# Tioga County 2022 Hazard Mitigation Plan

*Image provided by Rusty Glessner*


Prepared for:

Tioga County Department of Emergency Services

99 William Farrell Drive

Wellsboro, PA 16901

Prepared by:

MCM Consulting Group, Inc.

2595 Clyde Avenue, Suite #1

State College, PA 16801

## Certification of Annual Review Meetings

| YEAR | DATE OF MEETING | PUBLIC OUTREACH ADDRESSED? * | SIGNATURE |
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| 2022 | | | |
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**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) |
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| **REMINDER:** ***Please attach all associated meeting agendas, sign-in sheets, handouts and minutes.*** | | | |

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# Executive Summary

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. Hazard mitigation focuses attention and resources on county and municipal policies and actions that will produce successive benefits over time. State and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural as well as human caused hazards and develop long-term strategies for protecting people and property from future hazard events. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage. This plan represents the work of citizens, elected and appointed government officials, business leaders, and volunteer and nonprofit groups to protect community assets, preserve the economic viability of the community, and save lives.

In 2021, Tioga County Department of Emergency Services contracted the services of a consulting agency to revise and update the Tioga County Hazard Mitigation Plan. The plan was successfully updated in accordance with the requirements set forth by the Pennsylvania Emergency Management Agency (PEMA) and the Federal Emergency Management Agency (FEMA). The updated Tioga County Hazard Mitigation Plan was adopted by the Tioga County Commissioners in 2022.

The Tioga County Commissioners secured a grant to complete the 2022 update to the Tioga County Hazard Mitigation Plan. MCM Consulting Group, Inc. was hired to assist the county with the update of the plan. The planning kick-off meeting was conducted March 23, 2021.

The planning process for the 2022 Tioga County Hazard Mitigation Plan Update consisted of the following:

- Identification and prioritization of the hazards that may affect the county and its municipalities.
- Assessment of the county's and municipalities' vulnerability to these hazards.
- Identification of the mitigation actions and projects that can reduce that vulnerability.
- Development of a strategy for implementing the actions and projects, including identifying the agency(ies) responsible for that implementation.

Throughout the planning process, the general-public was given the opportunity to comment on the existing HMP and provide suggestions for the updated version. Due to COVID-19, public meetings were conducted via an online media to provide residents an opportunity to provide input on the HMP. Several meetings were held virtually, and participants were invited to submit surveys and other documents via an online survey.

The following hazards were identified by the local planning team as presenting the highest risk to the county and its municipalities:

- Drought

- Earthquake
- Extreme Temperature
- Flood, Flash Flood, and Ice Jam
- Invasive Species
- Landslide
- Pandemic, Epidemic, and Infectious Disease
- Solar Flare
- Subsidence and Sinkhole
- Tornado and Windstorm
- Wildfire
- Winter Storm
- Civil Disturbance/Criminal Activity
- Dam Failure
- Emergency Services
- Opioid Epidemic
- Environmental Hazards
- Disorientation
- Terrorism/Cyber Attack
- Transportation Accidents and Transportation HazMat
- Utility Interruption

A total of twenty-one hazards are identified in the 2022 Tioga County Hazard Mitigation Plan. A total of eighteen identified hazards were listed in the previous 2017 plan update. New hazards identified in this plan include civil disturbance/criminal activity, emergency services, opioid epidemic, disorientation, and utility interruption. Cyber-attack was included with terrorism; industrial, petroleum and gas well incident was renamed environmental hazards and incorporated CBRNE – Chemical, Biological, Radiological, Nuclear, Explosives.

To mitigate against the effects of these hazards, the local planning team identified the following goals for hazard mitigation over the next five years:

1. Reduce the level of risk to life and property from natural and human-caused disasters in Tioga County.
2. Reduce the potential impact to life and property from natural and human-caused disasters in Tioga County.
3. Increase the level of capabilities to protect life safety and property from natural and human-caused disasters in Tioga County.
4. Protect existing natural resources and open space, including parks and wetlands to improve their flood control functions.

5. Increase public awareness of existing hazards and communicate the differences between individual and municipal responsibilities for taking action to mitigate those hazards.
6. Participate in FEMA's High-Hazard Potential Dam Program (HHPD).

Mitigation actions are specific projects and activities that help achieve goals. A total of seventy-four actions were developed for this plan update as they pertain to hazards identified by the local planning team. The 2017 Tioga County Hazard Mitigation Plan consisted of sixty-seven total actions. The individual objectives and actions that will be implemented are shown in section 6.4. Each municipality was provided the opportunity to submit new project opportunity forms for this update. Municipalities were asked to indicate the current status of the projects submitted in 2017, of which ten indicated completed projects. A total of thirty-nine project opportunities were submitted for this plan update.

The 2022 Tioga County Hazard Mitigation Plan is the cornerstone to reducing Tioga County's vulnerability to disasters. It is the commitment to reducing risks form hazards and serves as a guide for decision makers as they commit resources to reducing the effects of hazards. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage, reconstruction, and repeated damage.

The 2022 Tioga County Hazard Mitigation Plan is a living document that reflects ongoing hazard mitigation activities and requires monitoring, evaluating, and updating to ensure the mitigation actions are implemented. To facilitate the hazard mitigation planning process and adhere to regulatory requirements, the plan will be reviewed annually, and any major revisions will be incorporated into the five-year update.

# 1. Introduction

## 1.1. Background

The Tioga 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 Tioga County and all of its thirty-nine municipalities. Tioga County Department of Emergency Services and Tioga County Planning Commission were charged by the County Board of Commissioners to prepare the 2022 plan. The 2017 HMP has been utilized and maintained during the five-year life cycle.

The Tioga 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 Tioga County as a sub-grantee. The Tioga County Commissioners assigned Tioga 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 Tioga County. This updated HMP will provide another solid foundation for the Tioga 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:

- Protect life, safety, and property by reducing the potential for future damages and economic loss that result from hazards.
- Qualify for additional grant funding, in both the pre-disaster and the post-disaster environment.
- Speed recovery and redevelopment following future disaster events.

- Demonstrate a firm local commitment to hazard mitigation principles.
- Comply with both state and federal legislative requirements for local hazard mitigation plans.

## 1.3. Scope

This Tioga County Multi-Jurisdictional Hazard Mitigation Plan serves as a framework for saving lives, protecting assets and preserving the economic viability of the thirty-nine municipalities in Tioga County. The HMP outlines actions designed to address and reduce the impact of a full range of natural hazards facing Tioga County, including drought, earthquakes, flooding, tornadoes, 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 Tioga 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
- FEMA Rehabilitation of High Hazard Potential Dams: Grant Program Guidance, June 2020

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: All-Hazard Mitigation Planning Standard Operating Guide, 2020.

