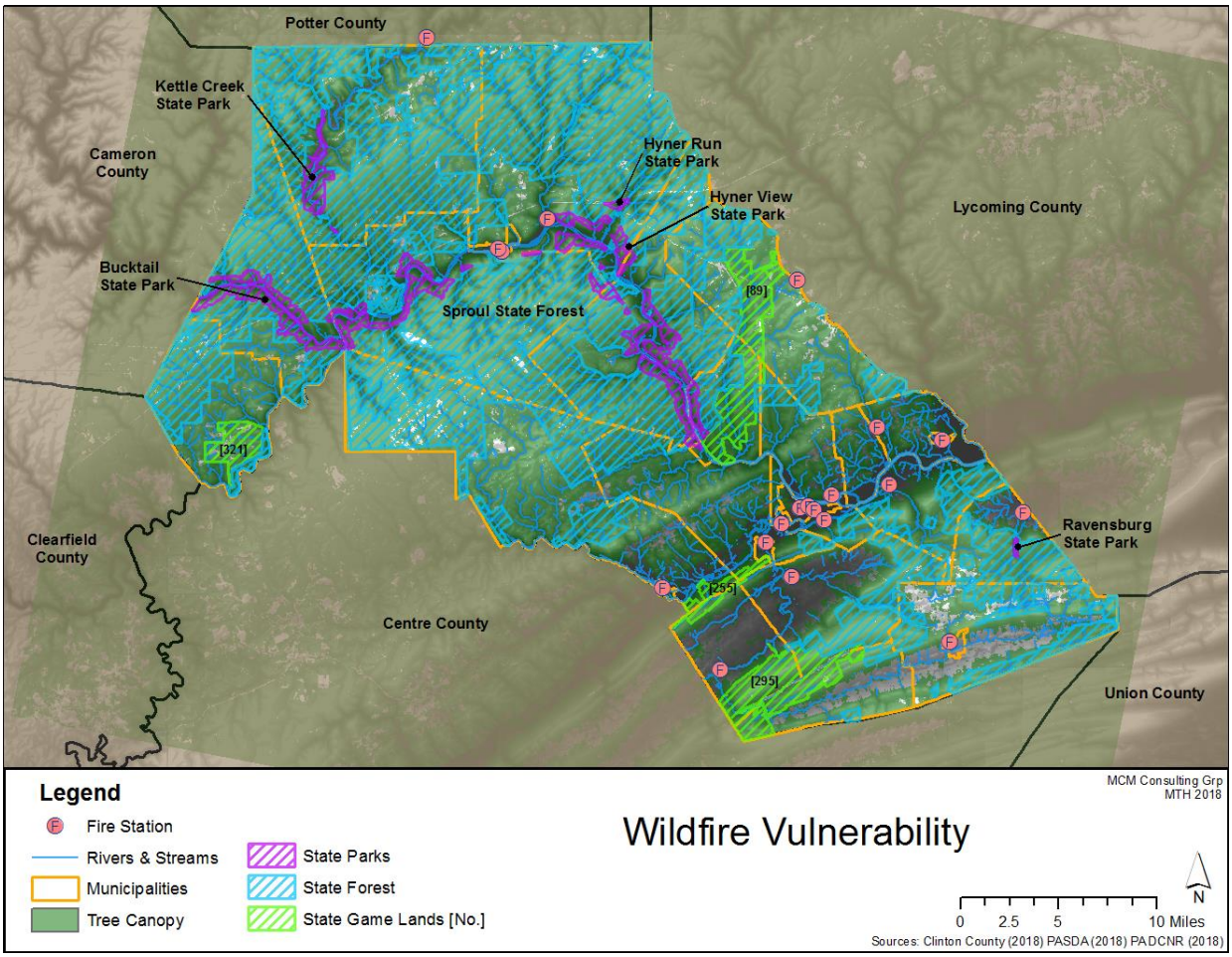
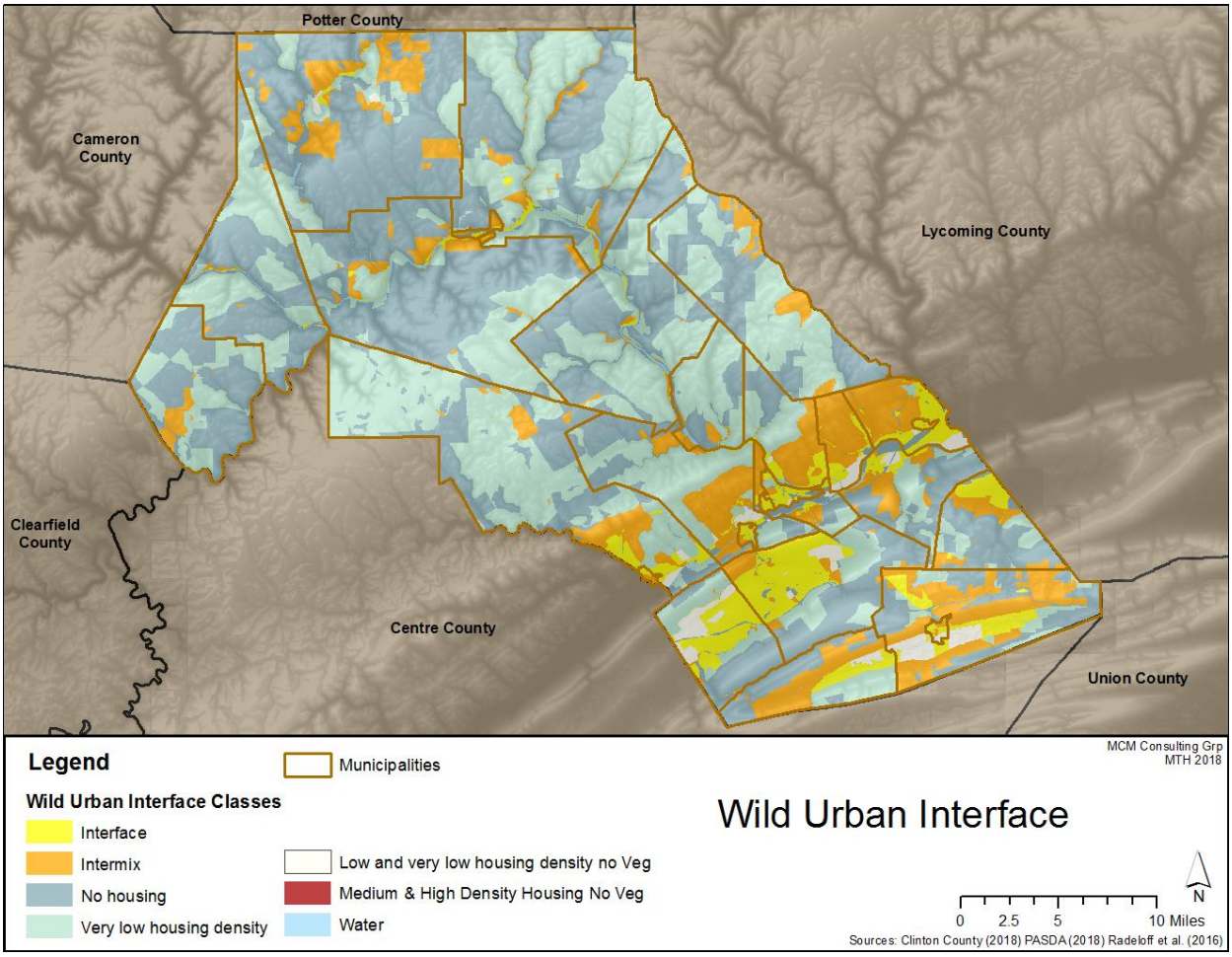


Figure 32 - Wild Urban Interface



4.3.10. Winter Storms

4.3.10.1 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 Clinton 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 Clinton 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).

4.3.10.2 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 39 - Severe 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 breaks 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 33 - Pennsylvania Annual Snowfall* shows mean annual snowfall in Clinton County to be between thirty-one and fifty seventy inches.

Table 38 - Recent Annual Snowfall summarizes annual snowfall accumulation for recent years not covered in *Figure 33 - Pennsylvania Annual Snowfall* as recorded in the weather station in Lock Haven.

Table 37 - 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.

Winter Weather Events	
Weather Event	**Classification**
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.

Figure 33 - Pennsylvania Annual Snowfall

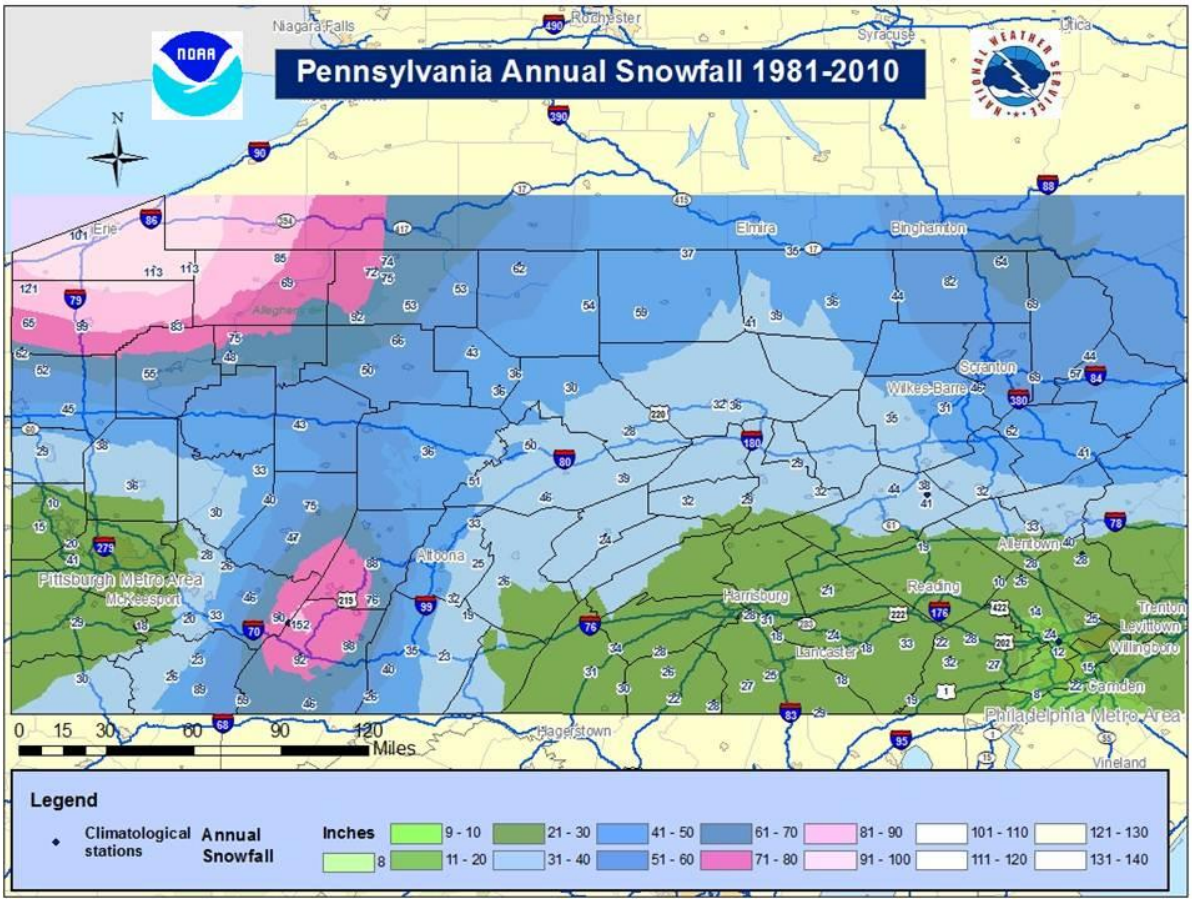


Table 38 - Recent Annual Snowfall

Recent Annual Snowfall *(NOAA, 2018)*	
Winter Season	**Total Snowfall (inches)**
2010-2011	41.0"
2011-2012	12.5"
2012-2013	36.8"
2013-2014	47.7"
2014-2015	46.1"
2015-2016	6.6"
2016-2017	37.9"

4.3.10.3 Past Occurrence

Historically, winter storms have occurred on the average of five times a year in Clinton 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.

On January 6, 2004, an arctic cold front crossed central Pennsylvania accompanied by a narrow band of intense snow squalls. The snow caused visibility to drop to near zero, causing roadways to quickly become snow covered and icy, causing two multi-vehicle accidents: one accident occurred on Interstate 80 between Lock Haven and Bellefonte, and involved 6 fatalities and numerous injuries. Many tractor trailers and

other vehicles were involved in the accident. The second accident also occurred on Interstate 80, between Bellefonte and Milesburg and involved three tractor trailers. The event resulted in an estimated $1.5 Million in damages (NOAA NCEI, 2018).

All other recorded winter weather events in Clinton County from 1960-January 2018 are summarized in *Table 39 - Severe Winter Weather Events*. Descriptive details for events between 1996 and January 2018 can be found at the NOAA NCEI Storm Events Database (www.ncdc.noaa.gov/stormevents). Deaths and Injuries reported as N/A did not have reliable numbers available.

Table 39 - Severe Winter Weather Events

Severe Winter Weather Events *(NOAA NCEI, 2018; Knowledge Center, 2018; 2011 HMP)*				
Date	**Type**	**Deaths**	**Injuries**	**Property Damage ($USD)**
02/13/60	Snow	N/A	N/A	0
02/18/60	Snow, Wind	N/A	N/A	0
03/03/60	Snow	N/A	N/A	0
12/01/60	Snowstorm	N/A	N/A	0
02/03/61	Snowstorm	N/A	N/A	$1,000
03/06/62	Snow, Wind, Rain	0	0	$1,000
12/06/62	Snow, Wind	0	0	$1,000
12/10/62	Snow	0	0	0
12/29/62	Snow, Wind	0	0	$75,000
01/12/64	Snowstorm	0	0	0
03/10/64	Ice	0	0	0
03/05/65	Snow	0	0	$16,000
01/30/66	Blizzard*	N/A	N/A	$7,000
01/14/68	Wind, Sleet	0	0	0
11/12/68	Snow, Wind	N/A	0	$1,000
12/05/68	Wind, Snow	0	N/A	$1,000
12/25/69	Snow	0	0	$1,000
03/12/70	Snowstorm	0	N/A	0
01/26/71	Wind, Snow, Lightning	0	N/A	$2,000
01/26/71	Blizzard, Wind	0	N/A	$29,000
01/27/71	Snowstorm, Wind	0	0	$1,000
02/13/71	Wind, Snow, Ice	0	0	$3,000
02/17/71	Lightning, Ice	0	0	0
03/04/71	Wind, Snowstorm	0	0	0
04/06/71	Snow, Wind	0	0	0
11/25/71	Snow	0	0	0
02/18/72	Snow, Wind*	0	0	$1,000
12/16/73	Snow	N/A	N/A	0
12/20/73	Ice, Snow, Rain	N/A	N/A	$2,000
01/02/74	Glaze, Snow	0	N/A	0

Severe Winter Weather Events *(NOAA NCEI, 2018; Knowledge Center, 2018; 2011 HMP)*				
Date	**Type**	**Deaths**	**Injuries**	**Property Damage ($USD)**
01/09/74	Snow, Glaze	0	N/A	0
01/18/74	Glaze	0	0	0
02/08/74	Snowstorm	0	N/A	0
03/29/74	Heavy Snow, Frozen Rain	0	N/A	$2,000
01/06/75	Snowstorm	0	0	0
01/12/75	Snowstorm	0	0	0
01/18/75	Snowstorm	0	0	0
01/19/75	Snowstorm	0	0	
02/12/75	Heavy Snow	0	0	0
04/03/75	Wind, Snow	0	0	$15,000
01/07/76	Freezing Rain, Heavy Snow	0	0	0
01/11/76	Heavy Snow	0	0	0
01/20/76	Snow	0	0	0
01/26/76	Flooding, Snow	0	0	0
02/02/76	Frozen Rain, Wind, Snow	0	0	$2,000
02/05/76	Freezing Rain, Snow	0	0	0
03/09/76	Heavy Snow	0	0	0
01/06/77	Heavy Snow	0	0	0
01/09/77	Heavy Snow, Wind	0	0	0
03/22/77	Heavy Snow, Rain, Wind	0	0	$2,000
10/16/77	Heavy Snow, Rain	0	0	$15,000
12/17/77	Ice Storm, Sleet	0	0	$15,000
01/03/78	Snow, Ice	0	0	$15,000
01/16/78	Heavy Snow, Rain	0	0	$2,000
01/19/78	Heavy Snow, Wind*	0	N/A	$15,000
02/05/78	Heavy Snow, Wind	0	0	$2,000
02/13/78	Snow	0	0	0
03/25/78	Heavy Rain, Ice Storm	0	0	$2,000
12/20/78	Glaze	0	0	0
12/10/92	Heavy Snow	0	0	$75,000
02/21/93	Heavy Snow	0	0	0
03/13/93	Heavy Snow, Blizzard	N/A	0	$56,000
03/13/93	Heavy Snow**	0	0	$50,000,000
01/01/94	Extreme Cold, Snow	N/A	0	0
01/04/94	Heavy Snow**	0	N/A	$5,000,000
01/14/94	Extreme Cold	0	N/A	$7,000
01/17/94	Heavy Snow**	0	0	$500,000
03/02/94	Heavy Snow, Blizzard, Ava-lanche	0	0	$7,000
03/02/94	Heavy Snow/blizzard/avalanche	0	N/A	$5,000,000
03/10/94	Ice	0	0	$500,000

Severe Winter Weather Events *(NOAA NCEI, 2018; Knowledge Center, 2018; 2011 HMP)*				
Date	**Type**	**Deaths**	**Injuries**	**Property Damage ($USD)**
04/19/94	Extreme Cold	N/A	0	0
11/27/94	Freezing Rain And Sleet	0	0	0
12/09/94	Freezing Rain	0	0	0
12/31/94	Freezing Rain	0	0	0
01/04/95	Heavy Snow	0	0	0
01/06/95	Winter Storm	0	0	0
01/07/95	Ice	0	0	0
01/11/95	Freezing Rain	0	0	0
01/31/95	Freezing Rain	0	0	0
02/03/95	Heavy Snow	0	0	0
02/15/95	Ice, Freezing Rain	0	0	0
02/26/95	Freezing Rain Sleet And Light	0	0	0
02/27/95	Freezing Rain	0	0	0
03/08/95	Snow	0	0	0
06/01/95	Snow Drought	0	0	0
11/14/95	Winter Storm	0	0	0
12/19/95	Winter Storm	0	0	0
01/02/96	Heavy Snow**	0	0	0
01/07/96	Blizzard**	0	0	0
03/07/96	Heavy Snow	0	0	0
11/28/96	Heavy Snow	0	0	0
02/13/97	Winter Storm	0	0	0
03/14/97	Ice Storm	0	0	0
11/14/97	Heavy Snow	0	0	0
12/29/97	Heavy Snow	0	0	0
01/15/98	Ice Storm	0	0	0
01/22/98	Ice Storm	0	0	0
02/23/98	Heavy Snow	0	0	0
01/02/99	Winter Storm	0	0	0
01/08/99	Winter Storm	0	0	0
01/14/99	Winter Storm	0	0	0
03/06/99	Heavy Snow	0	0	0
01/30/00	Heavy Snow	0	0	0
02/13/00	Ice Storm	0	0	0
02/18/00	Winter Storm	0	0	0
12/13/00	Winter Storm	0	0	0
03/04/01	Heavy Snow	0	0	$4,000
01/06/02	Heavy Snow	0	0	0
12/05/02	Heavy Snow	0	0	0
12/10/02	Ice Storm	0	0	0
12/25/02	Heavy Snow	0	0	0
01/01/03	Ice Storm	0	0	0

Severe Winter Weather Events *(NOAA NCEI, 2018; Knowledge Center, 2018; 2011 HMP)*				
Date	**Type**	**Deaths**	**Injuries**	**Property Damage ($USD)**
01/02/03	Heavy Snow	0	0	0
02/16/03	Heavy Snow	0	2	0
12/14/03	Heavy Snow	0	0	0
01/06/04	Winter Weather	6	12	$1,500,000
02/03/04	Heavy Snow	0	0	0
03/16/04	Heavy Snow	0	0	0
12/20/04	Cold/Wind Chill	0	0	0
01/05/05	Winter Storm	0	0	0
01/08/05	Ice Storm	0	0	0
01/22/05	Winter Storm	0	0	0
02/21/05	Winter Storm	0	0	0
03/01/05	Heavy Snow	0	0	0
10/25/05	Heavy Snow	0	0	0
12/09/05	Heavy Snow	0	0	0
12/16/05	Winter Storm	0	0	0
01/26/07	Extreme Cold/Wind Chill	0	0	0
02/03/07	Extreme Cold/Wind Chill	0	0	0
02/05/07	Extreme Cold/Wind Chill	0	0	0
02/13/07	Heavy Snow	0	0	0
02/16/07	Extreme Cold/Wind Chill	0	0	0
03/06/07	Extreme Cold/Wind Chill	0	0	0
03/16/07	Heavy Snow	0	0	0
12/02/07	Ice Storm	0	0	0
12/09/07	Ice Storm	0	0	0
12/13/07	Winter Storm	0	0	0
02/01/08	Winter Storm	0	0	0
02/10/08	Extreme Cold/Wind Chill	0	0	0
12/11/08	Winter Storm	0	0	0
12/19/08	Winter Storm	0	0	0
12/21/08	Extreme Cold/Wind Chill	0	0	0
12/23/08	Ice Storm	0	0	0
01/06/09	Ice Storm	0	0	0
01/10/09	Winter Storm	0	0	0
01/15/09	Extreme Cold/Wind Chill	0	0	0
01/16/09	Extreme Cold/Wind Chill	0	0	0
01/27/09	Winter Storm	0	0	0
03/02/09	Extreme Cold/Wind Chill	0	0	0
10/15/09	Winter Storm	0	0	0
02/01/11	Winter Storm	0	0	0
02/20/11	Heavy Snow	0	0	0
03/06/11	Heavy Snow	0	0	0
10/29/11	Heavy Snow	0	0	0

Severe Winter Weather Events (NOAA NCEI, 2018; Knowledge Center, 2018; 2011 HMP)				
Date	**Type**	**Deaths**	**Injuries**	**Property Damage ($USD)**
04/22/12	Heavy Snow	0	0	0
12/26/12	Winter Storm	0	0	0
11/26/13	Ice Storm	0	0	0
12/14/13	Heavy Snow	0	0	0
01/06/14	Extreme Cold/Wind Chill	0	0	0
01/28/14	Extreme Cold/Wind Chill	0	0	0
02/04/14	Winter Storm	0	0	0
02/13/14	Heavy Snow	0	0	0
11/22/14	Winter Weather	0	0	0
11/25/14	Heavy Snow	0	0	0
02/15/15	Extreme Cold/Wind Chill	0	0	0
02/19/15	Extreme Cold/Wind Chill	0	0	0
02/23/15	Extreme Cold/Wind Chill	0	0	0
02/15/16	Winter Storm	0	0	0
02/08/17	Winter Storm	0	0	0
02/09/17	Winter Storm	0	0	0
03/13/17	Winter Storm	0	0	0
*Gubernatorial Disaster Declaration				
**Presidential Disaster Declaration				

4.3.10.4 Future Occurrence

The prospect of climate change brings the future of the climate into uncertainty, however 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). 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 snow storms. Such thunderstorms can be followed by cold fronts and winter storms resulting in temperature drops of 50˚F in a few short hours.

Winter storms are a regular, annual occurrence in Clinton 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 Clinton County each year. *Table 40 - Probability of Measurable Snowfall* shows the normal

monthly in Clinton County and is based on data collected over a thirty-year period (NOAA, 2018).

Table 40 - Probability of Measurable Snowfall

Probability of Measurable Snowfall by Snow Station *(NOAA, 2017)*		
MONTH	**Normal Monthly Snowfall (inches)**	
	Renovo	**Lock Haven**
January	9.6	8.8
February	8.5	6.8
March	5.1	6.2
April	0.5	0.6
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0.1	0
November	1.0	1.0
December	5.5	5.0
Annual	**30.3**	**28.4**

4.3.10.5 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.

Severe winter storms can result in road closures which can directly affect the functionality of Lock Haven University and the Sieg Conference Center, especially because the Center is slightly more remote and in a rural setting. In cases of inclement weather and/or hazardous driving conditions, the University utilizes campus wide delays or complete closures. Students who reside in the residence halls will be in need of ser-

vices such as food, water, electricity and heat for the duration of the event. The use of auxiliary heat and power supplies such as wood-burning stoves, kerosene heaters, and gasoline-power generators are not a viable, practical solution to implement in these types of facilities. Students residing in dormitories that lack adequate equipment to protect against cold temperatures or significant snow and ice are more vulnerable to winter storm incidents. Faculty who are required to report during such times must have the University operational at a level needed for these students.

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 Clinton County.

4.3.11. Dam Failure

Due to security concerns the Dam Failure profile can be found in Appendix I of this document.