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

Tioga County is located in the central northern region of Pennsylvania, sharing its northern border with the state of New York. The county has a total area of 1,137 square miles which 3.2 square miles is water, and the remaining 1,134 square miles is land. The county is adjacent to the counties of Steuben County, New York to the north; Chemung County, New York to the northeast; Bradford County to the east; Lycoming County to the south; Potter County to the west. A base map of Tioga County is provided in *Figure 3 - Tioga County Base Map*. Tioga County is predominantly rural with Wellsboro being the county seat. It is considered the fourth-largest county in Pennsylvania by land area.

Tioga County has its name derived from the Native American word meaning "the forks of a stream", honors the Tioga River that runs through the county. Tioga County is known for its recreational landmarks that are located within the county that attract many from all over the state of Pennsylvania. Hills Creek State Park is located several miles north of U.S. Route 6 between the municipalities of Wellsboro and Mansfield borough in Charleston Township. Colton Point State Park and Leonard Harrison State Park are both part of the Pennsylvania Grand Canyon that is carved by Pine Creek in Tioga County. Wellsboro lies just twelve miles east of the Pennsylvania Grand Canyon, one of the state's most natural attractions. The PA Grand Canyon is surrounded by about 165,000 acres of Tioga State Forests. The Grand Canyon begins south of Ansonia along U.S. Route 6 and continues for approximately 47 miles. The maximum depth of the canyon is 1,450 feet at Waterville, near the southern end. At Leonard Harrison and Colton Point State Parks, the depth is more than 800 feet. Leonard Harrison and Colton Point State Parks are on opposite sides of the PA Grand Canyon. With the seven lakes and thousands of acres of state forest land throughout the county, tourists enjoy visiting to experience the natural beauty within the county of Tioga. *Figure 5 - Recreation Features* indicates the various areas in Tioga County that are related to recreational use.

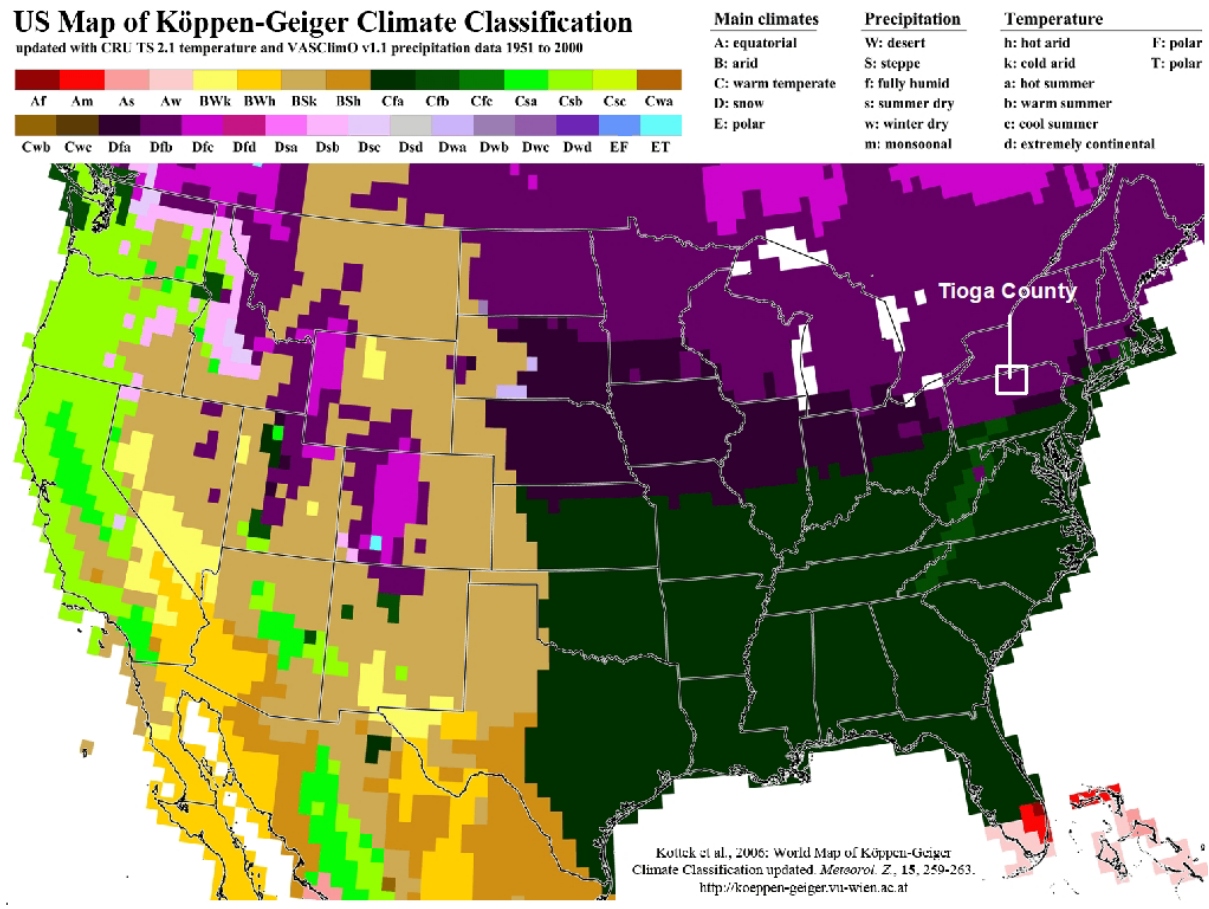
Because of its vast natural resources, Tioga County has been and continues to grow in popularity as a tourist destination. Ample recreation opportunities such as bicycling, camping, fishing, hiking, hunting, boating, swimming, cross-country skiing, and scenic drives are available through the county, making Tioga County popular year around.

There are six large watersheds in Tioga County. The watersheds include Chemung, Lower West Branch Susquehanna, Middle West Brand Susquehanna, Pine, Tioga, and Upper Susquehanna Tunkhannock. Pine and Tioga are the two biggest watersheds within the county. *Figure 6 – Large Watershed Map* illustrates the watersheds within Tioga County.

The climate in Tioga County is characterized as a warm-summer humid continental climate (a *Dfb* classification on the Köppen-Geiger Climate System). The Koppen-Geiger Climate Areas

map classifies Tioga County and the rest of Pennsylvania as Humid Continental. *Figure 1 – Koppen-Geiger Climate Map* demonstrates the climate classifications around the country.

*Figure 1 - Koppen-Geiger Climate Map*




Tioga County has an average low of 14.1°F around the month of January and an average high of 80.1°F around the month of July. January and February are considered to be the least comfortable months experienced in the county while June and July are considered the most pleasant months. The average snowfall for the county is about 50.7 inches of snow. January is the snowiest month in Tioga with 12.4 inches of snow a month. There is six months out of the year that have significant snowfall in Tioga County. The average rainfall for the county is about 38.1 inches of rain. June is considered the wettest month in the county with an average of 4.5 inches of rain. July is the second wettest month with an average of 4.0 inches of rainfall.