4.3.12. Disorientation

4.3.12.1 Location and Extent

Mental confusion, impaired awareness and/or disorientation is the loss of one's sense of direction, position, or relationship with one's surroundings. In Clinton County, disorientation can vary from a missing child to a lost hunter. Emergency services will be expected to search for missing or disoriented persons at all times of the year, in all types of weather conditions. Disorientation events have the potential to take place throughout the county.

Clinton County's terrain consists of mountains that are heavily forested to the north and western part of the county, and two prominent valleys in the southern part of the county. These valleys are Sugar Valley and Nittany Valley and are located between Bald Eagle Mountain and Nittany Mountain. A common feature in Clinton County are steep slopes of 15-25% grades and very steep slopes of grades over 25%. The major waterway in Clinton County is the West Branch Susquehanna River, and has the following major tributaries: Kettle Creek, Young Woman's Creek, Hyner Run, Queen's Run, Chatham Run, McElhattan Creek, Fishing Creek, Bald Eagle Creek, and Beech Creek. Approximately 96% of Clinton County's total land area is undeveloped, with

about 94% of this land forested or used for agriculture. *Figure 34 - Disorientation Vulnerability* shows the terrain.

Recreation activities such as hunting, fishing, hiking, and water sports occur in the wooded areas and along the waterways in the county. Most of the streams through the county are classified as high quality-cold water fisheries. There are approximately 312,000 acres of State Forests and 22,000 cares of State Game Lands in Clinton County.

4.3.12.2 Range of Magnitude

All ranges of the population, form age to social status, are susceptible to disorientation. Other hazards that could complicate or create a disorientation event would be severe winter weather, flooding, tropical storms, wildfires or tornados.

4.3.12.3 Past Occurrence

Past events that have required emergency service personnel to be utilized for search and rescue of disoriented persons is depicted in *Table 41 - Disorientation Incidents in Clinton County*.

Table 41 - Disorientation Incidents in Clinton County

Disorientation Incidents in Clinton County		
Date	**Location/ Municipality**	**Event**
07-04-13	Woodward Township	Water rescue on the west branch of Susquehanna River. Report of three people going over the dam at Lock Haven. Two were found deceased.
09-22-13	McElhattan	Search for a missing female in the area of Reservoir Road.
01-29-14	Avis Borough	14-year old male walked away from the Walnut Street Christian School.
02-16-14	Chapman Township	Individuals trapped in a snowed-in vehicle on Hyner View Road
04-05-15	Renovo Borough	Missing woman
07-17-15	Castanea Township	Missing 4-year old male
11-09-15	Lock Haven City	Mental health elopement
11-24-15	Gallagher Township	Lost hunter
11-30-15	Leidy Township	Land rescue for a missing hunter, 81-year old male
09-17-16	Fish Dam overlook	Missing 81-year old male
12-30-16	Lock Haven City	Missing 78-year old male with Alzheimer's
05-12-17	Clinton County	Missing hunter, 81-year old male

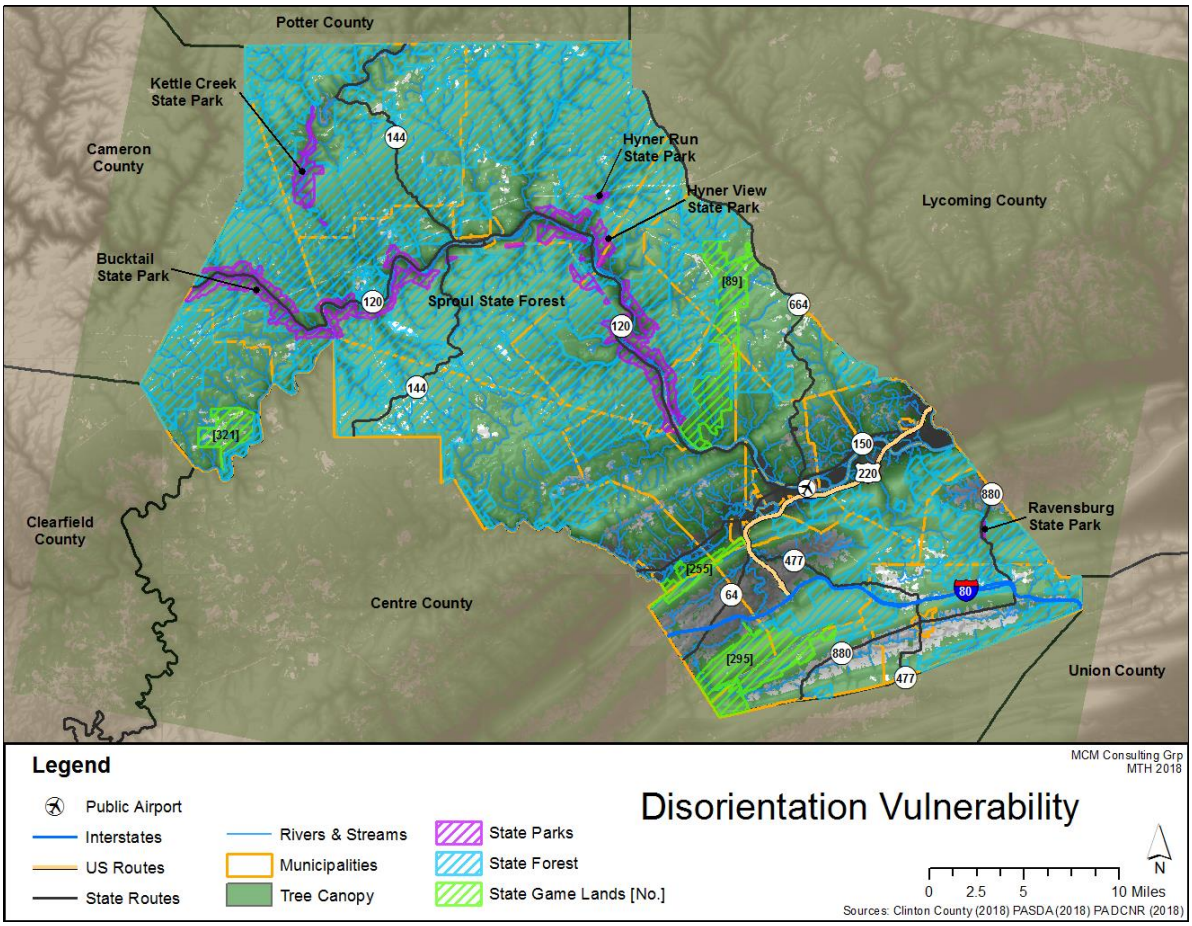
4.3.12.4 Future Occurrence

The probability of a disorientation event is likely, as the very young and those with mental or medical incapacities will always be at a higher risk of becoming lost. Residents and visitors to the county should try to be aware of their surroundings, whether they are hunting, fishing, hiking, or other activities that take them into the wilds. Maps, GPS units, and other resources would enhance the capabilities of these persons to navigate safely, and/or provide better location information to emergency services in the event of an accident or medical emergency.

4.3.12.5 Vulnerability Assessment

Disorientation events are typically a localized event, but sometimes they may span across municipality and county borders as state game lands and forests lie within multiple municipalities. A search and rescue operation can take place in all types of settings, to include cities, towns, villages, parks, forested lands, and waterways; to include rivers, streams, lakes, or ponds. *Figure 34 - Disorientation Vulnerability* shows the locations of state natural lands, as well as their proximity to major roadways and waterways.

Figure 34 - Disorientation Vulnerability



4.3.13. Environmental Hazards

4.3.13.1 Location and Extent

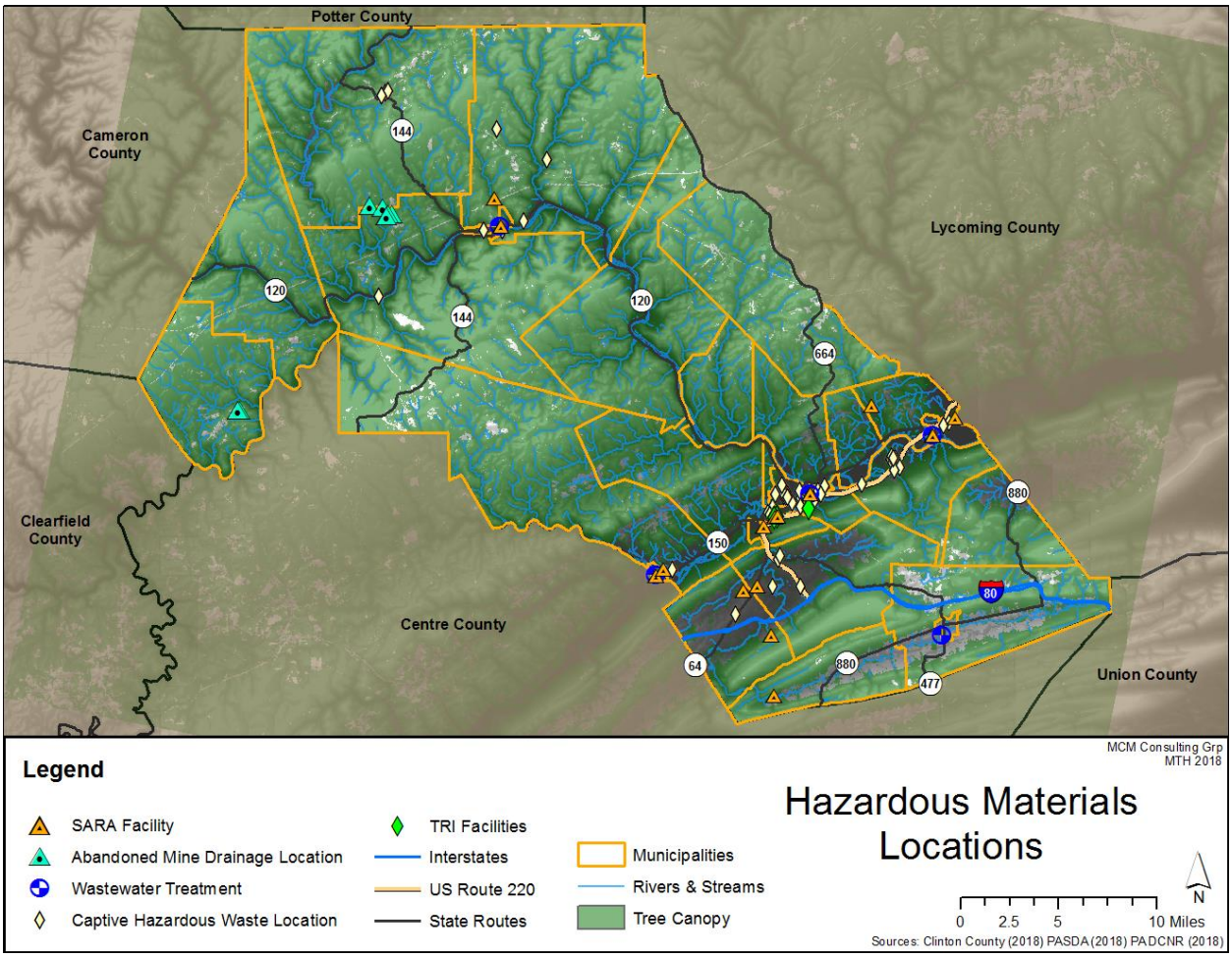
The main focus of environmental hazards in Clinton County is on hazardous material release, coal mining, and oil and gas well drilling. These hazards can result in injury or death to humans and damage to property or the environment; and are a result from human and industrial activities; most often associated with transportation accidents or accidents at fixed facilities.

Fixed-site facilities that use, manufacture, or store hazardous materials in Pennsylvania must comply with Title II of the federal Superfund Amendments and Reauthorization Act (SARA). This is also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), and the Commonwealth's reporting requirements under the Hazardous Materials Emergency Planning and Response Act (1990-165), as amended. These legislations require that all owners or operators of facilities that manufacture, produce, use, import, export, store, supply, or distribute any extremely hazardous substance, as defined by the EPA, at or above the threshold planning quantity, as es-

tablished by EPA. These facilities must also report to the county where the facility is located and to the Commonwealth that the facility is subject to the requirement to assist the Local Emergency Planning committee (LEPC) in the development of an off-site emergency response plan. The community right-to-know reporting requirements keep communities abreast of the presence and release of chemicals at individual facilities. The off-site emergency response plan for each SARA planning facility becomes a supplement to the county's emergency operations plan.

The EPA tracks vital information about the chemicals handled by manufacturing or processing facilities through its Toxic Release Inventory (TRI) database.

Figure 35 - Hazardous Materials Locations



Transportation of hazardous materials on highways involves tanker trucks, trailers or intermodal containers. Tanker trucks and trailers are at a greater risk of being responsible for a release of hazardous materials. Hazardous materials transportation on railways involves rail tank cars, box cars and intermodal containers. Collisions and derailments of train cars can result in large spills. Pipelines can be damaged during

excavation, incorrectly operated, or damaged by other forces. Accidents that occur along roadways railways, and pipelines that cross over or run parallel to rivers and streams have the potential to pollute watersheds.

Figure 36 - Major Transportation Routes

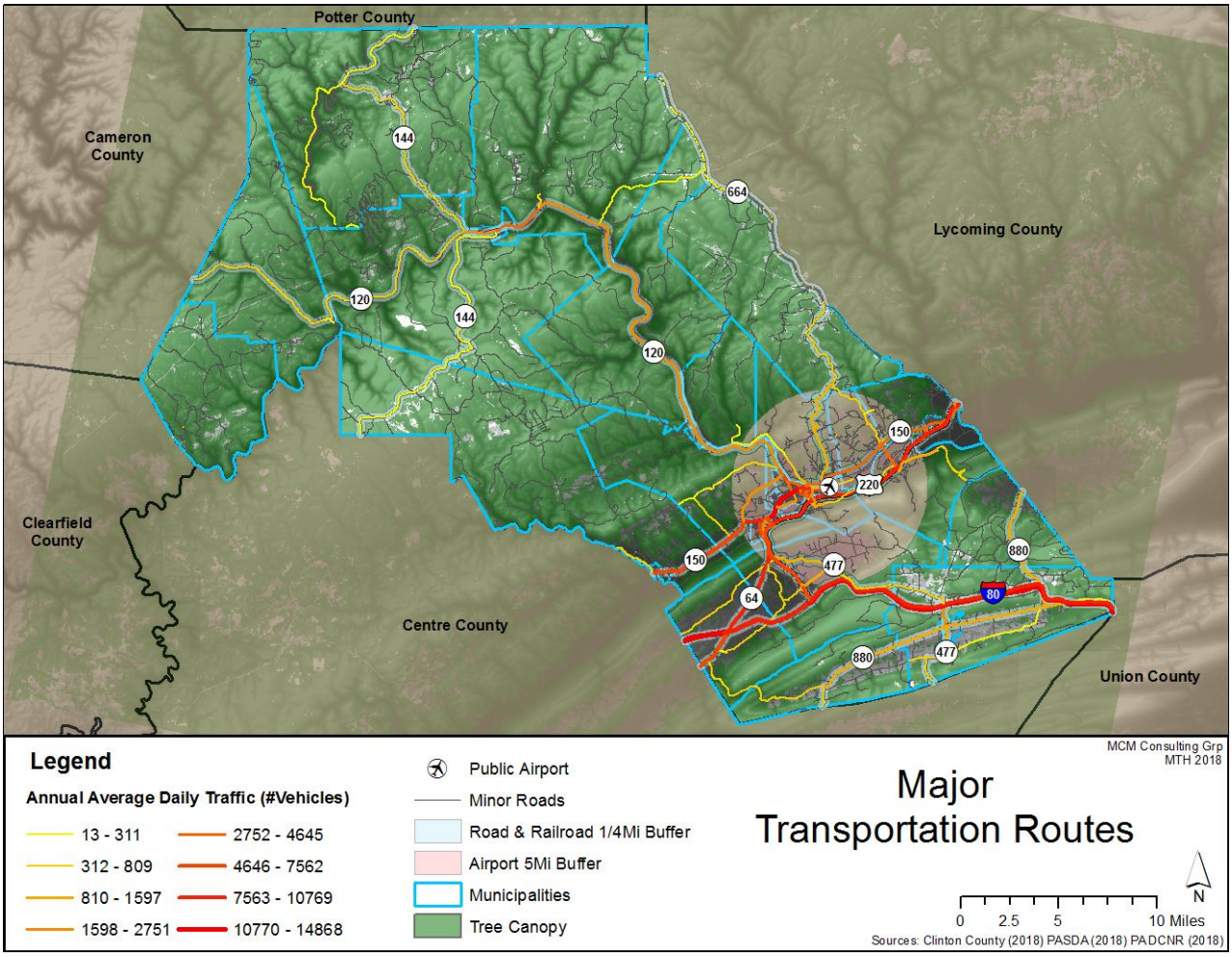
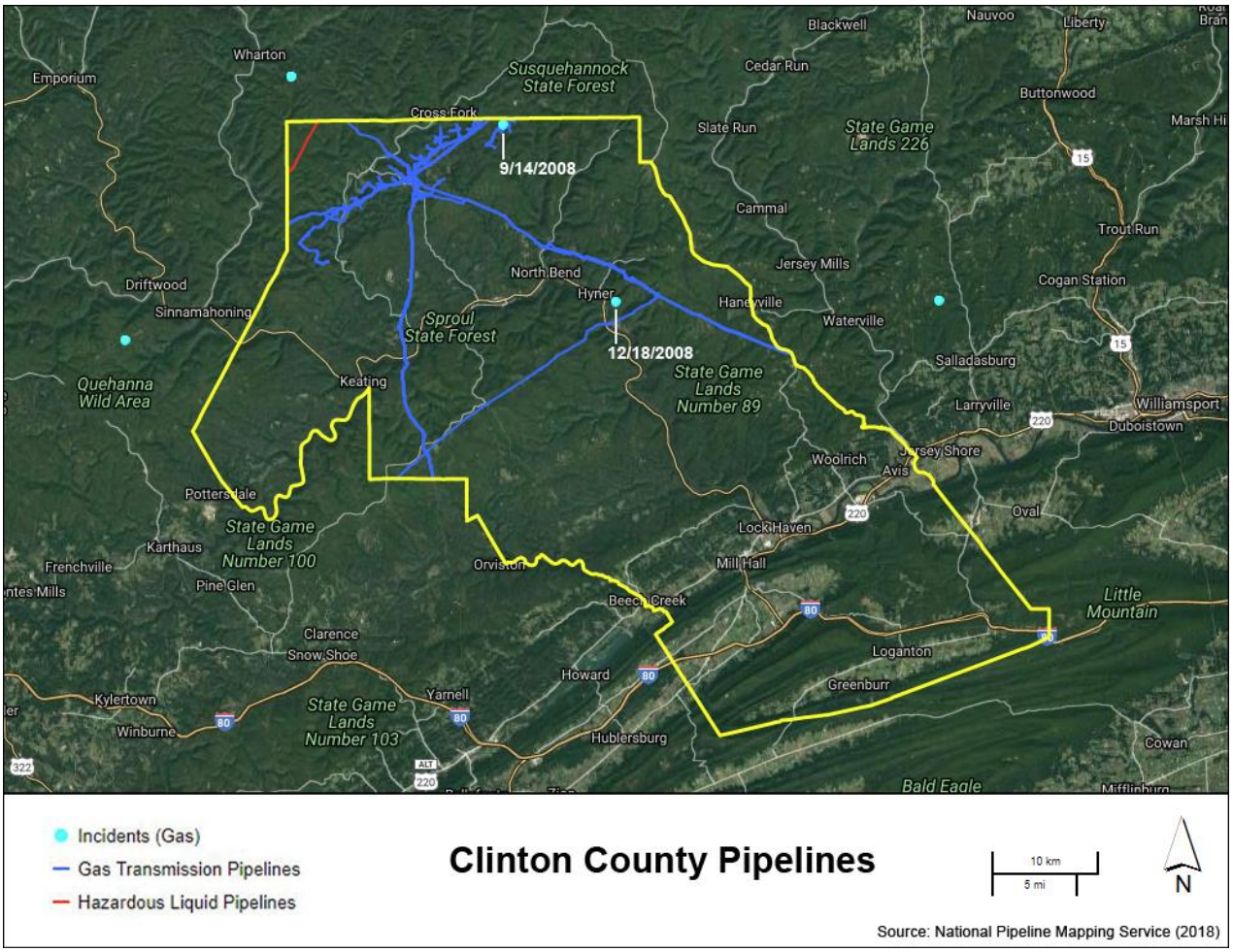


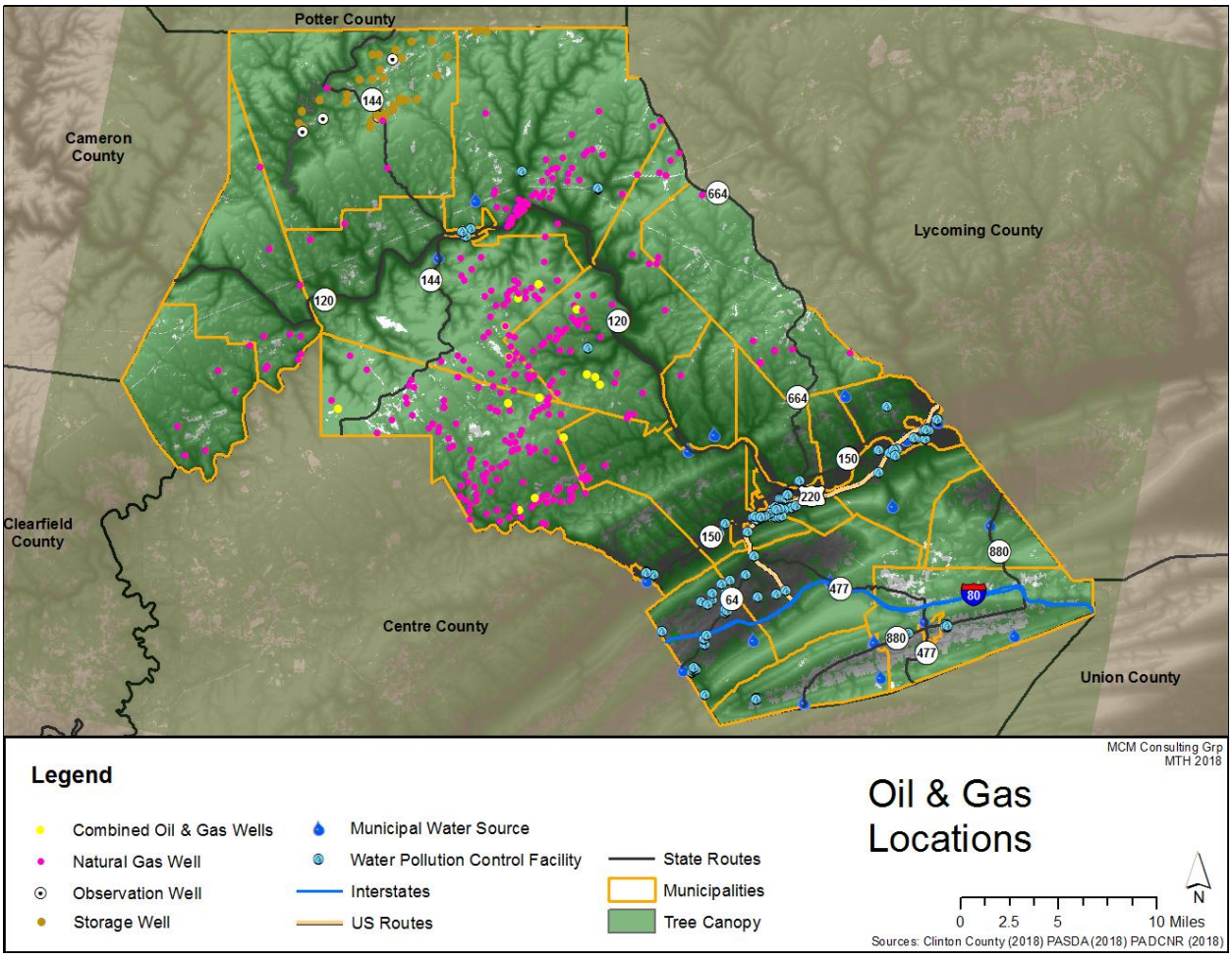
Figure 37 - Pipelines in Clinton County



Clinton County has approximately 400 active oil and gas wells and approximately 135 plugged and/or abandoned oil and gas wells. According to the Pennsylvania Department of Environmental Protection website there have not been any permits for conventional or unconventional oil and gas wells between 2017 and 2012. There were permits for:

- 2011: 1-conventional, 7-unconventional
- 2010: 49-conventional, 35-unconventional
- 2009: 50-conventional, 14-unconventional

Figure 38 - Oil and Gas Well Sites



Coal mining has been conducted in Pennsylvania before the 1680s and was instrumental in the development of the Commonwealth. Mining includes surface, underground, and open-pit operations for bituminous in the west and anthracite in the northeast portions of Pennsylvania, was probably the most important of Pennsylvania's mining activities. In an April 2017 report "*Can Coal Make a Comeback?*" released by Columbia University's Center on Global Energy Policy. By the end of 2015, the report states, "the industry had collapsed, with three of the four largest US miners filing for bankruptcy along with many other smaller companies."