## 2.2. Community Facts

Tioga County was created on March 26th, 1804 from part of Lycoming County. Wellsboro, known as the county seat, was laid out in 1806 and incorporated as a borough on March 6th, 1830. It was named for the Wells family. In 1808, the county commissioners were first elected

and in 1812 the court was fully organized for judicial purposes. The soldiers on the Continental Army's Sullivan Expedition in 1779 saw the potential of the area, but not until the Trenton Decree in 1782 abolished Connecticut's claims and the Ft. Stanwix Treaty of 1784 took title away from the Indians, did many settlers arrive. The county was originally settled by migrants from New England and western parts of New York. With the source of the Tioga River, New England settlers poured over the Allegheny Mountains. Tioga County was largely culturally contiguous with New England culture, which was influential across the Northern Tier of the United States through its migrants. In the late 19th and early 20th centuries, the county accepted more immigrants from Ireland, Germany, and eastern Europe, who came to work in the coal mines. A number of the immigrants were Roman Catholic, which introduced more diversity into the mixture of religions in the county. The boroughs and townships in Tioga County were incorporated and settled after the creation of the county in 1804, as seen in *Table 1 – Municipality Establishments for Tioga County.*

*Table 1 - Municipality Establishments for Tioga County*

| Municipality Establishments for Tioga County | | | |
|---|---|---|---|
| **Boroughs** | | | |
| **Name of Borough** | **Incorporated** | **Settled** | **Incorporated From** |
| Blossburg | 1871 | 1802 | Covington Township |
| Elkland | 1850 | 1806 | Elkland Township |
| Knoxville | 1851 | 1835 | Deerfield Township |
| Lawrenceville | 1831 | 1793 | Lawrence Township |
| Liberty | 1893 | N/A | Liberty Township |
| Mansfield | 1857 | 1824 | Richmond Township |
| Roseville | 1876 | 1806 | Rutland Township |
| Tioga | 1860 | 1798 | Tioga Township |
| Wellsboro | 1830 | 1806 | Delmar Township |
| Westfield | 1867 | 1809 | Westfield Township |
| **Townships** | | | |
| **Name of Township** | **Incorporated** | **Settled** | **Incorporated From** |
| Bloss | 1841 | 1806 | Covington Township |
| Brookfield | 1827 | 1809 | Westfield Township |
| Charleston | 1820 | 1842 | Delmar Township |
| Chatham | 1828 | 1818 | Deerfield Township |
| Clymer | 1850 | 1815 | Westfield Township |
| Covington | 1815 | 1801 | Tioga Township |
| Deerfield | 1814 | 1785 | Delmar Township |
| Delmar | 1808 | 1802 | N/A |
| Duncan | 1873 | 1870 | Delmar Township |
| Elk | 1856 | 1799 | Delmar and Morris Township |
| Farmington | 1830 | 1820 | Elkland Township |
| Gaines | 1837 | 1804 | Shippen Township |

| Name of Township | Incorporated | Settled | Incorporated From |
|---|---|---|---|
| Hamilton | 1871 | 1853 | Bloss and Ward Township |
| Jackson | 1815 | 1800 | Tioga Township |
| Lawrence | 1816 | 1816 | Tioga and Elkland Township |
| Liberty | 1823 | 1792 | Covington and Delmar Township |
| Middlebury | 1822 | 1800 | Delmar and Elkland Township |
| Morris | 1824 | 1800 | Delmar Township |
| Nelson | 1857 | 1800 | Elkland Township |
| Osceola | 1857 | 1795 | Elkland Township |
| Putnam | 1892 | N/A | N/A |
| Richmond | 1824 | 1794 | Covington Township |
| Rutland | 1828 | 1806 | Sullivan and Jackson Township |
| Shippen | 1823 | 1804 | Delmar Township |
| Sullivan | 1816 | 1806 | Covington Township |
| Tioga | 1797 | 1792 | Incorporated while part of Lycoming County |
| Union | 1830 | 1803 | Sullivan Township |
| Ward | 1852 | 1837 | Sullivan Township |
| Westfield | 1821 | 1794 | Deerfield Township |

The following boroughs and townships are found today in Tioga County:

**Boroughs (10):**

- Blossburg
- Elkland
- Knoxville
- Lawrenceville
- Liberty
- Mansfield
- Roseville
- Tioga
- Wellsboro
- Westfield

**Townships (29):**

- Bloss
- Brookfield
- Charleston
- Chatham
- Clymer
- Covington
- Deerfield
- Delmar
- Duncan
- Elk
- Farmington
- Gaines
- Hamilton
- Jackson
- Lawrence
- Liberty
- Middlebury
- Morris
- Nelson
- Osceola
- Putnam
- Richmond
- Rutland
- Shippen
- Sullivan
- Tioga
- Union
- Ward
- Westfield

Mining for coal began in 1802 when Aaron Bloss settled in Blossburg. In 1807, forestry and agriculture controlled the economy for a while until gristmills, sawmills, distilleries, and iron works appear in the 1840s which caused significant economic growth in the county. Also in 1840s, the Corning and Blossburg Railroad had opened. By 1883, the railroads connected coal fields with outlets on all four sides of the county. Tobacco production and cigar making flourished from 1880 to 1900. Celery was a major product from 1900 to 1950. In the 1930s, natural gas was discovered, sold off, and is now exhausted. Today, dairying, corn, and maple sugar produce income. Farms cover about 31% of Tioga County. In the years 1987 to 1992, the value added to the economy as the manufacturers increased by 71%. Therefore, there were many industries and manufacturers during the early settlement of Tioga County that were major aspects toward the economy. Today, some of these industries are either not as critical toward the economy or have completely vanished altogether.

As of the years prior to the COVID-19 pandemic, the county was at a minimum unemployment rate of 4.8% in the years 2018 and 2019. This low unemployment was just above the Pennsylvania minimum unemployment rate of 4.3%. Once the COVID-19 pandemic had hit, Tioga County's unemployment rate skyrocketed to a county's maximum of 15.0% for the unemployment rate. This rate was almost as high as the Pennsylvania unemployment rate of 16.2%. The COVID-19 pandemic and the high employment rates have added a huge burden to the economy and industries in Tioga County. This can be attributed to the shutting of businesses, cutbacks at companies, and the closure of restaurants / bars. The hardest hit industries during the downturn of the economy during the COVID-19 pandemic were the service industries, i.e. retail, food service, tourism, and entertainment industries. The tourist industry that is the major source of income for the county was significantly damaged by travel restrictions and social distancing regulations brought about by the pandemic. These measures have proven essential to stop the spread of COVID-19 but have also severely hurt the industry and businesses that rely upon tourists. However, in the year 2021, based on data prior to April 2021, the unemployment rate dropped to only 6.8%, but is still higher than before the hit of the pandemic. As of year 2021, there is about 17,400 employed Tioga County residents while 1,300 are still unemployed.