The EPA estimates that over 3,000 miles of streams in Pennsylvania have been contaminated by acid mine drainage which occurs when metal sulfides in rock oxidize and generate acidity in water that comes in contact with them (PA HMP, 2010). Pennsylvania was one of the first states to initiate, promulgate and enforce environmental regulations related to mining, including mine reclamation; however, there remains a legacy of abandoned mines, waste piles, and degraded groundwater and surface water in the Commonwealth. A slurry pond is an impoundment used to store waste created during

coal preparation, also known as washing. The waste contained in these impoundments consist of silt, dust, water, coal fines, and washing/treatment chemicals. (Coal slurry impoundments are considered dams and are classified accordingly by the DEP.) There are no slurry impoundments located in Clinton County.

4.3.13.2 Range of Magnitude

There are several mitigating circumstances that affect the severity or impact of a hazardous material release, whether it was accidental or intentional. Circumstances that can enhance or magnify the effects of a hazardous material release include:

- Weather conditions: affects how the hazard occurs and develops;
- Micro-meteorological effects of buildings and terrain, alters dispersion of hazardous materials;
- Non-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;
- The distance and related response time for emergency response teams.

Areas within close proximity to a release are at a greater risk, yet depending on the agent, a release can travel great distances or remain present in the environment for a long period of time (e.g. centuries to millennia for radioactive materials), resulting in extensive impacts on people and the environment.

FIXED FACILITIES

According to the 2016 Lock Haven University HMP there are nine EPA-identified hazardous materials sites throughout Clinton County. Of these, there are two located in Bald Eagle Township, two in Lock Haven City, and one each in Mill Hall Borough, Beech Creek Township, Castanea Township, Pine Creek Township, and Wayne Township. Of these, only three reported risk screening reports to the Toxic Release Inventory (TRI) – Avery Dennison, Croda Inc., and WSP Solvay Group.

OIL AND GAS

Active and abandoned oil and gas wells are located in: Bald Eagle Township, Beech Creek Township, Chapman Township, East Keating Township, Gallagher Township, Grugan Township, Leidy Township, Noyes Township, Renovo Borough, South Renovo Borough West Keating Township.

Potential impacts from Marcellus Shale gas well drilling include:

- Surface water depletion from high consumptive use with low return rates, affecting drinking water supplies and aquatic ecosystems and organisms.
- Contaminated surface and groundwater resulting from hydraulic fracturing and the recovery of contaminated hydraulic fracturing fluid.
- Mishandling of solid toxic waste.

Pipeline transportation of petroleum products through Clinton County is provided by companies identified in *Table 42 – Pipelines in Clinton County* and also identifies the product that may be transported through these pipelines. Emergency responders must contact the pipeline operator during any type of emergency to pipelines to determine what product is being moved through the line. The Williams Atlantic Sunrise and Dominion Sweden Valley are two ongoing construction projects for fixed facilities that are related to pipeline systems running through Clinton County.

Table 42 – Pipelines in Clinton County

Pennsylvania Gas Company Pipelines		
Company/Operator:	**Product(s):**	**UN ID#**
Somerset Gas Gathering of Pennsylvania, LLC (FKA Columbia Gas Transmission, LLC)	Natural Gas	1971
Dominion Transmission, Inc.	Natural Gas Propane	1971 1075
Energy Transfer	Natural Gas	1971
Enterprise Products Company	Ethane Iso-Butane N-Butane Propane	1035 1075 1075 1075
Mountain Gathering, LLC	Natural Gas	1971
National Fuel Gas Supply Corporation	Natural Gas	1971
UGI Utilities, Inc.	Natural Gas Hydrogen Sulfide	1971 1053
Anadarko Petroleum Corporation	Natural Gas	1971

Source: Pennsylvania Pipeline Emergency Response Planning Information 2016 Emergency Responder Manual

Truck traffic associated with the gas industry dramatically increase since 2008 as related in the December 23, 2011 column presented by the Public Education subcommittee of the Clinton County Natural Gas Task Force. The column states most trucking companies have to comply with Compliance, Safety, Accountability (CSA) 2010. This is an initiative of the Federal Motor Carrier Safety Administration to further reduce commercials motor vehicle crashes, fatalities, and injuries on the nation's highways. Citizens and companies alike can go on line at https://csa.fmcsa.dot.gov/ to see how safe a driver and company are in running their trucking company.

COAL MINING

Major impacts from mining include surface-elevation changes and subsidence, modification of vegetation, the chemical degradation and flow redistribution of surface water and groundwater, the creation of mine voids and entry openings, adverse aesthetic impacts, and changes in land use. Injuries or death can occur at an active or abandoned mine from mine collapse, entrapment, poisonous gases, inundation, explosions,

fires, equipment malfunction, and improper ventilation. Injuries and death can also occur at abandoned mine sites from All-Terrain Vehicle (ATV) accidents and drownings.

Municipalities with active and abandoned mines sites are: Bald Eagle Township, Beech Creek Township, Noyes Township, and West Keating Township. Huling Branch AML (abandoned mine lands) Reclamation/ATV Recreation and Watershed Improvement Project in Clinton County, won the 2017 National AMR (Abandoned Mine Reclamation) Award.

The mineral-waste disposal from coal mining is also a hazard, as past practices have dotted Pennsylvania's landscape with unsightly refuse piles. Many of the refuse piles contain combustible materials that cause long-term air-quality problems if ignited. Burning refuse piles have also been linked to major underground coal fires, such as those at Centralia (Columbia County) and Shamokin (Northumberland County).

The Sproul State Forest/Fran Contracting Surface Mine Restoration Project, in Clinton County, is part of the $30 million AML 2016 pilot project. This project was funded by the U.S. Office of Surface Mining Reclamation and Enforcement to reclaim fourteen abandoned mine land sites that have strong potential for post-reclamation community and economic development in addition to health, safety, and environmental benefits.

Clinton County's most recent commodity flow study was conducted in the year 2000. The study reports these major findings:

HIGHWAYS

- On Interstate 80 east and west bound lanes during the 11 hours of study a total of 5,546 commercial vehicles were observed. There are 47.95 miles of Interstate highway through Clinton County.
  - Of these commercial vehicles observed there were 296 that had placards.
  - Of these vehicles the highest percentage of placards identified were flammable liquids at 36%. Corrosive placards were in second place with 25% identified.
  - Calculations on national placarded truck accident frequency from the 2000 study estimates 13.68 accidents per year in Clinton County.

RAILROADS

- Norfolk Southern Railroad provided Clinton County a list of the top fifty hazardous materials shipped through Clinton County for a twelve-month period that ended on June 30, 2000. This data represents 4006 shipments during the time frame.
- The highest percentage was for Miscellaneous Dangerous (Class 9) shipments representing 54%.
- The second highest percentage was 15% for flammable gases (Class 2).

- It should be noted that only the number of shipments was reported, not actual volumes or weights.
- Another risk is the rail switching yard in the City of Lock Haven where shipments from Norfolk Southern would be picked up by Bald Eagle & Nittany Railroad for local transport.

PIPELINES

- Only two pipelines were in operation in Clinton County in 2000. Both pipelines carried natural gas. See *Table 42 – Pipelines in Clinton County* for all current pipelines in the County.
  - CNG/Dominion Transmission Corporation
    - Flowed an average of 1.5 billion cubic feet per day
  - The Williams/Transco
    - Flowed between 500 million to 2.2 billion cubic feet per day, depending on directions to market areas in New York City and New Jersey or to storage wells located in Potter County.

FIXED FACILITIES

- The report identified the amount of hazardous materials shipped by 22 facilities in Clinton County during 2000.
- The largest number of shipments were for flammable liquids and fuel oils.

Environmental impacts of hazardous material releases include:

- Hydrologic effects – surface and groundwater contamination
- Other effects on water quality such as changes in water temperature
- Damage to streams, lakes, ponds, estuaries, and wetland ecosystems
- Air quality effects – pollutants, smoke, and dust
- Loss of quality in landscape
- Reduced soil quality
- Damage to plant communities – loss of biodiversity; damage to vegetation
- Damage to animal species – animal fatalities; degradation of wildlife and aquatic habitat; pollution of drinking water for wildlife; loss of biodiversity; disease

4.3.13.3 Past Occurrence

Between 1987 and 2008 the EPA Toxic Release Inventory reports that 18,345,727 pounds of chemicals were released from facilities in Clinton County.

Clinton County utilizes Knowledge Center™ as an online reporting tool for many emergency events to include hazardous materials incidents. Hazardous materials incidents to include fixed facilities, highways, railways and pipelines are listed in *Table 43 - Hazardous Material Incidents.*

Table 43 - Hazardous Material Incidents

Hazardous Material Incidents in Clinton County between 2013 and 2017		
Date	**Location**	**Event**
04-20-13	Lock Haven	Home heating oil spill
04-26-13	Clinton County	Oil in the creek
05-05-13	Castanea Township	Vehicle accident with diesel leak
05-09-13	Clinton County	Propane tank leak
06-18-13	Porter Township	Comfort Inn hazmat release
07-01-13	City of Lock Haven	Fuel spill
07-06-13	Renovo Borough	NRC #1053314
08-21-13	Clinton County	Fuel spill
10-03-13	Clinton County	Hazardous materials leak
11-02-13	Clinton County	CO incident with multiple patients
11-24-13	Clinton County	Vehicle accident
01-12-14	Clinton County	Fuel oil spill
01-24-14	Clinton County	Fuel spill
01-25-14	Pine Creek Township	Military ordinance
02-06-14	Castanea Township	Fuel leak on River Road
04-04-14	Clinton County	Gas leak
05-13-14	Greene Township	Adhesive spill
08-21-14	Clinton County	Unknown substance in river
11-05-14	Porter Township	Hazardous materials spill
11-08-14	Clinton County	Possible hazardous materials incident
11-13-14	Clinton County	Fuel leak
01-14-15	Clinton County	Brine truck accident
01-26-15	Clinton County	Diesel fuel spill
03-24-15	Renovo Borough	Heating oil leak
04-02-15	Porter Township	Fuel truck leak
05-26-15	Clinton County	Diesel fuel leak
08-07-15	Clinton County	Gas main break
10-02-15	Clinton County	Adhesive spill on the roadway
12-09-15	Clinton County	Mercaptan odorant release
01-17-16	Lock Haven	Lube oil spill
02-22-16	Leidy Township	Dissolute and water release
04-06-16	Lock Haven	Hazardous materials spill
05-16-16	Lock Haven	Gas leak
07-20-16	Clinton County	Large fuel spill
08-05-16	Clinton County	Possible radiological incident
11-02-16	Clinton County	Natural gas leak
12-27-16	Beech Creek Borough	Diesel fuel leak
02-04-17	Clinton County	Fuel spill
06-13-17	Clinton County	Diesel fuel leak
06-21-17	Clinton County	Rail car venting
06-28-17	Lock Haven	NRC# 1182495 chemical release
07-07-17	Clinton County	Tractor trailer accident with fuel leak
09-21-17	Clinton County	Small diesel fuel spill

There is no comprehensive database that tracks coal mining accidents, to include environmental hazards, even though there have been many mining accidents in Pennsylvania during early mining history from the 1800's. Mine subsidence incidences have not been well documents in Clinton County either. However, the worse mine subsidence on record was on November 3, 1888, when a disaster occurred at the Kettle Creek Mine at Crook's Run, Clinton County, killing 17 people. The explosion was caused by a drill post giving way, falling on a supply of dynamite and caps that had just been brought into the mine. The explosion was propagated by coal dust throughout most of the mine and up the airshaft. Five of the victims working in the vicinity of the dynamite explosion were killed by violence. Twelve others died from suffocation and "afterdamp". The Kettle Creek mine has undergone a mitigation project in 2010 and has been sufficiently altered to prevent a mine "blowout". A blowout of this mine could have wreaked havoc on Kettle Creek and the West Branch of the Susquehanna River. The mine pool stabilization project was overseen by Trout Unlimited and the Kettle Creek Watershed Association at an abandoned deep mine on state forest land in Noyes Township. It prevented acid mine drainage that could have entered Kettle Creek and then ultimately the Susquehanna River.

There also isn't a comprehensive list of oil and gas related incidents. In the Clinton County 2011 HMP one incident was reported. This incident was at the South Renovo Borough Water System (SRBWS) that provides water to approximately 540 people. South Renovo receives water from two sources: a surface water reservoir and a groundwater well that supplements the reservoir during droughts. The system began experiencing operational problems due to the presence of methane discovered in the water drawn from the groundwater well. The water system brought this contamination problem to the attention of the PA Department of Conservation and Natural Resources (DCNR). DCNR identified a gas well, located 2,500 feet north of the groundwater well, as a possible source of the methane migration. According to DCNR, the old gas well was drilled in 1953, and was plugged and abandoned that same year. The materials and techniques used to seal the gas well were over 50-years old and may have been of questionable integrity. The DCNR theorized that the methane leaking from this old well was migrating from the gas-bearing rock, up through the compromised top hole and into the fresh water aquifer feeding the SRBWS groundwater well.

4.3.13.4 Future Occurrence

Hazardous material releases from any source are considered difficult to predict, regardless of the many incidents occurring in the past. The number of hazardous materials being produced, stored, and transported continues to increase each year in Pennsylvania. Thus, the occurrence of a hazardous material release is largely dependent upon the accidental or intentional actions of a person or group or are related to equipment failure.

Throughout time, the government has strengthened mining and reclamation operation and environmental regulations, permitting, and inspection criteria. Along those same lines, regulations and permitting have been put into place with pipelines, oil and gas well drilling, and for transportation along highways and railways of hazardous materials. These actions have not prevented accidents and environmental damage from occurring.

4.3.13.5 Vulnerability Assessment

Variables that factor the vulnerability of a community and environment to a spill or release of an extremely hazardous substance at a facility or from a transportation accident include:

- Specific chemical
- Amount of a spill or release
- Proximity of waterways
- Number of people residing in a radius from the facility or accident location, which can reasonably be expected to be adversely affected.

Furthermore, the vulnerability of a community and environment to a hazardous material release from a transportation incident is directly related to several specific variables; namely the mode and class of transportation. Each mode is further subject to several categories of hazard. Each mode of transportation (truck, aircraft, rail, watercraft, or pipeline) has separate and distinct factors affecting the vulnerability. Transportation carriers must have response plans in place to address accidents, otherwise the local emergency response team will step in to secure and restore the area. Quick response minimizes the volume and concentration of hazardous materials that disperse though air, water, and soil.

Populations that are within 1.5 miles of a SARA Title III facility are more vulnerable to a release, to include hospitals, schools, homes for the elderly, and critical infrastructure facilities. Jurisdictions within one-quarter mile of major highways and railways are considered more vulnerable in the event of a transportation incident involving hazardous materials.

4.3.14. Levee Failure

4.3.14.1 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 three levee systems in Clinton County, protecting Colebrook, Lock Haven, Mill Hall, Flemington Borough, and Castanea Township. The City of Lock Haven owns the Lock Haven Levee System. The city maintains approximately 6.5 mils of earth levee that consists of 38 drainage structures, one sanitary pumping station, five ponding areas, five closure structures, and several recreation areas.

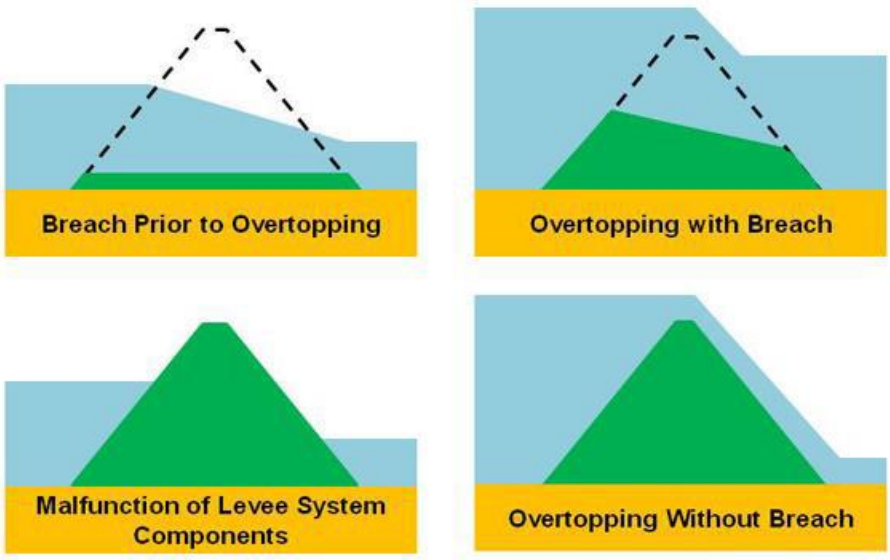
Mill Hall Borough owns the levee on Fishing Creek, and the Lick Run levee in Colebrook Township is privately owned and was paid for by the Army Corps of Engineers – this levee is known as a "farmer's dike" and is made of material dredged from Lick Run after flooding caused by hurricane Agnes in the 1980s. There are said to be several more farmer's dikes built after Agnes and in the 1980s, including one on the west bank of Chatham Run, on Young Woman's Creek in Chapman Township and on Fishing Creek near Route 64 in the village of Lamar. The Lock Haven Area Flood Protection Authority can obtain information regarding these systems.

The locations of the levee systems in Clinton County are shown in *Table 45 - Clinton County Levee Systems and Locations.*

4.3.14.2 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 39 - Types of Levee Failures



Any of these failures could lead to significant damages to Colebrook, Lock Haven, and Mill Hall. If an abrupt failure occurs, the rushing waters of a flood wave could result in catastrophic losses.

Levees require maintenance to continue to provide the level of protection they were designed and built to protect. Well maintained levees may obtain certification through independent inspections. Properties located in the area of reduced-risk landward of a levee system are not subject to the mandatory flood insurance purchase requirement of the National Flood Insurance Program. Thus, 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 will back up sanitary sewer systems and inundate waste water treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooded waterway. Unsecured containers of oil, fertilizers, pesticides, and other chemicals could contaminate flood waters.

4.3.14.3 Past Occurrence

There are no known significant historic levee failures in Clinton County.

4.3.14.4 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. Construction of the Lock Haven Levee System was completed in October of 1994.

4.3.14.5 Vulnerability Assessment

When assessing the vulnerability of a community protected by a levee, there are three questions that the 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 44 - Levee System Inspection Rating. Figure 40 - Fishing Creek Levee ,Figure 41 - Lick Run Levee* show maps of the three leveed areas in Clinton County.

Table 44 - Levee System Inspection Rating

Levee System Inspection Ratings	
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.

Within the areas of Clinton County's three levee systems, there are forty two critical facilities in either levee protected area or within 2,000 feet of a levee, this information is shown in *Table 45 - Clinton County Levee Systems and Locations*.

Table 45 - Clinton County Levee Systems and Locations

Clinton County Levee Systems, Locations, and Proximity to Critical Facilities and Addressable Structures					
Levee	**Flood Source**	**River Basin**	**Municipality**	**Critical Facilities within 2,000-foot Levee buffer or Levee protected area**	**Number of addressable structures within 2,000-foot Levee buffer**
Colebrook – Lick Run Levee	Lick Run	West Branch Susquehanna	Colebrook	1	47
Lock Haven Levee – Bald Eagle Creek and West Branch Susquehanna River	Bald Eagle Creek – West Segment	West Branch Susquehanna	Lock Haven	37	3506
	Bald Eagle Creek – Central Segment	West Branch Susquehanna	Lock Haven		
	Bald Eagle Creek – East Segment	West Branch Susquehanna	Lock Haven		
	West Branch Susquehanna River Segment	West Branch Susquehanna	Lock Haven		

Clinton County Levee Systems, Locations, and Proximity to Critical Facilities and Addressable Structures					
Levee	**Flood Source**	**River Basin**	**Municipality**	**Critical Facilities within 2,000-foot Levee buffer or Levee protected area**	**Number of addressable structures within 2,000-foot Levee buffer**
Mill Hall – Fishing Creek Levee	Fishing Creek	West Branch Susquehanna	Mill Hall	4	436
Total				**42**	**3989**