*Table 2 - Tioga County Top Fifty Employers*

| Tioga County Top Fifty Employers | | | |
|---|---|---|---|
| **Rank** | **Employer Name** | **Rank** | **Employer Name** |
| 1 | UPMC Susquehanna Soldiers & Sailors | 26 | Goodwill Industries of North Central PA |
| 2 | Ward Manufacturing, LLC | 27 | Acorn Markets Inc |
| 3 | PA State System of Higher Education | 28 | Penn-Wells Hotel |
| 4 | Northern Tioga School District | 29 | Electri-Cord Manufacturing Co |
| 5 | State Government | 30 | Keck's Food Service |
| 6 | Southern Tioga School District | 31 | Dominion Energy Transmission Inc |
| 7 | Wal-Mart Associates, Inc. | 32 | Rakoski Enterprises Inc |
| 8 | Tioga County Commissioners | 33 | Martha Lloyd Community Residential Facility |

| Rank | Employer Name | Rank | Employer Name |
|---|---|---|---|
| 9 | Wellsboro Area School District | 34 | Tyoga Container Co Inc |
| 10 | Tapco International Corporation | 35 | Rwls LLC |
| 11 | Truck Lite Co, LLC | 36 | Dolgencorp LLC |
| 12 | MedPlast Engineered Products Inc | 37 | Concern-Prof Svcs for Children |
| 13 | Federal Government | 38 | Costys Energy Services LLC |
| 14 | Citizens & Northern Bank | 39 | Tops Pt LLC |
| 15 | BJ Inspections Inc | 40 | C&T Enterprises |
| 16 | Broad Acres Nursing Home Association | 41 | Kingdom Inc |
| 17 | AIPHC Holding Company LLC | 42 | Bradford Tioga Head Start Inc |
| 18 | Lowe's Home Centers LLC | 43 | MetalKraft Industries Inc |
| 19 | First Citizens Community Bank | 44 | Gas Field Specialists Inc |
| 20 | The Green Home | 45 | Housing Auth of Bradford & Tioga |
| 21 | Hitachi Metals | 46 | Guthrie Medical Group PC |
| 22 | Partners in Progress | 47 | Workover Solutions Inc |
| 23 | GIW Enterprises | 48 | Mountain Laurel Recovery Center |
| 24 | Weis Markets Inc | 49 | The Wood Company |
| 25 | Service Access & Management Inc | 50 | Dandy Mini Marts Inc |

A great majority of the occupations and source of income for the county come from production occupations, management occupations, education occupations, and recreational related occupations. The Marcellus shale is another area that employment and income is high in the county as well. Compared to other counties, Tioga County has an unusually high number of Mining, Quarrying, & Oil/Gas Extraction (4.67 times higher than expected) due to the Marcellus shale. The highest paying industries in Tioga County, by median earnings, is Mining, Quarrying, & Oil/Gas Extraction. In 2012, Tioga County Commissioners approved a Marcellus shale impact fee ordinance. In 2014, there were 839 Marcellus shale wells in Tioga County. *Table 2 – Tioga County Top Fifty Employers* indicates the high employers found within the county for employment.

There are various public and private schools within Tioga County. Additionally, there is one high education institution in Tioga County. Mansfield University in Mansfield is one of the members of the Pennsylvania State System of Higher Education. In 2019, Mansfield University of Pennsylvania awarded 445 degrees with $7,716 in-state tuition and $10,032 out-of-state tuition. The most popular majors at Mansfield University of Pennsylvania are registered nursing (15.1%), general psychology (9.66%), and criminal justice – law enforcement administration (8.31%). This institution and the other educational facilities create a lot of employment in the county. The public-school districts include Northern Tioga School District, Southern Tioga School District, and Wellsboro Area School District. Along with the five public school districts, there are numerous private schools as well.

## 2.3. Population and Demographics

Tioga County is ranked fifty-third in terms of population within the Commonwealth of Pennsylvania. Tioga County has a population of 41,981 for the 2010 census and a population of 40,591 for the 2019 census. There are no official population statistics for the year of 2020 as the United States Census was delayed due to the worsening of the COVID-19 pandemic in the United States. A data brief released by the Pennsylvania State Data Center, based at Penn State Harrisburg's Institute of State and Regional Affairs, reported that Mansfield Borough in Tioga County had the greatest percentage decrease (-18.1%) for the state. The data brief noted the change in population from 2010 to 2020, noting that this is not the official 2020 census counts, it is just an estimate. The populations per municipality are identified in *Table 3 – Tioga County Municipal Population*. *Figure 2 – Tioga County Population Density* illustrates in a visual way the values of population density by census tracks from the U.S. 2010 Census.

*Table 3 - Tioga County Municipal Population*

| Tioga County Municipality Population | | |
|---|---|---|
| **Municipality** | **2010 Population** | **2019 Population** |
| Blossburg Borough | 1,722 | 2,114 |
| Elkland Borough | 2,201 | 1,831 |
| Knoxville Borough | 645 | 783 |
| Lawrenceville Borough | 799 | 548 |
| Liberty Borough | 287 | 261 |
| Mansfield Borough | 3,557 | 3,031 |
| Roseville Borough | 113 | 117 |
| Tioga Borough | 739 | 753 |
| Wellsboro Borough | 3,266 | 3,256 |
| Westfield Borough | 1,297 | 1,333 |
| Bloss Township | 353 | 502 |
| Brookfield Township | 421 | 409 |
| Charleston Township | 3,364 | 3,432 |
| Chatham Township | 588 | 584 |
| Clymer Township | 581 | 570 |
| Covington Township | 1,031 | 1,017 |
| Deerfield Township | 662 | 654 |
| Delmar Township | 2,870 | 2,802 |
| Duncan Township | 208 | 216 |
| Elk Township | 51 | 49 |
| Farmington Township | 644 | 661 |
| Gaines Township | 542 | 544 |
| Hamilton Township | 499 | 499 |
| Jackson Township | 1,880 | 1,858 |
| Lawrence Township | 1,723 | 1,652 |
| Liberty Township | 1,039 | 1,024 |

| Municipality | 2010 Population | 2019 Population |
|---|---|---|
| Middlebury Township | 1,285 | 1,308 |
| Morris Township | 611 | 585 |
| Nelson Township | 568 | 561 |
| Osceola Township | 659 | 645 |
| Putnam Township | 428 | 425 |
| Richmond Township | 2,291 | 2,293 |
| Rutland Township | 820 | 808 |
| Shippen Township | 527 | 521 |
| Sullivan Township | 1,474 | 1,455 |
| Tioga Township | 666 | 647 |
| Union Township | 1,000 | 991 |
| Ward Township | 167 | 176 |
| Westfield Township | 1,039 | 997 |
| **Total** | **41,981** | **40,591** |

In Tioga County, 19.9% of the population's age is between zero and seventeen, 8.9% is ages eighteen to twenty-four, 11.1% is ages twenty-five to thirty-four, 10.5% is ages thirty-five to forty-four, 12.8% is ages forty-five to fifty-four, 15.3% is ages fifty-five to sixty-four, 12.0% is ages sixty-five to seventy-four, and 9.5% is ages seventy-five or older. The median age in Tioga County is forty-four. Tioga County has a race of predominantly white with 97.2%, black/African American 0.8%, American Indian 0.3%, Asian 0.6%, and Hispanic 1.3%. There are 81.3 times more white (non-Hispanic) Tioga County residents than any other race or ethnicity.