Figure 40 - Fishing Creek Levee

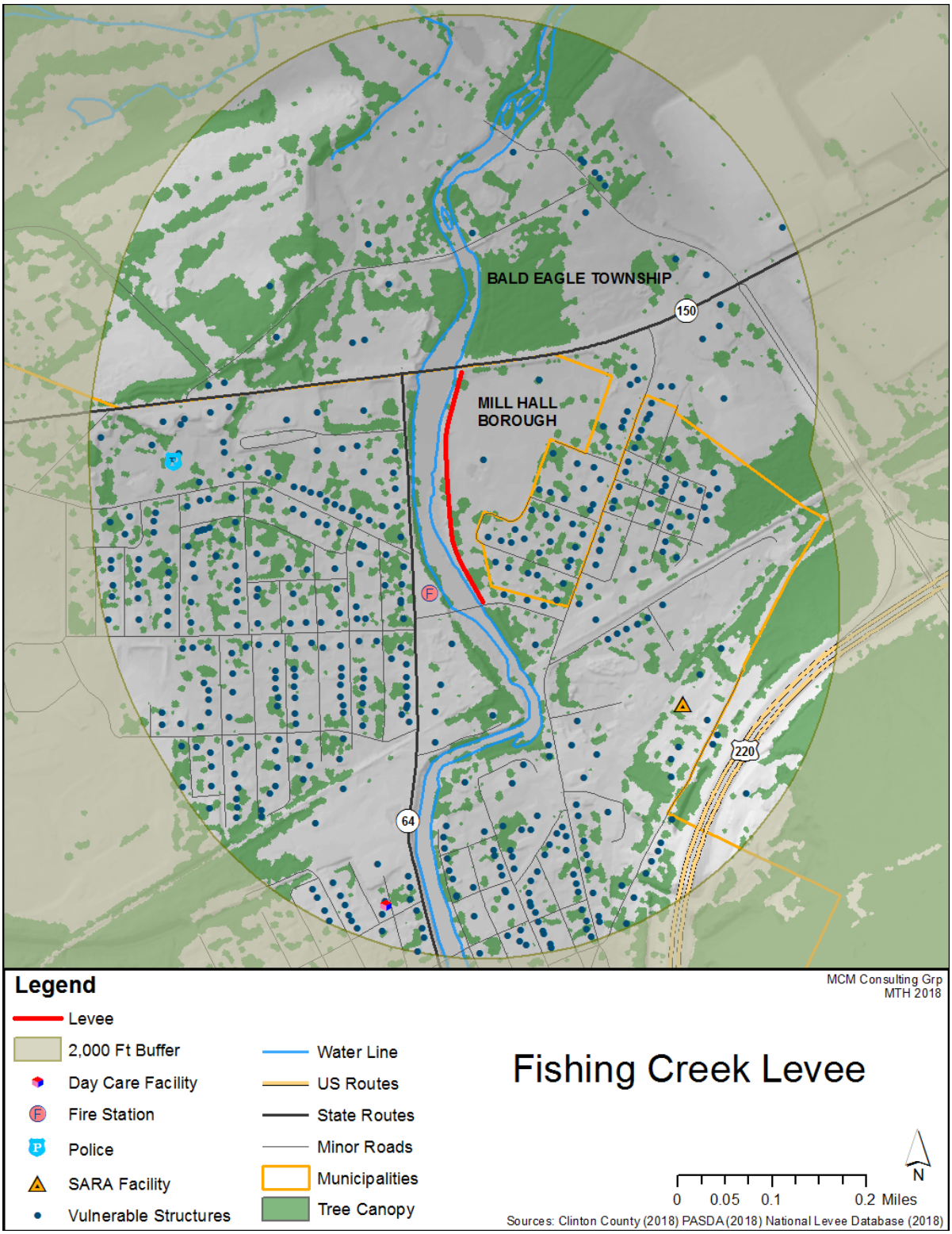


Figure 41 - Lick Run Levee

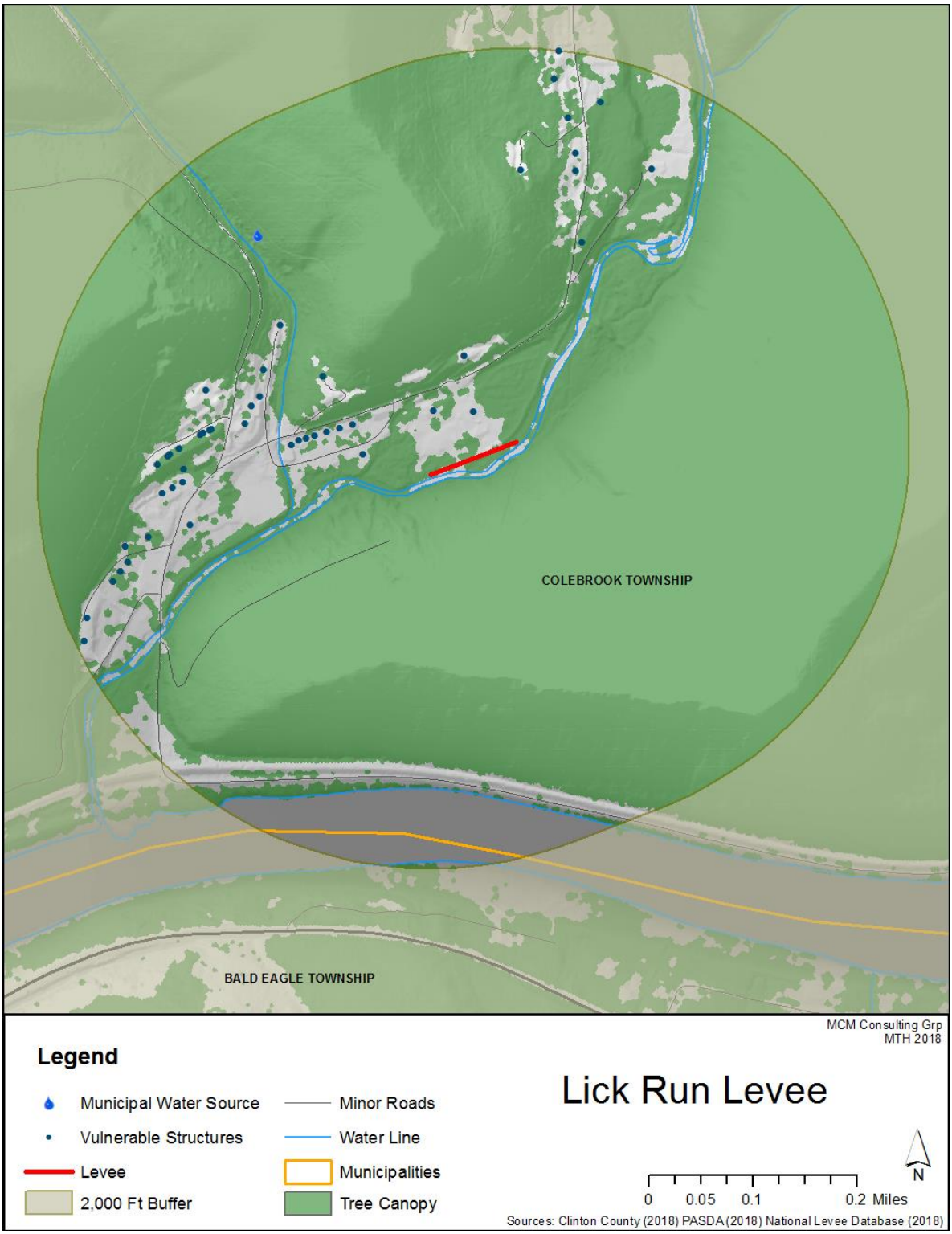
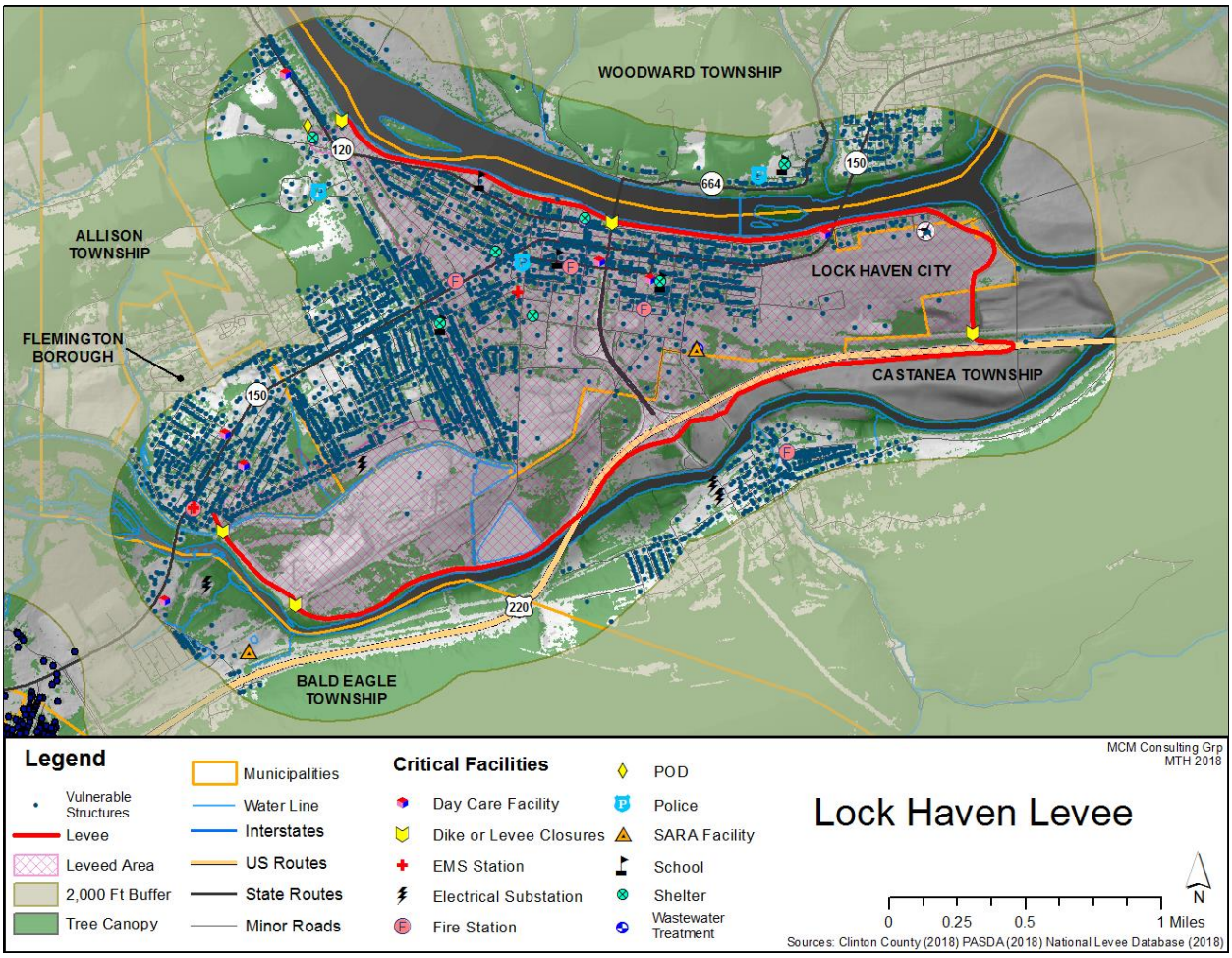


Figure 42 - Lock Haven Levee



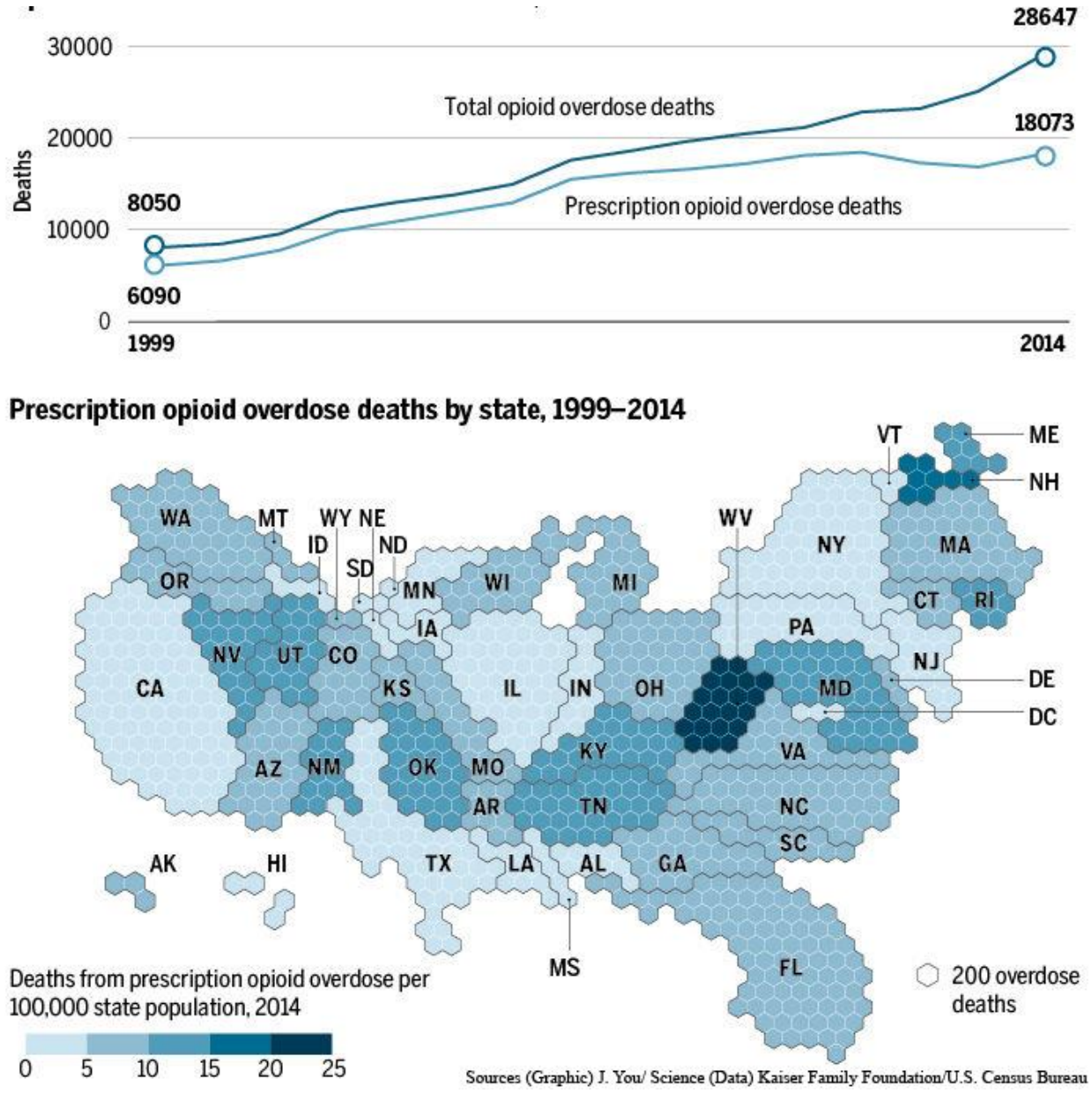
4.3.15. Opioid Epidemic

4.3.15.1 Location and Extent

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* (Science, 2016)). 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 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, increase access to treatment.

Figure 43 - US Opioid Deaths 1999-2014 (Science, 2016)



4.3.15.2 Range of Magnitude

According to the CDC, more than 140 Americans die every day from an opioid overdose. In 2015, 3,383 overdose deaths were reported in Pennsylvania, compared to 2014, when there were 2,742 overdose deaths in PA – an increase of 23.4 percent (DEA, 2015). Pennsylvania ranked 8th in the country for overdose deaths in 2014 at 21.9 deaths per 100,000 people (DEA, 2015).

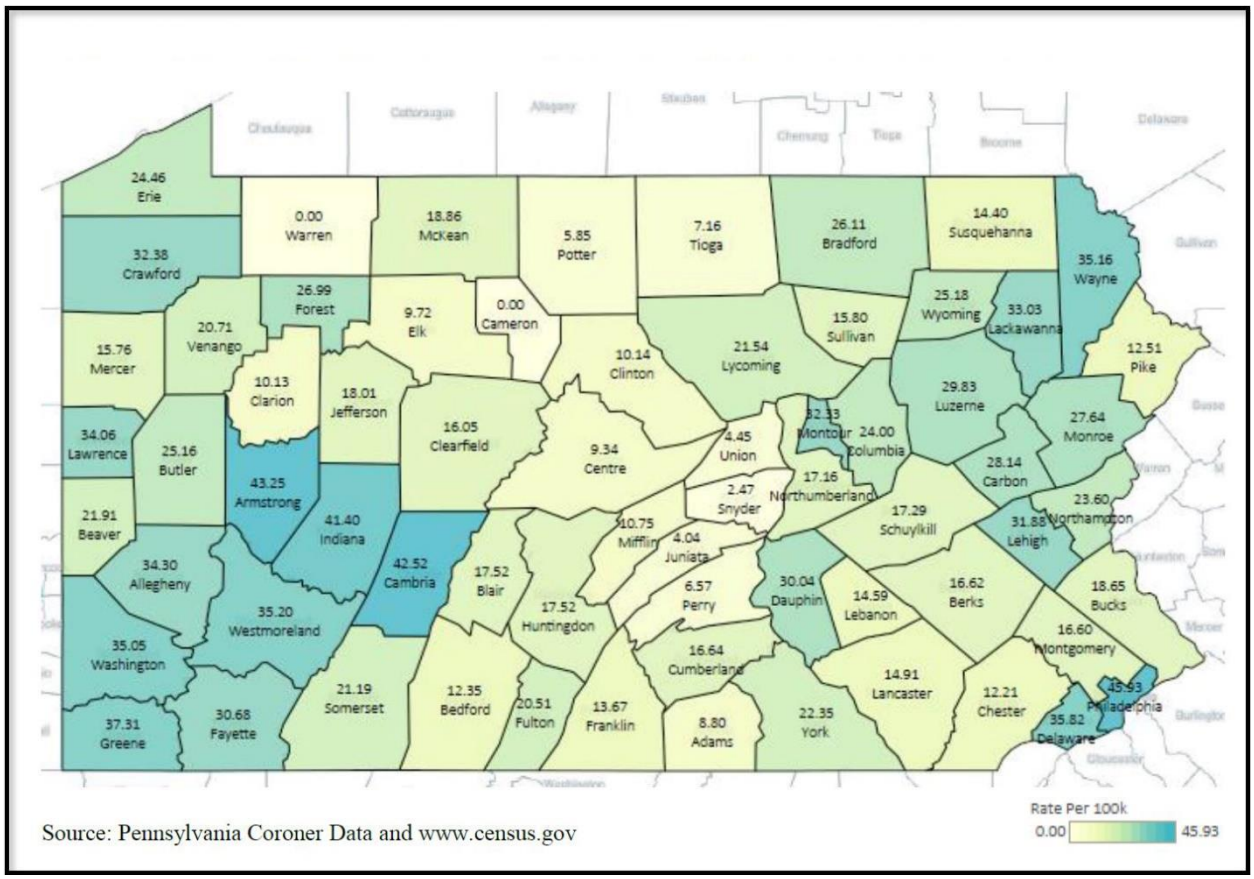
4.3.15.3 Past Occurrence

Table 46 - PA Opioid Overdose History

Overdose Death History *(Clinton County Coroner, 2018)*	
Year	**Overdose Deaths**
2010	2
2011	9
2012	6
2013	9
2014	9
2015	7
2016	13
2017	4
Total	**59**

For both years of 2014 and 2015, Clinton County had 10.14 overdose deaths per 100,000 people per year, with fewer than ten recorded overdose deaths occurring in the county each year (DEA, 2015). *Figure 44 - PA Opioid Overdose Deaths 2015 (DEA, 2016)* shows overdose deaths per 100,000 people in the year 2015 for Pennsylvania by County. *Table 46 - PA Opioid Overdose History* shows recorded overdose deaths in Clinton County as reported by the Clinton County Coroner. The most number of reported overdoses in recent Clinton County history occurred in 2016, with 13 reported overdoses.

Figure 44 - PA Opioid Overdose Deaths 2015 (DEA, 2016)



4.3.15.4 Future Occurrence

According to recent research, in states where medical marijuana has been permitted, overdose deaths from opioids have decreased about twenty-five percent, and the effect was even stronger five to six years after medical marijuana was allowed (Bachhuber et al., 2014). In those states where medical marijuana is permitted, each physician prescribed an average of 1826 fewer doses of pain medication each year (Bradford & Bradford, 2016), suggesting that medical marijuana could help prevent patients from ever being exposed to addicting opioids (Miller, 2016). Another possible alternative pain treatment comes from hemp extracted cannabidiol, or CBD. Unlike THC (the psychoactive constituent of marijuana) CBD in non-psychoactive and does not have the same intoxicating effect as THC, however CBD and can provide relief from pain (Lynch & Campbell, 2011) inflammation (Burstein, 2015), anxiety (Scuderi et al., 2009) and even psychosis (Iseger & Bossong, 2015).

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, in-

creasing 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).

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 10th 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.

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. CBD and medical marijuana appear to be promising alternatives in some contexts. CBD is legal to purchase and use without a prescription, making it much more accessible for Pennsylvanian residents compared to medical marijuana.

The January 10th 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 and 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 authori-

zation 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. Transportation Accidents

4.3.16.1 Location and Extent

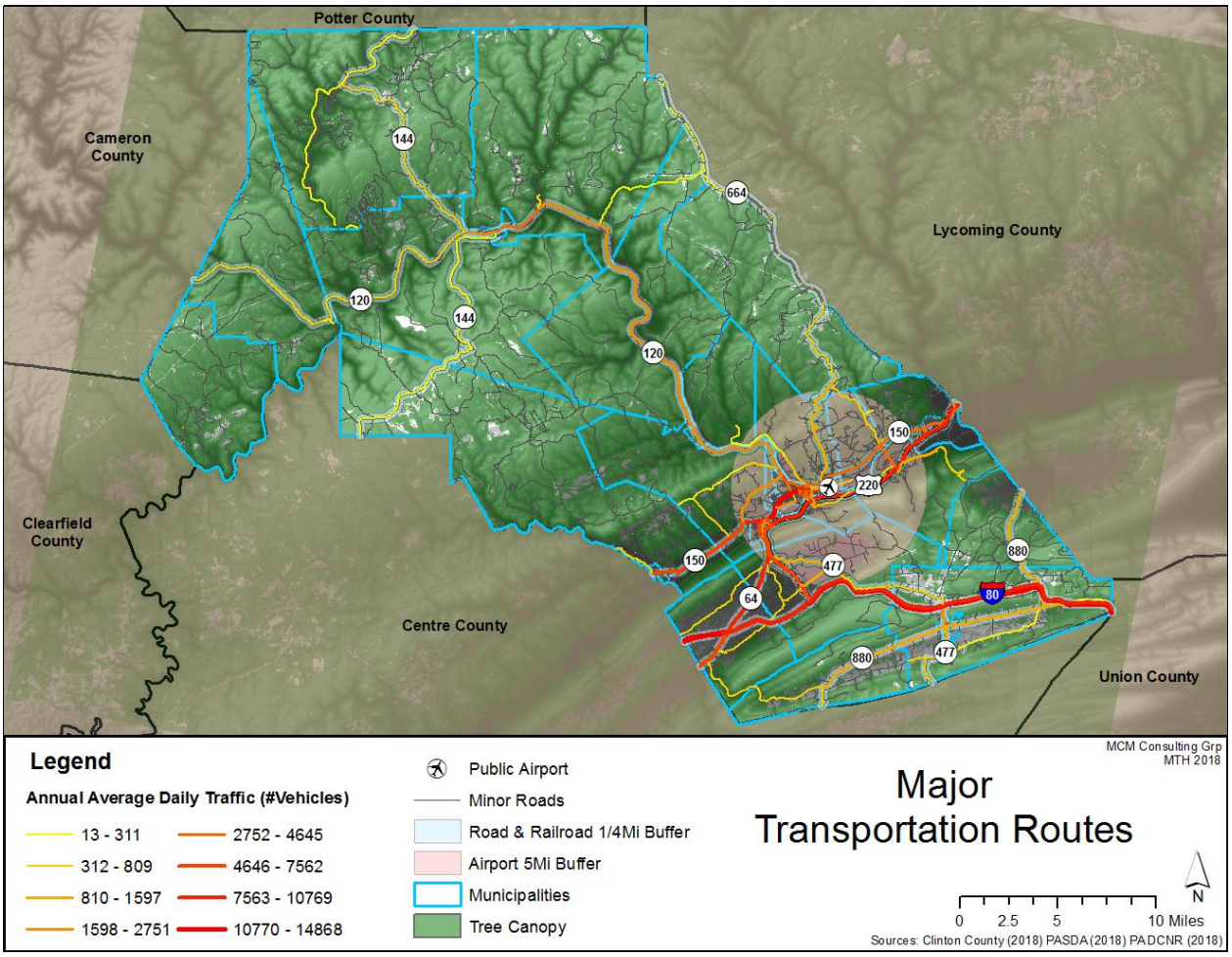
There is a total of approximately 1,083 miles of developed roads within Clinton County. This includes 673 miles of state and federal highways and 410 miles of secondary or municipal roads. Clinton County serves as a major transportation corridor and is heavily traveled by various motorists. Major highways include US Route 220. Interstate 80, State Route 44, and State Route 150. *Figure 45 - Major Transportation Routes* shows the major transportation systems in Clinton County.

The coal mining industry prompted the construction of numerous rail lines that run through Clinton County including– Norfolk Southern Railway (NS) as well as. Additionally, the Nittany & Bald Eagle Railroad Company. Both of these rail lines transport various forms of freight including hazardous materials such as coal. Certain areas are more prone to railway incidents because of heavier railroad traffic such as East Keating Township, West Keating Township, Renovo Borough, Chapman Township, Grugan Township, Colebrook Township, and the City of Lock Haven. There is one public airport in the county, the William T. Piper Memorial Airport, two heliports, and one other airport in close proximity to the County – the Jersey Shore Airport. For more details see *Table 47 - Clinton County Airports.*

Table 47 - Clinton County Airports

Clinton County Airports			
Name	**Address**	**Ownership**	**Usage**
William T. Piper Memorial Airport - LHV	353 Proctor St Lock Haven, PA 17745	Public	Airport
Jersey Shore Airport	1181 Pine Creek Ave Jersey Shore, PA 17740	Public	Airport
Lock Haven Hospital Heliport – 4PA4	24 Cree Drive Lock Haven, PA 17745	Private	Heliport
Bucktail Medical Center Heliport – 7PS8	1001 Pine St Renovo, PA 177643	Private	Heliport
Ponderosa Airport	Simon Road in Gallagher Township	Private	Airport
The Auto Auction Strip	Airstrip Drive off of Auction Road	Private	Airport

Figure 45 - Major Transportation Routes



4.3.16.2 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 4.3.12 Environmental Hazards*.

Aviation incidents most often occur near landing or take-off sites; a five-mile radius around each airport in Clinton County is considered high-risk areas.

4.3.16.3 Past Occurrence

The most serious transportation concerns in Clinton County involve I-80, U.S. 220, State Routes 44 and 150. *Table 48 - Transportation Incidents* shows the accidents that were reported to the Clinton County 9-1-1 as entered into the Clinton County Knowledge Center™ database between January 2013 and September 2017. Table 48 - Transportation Incidents shows crash statistics recorded by the Pennsylvania Department of Transportation between 2013 and 2017.

There have been several transportation incidents in Clinton County. One recent incident took place on March 3, 2017. Due to a snow squall, 53 vehicles were involved in an accident that took place on Interstate 80, mile marker 189 west. This was the second multi-vehicle accident to have taken place within hours of each other on that day. A total of 9 people were injured and approximately 50 non-injured people were taken to a nearby shelter. This incident shut down this portion of Interstate 80 for approximately 18 hours.

Table 48 - Transportation Incidents

Clinton County Transportation Incidents		
Description	**Location**	**Date**
MVA I-80 East MM 190	Clinton	2/27/2013
Fatal MVA	Noyes Township	5/4/2013
MVA with Diesel Fuel Leak	Castanea Township	5/5/2013
Manure on I-80 (large volume)	Clinton	8/1/2013
Tractor Trailer MVA with entrapment	Porter Township	9/26/2013
MVA on I-180	Greene Township	10/13/2013
Responder Accident	Clinton	10/29/2013
MVA w/ Tractor Trailer	Clinton	11/12/2013
School Bus Accident	Clinton	11/19/2013
Hit & Run Involving Police Vehicle	Lock Haven City	2/3/2014
Tractor Trailer Rollover	Lamar Township	5/6/2014
MVA Involving Ambulance	Lamar Township	6/8/2014
Train vs. Truck	Clinton	8/15/2014
MVA w/ Tractor Trailer	Greene Township	9/10/2014
MVAT w/ Entrapment	Greene Township	11/4/2014
Diesel Fuel Spill	Clinton	1/26/2015
Triaxle Overturned	Greene Township	3/10/2015
Water Truck Accident	Clinton	3/20/2015
Train Struck Pedestrian	Wayne Township	3/29/2015
MVA on I-80	Clinton	3/31/2015
Vehicle into Pine Creek	Pine Creek Township	5/5/2015
MVA w/ Tractor Trailer	Clinton	10/16/2015
Bus Accident	Woodward Township	1/7/2016
MVA w/ Entrapment	Crawford Township	1/7/2016

Clinton County Transportation Incidents		
Description	**Location**	**Date**
MVA w/ Entrapment (State Road Closure)	Flemington Borough	3/4/2016
MVA	Wayne Township	4/18/2016
MVA w/ Tractor Trailer	Clinton	5/6/2016
Tractor Trailer Fire	Noyes Township	5/26/2016
MVA w/ SR-664 Road Closure	Woodward Township	6/10/2016
Hang Glider Accident	Clinton	7/3/2016
Vehicle Accident with Entrapment	Clinton	7/16/2016
Officer Involved in Crash	Lamar Township	8/30/2016
MVA	Porter Township	12/13/2016
MVA	Clinton	1/22/2017
School Bus Accident	Lamar Township	5/25/2017
Tractor Trailer Accident w/ Fuel Leak	Clinton	7/7/2017

Over a nine-year period from 2007-2016, traffic accidents on both state and local roads have slowly decreased. Additionally, the total number of alcohol related accidents have also slowly decreased since 2007. *Table 49 - PennDOT Clinton County Crash Report* summarizes the overall crash data within a nine-year period for Clinton County. Information was gathered from PennDOT Crash Information Tool.

Table 49 - PennDOT Clinton County Crash Report

PennDOT Clinton County Crash Report											
Type	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
State Road	86	118	84	88	78	102	89	96	103	79	923
Local Road	145	116	111	135	122	126	128	126	119	124	1252
Hazardous Truck	0	1	0	2	2	1	1	3	1	2	13
School Bus	3	3	4	1	3	2	0	1	0	1	18
Alcohol Related	46	48	32	44	25	37	32	32	29	29	354
Pedestrian	6	1	6	5	8	7	3	2	4	7	49
Fatal	14	11	18	22	15	8	12	9	15	17	141
Total Incidents	**300**	**298**	**255**	**297**	**253**	**283**	**265**	**269**	**271**	**259**	**2,750**

4.3.16.4 Future Occurrence

Automobile accidents occur frequently, and typically occur more frequently than a rail or aviation accident. The most traveled roadways in Clinton County are I-80, U.S. 220,

State Routes 44 and 150. 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. Therefore, the likelihood of an aviation incident in Clinton County is considered low, however past events show that they are not impossible. While they are infrequent, railroad accidents have a greater likelihood of affecting 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 2.7 has been determined by the local planning team using this methodology.

4.3.16.5 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. Like highway incidents, rail incidents can impact populations living near rail lines. Vulnerability for rail incidents fall within a ¼ mile of the rail line. This includes populations in Allison Township, Avis Borough, Bald Eagle Township, Beech Creek Township, Castanea Township, Chapman Township, Colebrook Township, East Keating Township, Grugan Township, Mill Hall Borough, Noyes Township, Pine Creek Township, Renovo Borough, South Renovo Borough, Wayne Township, West Keating Township, and Woodward Township. Clinton County is also prone to aviation incidents near the City of Lock Haven and surrounding municipalities. Based on their close proximity to the William T. Piper Memorial Airport.

Table 50 - Transportation Vulnerability

Transportation Vulnerability *(Clinton County GIS, 2018)*				
Municipalities	**Roads & Railroads**		**Public Airports**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
Allison Township	53	-	104	-
Avis Borough	223	3	-	-
Bald Eagle Township	505	6	754	6
Beech Creek Borough	262	6	-	-
Beech Creek Township	142	3	-	-
Castanea Township	76	3	595	7
Chapman Township	441	7	-	-
Colebrook Township	32	-	1	-
Crawford Township	193	2	-	-
Dunnstable Township	84	-	464	-

Transportation Vulnerability *(Clinton County GIS, 2018)*				
Municipalities	**Roads & Railroads**		**Public Airports**	
	Addressable Structures	**Critical Facilities**	**Addressable Structures**	**Critical Facilities**
East Keating Township	71	-	-	-
Flemington Borough	481	4	619	4
Gallagher Township	207	1	14	-
Greene Township	484	1	-	-
Grugan Township	98	1	-	-
Lamar Township	738	6	808	5
Leidy Township	285	-	-	-
Lock Haven City	2111	29	2651	30
Logan Township	126	3	-	-
Loganton Borough	223	5	-	-
Mill Hall Borough	642	5	734	10
Noyes Township	277	1	-	-
Pine Creek Township	588	5	546	3
Porter Township	432	2	-	-
Renovo Borough	605	9	-	-
South Renovo Borough	231	4	-	-
Wayne Township	167	4	602	7
West Keating Township	-	-	-	-
Woodward Township	919	5	1243	5
Total	**10696**	**115**	**9135**	**77**

4.3.17. Utility Interruptions

4.3.17.1 Location and Extent

Utility interruptions include any damage to electricity, natural gas, telecommunications, and water. Energy interruptions can be caused by severe solar storms, regional or national fuel or resource shortages, an electromagnetic pulse, public works failure, transmission facility accidents, and other major utility failures. Clinton County has utility services for electric, water, fuel and telecommunications, all of which can experience interruptions for several different reasons.

Often, utility interruptions are a secondary impact of other hazards such as severe thunderstorms, windstorms, tornadoes, winter storms and even traffic accidents. Heat waves may also result in rolling blackouts causing electric to not be available for an extended period of time. All municipalities within the county have a probability of experiencing a utility interruption.

Solar flares are concentrated releases of magnetic energy that emanate from sunspots and can last for minutes or hours. Solar flares can also cause coronal mass ejections (CME) from the outer solar atmosphere which are large clouds of plasma and magnetic field which induce geomagnetic currents when they reach the surface of Earth. A combination of these events can be referred to as solar storms or solar weather. Solar weather only impacts Earth when it occurs on the side of the sun that is actively facing Earth. A severe solar storm can have a geographically wide-ranging impact that can last for days or weeks (NASA, 2016). Most significantly, a severe solar storm has the potential to disrupt power grids, resulting is rolling blackouts.

Minor solar flares have no negative impacts on Earth thanks to the protection afforded by Earth's magnetic field and atmosphere. In fact, minor solar flares cause beautiful visual displays known as the Northern Lights or Aurora Borealis. However, severe solar storms can cause an electromagnetic pulse (EMP) that is able to break through Earth's magnetic field and send current to Earth's surface, inducing geomagnetic currents. Geomagnetic ally induced currents (GICs) impact the electrical grid and can cause transformers to burn and fail, potentially knocking out wide swatches of electricity infrastructure resulting in blackouts (Phillips, 2009).

4.3.17.2 Range of Magnitude

At a minimum, energy emergencies can cause short term disruption in the daily operation of business, government, healthcare, and private citizens. A loss of energy and other utility services can have numerous impacts including, losing perishable foods and medicines, loss of functionality at health care and emergency medical facilities, limited water distribution capabilities, losing heating and air conditioning, losing telecommunication and internet services, basement flooding (sump pump failure), and lack of lighting. Energy emergencies can be most troubling when temperatures are at extremes due to the loss of heating or cooling capabilities and the added hazard that extreme heat and extreme cold present. Fuel shortages can result in increased cost of automotive gasoline, long lines at gas stations, disruptions in freight traffic, and shortage of heating fuels. On a small scale, these hazards can be a nuisance, but impacts can be devastating when an energy emergency has a large scope and impacts wide areas and a large population. Severe energy emergencies are often regional or national events.

4.3.17.3 Past Occurrence

The OPEC oil embargo of 1973 – 1974 caused fuel shortages and long lines at gasoline pumps nationwide. Government actions were taken to ensure that fuels and power were available for emergency and priority users. Between 1976 and 1977 there was a rapid increase in fuel prices accompanied by a severe winter resulting in a similar if less extreme fuel shortage. Those two events as well as the national gasoline shortage

in 1979 emphasized the vulnerability of all residents in Clinton County to energy emergencies.

Minor outages of electric and phone services occur annually. A minor outage occurred on May 7, 2013 when power was lost at Lock Haven Hospital. In Clinton County, power outages are most often associated with winter storms and wind storms. *Table 51 - Electrical Service Interruptions, Table 52 - Telephone Service Interruptions* and *Table 53 - Water Service Interruptions* show events reported to the Knowledge Center from 2013 until August 2017.

Electricity

Table 51 - Electrical Service Interruptions

Electrical Service Interruptions		
Description	**Location**	**Date**
Power Outage	Clinton	05/03/13
Lock Haven Hospital Power Outage	Clinton	05/07/13
Power Outage	Bald Eagle Township	06/10/13
Power Outage	Clinton	07/16/13
Power Outage	Clinton	04/11/14
Power Outage	Clinton/Lycoming	04/26/14
Power Outage	Clinton	02/22/15
Power Outage	Clinton	07/04/15
Power Outage	Renovo Borough	08/04/17

Telecommunications

Table 52 - Telephone Service Interruptions

Telephone Service Interruptions		
Description	**Location**	**Date**
Telephone Outage	Chapman Township	05/22/13
Telephone Outage (Comcast)	Clinton	06/25/13
Telephone Outage	Clinton	03/12/14
Phone Outage Including 911	Leidy Township	06/12/14
Phone Outage	Leidy Township	09/06/14
Verizon Phone Outage	Wayne Township	12/04/14
Telephone Outage	Clinton	12/08/15
911 Phone Outage	Avis Borough	09/05/16
Telephone Outage	Gallagher Township	03/16/17
Phone Outage	Lock Haven City	08/09/17

Water

Table 53 - Water Service Interruptions

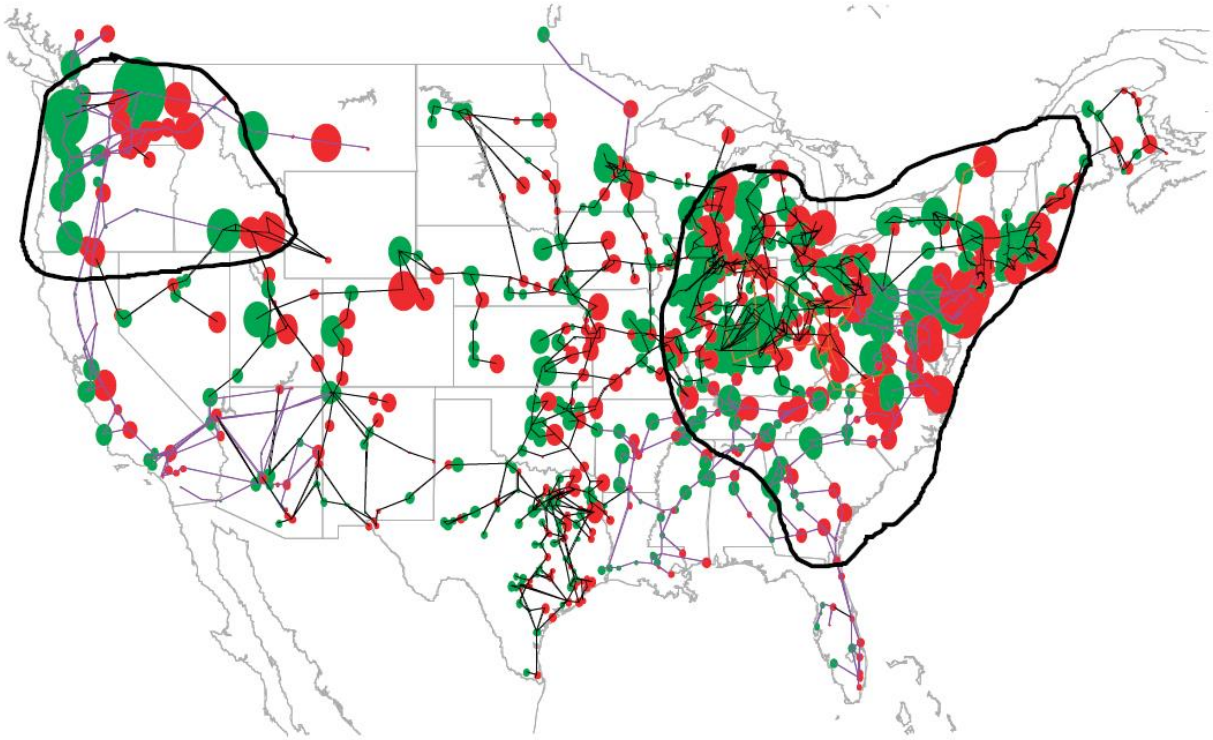
Water Service Interruptions		
Description	**Location**	**Date**
Water Outage	Woodward Township	04/11/13
Water Main Break	Clinton	08/31/13
Water Main Break	Pine Creek Township	10/13/13
Water Main Break	Mill Hall Borough	11/09/13
Residential Well Contamination	Crawford Township	03/12/14

4.3.17.4 Future Occurrence

Minor, short-term outage events may occur several times a year for any given area in Clinton County, while major, widespread and long-term events may take place once every few years. Utility interruptions are difficult to predict, even though minor interruptions to utilities may occur several times a year. Utility interruptions are most often by-products of severe weather events. Therefore, citizens should also prepare for such interruptions in addition to severe weather events alone.

As utility infrastructure ages, interruption events could occur more frequently. Utility providers can reduce Clinton County's vulnerability to power outages by implementing improvements. The probability of transportation accidents is characterized as highly likely as defined by the risk factor methodology probability criteria. An overall risk factor of 2.7 has been determined by the local planning team using this methodology.

Figure 46 - Potential Electricity Grid Failure



Scenario showing effects of a 4800 nT/min geomagnetic field disturbance at 50° geomagnetic latitude scenario. The regions outlined are susceptible to system collapse due to the effects of the GIC disturbance; the impacts would be of unprecedented scale and involve populations in excess of 130 million. SOURCE: J. Kappenman, Metatech Corp., "The Future: Solutions or Vulnerabilities?," presentation to the space weather workshop, May 23, 2008.

4.3.17.5 Vulnerability Assessment

All municipalities in Clinton County are vulnerable to utility interruptions. Critical facilities such as emergency medical facilities, retirement homes and senior centers are particularly vulnerable to power outages. While back-up generators are often used at these facilities, loss of electricity accompanied by temperature extremes can be dangerous for elderly and other high-risk populations. Appendix E provides a list of critical facilities located in Clinton County.

Extreme temperatures can disrupt fuel and electricity supplies, with extreme cold weather triggering a higher demand for heating oil and natural gas as well as causing low gas pressure, and extreme hot weather possibly overloading electrical grids resulting in blackouts.

PPL Electric Utilities implemented a dispatch communications system called Mobile Operations Management (MOM). This system links every Pennsylvania Power and Lighting crew to a central emergency response coordination center. This technology

has reduced average outage times in Pennsylvania from an average of 108 minutes between 2004 and 2008 to seventy-one minutes in 2009.

The National Oceanic and Atmospheric Administration (NOAA) monitors solar activity from the Space Weather Prediction Center (SWPC) and is able to alert power grid operators of the impending geomagnetic storm so they may make efforts to protect the grid from GICs (Baker et al., 2008). Events such as the 1989 Hydro-Quebec blackout have illuminated the hazard that solar storms pose to electricity infrastructure, however modern power grids are more vulnerable than ever. Power grids have become increasingly interconnected, improving efficiency in many ways, but also making them more vulnerable to wide ranging rolling failures. *Figure 46 - Potential Electricity Grid Failure* (Baker et al., 2008) shows two large regions in North America that are identified as highly interconnected and vulnerable to failure in the case of ground induced currents – the green and red ovals represent transformers where GIC would either flow into (red) or out of (green) the network, and the size of the oval represents the amount of current. It's important to note the extensive geographic range that could fail on the East Coast in the event of significant GICs.

Geomagnetic storms can cause permanent damage to transformers that could result in much longer restoration times than experienced in the 1989 Hydro-Quebec outage. Transformer damage occurs when GICs cause excessive internal heating resulting in melting and burning of many large-amperage copper windings and leads. Such damage cannot be repaired, and the damaged transformer must be replaced. Transformers are extremely large and heavy apparatuses, and replacement can be a long process, suggesting that efforts should be taken to protect resident transformers from GICs. A workshop held by the Committee on the Societal and Economic Impacts of Severe Space Weather Events offered solutions to mitigating negative impacts of GICs, suggesting that supplemental transformer neutral ground resistors should be installed because they are relatively inexpensive, have low engineering trade-offs, and can produce sixty to seventy percent reduction of GIC levels during severe solar storms (Baker et al., 2008).

The Department of Homeland Security (DHS) has a Solar Storm Mitigation effort, which "aims to provide owners and operators of the electricity grid with advanced and actionable information about anticipated GCI current levels in the event of a solar storm" (US GAO, 2017). According to the DHS, when provided with accurate solar storm warnings, utility operators can "make operational decisions to mitigate the impacts from solar storms. This can range from canceling maintenance work to temporarily shutting down vulnerable grid components and preventing permanent damage" (DHS, 2015).

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 54 - 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 54 - 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 54 - 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 55 - Risk Factor Assessment* lists the Risk Factor calculated for each of the twenty-one potential hazards identified in the 2018 HMP. 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.

Table 55 - Risk Factor Assessment

Clinton County Hazard Ranking Based on RF Methodology.							
HAZARD RISK	HAZARD NATURAL(N) OR MANMADE(M)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
		PROBABILITY	ECONOMIC IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
HIGH	Invasive Species	4	3	4	1	4	3.4
	Opioid Epidemic	4	3	4	4	1	3.4
	Flood	3	4	4	1	3	3.3
	Flash Flood	4	3	2	4	1	3
	Hurricane/ Tropical Storm	2	3	4	1	3	2.7
	Transportation Accidents	4	2	2	4	1	2.7
	Utility Interruptions	4	2	2	4	1	2.7
	Winter Storm	4	2	3	1	2	2.7
	Nor' Easter	3	2	4	1	2	2.6
	Wildfire	4	1	2	4	3	2.6
	Drought	3	1	4	1	4	2.5
	Tornado	2	3	2	4	2	2.5
	Windstorm	3	2	2	4	2	2.5
MODERATE	Ice Jam Flood	3	2	2	3	2	2.4
	Levee Failure	2	3	2	2	3	2.4
	Pandemic, Epidemic and Infectious Disease	3	2	2	1	4	2.4
	Radon	4	1	2	1	4	2.4
	Disorientation	4	1	1	4	2	2.3
	Environmental Hazards: Transportation	3	2	1	4	1	2.2
	Environmental Hazards: Fixed Facility	2	2	2	4	2	2.2
LOW	Landslides	3	1	1	4	1	1.9

Based on these results, there are thirteen *high* risk hazards, seven *moderate* risk hazards and one *low* risk hazards in Clinton 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 56 - Countywide Risk Factor by Hazard* shows the different municipalities in Clinton 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 4.3.17.

Table 56 - Countywide Risk Factor by Hazard

JURISDICTION	Invasive Species	Opioid Epidemic	Flooding	Flash Flooding	Hurricane/Tropical Storm	Transportation Accidents	Utility Interruptions	Winter Storm	Nor' Easter	Wildfire	Drought
	3.4	***3.4***	***3.3***	***3.0***	***2.7***	***2.7***	***2.7***	***2.7***	***2.6***	***2.6***	***2.5***
Allison Township	=	=	=	=	=	=	=	=	=	=	=
Avis Borough	=	=	**1.7**	<	=	=	=	=	=	<	=
Bald Eagle Township	=	<	>	>	<	=	=	=	=	=	=
Beech Creek Borough	<	<	<	=	=	<	=	=	=	>	=
Beech Creek Township	=	=	**2.2**	>	=	>	=	>	=	>	>
Castanea Township	=	=	=	=	=	=	=	=	=	=	=
Chapman Township	=	=	**2.9**	>	=	>	=	>	=	>	>
Colebrook Township	<	<	**2.8**	=	<	=	=	=	<	>	=
Crawford Township	<	<	**1.6**	=	<	<	=	=	=	=	=
Dunnstable Township	=	=	**2.5**	>	=	>	=	>	=	>	>
East Keating Township	=	<	=	=	=	=	>	=	=	=	=
Flemington Borough	<	<	**1.3**	=	=	=	=	=	=	<	=
Gallagher Township	=	=	=	=	=	=	=	=	=	=	=
Greene Township	=	=	**1**	=	=	>	=	=	=	>	=
Grugan Township	<	<	**1.5**	=	=	>	>	=	<	=	=
Lamar Township	=	<	**2.4**	=	<	>	<	>	>	>	=
Leidy Township	<	<	**2.8**	=	<	=	=	=	<	>	=
Lock Haven City	<	=	**1.7**	=	=	=	=	=	=	<	=
Lock Haven University	<	<	<	=	=	<	=	=	=	>	=
Logan Township	=	=	**2.3**	=	=	=	>	=	=	>	>

JURISDICTION	Invasive Species	Opioid Epidemic	Flooding	Flash Flooding	Hurricane/Tropical Storm	Transportation Accidents	Utility Interruptions	Winter Storm	Nor' Easter	Wildfire	Drought
	3.4	***3.4***	***3.3***	***3.0***	***2.7***	***2.7***	***2.7***	***2.7***	***2.6***	***2.6***	***2.5***
Loganton Borough	=	=	**1**	<	<	>	=	=	=	<	>
Mill Hall Borough	<	<	**2.3**	=	<	=	=	=	=	=	=
Noyes Township			**3.2**								
Pine Creek Township	>	=	**3.7**	=	=	>	=	=	=	=	=
Porter Township	<	<	=	=	<	>	=	=	<	<	<
Renovo Borough	<	=	>	=	<	<	<	=	=	<	<
South Renovo Borough	=	=	<	=	=	=	>	=	=	>	>
Wayne Township	=	<	=	>	<	>	<	=	=	=	=
West Keating Township	<	<	**1.3**	<	<	<	>	=	=	=	<
Woodward Township	=	=	=	=	=	=	=	=	=	=	=

JURISDICTION	Tornado	Windstorm	Ice Jam Flooding	Levee Failure	Pandemic, Epidemic and Infectious Disease	Radon	Disorientation	Environmental Hazards - Transportation	Environmental Hazards – Fixed Facility	Landslides
	2.5	***2.5***	*2.4*	*2.4*	*2.4*	*2.4*	*2.3*	*2.2*	*2.2*	***1.9***
Allison Township	=	=	=	=	=	=	=	=	=	=
Avis Borough	=	=	<	<	=	=	=	=	<	<
Bald Eagle Township	<	=	>	=	=	=	=	=	>	=
Beech Creek Borough	=	=	<	=	>	=	<	<	=	=
Beech Creek Township	=	=	>	=	=	=	>	=	>	=
Castanea Township	=	=	=	=	=	=	=	=	=	=
Chapman Township	=	=	<	=	>	=	<	<	=	=

JURISDICTION	Tornado	Windstorm	Ice Jam Flooding	Levee Failure	Pandemic, Epidemic and Infectious Disease	Radon	Disorientation	Environmental Hazards - Transportation	Environmental Hazards – Fixed Facility	Landslides
	2.5	***2.5***	*2.4*	*2.4*	*2.4*	*2.4*	*2.3*	*2.2*	*2.2*	***1.9***
Colebrook Township	=	<	=	<	=	=	<	=	>	=
Crawford Township	<	<	<	<	=	=	<	<	<	<
Dunnstable Township	=	=	=	=	=	=	=	=	=	=
East Keating Township	=	=	=	=	=	=	=	>	=	>
Flemington Borough	=	=	<	=	<	<	=	=	<	<
Gallagher Township	=	=	=	=	=	=	=	=	=	=
Greene Township	=	=	<	<	=	>	=	>	>	<
Grugan Township	<	<	>	<	=	=	<	=	<	>
Lamar Township	=	=	<	=	=	<	>	>	<	=
Leidy Township	=	<	=	<	=	=	<	=	>	=
Lock Haven City	=	=	=	>	=	=	=	=	=	=
Lock Haven University	=	=	<	=	>	=	<	<	=	=
Logan Township	=	=	=	<	=	=	=	=	=	>
Loganton Borough	=	=	<	<	=	>	=	>	>	<
Mill Hall Borough	<	=	<	=	<	=	=	=	=	<
Noyes Township	=	=	<	=	>	=	<	<	=	=
Pine Creek Township	=	=	>	=	=	=	=	>	>	=
Porter Township	<	<	<	<	<	<	<	<	<	<
Renovo Borough	<	=	=	<	=	=	<	=	=	=
South Renovo Borough	=	=	<	=	>	=	<	<	=	=
Wayne Township	=	=	=	<	<	=	=	>	>	<
West Keating Township	=	<	<	<	<	<	<	<	<	<
Woodward Township	=	=	=	=	=	=	=	=	=	=

4.4.3. Potential Loss Estimates

Based on various kinds of available data, potential loss estimates were established for flood, flash flood, and ice jam flooding. Estimates provided in this section are based on HAZUS-MH, version MR4, geospatial analysis, and previous events. 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:

Flooding is a high risk natural hazard in Clinton 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. The quantity of commercial and residential structures in each Clinton County municipality is outlined in section 4.3.2 of the flooding hazard profile.

MCM Consulting Group conducted a county wide flood study using the Hazards U.S. Multi-Hazard (HAZUS-MH) software that is provided by the Federal Emergency Management Agency. HAZUS 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.

Using HAZUS-MH, total building-related losses from a 1%-annual-chance flood in Clinton County are estimated to equal $303,500,000. Residential occupancies make up 23.43% of the total estimated building-related losses. Total economic loss, including replacement value, content loss, functional loss and displacement cost, from a countywide 1%-annual-chance flood are estimated to equal $723,380,000. These estimates provide a general baseline for anticipated damage and loss values. The estimates appear to be lower than anticipated. Additional loss estimates will be completed during the next planning period to identify the highest risk areas to flooding loss.

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. Clinton 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.

Total population in Clinton County increased more than three percent between 2000 and 2010 from 37,914 to 39,238. The population changes can be seen in *Table 57 - 2000-2015 Population Change* This overall change reflects areas of growth in eighteen municipalities along with no change in five municipalities and a loss in population in the remaining six. Of the six municipalities that experienced a decline, only two were greater than one percent based off the 2015 estimate. The two municipalities that experienced greater than one percent of population loss were Lock Haven City and South Renovo Borough. However, much of Lock Haven City's fluctuation in population numbers from year to year can be attributed to the current student population at Lock Haven University. The 2015 estimated population for Clinton County is 39,359 which is 121 more than the 2010 census. There was an overall increase of 0.3% in population based on the estimate.