There are 16,310 households estimated to be in Tioga County from 2015 to 2019 year data. The median household income is $50,667.00, which is less than the median annual income of $61,937.00 across the entire United States, with the highest income in Tioga County to be $62,929.00. The median property value in Tioga County was $138,700.00 in 2018, which is 0.604 times smaller than the national average of $229,700.00. Between 2017 and 2018, the median property value decreased from $139,400.00 to $138,700.00, a 0.502% decrease. The homeownership rate in Tioga County is 73.6% which is higher than the national average of 63.9%. The largest share of households in Tioga County pays property taxes ranging from $800.00 to $1,5000.00. Tioga County residents have an average commute time of 22.9 minutes and they typically drive alone to work (79.8%). Other ways to get to work that are commonly seen in Tioga County is carpooling (9.16%) and walking (4.71%). Employees in Tioga County have a shorter commute time than the normal US worker which is about 25.3 minutes. Additionally, 2.59% of the workforce in Tioga County have "super commutes" in excess of ninety minutes. Car ownership in Tioga is approximately the same at the national average with an average of two cars per household.

There are thirteen major transportation routes within the county that would be capable of handling a large amount of heavy truck traffic. The interstate future I-99 runs through the county. Two U.S. Routes go through Tioga County as well which include US 6 and US 15. There are

additionally various Pennsylvania Routes that flow through the county as well which include PA 14, PA 49, PA 249, PA, 287, PA 328, PA 349, PA 362, PA 414, PA 549, and PA 660. Major state routes can be viewed on the county base map, *Figure 3 – Tioga County Base Map*.

For any possible vehicle accidents that could occur on the major roadways that flow through the county, there are various fire, EMS, and police departments used for first response. There are seventeen fire departments, nine EMS stations, and fifteen police departments.

## 2.4. Land Use and Development

Along with recreational use of the land, as discussed in section 2.1, agriculture is another major use of the land in Tioga County. *Figure 4 - Land Use/Land Cover Map* illustrates the various types of agriculture area used in Tioga County. There is a total of 1,056 farms in Tioga County with a total of 212,797 acres of farmland. The average size of farms in Tioga County is about 202 acres. The total market value of products sold from farm use is $92 million with a product value of $87,363.00 per farm. About 176 farms in Tioga County have a sales value of $100,000.00 or more.

There is a 72% sale for livestock, poultry, and products and a 28% sale for crops with the total farm use in Tioga County. The use of land by farms is 58% cropland, 11% pastureland, 24% woodland, and 7% other type. The most popular crop sold from farms in Tioga County is hay products and the second most popular is grains, oilseeds, dry beans, and dry peas. Other commonly grown and sold crops in Tioga County are vegetables, melons, and sweet potatoes. Much of the land is used to grow hay with is about 74,659 acres, corn for grain with 8,304 acres, corn for silage with 6,767 acres, soybeans for beans with 2,649 acres, and oats for grain with 1,114 acres. The most popular livestock or poultry related items from farms in Tioga County is milk from cows. Hogs and pigs are another very popular livestock sold from farms in Tioga County. Cattle and calves are also commonly sold from the farms as well.

## 2.5. Data Sources

The county relied heavily on existing data sources developed by other Tioga County departments, including:

- Tioga County Hazard Vulnerability Analysis.
- Tioga County Comprehensive Plan - 2030.
- Tioga County Assessment Department data.
- Tioga County Subdivision and Land Development Ordinance.
- Tioga County Open Space Management Plan.
- Tioga County Greenways Plan.
- Tioga County Digital Tax Assessment Data.
- Tioga County Commodity Flow Study.

The following is additional data sources used during the update process:

- U.S. Census Bureau.
- National Climatic Data Center (NCDC).
- National Oceanic and Atmospheric Administration (NOAA).
- Pennsylvania Department of Conservation and Natural Resources.
- Pennsylvania Groundwater Information System.
- Pennsylvania Emergency Incident Reporting System.
- Pennsylvania Emergency Management Agency.
- Pennsylvania Department of Labor and Industry.

The countywide digital flood insurance rate maps (DFIRM), were used for all flood risk analysis and estimation of loss. The Tioga County DFIRMs were approved and effective on May 16, 2008. The DFIRM database provides flood frequency and elevation information used in the flood hazard risk assessment. Other Tioga County GIS datasets including road centerlines, parcels and structures were utilized in conjunction with the DFIRM. In addition to the county's existing spatial datasets, the Tioga County Planning Commission developed a database and maps of the county's critical facilities, special needs populations, transportation systems and hazardous materials facilities. Potential losses were then analyzed by using existing county tax assessment data and DFIRM data.

### Geographic Information Systems (GIS) Data

GIS data was utilized in risk assessment, estimation of loss and the development of map products for the hazard mitigation plan update. A core foundation of data was available from Tioga County Department of Emergency Services and Tioga County Planning Commission. Some data was downloaded from the Pennsylvania Spatial Data Access (PASDA) and utilized. The following is a list of existing GIS data that was utilized in the plan update process and a list of new GIS data that was developed to complete the 2022 mitigation plan update.

Existing Tioga County GIS Data Used:

- Structures
- Road Centerlines
- Tax Parcels
- Municipality Boundaries
- Digital Flood Insurance Rate Maps
- Watershed and Sub-Sheds
- Lakes and Streams

New GIS Data Developed and Used:

- Critical Facilities
- Functional Needs Facilities
- Bedrock Geology
- Land Slope Features
- Land Use Features
- Mobile Homes
- Utility Locations

- Shared Relief Digital Elevation Model
- Tornado Paths
- Recreational Opportunities
- Zip Codes
- Wildlife Urban Interface Values

The Tioga County parcel dataset includes a value for the land in each parcel, as well as a combined value for all buildings on each parcel. Some parcels that contain multiple buildings with one or more buildings in the flood plain and one or more buildings out of the flood plain. The individual value by specific building within any given parcel was indeterminate from the data provided by Tioga County. Therefore, the combined value of all buildings in that parcel has been used – not simply the value of only the structures in the floodplain.

HAZUS calculations and statistics were based on a total of twelve reaches. There were zero failed reaches. The loss estimations were completed as part of the HAZUS scenario processing and represent FEMA depths grids and general building information from FEMA's general building stock.

The following maps provide a base map of Tioga County and other specific features of the county.