Lock Haven City is the most populated municipality in Clinton County. Lock Haven City completed a Comprehensive Plan in 2005 and discussed its future population projections, it stated that "Despite projected student enrollment increases at the University, recent population projections anticipate a gradual decline in the City's total population. By 2025 the City of Lock Haven's population is expected to decrease by approximately five percent, or about 421 people." Municipalities that have grown in population have a greater vulnerability to hazards that may impact a denser population (for example - pandemic, transportation accidents, and environmental hazards).

Table 57 - 2000-2015 Population Change

2000-2015 Population Change				
Municipality	**2000 Population**	**2010 Population**	**2015 Estimated Population**	**Percent of Change**
Allison Township	198	193	195	1.0%
Avis Borough	1,492	1,484	1,505	1.4%
Bald Eagle Township	1,898	2,065	2,093	1.4%
Beech Creek Borough	717	701	698	-0.4%
Beech Creek Township	1,010	1,015	1,014	-0.1%
Castanea Township	1,233	1,185	1,187	0.2%
Chapman Township	993	848	853	0.6%
Colebrook Township	179	199	202	1.5%
Crawford Township	848	939	941	0.3%

2000-2015 Population Change				
Municipality	**2000 Population**	**2010 Population**	**2015 Estimated Population**	**Percent of Change**
Dunnstable Township	945	1,008	1,016	0.8%
East Keating Township	24	11	11	0%
Flemington Borough	1,319	1,330	1,336	0.5%
Gallagher Township	340	381	386	1.3%
Greene Township	1,464	1,695	1,733	2.2%
Grugan Township	52	51	52	0.2%
Lamar Township	2,450	2,517	2,559	1.7%
Leidy Township	229	180	180	0%
Lock Haven City	9,149	9,772	9,587	-1.9%
Logan Township	773	817	817	0%
Loganton Borough	435	468	469	0.2%
Mill Hall Borough	1,568	1,613	1,612	-0.1%
Noyes Township	419	357	357	0%
Pine Creek Township	3,184	3,215	3,280	2.0%
Porter Township	1,419	1,460	1,495	2.4%
Renovo Borough	1,319	1,228	1,226	-0.2%
South Renovo Borough	557	439	434	-1.1%
Wayne Township	1,363	1,666	1,695	1.7%
West Keating Township	42	29	30	0%
Woodward Township	2,296	2,372	2,396	1.0%
TOTAL	37,914	39,238	39,359	0.3%

5. Capability Assessment

5.1. Update Process Summary

The capability assessment is an evaluation of Clinton 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 Clinton 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 twenty-nine 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. Additionally, NFPA 1600 recommends that a corrective action program be established to address shortfalls and provide mechanisms to manage the capabilities improvement process.

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 Clinton County and its municipalities have the capacity to do and provides an understanding of what must be changed to mitigate loss.

Clinton 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 identi-

fying 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

Of the twenty-nine municipalities within Clinton County, twenty four 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 Clinton 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 Clinton County adhere to the standards of the Pennsylvania Uniform Construction Code (Act 45). Of the twenty-nine municipalities in Clinton County, 18 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. Of the twenty-nine municipalities that reside in Clinton County, seven have adopted the county zoning ordinance. Zoning administration and enforcement for these seven is conducted by the County Planning Office.

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 improve-

ments. 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 commissions 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. To date, fourteen of the municipalities in Clinton County have developed their own subdivision ordinance. Additionally, Dunnstable Township has their own Subdivision and Land Use Development Ordinance, but the Clinton County Planning Commission approves subdivisions on its behalf. The remaining fourteen municipalities have adopted the countywide plan.

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.

There are currently two Act 167 stormwater management plans that have been adopted in Clinton County: Chatham Run and Fishing Creek/Cedar Run. The Fishing Creek/Cedar Run Stormwater Management Plan was updated and adopted in 2006 and involved several municipalities including Bald Eagle Township, Loganton Bor-

ough, Castanea Township, Crawford Township, Greene Township, Lamar Township, Logan Township, Mill Hall Borough, Porter Township, and municipalities from neighboring counties. Chatham Run Stormwater Management Plan was originally adopted in 1989 and updated in 2006. This watershed encompasses approximately 23.77 square miles and is composed of three sub watersheds – Chatham Run mainstream, Little Plum Run and Big Plum Run. Municipalities involved with the development of this plan were: Gallagher Township, Dunnstable Township, Pine Creek Township, and Woodward Township.

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 10 years.

With regard to hazard mitigation planning, Section 301.a(2) of the Municipalities 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.

Clinton County has a county comprehensive plan that was adopted on April 10, 2014.

Article III of the Municipalities Planning Code (MPC) enables municipalities to prepare a comprehensive plan; however, development of a comprehensive plan is voluntary. All municipalities in Clinton County have adopted the Clinton County Comprehensive Plan as the municipal plan. The City of Lock Haven is the only municipality that has a completed independent plan, and Wayne and Porter Townships have nearly completed comprehensive plans as of May 2018.

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 no municipalities within Clin-

ton County that have an identified capital improvements plan. However, Lock Haven University does have capital improvement programming in place being that it is one of the fourteen Pennsylvania State System of Higher Education (PASSHE) schools.

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 10 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 ma-

terials 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.

Of the municipalities who completed the capability assessment, 10 indicated that they do not participate in the NFIP or were unsure. 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 seven boroughs, twenty-one townships and one city within Clinton 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 Clinton 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 Clinton 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 Clinton County GIS Department. There are no employees that has/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 Clinton County and its municipalities to have an emergency management coordinator.

The Clinton County Department of Emergency Services 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. Each municipality is required to adopt the countywide EOP. The Notification and Resource Section of the plan was developed individually by each municipality. A copy of each EOP is on file with the Department of Emergency Services. Clinton County updates the EOP every five years. The next update will occur in 2022.

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 capability, 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 58 - Capability Self-Assessment Matrix* summarizes the results of the self-assessment survey.

Table 58 - Capability Self-Assessment Matrix

Clinton County Capability Self-Assessment Matrix				
Municipality Name	**Capability Category**			
	Planning and Regulatory Capability	**Administrative and Technical Capability**	**Fiscal Capability**	**Community Political Capability**
Allison Township	Not completed by municipality			
Avis Borough	L	L	L	L
Bald Eagle Township	M	M	M	M
Beech Creek Borough	L	L	L	L
Beech Creek Township	L	L	L	L
Castanea Township	Not completed by municipality			
Chapman Township	M	H	M	M
Colebrook Township	L	L	L	L
Crawford Township	L	L	L	L
DCNR	M	M	H	M
Dunnstable Township	L	L	L	L
East Keating Township	M	M	M	M
Flemington Borough	L	L	L	M
Gallagher Township	Not completed by municipality			
Greene Township	H	H	M	H
Grugan Township	L	L	L	L
Lamar Township	This section was not completed by municipality			
Leidy Township	L	L	L	L
Lock Haven City	H	M	L	M
Lock Haven University	M	H	M	M
Logan Township	L	M	L	L
Loganton Borough	M	M	M	H
Mill Hall Borough	M	L	L	M
Noyes Township	This section was not completed by municipality			
Pine Creek Township	L	L	L	L
Porter Township	M	M	L	L
Renovo Borough	M	M	L	H
South Renovo Borough	L	L	L	L
Wayne Township	L	L	L	L
West Keating Township	L	L	L	L
Woodward Township	Not completed by municipality			

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

Clinton County has a limited education and outreach program. The Clinton County Department of Emergency Services conducts some public outreach at public events to

update the citizens and visitors of the county on natural and human-caused 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 Clinton 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 Clinton County.

Education and outreach on the NFIP is 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 Clinton County Local Planning Team will identify actions necessary to complete this – they are currently planning a Flood Plain Summit to be held in the County, in partnership with the Lycoming County Planning Department.

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 2013 Commonwealth of Pennsylvania Standard All-Hazard Mitigation Plan, local floodplain management ordinances, the Clinton County Comprehensive Plan, Clinton 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 Clinton 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).

Some areas of the county do not have implemented stormwater management plans, and full coverage of stormwater management plans should strongly be considered and encouraged in the future. In the event that these plans are implemented, Clinton County officials will ensure that hazard mitigation data and principles are implemented as appropriate.

Clinton County is a small county with a very limited amount of population and resources to appropriately ensure and implement hazard mitigation principles into all

regulatory tools. Clinton County will continue to explore options to further enhance the implementation of these principles utilizing already multi-tasked staff and resources. Clinton County will review other local and state plans that could be impacted with hazard mitigation principles over the next five-year planning period.

Pennsylvania All-Hazard Mitigation Plan – 2013

The Pennsylvania All-Hazard Mitigation Plan (PAHMP) is the baseline document for all county hazard mitigation plans in the Commonwealth of Pennsylvania. During the 2018 Clinton County HMP update, the local planning team and steering committee reviewed and utilized the various sections of the PAHMP to provide information specific to the same sections of the Clinton County HMP. As an example, the PAHMP Risk Assessment section provided copious amounts of past occurrence and vulnerability data for every hazard profile that was updated or developed new in the 2018 Clinton County HMP. The PAHMP also provided information and data on contiguous counties to Clinton County within the Commonwealth. Contiguous counties to Clinton County are Centre, Clearfield, Cameron, Potter, Lycoming and Union Counties. Information on past occurrences of hazards and mitigation actions and opportunities were utilized.

The PAHMP was also utilized to ensure that the updated Clinton County mitigation strategy was aligned with the PAHMP mitigation strategy. High priority mitigation strategies in the PAHMP (like removal of repetitive loss and severe repetitive loss properties from the floodplain) were considered with the Clinton County HMP mitigation strategy development. The local planning team consulted the PAHMP as they developed new actions and project opportunities.

Lock Haven University Hazard Mitigation Plan – 2016

Lock Haven University's (LHU) Main Campus is located in the City of Lock Haven. LHU participated in the Pennsylvanian Disaster Resistant University (DRU) planning process which ensures that all Commonwealth universities have a FEMA approved hazard mitigation plan. LHU participated in the planning process during this hazard mitigation plan update. The Clinton County steering committee and local planning team utilized the LHU 2016 HMP during this HMP update.

All sections within 4.3 of the LHU HMP were consulted writing profiles for this plan. This section provided information and statistics on many of the hazards that appear in this Clinton County HMP. Information on the locations of specific hazards on campus, past occurrences of hazards specific to campus, and vulnerability assessment data specific to campus locations and infrastructure were used to update all hazard profiles common to both HMPs. One notable example is the Pandemic, Epidemic and Infectious Disease Profile from the LHU HMP, which provided significant information about event response from the University perspective. Interconnected university communi-

ties can be significant locations for the spread of diseases, so the University perspective was particularly valuable for this profile.

The Parts of the Capability Assessment Findings (LHU HMP Section 5.2) were incorporated into the Capability Assessment Section of this plan.

Section 6 of the LHU HMP outlines the mitigation strategy for LHU. Information contained in this section assisted the local planning team and steering committee with the development of the 2018 HMP mitigation strategy. The LHU HMP strategy is defined to actions and projects that can be completed to decrease the impact of natural and human-caused hazards identified in the LHU HMP risk assessment. The LHU HMP actions were all integrated into the 2018 Clinton County HMP Update. The local planning team felt that full integration of the LHU HMP was critical for future hazard mitigation activities. LHU also implemented one new project opportunity that can be found in appendix G.

Clinton 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 Clinton County Commissioners adopted the updated Clinton County Comprehensive Plan in 2014. This plan is very limited on the amount of hazard mitigation principles 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. This hazard mitigation plan is a fitting supplement to the comprehensive plan.

The Clinton County Planning Commission is responsible for maintaining and updating the Clinton County Comprehensive Plan and many other regulatory tools. Technical assistance on community planning matters is provided to the Clinton County Board of Commissioners through the Clinton County Planning Commission. The planning commission administers the Clinton 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.

The Clinton County Comprehensive Plan was one of the primary documents integrated into the 2018 Clinton County HMP update. Chapter 2, Clinton County Today Trends and Issues, provided a solid foundation for the community profile section of the 2018 HMP. County history information, economics, population, households and community information was all used in the development and update of this section in the 2018 HMP.

Identified future growth and development areas was specific information from the comprehensive plan that was used when updating the 2018 vulnerability assessment sections for all hazard profiles in the section 4.3 of the 2018 HMP. Very specific information about new and existing developments in high population areas was used in vulnerability assessments for the hazards that could impact these areas. In some cases, the new development areas and the community infrastructure that supports these developments was identified in specific hazard areas. Any residential, commercial or critical infrastructure that was identified in the hazard vulnerable area was noted in the vulnerability assessment for each hazard profile. Information and data specific to storm water management and planning was utilized to identify new project opportunities for municipalities as well.

Although specific portions of the comprehensive plan outlined projects, actions or specific planning items that would support hazard mitigation, the information will be more comprehensive with the integration of new hazard mitigation principals and data from the 2018 Clinton County HMP. During discussions with county planning personnel as part of this hazard mitigation plan update, discussions about the importance of hazard mitigation integration during the next comprehensive plan update was expressed. Specifically, the risk assessment section and mitigation strategy section hold vital information that requires integration into the next plan update. Identification of hazard areas, vulnerable structures and developments and future risk is critical in the determination of and management of economic growth and development areas in the county. Numerous mitigation opportunity forms have been received during the planning period and would provide beneficial information for the next comprehensive plan update as well. The local planning team determined that an action to integrate 2018 hazard mitigation principals and data into the next updated county comprehensive plan was needed in the 2018 Clinton County Hazard Mitigation Plan. Action 1.4.4 identifies this.

Clinton 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). Clinton County Department 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 Clinton 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.

EMA will consider the Clinton 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.

National Flood Insurance Program and Municipal Floodplain Ordinance

The National Flood Insurance Program provided specific information that was incorporated into the Flooding Profile (section 4.3.3) and the Capability Assessment Findings (section 5.2). Specifically, the amount of active insurance policies per municipality, repetitive loss properties and severe repetitive loss properties were used in the vulnerability assessment section of the flooding profile. This afforded the local planning team specific vulnerability information that was then used to develop mitigation actions and municipal mitigation project opportunity forms. Numerous municipalities identified flooding, flash flooding and ice jam flooding project opportunities that would decrease the loss of life and property damage when completed. These opportunities are identified in Appendix G.

A GIS dataset of the 1% annual chance floodplain as identified by FEMA Digital Flood Insurance Rate Maps (DFIRM) from 2016 was used to identify structures and critical facilities that fall within the floodplain in Clinton County for the vulnerability assessment of the Flooding Profiles (section 4.3.3). While DFIRM maps are a useful tool and important to integrate into this planning process, it should also be noted that these are not completely accurate, and are estimates and models of vulnerability. A map of these floodplains for each municipality in Clinton County can be found in Appendix D.

In the future, Clinton County should ensure that all floodplain ordinance updates have integrated hazard mitigation principles by participation in NFIP programs and integrating the NFIP program data into any applicable hazard mitigation sections.

Other Resources and Interconnectivity

Other resources utilized in the planning process include the Clinton County Conservation District Strategic Plan which was consulted when developing the Community Profile for this plan, specifically providing detailed information about land use and development within the County. The Clinton County Soil Survey also informed the Community Profile, providing information about the physiography of the county. The Clinton County Commodity Flow Study from 2000 was reviewed for the Environmental Hazards profile of this plan, which provided a good summary of past activity of hazardous materials within the county.

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, Clinton 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. The county includes the GIS and Planning Directors on the hazard mitigation planning team to aid in this consistency. Clinton 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 twenty goals and forty-three objectives identified in the 2011 hazard mitigation plan. The 2018 Clinton County Hazard Mitigation Plan Update has eight goals and twenty-five objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. These changes are noted in *Table 59 - 2011 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 59 - 2011 Mitigation Goals and Objectives.* These reviews are based on the five-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 sixty-six actions identified in the 2011 mitigation strategy. A review of the 2011 mitigation actions was completed by the local planning team. The results of this review are identified in *Table 59 - 2011 Mitigation Goals and Objectives.* 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 59 - 2011 Mitigation Goals and Objectives

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 1	Ensure that local building codes/ordinances are consistent with FEMA and PA DCED guidelines and are properly enforced.	The team decided that this goal needed to be more of a broad statement.

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 1A	Develop a new Comprehensive Plan or amend an existing Comprehensive Plan to include an assessment and associated mapping of the municipality's vulnerability to location-specific hazards and appropriate recommendations for the use of these hazard areas.	Katie indicated that this objective can be eliminated because it has been accomplished. There will be no maintenance of this plan. The Comprehensive Plan will not be touched for the next 5 or so years.
Objective 1B	Develop a new Subdivision and Land Development Ordinance or revise an existing Subdivision and Land Development Ordinance to include municipality-specific, hazard mitigation-related development criteria and/or provisions for the mandatory use of conservation subdivision design principles in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	Katie indicated that this is currently underway. It is expected to be completed by the end of the year.
Objective 1C	Develop a new Zoning Ordinance or revise an existing Zoning Ordinance to include separate zones or districts with appropriate development criteria for known hazard areas.	This was completed in 2016. All municipalities have zoning, though only 7 municipalities are covered by the County zoning ordinance.
Objective 1D	Make available for municipal use the digital natural hazard mapping files that were developed as part of this hazard vulnerability assessment and mitigation planning effort.	This will be continued for the 2018 update. This is a partially completed action. Floodplain maps are available on website. Take "natural" out make it "all-hazard" mapping. Use the phrase "public use" instead of "municipal".
GOAL 2	*Minimize future damage due to flooding of the Susquehanna River and its tributaries.*	This statement is broad enough to cover everything but instead it should say west / north branch of Susquehanna River. (geographic location of tributaries).
Objective 2A	Ensure continued implementation of appropriate operations and maintenance procedures (routine inspections and regular maintenance) at the Ohl, Keller, and Castenea Dams in an effort to prevent a potential failure.	This will be continued as an action in the new update. Assign it to the specific municipality (City of Lock Haven).
GOAL 3	*Regulate construction/development in the County to prevent increases in runoff and subsequent increases in flood flows.*	This goal can be an objective to goal number 2.

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 3A	Ensure municipal compliance with local watershed-specific Act 167 Stormwater Management Plans and Ordinances.	Continuous action item.
Objective 3B	Regulate construction/development in the County to prevent increases in runoff and subsequent increases in flood flows.	Continuous action item.
GOAL 4	*Ensure that new construction is resistant to natural hazards.*	Change to "all-hazards" eliminate "natural". This is an objective, not a goal.
Objective 4A	Develop a technical proficiency at the municipal level for conducting post-disaster damage assessments and regulating reconstruction activities to ensure compliance with NFIP substantial damage/substantial improvement requirements.	Action item. This may go to the new "goal #2".
Objective 4B	Ensure that high-risk, pre-FIRM residential structures do not get repeatedly flooded by using retrofitting techniques to reduce the flood risk to the properties.	This sounds exactly like the objective above. Combine this and 4A above as well as 4C below.
Objective 4C	Relocate and/or acquire known flood-prone structures.	Combine this with the two objectives above.
Objective 4D	Develop a technical proficiency at the municipal level for assisting local residents and business owners in applying for hazard mitigation and assistance funds and identifying cost beneficial hazard mitigation measures to be incorporated into reconstruction activities.	This is a continuous action item. Change "develop" to "maintain".
GOAL 5	Provide residents with adequate warning of potential hazard events.	Bill thought this goal could be tied to goal number 2. Move this forward as an objective and make it "all hazards in nature". Moved to objective 6.1
Objective 5A	Continue to work with the NWS Mid-Atlantic River Forecast Center to ensure funding is continued to maintain Susquehanna River Basin Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program.	Continued action item. Will support goal 2.

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 5B	Coordinate with the U.S.G.S., local watershed organizations, and/or the CCCD to increase the number of U.S.G.S. and Integrated Flood Observing and Warning System (IFLOWS) rain and stream gauges in the County as a potential enhancement to the existing Susquehanna River Basin Flood Forecast and Warning System.	Continued action item. Will support goal 2.
Objective 5C	Ensure that a planned, coordinated, and effective public warning dissemination program exists at the County level.	Continued action item. Will support goal 5 (mention of Code Red being used?)
GOAL 6	Ensure that emergency response services and critical facilities functions are not interrupted by natural hazards.	Change to "all hazards". Take out the word "ensure".
Objective 6A	Continue to develop and distribute public informational through pamphlets and the County's web page related to the potential health and safety implications of various natural hazard events.	Put this under a public outreach/training goal.
GOAL 7	Provide adequate shelters during hazard events.	This should be an objective. "Conduct coordination with the Red Cross…" Change to "all hazard events".
Objective 7A	Coordinate with Red Cross	This is an action based item.
GOAL 8	Ensure that local officials are well trained regarding natural hazards and appropriate prevention and mitigation activities.	Put this under a public outreach/training goal.
Objective 8A	Adopt via resolution and respond to hazards with actions that are consistent with, the Municipal-level EOP.	Remove from plan
Objective 8B	Post and keep current with any additions to or updates of this planning document on Clinton County Government's web site (www.clintoncountypa.com) for public review and/or comment.	This is a maintenance item for the new plan.
Objective 8C	Develop and implement a post-disaster recovery and mitigation training program for local officials (See ES-11 and ES-12).	Action based item.

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 8D	Create a website links/references section on the Clinton County and/or CCDES website homepage to include links to FEMA - http://www.fema.gov/, PEMA - http://www.pema.state.pa.us/, PA DCED - http://www.inventpa.com/, and NWS - http://www.nws.noaa.gov/.	Action based. Change to maintain and enhance the website and links section.
Objective 8E	County Emergency Services Department to hold elected official training on emergency management practices related to hazard mitigation.	Action based item. New curriculum coming out from PEMA
GOAL 9	Provide adequate communication systems for emergency management agencies and emergency response units.	Objective based item. Maintain and enhance the communications systems for emergency management agencies and emergency response units. Action item for the Code Red program. The "I Am Responding" program educational outreach for muni LEMCs.
Objective 9A	Maintain and continue to provide pagers to local emergency management coordinators as a means of improving the County's warning dissemination program.	Provided pagers to county coordinators previously. Technology changes has opened up new ways for notification to the LEMCs.
GOAL 10	Reduce impacts from severe storms and/or improve response procedures.	Enhance to either an objective or action based item
Objective 10A	County conduct hazard response practice drills and emergency management training exercises on an annual basis.	Objective based item. Actions to support this are annual weather exercise. Also, LEPCs exercises, ASOW items,
GOAL 11	Improve the participation rate in federal flood insurance through education.	This is objective based items. Actions to support this may be for Crawford Twp, Rock Town area.
Objective 11A	Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP.	Action based item. Combine objectives 11A and 11B into one action.
Objective 11B	Ensure that property owners and potential property owners are aware of the availability and benefits of obtaining federal flood insurance.	See above.
GOAL 12	Reduce impacts related to flash flooding and stormwater problems.	Add in flash flooding, flooding and ice jam flooding and make this the new Goal Statement.
Objective 12A	Ensure that existing drainage systems (pipes, culverts, channels) are adequate and functioning properly.	Good objective to roll forward to the 2018 mitigation action plan. Encourage to maintain existing stormwater drainage systems

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
Objective 12B	Coordinate with the local municipality and/or PennDOT on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that were identified during the Act 167 Stormwater Management Planning process as being unable to pass the 10-year frequency flood flow.	Coordinate with the county transportation committee and SEDA COG. Katie DeSilva researched this item.
GOAL 13	Investigate retrofitting alternatives to reduce impacts from other natural hazards.	Move to a flooding related objective under the flooding goal.
Objective 13A	Encourage local business and industry owners in known flood hazard areas to develop an emergency response plan as a potential alternative to implementing a physical property protection measure, where otherwise not technically or fiscally appropriate.	Action based item. Possibly for Bald Eagle Township? Consortium to share ideas with other municipalities. Possibly in here because of Hogan Blvd.
Objective 13B	Reduce the impact of flooding on commercial structures through retrofitting techniques.	Remove this from the plan.
GOAL 14	Investigate structural solutions to natural hazards.	Remove this from the plan
GOAL 15	Reduce threats related to landslides.	Move to an objective under an all hazard goal statement.
Objective 15A	Coordinate with PennDOT and the CCCD to determine the feasibility of implementing mitigation measures on a site specific basis to lessen traffic hazards from Landslides / slumps.	Move to an action to support the goal
Objective 15B	Obtain PennDOT studies on geomorphology	Remove from the plan.
GOAL 16	Preserve areas where natural hazard potential is high (i.e., steeply sloping areas, sinkhole areas, floodplains, wetlands, etc.).	This goal will be moved to an objective in the 2018 plan
Objective 16A	Preserve the highest priority undeveloped steep slope areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize/prevent potential landslide damages and enhance the regional environment. Less critical steep slope areas may be preserved / protected via local ordinance (see PM-2 and PM-4).	This is action based. Maybe add another action for Karst based issues.

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 17	Protect existing natural resources and open space, including parks and wetlands, within the floodplain.	Objective based item under the flooding goal.
Objective 17A	Conduct a detailed inventory and prioritization of local environmental resources via the Comprehensive Planning or similar natural resources planning process.	Action based item: Maintain the Clinton County Natural Resources Inventory and prioritization. Clinton County Planning Department is the champion.
Objective 17B	Preserve the highest priority undeveloped floodplain areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize/prevent potential flooding damages and enhance the regional environment. Less critical floodplain areas may be preserved / protected via local ordinance (see PM-2 and PM-4).	This objective is no longer valid and should be removed.
Objective 17C	Preserve high priority wetland areas (see NR-1) via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize potential flooding damages and enhance the regional environment.	All completed, remove from the plan. All wetlands are on state property.
Objective 17D	Develop and implement a wetland protection program consisting of public education materials that highlight the functions and values of wetlands and local ordinance provisions that require the identification of wetlands in accordance with federal and state standards and minimize/eliminate their disturbance in accordance with federal and state laws.	Conservation Office would do this if applicable. But this is already in place by DEP. Maybe change to maintain.
Objective 17E	Working through the Conservation District, the County should ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and should continue to work with local farmers to implement erosion and sedimentation control BMPs.	Action based item that is continuous in nature.
GOAL 18	Restore degraded natural resources and open space to improve their flood control function.	Integrate with old goal 17

Clinton County 2011 Mitigation Goals and Objectives Review Worksheet		
GOAL Objective	**Description**	**Review**
GOAL 19	Ensure that all residents and business owners are aware of the potential hazards associated with their environment and the ways they can protect themselves.	Objective based and educational in nature.
Objective 19A	Develop and distribute a public summary of this hazard mitigation plan including relevant information on hazard specific "do's" and "don'ts", hazard-prone areas, and emergency contact information.	Action based item. Change wording some
Objective 19B	Develop citizen information on natural, technological, and man-made disaster response.	Remove this from the plan. Not applicable.
Objective 19C	Maintain natural hazard risk assessment and mitigation publications/materials at public libraries throughout the County.	Remove from the plan.
Objective 19D	Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and the FEMA guidance documents that were provided as part of the hazard mitigation planning program.	Store in an easily accessible location and make available for public inspection, this hazard mitigation plan
Objective 19E	Create a public information resource to inform residents and business owners about hazards related to natural resource exploration and development.	This was part of the previous Marcellus Shale boom and is no longer applicable.
GOAL 20	Increase the length of stream reaches mapped on FIRM maps and/or increase accuracy and density of flood elevation data where this future mapping would be beneficial.	Eliminate this goal, move it under goal number 2.
Objective 20A	Coordinate to see if additional funding is available via RISK MAP.	Keep

Table 60 - 2011 Mitigation Actions Review

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 1 Require Municipal officials to inspect infrastructure (sewers, bridges, water lines, etc. to ensure stability on a routine basis.			**X**			Flemington Borough
ACTION NO: 2 Educate community and municipal officials on possible chemical company and environmental disasters.			**X**			Flemington Borough
ACTION NO: 3 Identify a place where FEMA NFIP Flood Maps and Studies can be stored for easy access to the public and zoning officials.			**X**			Leidy Township and Grugan Township
ACTION NO: 4 Obtain funding to improve roads within the Township.			**X**			Beech Creek Township
ACTION NO: 5 Educate Township officials and the community about floodplain management.		**X**				This will be conducted by the Clinton County Planning Department. Change the action to read: Conduct a Floodplain Summit to outline municipal officials' duties and responsibilities in regard to permitting and construction in the special flood hazard area.
ACTION NO: 6 Review FEMA NFIP Flood Maps and Studies to become more aware of flood hazards within the Borough and provide information to property owners about Flood Insurance.			**X**			Mill Hall Borough and Wayne Township

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 7 Obtain funding for flood gauges along Fishing Creek.			**X**			Mill Hall Borough
ACTION NO: 8 Planning Department and applicable municipal offices to review their Comprehensive Plans to ensure that designated growth areas are not in high hazard areas identified in this plan.		**X**				Loganton Borough and Logan Township Clinton County Planning Department has started this process but the next comprehensive plan update is not until 2024.
ACTION NO: 9 Develop a Flood Protection Plan for Drury's Run Creek.	**X**					Noyes Township
ACTION NO: 10 Debris removal for Drury's Run Creek and other areas as needed.	**X**					Noyes Township
ACTION NO: 11 Develop and enforce more stringent building codes for residents and developers in flood prone areas.	**X**					Chapman Township Combine with Action #5
ACTION NO: 12 Provide public awareness about hazards.	**X**					Chapman Township Combine with Action #5
ACTION NO: 13 Provide information to individuals building in forest areas about wildfires.	**X**					Grugan Township
ACTION NO: 14 Review and update ordinances and planning mechanisms.			**X**			Avis Borough. Recently had a company complete this.
ACTION NO: 15 Review and update floodplain ordinances and enforce regulations and other best practices.			**X**			Avis Borough. Will need to combine into one master action.

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 16 Assist water authority with flooding and erosion issues.	**X**					Crawford Township
ACTION NO: 17 Coordinate with PennDOT and township for snow removal.	**X**					Leidy Township
ACTION NO: 18 Upgrade roads to prevent flooding.	**X**					Crawford Township
ACTION NO: 19 Municipalities should store in an easily accessible location and make available for public inspection, their community's Flood Insurance Rate Mapping and associated Flood Insurance Study. Clinton County could provide copies of these maps at the courthouse and/or conservation district offices and/or scan and post current maps on their website for all communities or those unable to provide information on their own website.			**X**			Clinton County and other County Departments and all municipalities. Hard copies at planning and conservation. Digital copies on line.
ACTION NO: 20 Road and stream clearing improvement.	**X**					West Keating Township

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 21 Planning department and applicable municipal offices of Greene Township to review their comprehensive plans to ensure that growth areas are not in high hazard areas identified in 2011 Clinton County HMP.					**X**	Greene Township Duplicate
ACTION NO: 22 Review existing building codes to ensure anchoring requirements for manufactured homes are adequate. If determined inadequate for existing vulnerability, consider revising.			**X**			All municipalities in Clinton County
ACTION NO: 23 Issue County-wide "advisory" water usage guidelines during times of drought and supply drought information to the public (brochures, news releases, etc.)			**X**			Clinton County. Disseminate versus Issue. EMA office.
ACTION NO: 24 Enforce builders that want to construct large developments in landslide prone areas to complete a geomorphologic study.					**X**	Clinton County and West Keating, Porter, Lamar, Crawford, Logan, Loganton, and Greene Townships. Could include sink holes as well. Clinton County Planning states that this is in the new SALDO.
ACTION NO: 25 Develop a new, or amend an existing, Comprehensive Plan to include an assessment of hazard vulnerability and appropriate mitigation recommendations.			**X**			Clinton County Switch to maintain

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 26 Ensure municipal compliance with minimum NFIP and PA Act 166 floodplain development regulations.					**X**	Clinton County and Municipalities Covered with Action #5
ACTION NO: 27 Ensure municipal compliance with local watershed-specific Act 167 Stormwater Management Plans.			**X**			Clinton County and Municipalities Fishing Creek/Cedar Run; Chatham Run
ACTION NO: 28 Ensure continued implementation of appropriate operations and maintenance procedures at the Ohl, Keller and Castanea, and Warren Dams.			**X**			City of Lock Haven and Wayne Township: City has plans in place.
ACTION NO: 29 Relocate and/or acquire known flood-prone structures in accordance with the general guidelines of Table 5-3 in previous mitigation plan.	**X**					All Municipalities Remove the wording Table 5-3
ACTION NO: 30 Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP.			**X**			Clinton County and Municipalities Township
ACTION NO: 31 Conduct a detailed inventory and prioritization of local environmental resources via the Comprehensive Planning or similar natural resources planning process.			**X**			Clinton County. Remove the word detailed and add the word utilize. This is outlined in the Clinton County Natural Heritage Inventory

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 32 Preserve the highest priority undeveloped floodplain areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical floodplain areas may be preserved/protected via local ordinance.					**X**	Clinton County Covered by previous action 5
ACTION NO: 33 Store in an easily accessible location and make available for public inspection, the community's Flood Insurance Rate Mapping and associated Flood Insurance Study.					**X**	Clinton County and Municipalities Duplicate
ACTION NO: 34 Maintain natural hazard risk assessment and mitigation publications/materials at public libraries throughout the County.	**X**					Clinton County. Two separate actions
ACTION NO: 35 Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and the FEMA guidance documents that were provided as part of the hazard mitigation planning program.			**X**			Clinton County. Reword the action and remove the FEMA wording

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 36 Develop and distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific "do's" and "don'ts" and emergency contact information.			**X**			Clinton County EMA and Conservation do hand out some specific information. Al hazards
ACTION NO: 37 Develop a new, or revise an existing, Zoning Ordinance to include separate zones or districts for known hazard areas.	**X**					This would impact all municipalities
ACTION NO: 38 Develop a new, or revise an existing, Subdivision and Land Development Ordinance to include municipality-specific, hazard mitigation-related development criteria and/or provisions for the mandatory use of conservation subdivision design principles.		**X**				Clinton County. The SALDO is currently being updated.
ACTION NO: 39 Develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events.			**X**			Clinton County. Remove pamphlet. Do public outreach

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 40 Develop a technical proficiency at the municipal level for conducting post-disaster damage assessments and regulating reconstruction activities to ensure compliance with NFIP substantial damage/improvement requirements.			**X**			Clinton County. 2 actions. Damage assess training, EMA. Other to municipalities
ACTION NO: 41 Develop a technical proficiency at the municipal level for assisting local residents and business owners in applying for hazard mitigation/assistance funds and identifying cost beneficial mitigation measures to incorporate into reconstruction activities.	**X**					Clinton County. Conservation works with municipalities on dirt and gravel road program and projects. NEW: identify cost beneficial mitigation actions or projects to incorporate into mitigation activities.
ACTION NO: 42 Preserve the highest priority undeveloped steep slope areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses. Less critical steep slope areas may be preserved/protected via local ordinance.					**X**	Clinton County. Any area along the river, 220 and 120 areas.

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 43 Preserve high priority wetland areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses.			**X**			Clinton County. Preserve high priority wetland areas through a permitting process in accordance with state and federal regulations. Conservation District action.
ACTION NO: 44 Coordinate with the local municipality and/or the PA Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that were identified during the Act 167 Stormwater Management Planning process as being unable to pass the 10-year frequency flood flow.		**X**				Clinton County: Trout Unlimited Involved. Change to the following: Coordinate with the local municipality and/or the PA Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that were identified during ongoing inventories by the Conservation District and Trout Unlimited, and the Act 167 Stormwater Management Planning process as being unable to pass the 10-year frequency flood flow.
ACTION NO: 45 Develop and implement a wetland protection program consisting of public education materials that highlight the functions and values of wetlands and local ordinance provisions that minimize/eliminate wetland disturbance.			**X**			Clinton County: ADD In accordance with state and federal regulations. Conservation does outreach and education on this type action.

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 46 Ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and continue to work with local farmers to implement BMPs.			**X**			Clinton County: BMP: Best management practice. Change to the following: Ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and continue to work with local farmers to implement innovative soil health practices that increase water infiltration, groundwater recharge, and decrease runoff.
ACTION NO: 47 Obtain more detailed information at the municipal level so that the general extent and magnitude for each municipality can be better determined.					**X**	Clinton County and Municipalities Remove
ACTION NO: 48 Identify structures, systems, and populations, or other community assets as defined by each municipality that are susceptible to damage and loss from hazard events.			**X**			Clinton County and Municipalities. EMA and GIS completes numerous updates.
ACTION NO: 49 Identify sites of future development and identify to what potential hazards these future growth areas may be vulnerable.			**X**			Clinton County. County Planning doing this regularly. Combine with Action 37

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 50 Obtain potential dollar loss information for buildings, infrastructure, and critical facilities when they are identified in other hazard areas besides flooding.			**X**			The local
ACTION NO: 51 Work with the Fire Association, Hospital EMS, and Sheriff's Department to increase the number of trained Citizen Emergency Responders by meeting with groups of potential volunteers.					**X**	Loganton Borough and Logan Township. No CERT program in the County
ACTION NO: 52 Increase the number of NOAA Weather Alert radios in public places across the County (i.e., municipal buildings, public libraries, police stations, fire stations, etc.).			**X**			Clinton County: County buildings completed in the past with local tax dollars. NOAA provided some radios for dissemination
ACTION NO: 53 Conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event.			**X**			Clinton County: Conduct routine tests of communications systems and public alert systems to ensure proper operations during an emergency

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 54 Encourage those critical facilities that are responsible for emergency response efforts to develop and implement an emergency response plan to mitigate potential flooding impacts.			**X**			Clinton County: remove flooding. All-hazard impacts.
ACTION NO: 55 Improve working relationship with PennDOT regarding snow removal.	**X**					West Keating Township
ACTION NO: 56 Greene Township will work with the fire association, hospital EMS and the sheriff's department to increase the number of trained citizen emergency responders by meeting with groups of potential volunteers. All areas of Clinton County will benefit.					**X**	Greene Township Duplicate
ACTION NO: 57 Conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event.					**X**	Clinton County: Duplicate
ACTION NO: 58 Ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level.			**X**			Clinton County: Code Red implemented and EAS utilized Continue to utilize public warning systems……

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 59 Adopt via resolution, and respond to hazards with actions that are consistent with, the County-level EOP.		**X**				Clinton County and Municipalities. Some municipalities have adopted county EOP.
ACTION NO: 60 Conduct hazard response practice drills and emergency management training exercises on an annual basis.			**X**			Clinton County: Weather exercise
ACTION NO: 61 Encourage those facilities that are responsible for emergency response efforts to develop and implement an emergency response plan to mitigate potential flooding impacts.					**X**	Clinton County and Municipalities. All EOPs are all-hazard in nature. Duplicate, remove
ACTION NO: 62 Develop and implement a post-disaster recovery and mitigation training program for local officials.	**X**					Clinton County. This should be split into 2 actions.
ACTION NO: 63 Establish a partnering relationship with the NWS Mid-Atlantic River Forecast Center to enhance the existing Susquehanna River Basin Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program.			**X**			Clinton County

2011 Clinton County Mitigation Actions Review						
Existing Mitigation Actions	**Status**					***Review Comments***
	No Progress / Unknown	**In Progress / Not Yet Complete**	**Continuous**	**Completed**	**Discontinued**	
ACTION NO: 64 Encourage local business and industry owners in known flood hazard areas to develop an emergency response plan as a potential alternative to implementing a physical property protection measure, where otherwise not technically or fiscally appropriate.					**X**	Clinton County: Action 54 covers this.
ACTION NO: 65 Coordinate with the U.S.G.S., local watershed organizations, and/or the CCCD to increase the number of U.S.G.S. and IFLOWS rain and stream gages in the County.			**X**			Clinton County EMA
ACTION NO: 66 Increase the number of NOAA Weather Alert radios in public places across the County.					**X**	Clinton County: Duplicate

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 eight goals and twenty-six corresponding objectives was developed. Goals five through eight outline the goals and corresponding objectives that Lock Haven University integrated into the 2018 Clinton County Hazard Mitigation Plan. *Table 61 - 2018 Goals and Objectives* details the mitigation goals and objectives established for the 2018 Clinton County Hazard Mitigation Plan.

Table 61 - 2018 Goals and Objectives

2018 Clinton County Goals and Objectives	
GOAL Objective	**Description**
GOAL 1	**Reduce the potential impact and losses stemming from natural and human caused hazards**
Objective 1.1	Ensure new construction is resistant to all hazards and enforce building codes
Objective 1.2	Provide adequate shelters during hazard events
Objective 1.3	Regulate, limit or prohibit development in high hazard areas
Objective 1.4	Integrate hazard mitigation principles into all local planning efforts
Objective 1.5	Reduce threats related to landslides
GOAL 2	**Reduce future impacts of flooding, flash flooding and ice jam flooding in Clinton County and the West Branch Susquehanna River and tributaries**
Objective 2.1	Encourage all Clinton County municipalities to participate in the National Flood insurance Program
Objective 2.2	Regulate construction/development in the county to prevent increased runoff
Objective 2.3	Protect existing and restore degraded natural resources and open space, including parks and wetlands, within the floodplain to improve their flood control functions
Objective 2.4	Conduct mitigation projects like construction, elevation, retrofitting and flood proofing to protect private and public assets
Objective 2.5	Acquire, elevate, demolish or demolish/reconstruct flood prone properties to remove or mitigate risks to homeowners and property.
Objective 2.6	Update and maintain mapping and GIS capabilities to conduct enhanced vulnerability assessments for all flooding hazards.
GOAL 3	**Increase awareness and conduct education sessions on potential impacts and vulnerabilities to natural and human-caused hazards.**
Objective 3.1	Utilize various county and municipal websites for hazard mitigation info dissemination.

2018 Clinton County Goals and Objectives	
GOAL Objective	**Description**
Objective 3.2	Conduct education programs for elected and appointed government officials
Objective 3.3	Increase public outreach throughout the county.
Objective 3.4	Develop procedures to utilize social media in prevention, response and mitigation efforts.
GOAL 4	Enhance and improve emergency preparedness, warning and response procedures and capabilities
Objective 4.1	Provide residents and visitors adequate warning of all hazards
Objective 4.2	Maintain and enhance the communications systems for emergency management agencies and emergency response units
Objective 4.3	Conduct annual preparedness and response exercises
GOAL 5	Increase education and awareness of natural and human-caused hazards at the university.
Objective 5.1	Provide education and training on University-specific hazards for faculty, and staff within two years of HMP adoption.
GOAL 6	Improve university structural and operational resiliency to the impacts of natural and human-caused hazards.
Objective 6.1	Continue to minimize development in areas with greater vulnerability to hazards over the next five-year HMP update period.
Objective 6.2	Lessen facility, building and infrastructure vulnerability to hazard events on a continual basis.
Objective 6.3	Lessen vulnerability from hazard events for natural resources and open space areas on a continual basis.
Objective 6.4	Ensure continued stable functioning of critical facilities and essentials operations during and immediately following natural and human-caused hazard events.
GOAL 7	Improve emergency services and capabilities in the university to protect citizens from natural and human-caused hazards.

2018 Clinton County Goals and Objectives	
GOAL Objective	**Description**
Objective 7.1	Maintain pro-active protection, preparedness, response, and recovery planning efforts based on known hazards, vulnerabilities, and threats documented in the HMP
GOAL 8	Improve coordination and communication with regards to hazard mitigation programs
Objective 8.1	Encourage participation in the HMP throughout the five-year HMP update period.
Objective 8.2	Improve coordination and communication between academic departments, administrative departments, and other university offices on a continuing basis.
Objective 8.3	Improve coordination and communication between the University, local governments (i.e., the County and municipalities), and local industries/organizations on a continuing basis.

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 *62 - 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 63 - 2018 Mitigation Action Plan.

Table 62 - Mitigation Strategy Technique Matrix

Clinton County Mitigation Strategy Technique Matrix				
HAZARD	**MITIGATION TECHNIQUE**			
	Local Plans and Regulations	**Structural and Infra-structure**	**Natural Systems Protection**	**Education and Awareness**
Drought			X	X
Flood, Flash Flood, Ice Jam Flooding	X	X	X	X
Hurricane, Tropical Storm and Nor' Easter	X	X	X	X
Invasive Species	X		X	X
Landslides	X	X	X	X
Pandemic and Infectious Disease	X		X	X
Radon	X	X		X
Tornados and Wind Storms	X	X		X
Wildfire	X	X	X	X
Winter Storms	X	X		X
Dam Failure	X	X		X
Disorientation	X			X
Environmental Hazard	X	X		X
Levee Failure	X	X	X	X
Opioid Epidemic	X			X

Transportation Accidents	X	X		X
Utility Interruptions	X	X		X

6.4. Mitigation Action Plan

The Clinton County Hazard Mitigation Local Planning Team (LPT) immediately began work on the mitigation strategy section of the 2018 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2011 HMP mitigation strategy section. A review of the previous goals, objectives, actions and project opportunities documented in the 2011 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 Clinton County Department of Emergency Services. 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 2018 Clinton County HMP are listed in the mitigation action plan.

Table 63 - 2018 Mitigation Action Plan is the 2018 Clinton County Mitigation Action Plan. This plan outlines mitigation actions and projects that comprise a strategy for Clinton County. The action plan includes actions, a benefit and cost prioritization, a schedule for implementation, any funding sources to complete the action, a responsible agency or department and an estimated cost. 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 64 - 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 63 - 2018 Mitigation Action Plan

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.1.1	Local Plans and Regulations	Require Municipal officials to inspect infrastructure (sewers, bridges, water lines, etc.) to ensure stability on a routine basis.	Flooding		X		Ongoing	Local	Clinton County Municipalities
1.1.2	Local Plans and Regulations	Regulate reconstruction activities to ensure compliance with NFIP substantial damage/improvement requirements	Flooding		X		Ongoing	Local	Clinton County Municipalities
1.3.1	Local Plans and Regulations	Review existing building codes to ensure anchoring requirements for manufactured homes are adequate. If determined inadequate for existing vulnerability, consider revising.	Wind Storms, Tornados, Hurricanes, Tropical Storms, Winter Storms, Nor' Easters		X		Ongoing	Local	Clinton County Municipalities
1.3.2	Structural and Infrastructure	Ensure continued implementation of appropriate operations and maintenance procedures at the Ohl, Keller and Castanea, and Warren Dams.	Dam Failure		X		Ongoing	Local	Castanea Township, Greene Township, Lock Haven City and Wayne Township
1.3.3	Local Plans and Regulations	Develop a new, or revise an existing, Zoning Ordinance to include separate zones or districts for known hazard areas.	All Hazards	X			Ongoing	Local	Clinton County Planning

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.3.4	Local Plans and Regulations	The new Subdivision and Land Development Ordinance will incorporate the most recent county HMP by reference and will require the most recent HMP hazard mapping, Stormwater Management Plans, and FEMA flood plain mapping to be used during the design process	All Hazards	X			Ongoing	Local	Clinton County Planning
1.3.5	Local Plans and Regulations	Identify structures, systems, and populations, or other community assets as defined by each municipality that are susceptible to damage and loss from hazard events.	All Hazards	X			Ongoing	Local	Clinton County HMP Local Planning Team
1.3.6	Local Plans and Regulations	Identify sites of future development and identify to what potential hazards these future growth areas may be vulnerable	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
1.3.7	Local Plans and Regulations	Obtain potential dollar loss information for buildings, infrastructure, and critical facilities when they are identified in other hazard areas besides flooding.	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
1.4.1	Local Plans and Regulations	Planning Department and applicable municipal offices to review their Comprehensive Plans to ensure that designated growth areas are not in high hazard areas identified in this plan.	All Hazards		X		Ongoing	Local	Clinton County Planning
1.4.2	Local Plans and Regulations	Maintain, develop new, or amend the existing Comprehensive Plan to include an assessment of hazard vulnerability and appropriate mitigation recommendations	All Hazards		X		Ongoing	Local	Clinton County Planning
1.4.3	Local Plans and Regulations	Adopt via resolution, and respond to hazards with actions that are consistent with, the County-level EOP.	All Hazards			X	Ongoing	Local	Clinton County Municipalities

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
1.4.4	Local Plans and Regulations	Integrate the 2018 hazard mitigation plan to the Clinton County Comprehensive Plan.	All Hazards	X			2018-2023	Local	Clinton County HMP Local Planning Team
2.1.1	Educations and Awareness	Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP.	Flooding	X			Ongoing	Local	Clinton County Municipalities
2.2.1	Local Plans and Regulations	Review and update floodplain ordinances and enforce regulations and other best practices.	Flooding	X			Ongoing	Local	Clinton County Municipalities
2.3.1	Local Plans and Regulations	Develop a Flood Protection Plan for Drury's Run Creek.	Flooding		X		Ongoing	Local	Clinton County Planning, Leidy Township, Noyes Township and Renovo Borough
2.3.2	Structural and Infrastructure	Debris removal for Drury's Run Creek and other areas as needed.	Flooding			X	Ongoing	Local	Clinton County Planning, Leidy Township, Noyes Township and Renovo Borough
2.3.3	Natural Systems Protection	Ensure municipal compliance with local watershed-specific Act 167 Stormwater Management Plans.	Flooding		X		Ongoing	Local	Clinton County Municipalities
2.3.4	Natural Systems Protection	Preserve high priority wetland areas through a permitting process in accordance with state and federal regulations. Conservation District action.	All Hazards		X		Ongoing	Local	Clinton County Municipalities
2.3.5	Natural Systems Protection	Develop and implement a wetland protection program consisting of public education materials that highlight the functions and values of wetlands and local ordinance provisions that minimize/eliminate wetland disturbance in accordance with state and federal regulations	All Hazards		X		Ongoing	Local	Clinton County Municipalities