*Figure 2 - Tioga County Population Density*

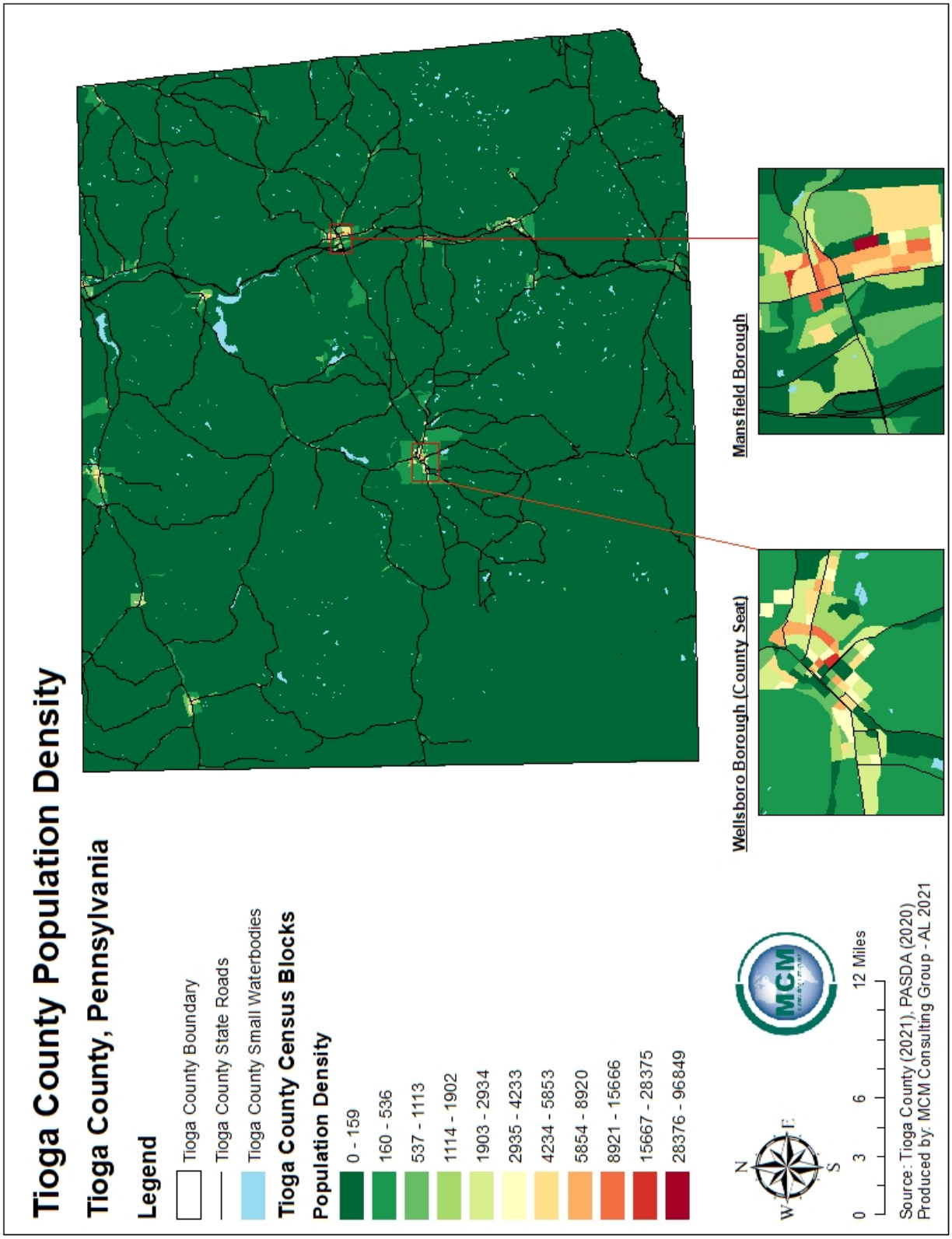


*Figure 3 - Tioga County Base Map*

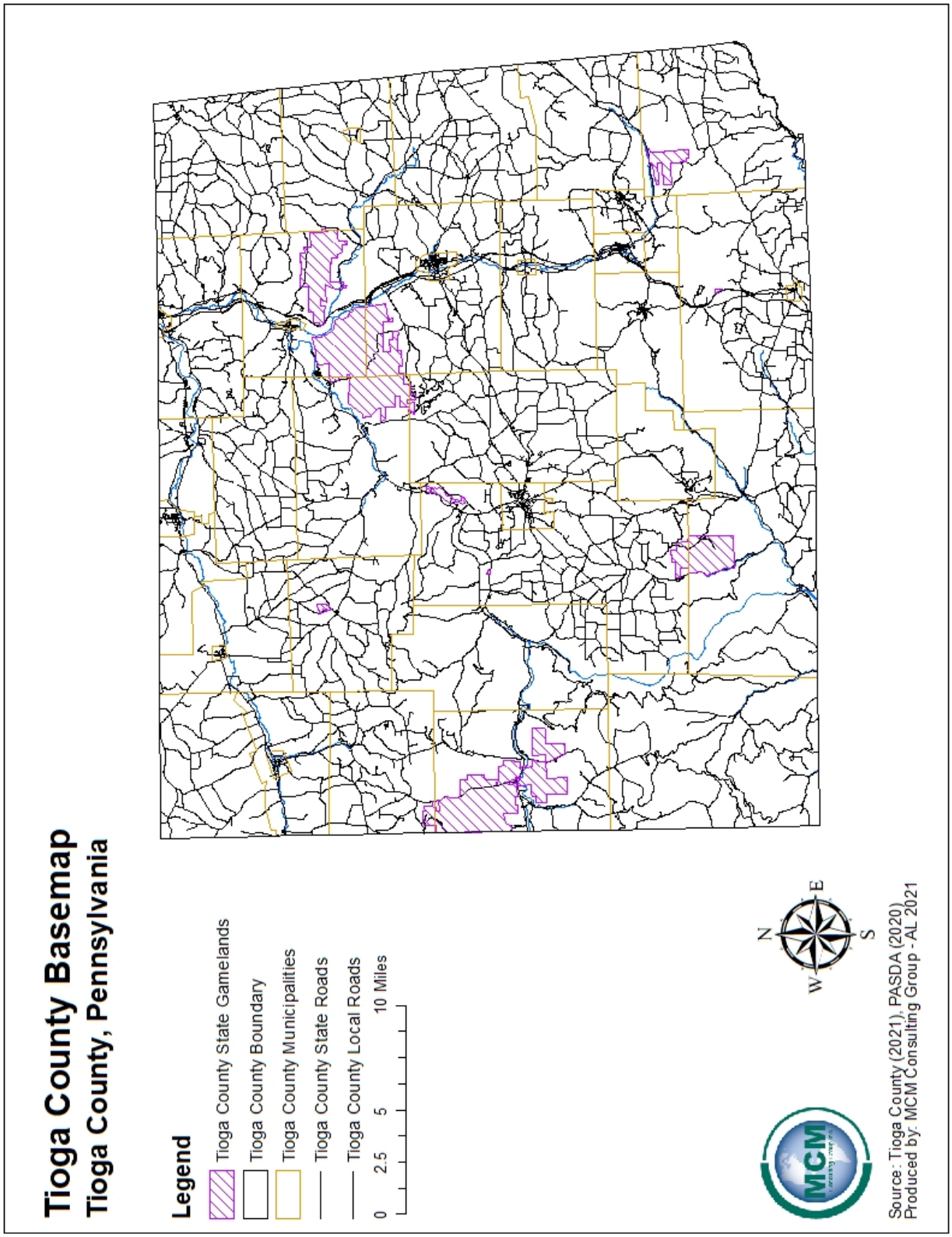


*Figure 4 - Land Use/Land Cover Map*

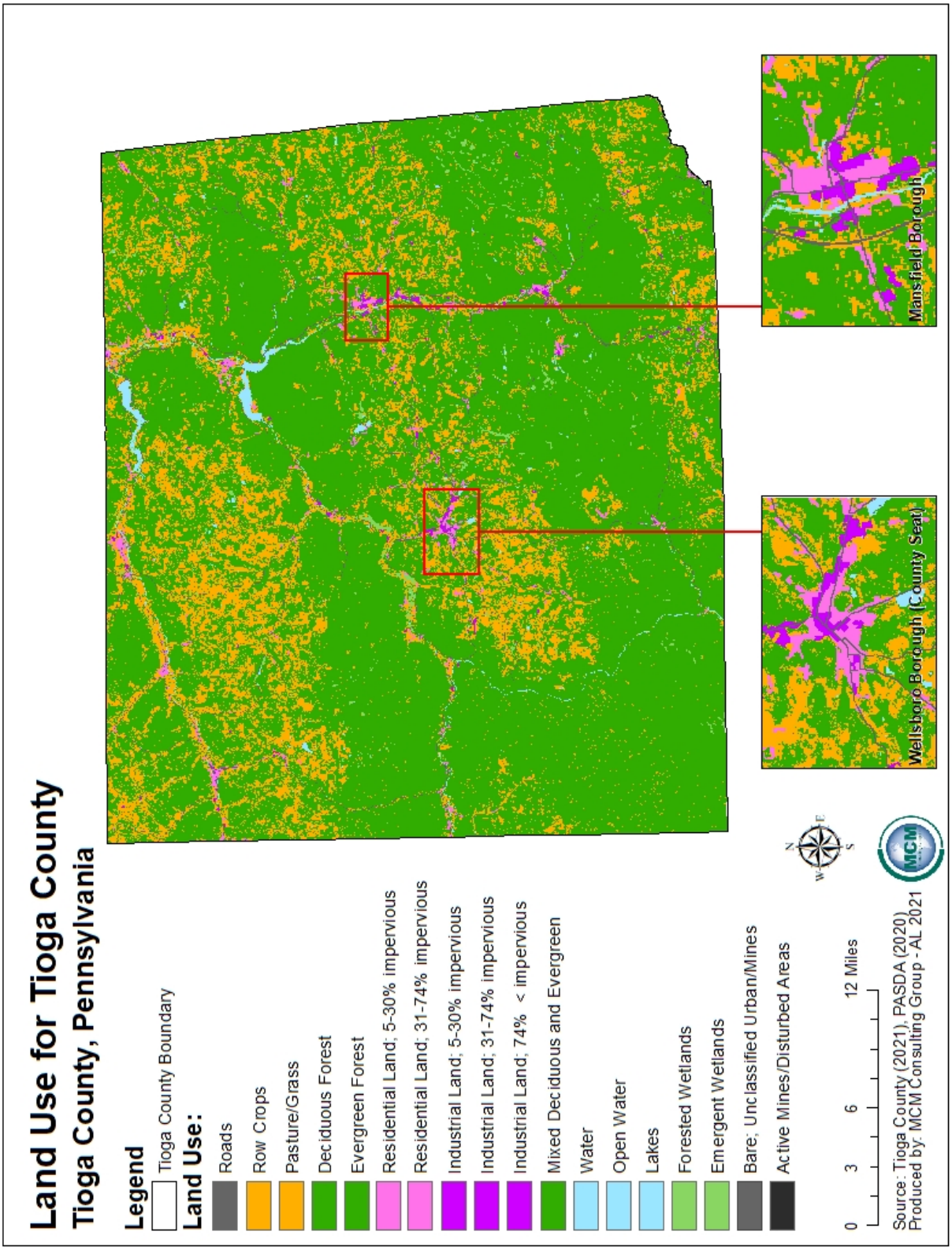


*Figure 5 - Recreation Features*

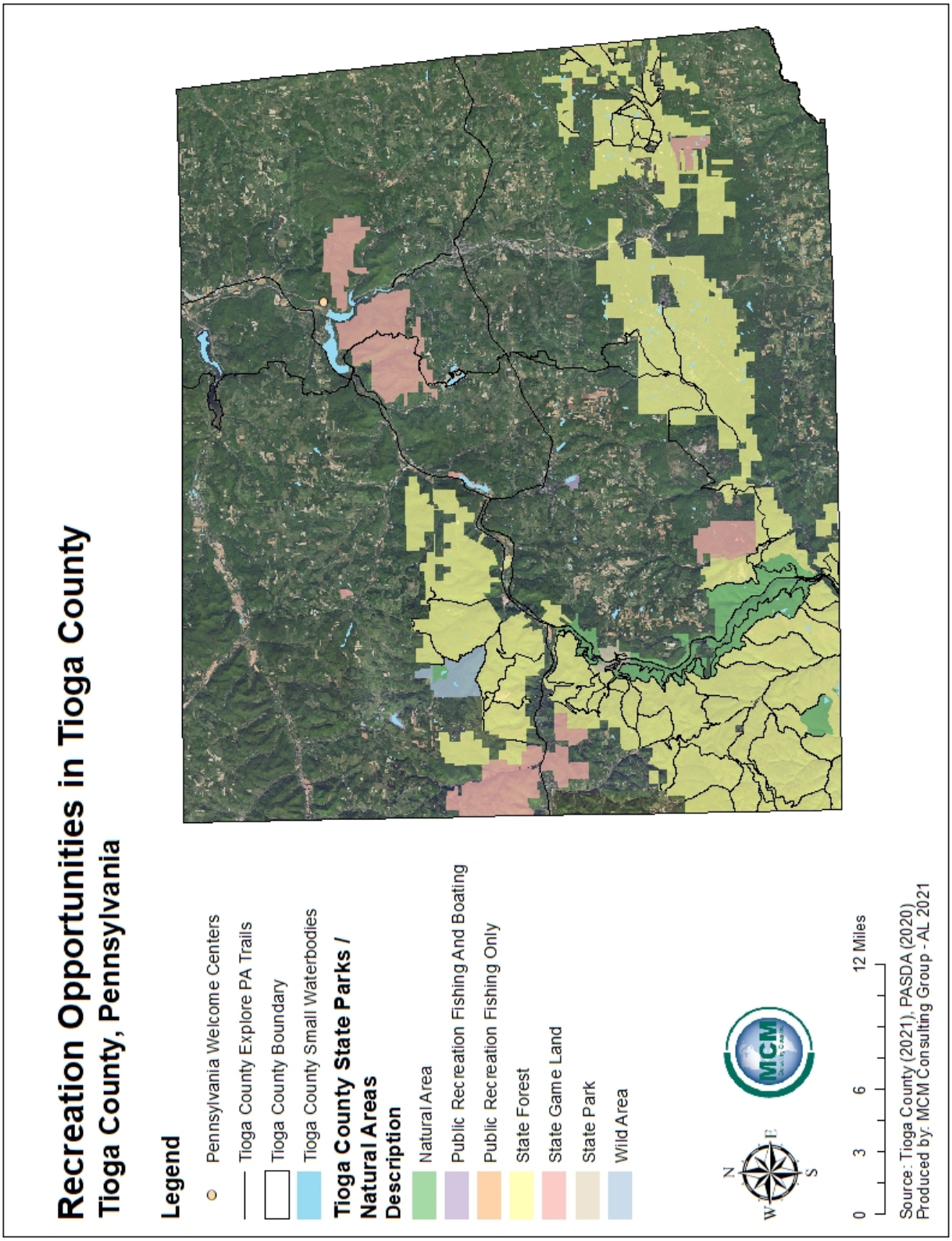
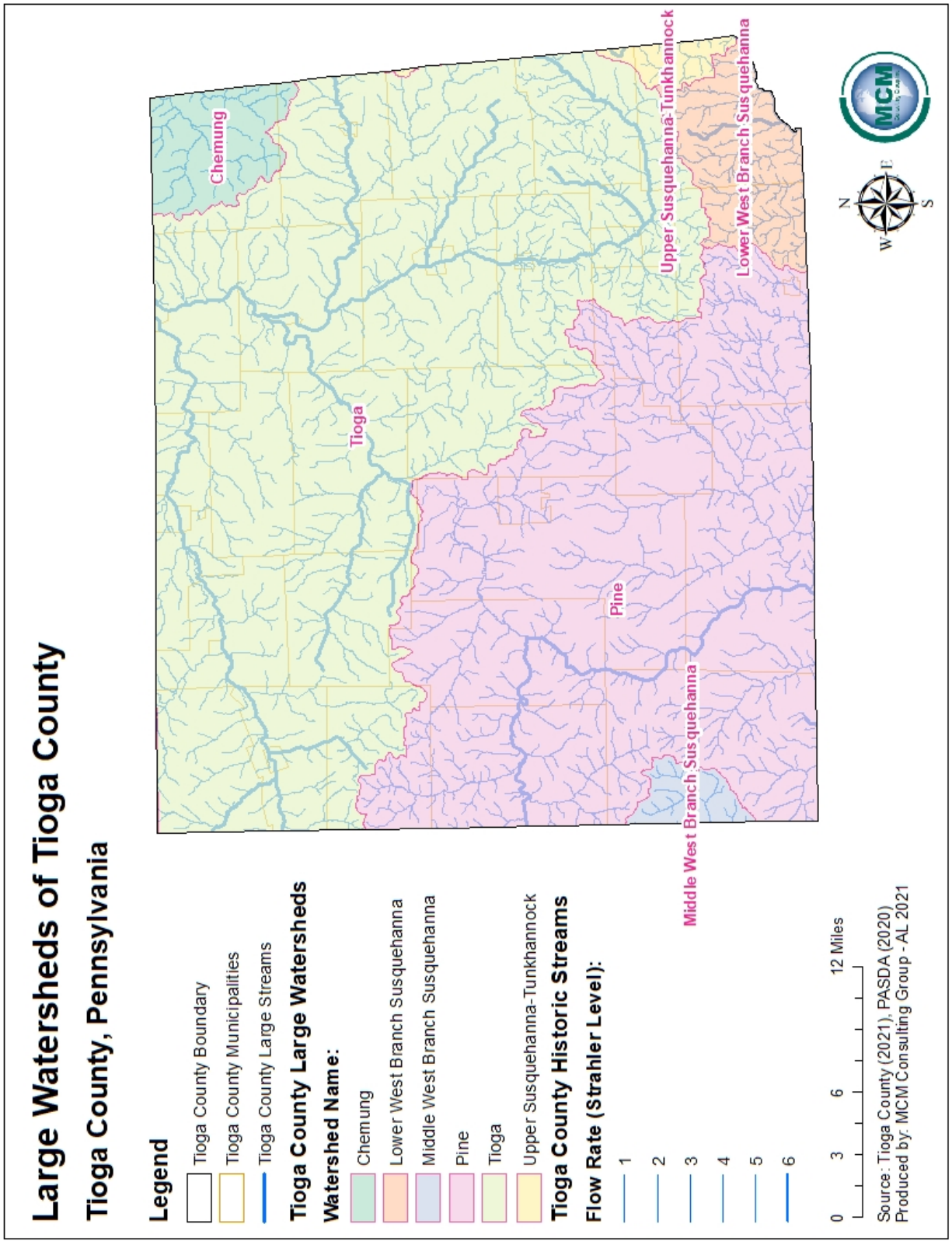


*Figure 6 - Large Watershed Map*



# 3. Planning Process

## 3.1. Update Process and Participation Summary

The Tioga County Hazard Mitigation Plan update began March 23, 2021. The Tioga County Commissioners were able to secure a hazard mitigation grant to start the process. Tioga County Geographic Information Systems (GIS) was identified as the lead agency for the Tioga County Hazard Mitigation Plan update. The planning process involved a variety of key decision makers and stakeholders