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.3.6	Natural Systems Protection	Ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and continue to work with local farmers to implement innovative soil health practices that increase water infiltration, groundwater recharge, and decrease runoff.	All Hazards			X	Ongoing	Local	Clinton County Municipalities
2.4.1	Local Plans and Regulations	Identify cost beneficial mitigation actions or projects to incorporate into mitigation activities	All Hazards		X		2018-2023	Local	Clinton County HMP Local Planning Team
2.4.2	Structural and Infrastructure	Coordinate with the local municipality and/or the PA Department of Transportation on the potential feasibility of replacing, removing, or enlarging those bridge and culvert stream crossings that were identified during ongoing inventories by the Conservation District and Trout Unlimited, and the Act 167 Stormwater Management Planning process as being unable to pass the 10-year frequency flood flow	Flooding		X		2018-2023	Local	Clinton County HMP Local Planning Team
2.5.1	Structural and Infrastructure	Continue to target, prioritize, and perform acquisitions, relocations, elevations and demolition/reconstruction projects for at-risk structures countywide, completing Hazard Mitigation Opportunity Forms when applicable, and meet with homeowners on the benefits of mitigation.	Flooding		X		Ongoing	HMGP, PDM and FMA	Clinton County Municipalities

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
2.6.1	Local Plans and Regulations	Identify a place where FEMA NFIP Flood Maps and Studies can be stored for easy access to the public and zoning officials.	Flooding		X		Ongoing	Local	Grugan Township and Leidy township
2.6.2	Local Plans and Regulations	Municipalities should store in an easily accessible location and make available for public inspection, their community's Flood Insurance Rate Mapping and associated Flood Insurance Study. Clinton County could provide copies of these maps at the County Offices and/or scan and post current maps on their website for all communities or those unable to provide information on their own website.	Flooding		X		Ongoing	Local	Clinton County Municipalities
2.6.3	Natural Systems Protection	Utilize the Natural Heritage Inventory for future and additional planning purposes.	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
3.2.1	Education and Awareness	Educate community and municipal officials on possible chemical company and environmental disasters.	Environmental Hazards			X	2018-2023	Act 165 Funds	Clinton County DES and Flemington Borough
3.2.2	Local Plans and Regulations	Obtain funding to improve roads within the Township.	Transportation Accidents			X	Ongoing	Local	Beech Creek Township
3.2.3	Education and Awareness	Educate Township officials and the community about floodplain management	Flooding		X		Ongoing	Local and FMA	Clinton County HMP Local Planning Team
3.2.4	Local Plans and Regulations	Obtain funding for flood gauges along Fishing Creek.	Flooding		X		Ongoing	Local	Mill Hall borough
3.2.5	Education and Awareness	Develop a technical proficiency at the municipal level for conducting post-disaster damage assessments	All Hazards		X		Ongoing	Local and EMPG	Clinton County HMP Local Planning Team
3.2.6	Education and Awareness	Develop and implement a mitigation training program for local officials.	All Hazards	X			Ongoing	Local and EMPG	Clinton County HMP Local Planning Team

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
3.3.1	Local Plans and Regulations	Review FEMA NFIP Flood Maps and Studies to become more aware of flood hazards within the Borough and provide information to property owners about Flood Insurance.	Flooding	X			Ongoing	Local	Clinton County Municipalities
3.3.2	Education and Awareness	Disseminate County-wide "advisory" water usage guidelines during times of drought and supply drought information to the public (brochures, news releases, etc.).	Drought		X		Ongoing	Local and EMPG	Clinton County DES
3.3.3	Education and Awareness	Maintain natural hazard risk assessment and mitigation publications/materials at public libraries throughout the County.	All Hazards		X		Ongoing	Local and EMPG	Clinton County DES
3.3.4	Education and Awareness	Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and the guidance documents that were provided as part of the hazard mitigation planning program	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
3.3.5	Education and Awareness	Develop and distribute a public summary of this hazard mitigation plan including relevant information on hazard-prone areas, hazard specific "do's" and "don'ts" and emergency contact information.	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
3.3.6	Education and Awareness	Complete public outreach related to the potential health and safety implications of various hazards events.	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
3.3.7	Local Plans and Regulations	Encourage those critical facilities that are responsible for emergency response efforts to develop and implement an emergency response plan to mitigate all hazard impacts.	All Hazards	X			Ongoing	Local	Clinton County HMP Local Planning Team
3.3.8	Education and Awareness	Clinton County will encourage first responder, government and other organizations with a vision to decrease the opioid epidemic to participate in an opioid prevention group or council to decrease the impact of the epidemic	Opioid Epidemic		X		Ongoing	Local	Clinton County HMP Local Planning Team
3.3.9	Education and Awareness	Clinton County and all municipalities will continue to partner with state and local agencies to identify and implement programs and projects to decrease the impact of invasive species in Clinton County	Invasive Species		X		Ongoing	Local	Clinton County HMP Local Planning Team
4.1.1	Education and Awareness	Provide information to individuals building in forest areas about wildfires.	Wildfires		X		Ongoing	Local	Clinton County HMP Local Planning Team
4.1.2	Education and Awareness	Increase the number of NOAA Weather Alert radios in public places across the County (i.e., municipal buildings, public libraries, police stations, fire stations, etc.).	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
4.1.3	Structural and Infrastructure	Ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level.	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
4.1.4	Structural and Infrastructure	Establish a partnering relationship with the NWS Mid-Atlantic River Forecast Center to enhance the existing Susquehanna River Basin Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program.	Flooding		X		Ongoing	Local	Clinton County HMP Local Planning Team
4.1.5	Structural and Infrastructure	Coordinate with the U.S.G.S., local watershed organizations, and/or the CCCD to increase the number of U.S.G.S. and IFLOWS rain and stream gages in the County.	Flooding			X	Ongoing	Local	Clinton County HMP Local Planning Team
4.2.1	Structural and Infrastructure	Conduct routine inspections, regular maintenance, and annual tests on all communications systems and public alert systems to ensure proper operations during an emergency	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
4.3.1	Education and Awareness	Conduct hazard response practice drills and emergency management training exercises on an annual basis.	All Hazards		X		Ongoing	Local	Clinton County HMP Local Planning Team
5.1.1	Education and Awareness	Continue to conduct training on behaviors faculty and staff should report to the threat assessment team	Transportation accidents	X			2018-2023	Local	Lock Haven University
5.1.2	Education and Awareness	Develop and distribute information via pamphlets, notices in the school media, and via the University web page on protective and preparedness actions students, faculty, and staff can take before any disaster incident	All Hazards	X			2018-2023	Local	Lock Haven University

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
5.1.3	Education and Awareness	Educate students, faculty, and staff on the development of personal response plans, go kits, and University actions addressing key hazards	All Hazards	X			2018-2023	Local	Lock Haven University
6.1.1	Local Plans and Regulations	Review long-term growth/development plans biannually or when related campus and local government plans are updated	All Hazards	X			2018-2023	Local	Lock Haven University
6.1.2	Local Plans and Regulations	Ensure that the University growth and development plans are consistent with the University HMP, the host County Comprehensive Plan, the host County HMP, surrounding jurisdictional land use plans, and other plans, as identified	All Hazards	X			2018-2023	Local	Lock Haven University
6.1.3	Local Plans and Regulations	Collaborate with County and municipal zoning boards to ensure that the University has access to the most recent zoning and construction ordinances and regulations	All Hazards			X	2018-2023	Local	Lock Haven University
6.1.4	Local Plans and Regulations	Identify buildings, exterior walkways, exterior stairwells that are vulnerable to damage or have previous damage from winter storms	Winter Storms			X	2018-2023	Local	Lock Haven University
6.2.1	Local Plans and Regulations	Continue to conduct regular assessments on facilities, buildings and infrastructure to confirm structural integrity and current vulnerability to hazards	All Hazards			X	2018-2023	Local	Lock Haven University
6.2.2	Structural and Infrastructure	Renovate facilities, buildings and infrastructure as funding is available and in accordance with the Campus Facilities Plan	All Hazards			X	2018-2023	Local	Lock Haven University

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
6.2.3	Local Plans and Regulations	Identify cost effective projects to implement for protecting and mitigating the impacts of hazards on facilities, buildings and infrastructure until full renovation can be completed	All Hazards		X		2018-2023	Local	Lock Haven University
6.2.4	Local Plans and Regulations	Secure funding and install a generator for Bentley Hall to ensure continuing food services during emergency response and recovery	All Hazards		X		2018-2023	Local	Lock Haven University
6.2.5	Local Plans and Regulations	Secure funding and install protective systems to prevent and/or mitigate financial losses due to the impact of hazards on electrical and mechanical systems	Utility Interruptions	X			2018-2023	Local	Lock Haven University
6.2.6	Local Plans and Regulations	Secure additional funding as needed to address previous winter storm damage or utilize available funding to bolster winter storm response assets (plows, ice melt, etc.)	Winter Storms			X	2018-2023	Local	Lock Haven University
6.3.1	Local Plans and Regulations	Conduct an assessment on any campus natural resources and open space areas to determine current vulnerability to hazards	All Hazards			X	2018-2023	Local	Lock Haven University
6.3.2	Local Plans and Regulations	Identify mitigation projects to implement, based on priorities from the natural resources and open space areas assessment	All Hazards			X	2018-2023	Local	Lock Haven University
6.3.3	Local Plans and Regulations	Coordinate with the Facilities Department and Campus Events to implement mitigation projects in natural and open space areas	All Hazards		X		2018-2023	Local	Lock Haven University

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
6.3.4	Local Plans and Regulations	Conduct a Flood Mitigation Study and develop an Implementation Plan for mitigation actions related to the land and surrounding roadways at Sieg Conference Center	Flooding		X		2018-2023	Local	Lock Haven University
6.4.1	Local Plans and Regulations	Conduct a thorough critical facilities vulnerability assessment and impact analysis	All Hazards	X			2018-2023	Local	Lock Haven University
6.4.2	Local Plans and Regulations	Develop a comprehensive Continuity of Operations Plan for University operations and services.	All Hazards		X		2018-2023	Local	Lock Haven University
6.4.3	Local Plans and Regulations	Continue to maintain emergency procedures and policies, such as essential employee identification and closing procedures, on an annual basis	All Hazards	X			2018-2023	Local	Lock Haven University
6.4.4	Local Plans and Regulations	Identify and implement the measures necessary to become a StormReady community	All Hazards			X	2018-2023	Local	Lock Haven University
7.1.1	Local Plans and Regulations	Identify and assess the requirements for people with access and functional needs (PAFN) who reside or attend functions on campus	All Hazards			X	2018-2023	Local	Lock Haven University
7.1.2	Local Plans and Regulations	Review and revise, as necessary, protection, preparedness, response and recovery plans and activities to ensure PAFN requirements are addressed	All Hazards	X			2018-2023	Local	Lock Haven University
7.1.3	Local Plans and Regulations	Develop comprehensive all hazards Evacuation and Shelter-in-Place Plans for the LHU Main Campus and Sieg Conference Center	All Hazards			X	2018-2023	Local	Lock Haven University
8.1.1	Local Plans and Regulations	Encourage mitigation project suggestions from students, faculty, and staff on an annual basis	All Hazards			X	2018-2023	Local	Lock Haven University

Clinton County 2018 Mitigation Action Plan									
Action Number	Mitigation Actions			Prioritization			Implementation		
	Category	Description/ Action Items	Hazard Vulnerability	High	Medium	Low	Schedule	Funding	Responsibility
8.1.2	Local Plans and Regulations	Continue to elicit support for the University HMP and mitigation projects from government and public stakeholders	All Hazards	X			2018-2023	Local	Lock Haven University
8.2.1	Local Plans and Regulations	Encourage the involvement of relevant academic and administrative departments with HMP revisions	All Hazards			X	2018-2023	Local	Lock Haven University
8.2.2	Local Plans and Regulations	Continue to provide participation opportunities in the HMP for all campus community members	All Hazards			X	2018-2023	Local	Lock Haven University
8.3.1	Local Plans and Regulations	Encourage the involvement of local industries/organizations with HMP revisions	All Hazards			X	2018-2023	Local	Lock Haven University
8.3.2	Local Plans and Regulations	Coordinate with host County and municipal governments to ensure consistency between the University HMP and the County HMP, County Comprehensive Plan, County/municipal EOPs, and other related plans	All Hazards		X		2018-2023	Local	Lock Haven University
8.3.3	Local Plans and Regulations	Attend County public meetings during the County HMP update process	All Hazards	X			2018-2023	Local	Lock Haven University

Funding acronym definitions:

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 64 - Municipal Hazard Mitigation Actions Checklist

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.1.1**	**1.1.2**	**1.3.1**	**1.3.2**	**1.3.3**	**1.3.4**	**1.3.5**	**1.3.6**	**1.3.7**	**1.4.1**
Allison Township	x	x	x		x	x	x	x	x	x
Avis Borough	x	x	x		x	x	x	x	x	x
Bald Eagle Township	x	x	x		x	x	x	x	x	x
Beech Creek Borough	x	x	x		x	x	x	x	x	x
Beech Creek Township	x	x	x		x	x	x	x	x	x
Castanea Township	x	x	x	x	x	x	x	x	x	x
Chapman Township	x	x	x		x	x	x	x	x	x
Colebrook Township	x	x	x		x	x	x	x	x	x
Crawford Township	x	x	x		x	x	x	x	x	x
Dunnstable Township	x	x	x		x	x	x	x	x	x
East Keating Township	x	x	x		x	x	x	x	x	x
Flemington Borough	x	x	x		x	x	x	x	x	x
Gallagher Township	x	x	x		x	x	x	x	x	x
Greene Township	x	x	x	x	x	x	x	x	x	x
Grugan Township	x	x	x		x	x	x	x	x	x
Lamar Township	x	x	x		x	x	x	x	x	x
Leidy Township	x	x	x		x	x	x	x	x	x
Lock Haven City	x	x	x	x	x	x	x	x	x	x
Lock Haven University	x	x	x		x	x	x	x	x	x
Logan Township	x	x	x		x	x	x	x	x	x
Loganton Borough	x	x	x		x	x	x	x	x	x
Mill Hall Borough	x	x	x		x	x	x	x	x	x
Noyes Township	x	x	x		x	x	x	x	x	x
Pine Creek Township	x	x	x		x	x	x	x	x	x
Porter Township	x	x	x		x	x	x	x	x	x
Renovo Borough	x	x	x		x	x	x	x	x	x
South Renovo Borough	x	x	x		x	x	x	x	x	x
Wayne Township	x	x	x	x	x	x	x	x	x	x
West Keating Township	x	x	x		x	x	x	x	x	x
Woodward Township	x	x	x		x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.1.1**	**1.1.2**	**1.3.1**	**1.3.2**	**1.3.3**	**1.3.4**	**1.3.5**	**1.3.6**	**1.3.7**	**1.4.1**
Clinton County	x	x	x		x	x	x	x		x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**1.4.2**	**1.4.3**	**1.4.4**	**2.1.1**	**2.2.1**	**2.3.1**	**2.3.2**	**2.3.3**	**2.3.4**	**2.3.5**
Allison Township				x	x			x		
Avis Borough				x	x			x		
Bald Eagle Township				x	x			x		
Beech Creek Borough				x	x			x		
Beech Creek Township				x	x			x		
Castanea Township				x	x			x		
Chapman Township				x	x			x		
Colebrook Township				x	x			x		
Crawford Township				x	x			x		
Dunnstable Township				x	x			x		
East Keating Township				x	x			x		
Flemington Borough				x	x			x		
Gallagher Township				x	x			x		
Greene Township				x	x			x		
Grugan Township				x	x			x		
Lamar Township				x	x			x		
Leidy Township				x	x	x	x	x		
Lock Haven City				x	x			x		
Lock Haven University				x	x			x		
Logan Township				x	x			x		
Loganton Borough				x	x			x		
Mill Hall Borough				x	x			x		
Noyes Township				x	x	x	x	x		
Pine Creek Township				x	x			x		
Porter Township				x	x			x		
Renovo Borough				x	x	x	x	x		
South Renovo Borough				x	x			x		
Wayne Township				x	x			x		
West Keating Township				x	x			x		
Woodward Township				x	x			x		
Clinton County	x	x	x	x	x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**2.3.6**	**2.4.1**	**2.4.2**	**2.5.1**	**2.6.1**	**2.6.2**	**2.6.3**	**3.2.1**	**3.2.2**	**3.2.3**
Allison Township				x		x				
Avis Borough				x		x				
Bald Eagle Township				x		x				
Beech Creek Borough				x		x				
Beech Creek Township				x		x			x	
Castanea Township				x		x				
Chapman Township				x		x				
Colebrook Township				x		x				
Crawford Township				x		x				
Dunnstable Township				x		x				
East Keating Township				x		x				
Flemington Borough				x		x		x		
Gallagher Township				x		x				
Greene Township				x		x				
Grugan Township				x	x	x				
Lamar Township				x		x				
Leidy Township				x	x	x				
Lock Haven City				x		x				
Lock Haven University				x		x				
Logan Township				x		x				
Loganton Borough				x		x				
Mill Hall Borough				x		x				
Noyes Township				x		x				
Pine Creek Township				x		x				
Porter Township				x		x				
Renovo Borough				x		x				
South Renovo Borough				x		x				
Wayne Township				x		x				
West Keating Township				x		x				
Woodward Township				x		x				
Clinton County	x	x	x	x	x	x	x	x		x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**3.2.4**	**3.2.5**	**3.2.6**	**3.3.1**	**3.3.2**	**3.3.3**	**3.3.4**	**3.3.5**	**3.3.6**	**3.3.7**
Allison Township		x		x	x	x	x		x	x
Avis Borough		x		x	x	x	x		x	x
Bald Eagle Township		x		x	x	x	x		x	x
Beech Creek Borough		x		x	x	x	x		x	x
Beech Creek Township		x		x	x	x	x		x	x
Castanea Township		x		x	x	x	x		x	x
Chapman Township		x		x	x	x	x		x	x
Colebrook Township		x		x	x	x	x		x	x
Crawford Township		x		x	x	x	x		x	x
Dunnstable Township		x		x	x	x	x		x	x
East Keating Township		x		x	x	x	x		x	x
Flemington Borough		x		x	x	x	x		x	x
Gallagher Township		x		x	x	x	x		x	x
Greene Township		x		x	x	x	x		x	x
Grugan Township		x		x	x	x	x		x	x
Lamar Township		x		x	x	x	x		x	x
Leidy Township		x		x	x	x	x		x	x
Lock Haven City		x		x	x	x	x		x	x
Lock Haven University		x		x	x	x	x		x	x
Logan Township		x		x	x	x	x		x	x
Loganton Borough		x		x	x	x	x		x	x
Mill Hall Borough	x	x		x	x	x	x		x	x
Noyes Township		x		x	x	x	x		x	x
Pine Creek Township		x		x	x	x	x		x	x
Porter Township		x		x	x	x	x		x	x
Renovo Borough		x		x	x	x	x		x	x
South Renovo Borough		x		x	x	x	x		x	x
Wayne Township		x		x	x	x	x		x	x
West Keating Township		x		x	x	x	x		x	x
Woodward Township		x		x	x	x	x		x	x
Clinton County		x	x	x	x	x	x	x	x	x

Municipal Hazard Mitigation Actions Checklist										
Municipality	**3.3.8**	**3.3.9**	**4.1.1**	**4.1.2**	**4.1.3**	**4.1.4**	**4.1.5**	**4.2.1**	**4.3.1**	**5.1.1**
Allison Township	x	x	x	x	x	x			x	
Avis Borough	x	x	x	x	x	x			x	
Bald Eagle Township	x	x	x	x	x	x			x	
Beech Creek Borough	x	x	x	x	x	x			x	
Beech Creek Township	x	x	x	x	x	x			x	
Castanea Township	x	x	x	x	x	x			x	
Chapman Township	x	x	x	x	x	x			x	
Colebrook Township	x	x	x	x	x	x			x	
Crawford Township	x	x	x	x	x	x			x	
Dunnstable Township	x	x	x	x	x	x			x	
East Keating Township	x	x	x	x	x	x			x	
Flemington Borough	x	x	x	x	x	x			x	
Gallagher Township	x	x	x	x	x	x			x	
Greene Township	x	x	x	x	x	x			x	
Grugan Township	x	x	x	x	x	x			x	
Lamar Township	x	x	x	x	x	x			x	
Leidy Township	x	x	x	x	x	x			x	
Lock Haven City	x	x	x	x	x	x			x	
Lock Haven University	x	x	x	x	x	x			x	x
Logan Township	x	x	x	x	x	x			x	
Loganton Borough	x	x	x	x	x	x			x	
Mill Hall Borough	x	x	x	x	x	x			x	
Noyes Township	x	x	x	x	x	x			x	
Pine Creek Township	x	x	x	x	x	x			x	
Porter Township	x	x	x	x	x	x			x	
Renovo Borough	x	x	x	x	x	x			x	
South Renovo Borough	x	x	x	x	x	x			x	
Wayne Township	x	x	x	x	x	x			x	
West Keating Township	x	x	x	x	x	x			x	
Woodward Township	x	x	x	x	x	x			x	
Clinton County	x	x	x	x	x	x	x	x	x	

Municipal Hazard Mitigation Actions Checklist										
Municipality	**5.1.2**	**5.1.3**	**6.1.1**	**6.1.2**	**6.1.3**	**6.1.4**	**6.2.1**	**6.2.2**	**6.2.3**	**6.2.4**
Allison Township										
Avis Borough										
Bald Eagle Township										
Beech Creek Borough										
Beech Creek Township										
Castanea Township										
Chapman Township										
Colebrook Township										
Crawford Township										
Dunnstable Township										
East Keating Township										
Flemington Borough										
Gallagher Township										
Greene Township										
Grugan Township										
Lamar Township										
Leidy Township										
Lock Haven City										
Lock Haven University	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Logan Township										
Loganton Borough										
Mill Hall Borough										
Noyes Township										
Pine Creek Township										
Porter Township										
Renovo Borough										
South Renovo Borough										
Wayne Township										
West Keating Township										
Woodward Township										
Clinton County										

Municipal Hazard Mitigation Actions Checklist										
Municipality	**6.2.5**	**6.2.6**	**6.3.1**	**6.3.2**	**6.3.3**	**6.3.4**	**6.4.1**	**6.4.2**	**6.4.3**	**6.4.4**
Allison Township										
Avis Borough										
Bald Eagle Township										
Beech Creek Borough										
Beech Creek Township										
Castanea Township										
Chapman Township										
Colebrook Township										
Crawford Township										
Dunnstable Township										
East Keating Township										
Flemington Borough										
Gallagher Township										
Greene Township										
Grugan Township										
Lamar Township										
Leidy Township										
Lock Haven City										
Lock Haven University	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Logan Township										
Loganton Borough										
Mill Hall Borough										
Noyes Township										
Pine Creek Township										
Porter Township										
Renovo Borough										
South Renovo Borough										
Wayne Township										
West Keating Township										
Woodward Township										
Clinton County										

Municipal Hazard Mitigation Actions Checklist										
Municipality	**7.1.1**	**7.1.2**	**7.1.3**	**8.1.1**	**8.1.2**	**8.2.1**	**8.2.2**	**8.3.1**	**8.3.2**	**8.3.3**
Allison Township										
Avis Borough										
Bald Eagle Township										
Beech Creek Borough										
Beech Creek Township										
Castanea Township										
Chapman Township										
Colebrook Township										
Crawford Township										
Dunnstable Township										
East Keating Township										
Flemington Borough										
Gallagher Township										
Greene Township										
Grugan Township										
Lamar Township										
Leidy Township										
Lock Haven City										
Lock Haven University	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Logan Township										
Loganton Borough										
Mill Hall Borough										
Noyes Township										
Pine Creek Township										
Porter Township										
Renovo Borough										
South Renovo Borough										
Wayne Township										
West Keating Township										
Woodward Township										
Clinton County										

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. Action numbers1.1.2; 2.1.1; 2.2.1; 2.3.1; 2.3.3; 2.5.1; 2.6.1; 2.6.2; 3.2.3; 3.3.1 and 6.3.4 comply for Clinton County and all its municipalities.

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 Clinton 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 Clinton County HMP Local Planning Team decided to alter the current maintenance procedures. The 2018 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 2018 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 Clinton County is a responsibility of all levels of government (i.e., county and local), as well as the citizens of the county. The Clinton 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 and the university will 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 circumstances 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 next 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 Clinton 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 Clinton County Department of Emergency Services will maintain a copy of these records and place them in Appendix J of this plan. Clinton 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 Clinton County Department of Emergency Services will ensure that the 2018 Clinton County Hazard Mitigation Plan is posted and maintained on the Clinton County website and will continue to encourage public review and comment on the plan. The Clinton County website that the plan will be located at is as follows: www.clintoncountypa.com/departments/emergency_services/des/

The public will have access to the 2018 HMP through their local municipal office, the Clinton County Planning Department, or the Clinton County Department of Emergency Services. Information on upcoming events related to the HMP or solicitation for comments will be announced via newsletters, newspapers, mailings, and the county website.

The citizens of Clinton County are encouraged to submit their comments to elected officials and/or members of the Clinton County HMP Local Planning Team. To promote public participation, the Clinton 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 Clinton 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 2018 Clinton 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: 2018 HAZUS Reports

APPENDIX G: 2018 Mitigation Project Opportunities

APPENDIX H: 2018 Mitigation Action Evaluation & Prioritization

APPENDIX I: Dam Failure Profile

APPENDIX J: Annual Review Documentation

APPENDIX K: Clinton County & Municipal Adoption Resolutions