within Tioga County. Tioga 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 Tioga County GIS Department, Tioga County Department of Emergency Services, Tioga County Planning Commission, and MCM Consulting Group, Inc. (MCM).

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

MCM Consulting Group, Inc. assisted Tioga County GIS Department, Tioga County Department of Emergency Services, as well as Tioga County Planning Commission in coordinating and leading public involvement meetings, local planning team meetings, analysis, and the writing of the updated HMP. The Tioga County Local Planning Team (LPT) worked closely with MCM in the writing and review of the HMP. MCM conducted project meetings and local planning team meetings throughout the update process. Due to COVID-19, most meetings were held virtually. Meeting agendas, and meeting minutes 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 Tioga County Local Planning Team and staff. Due to COVID-19, most meetings were held virtually. 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 capability's assessment and review, and eventually adopt the county hazard mitigation plan. Tioga 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 Tioga County Board of Commissioners.
- Plan submission to FEMA and PEMA.

The 2022 Tioga County HMP was completed September 30, 2021. The 2022 plan follows an outline developed by PEMA which provides a standardized format for all local HMPs in the Commonwealth of Pennsylvania. The 2022 HMP format is consistent with the PEMA recommended format. The 2022 Tioga 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 2022 Tioga County Hazard Mitigation Plan update was led by the Tioga County Steering Committee. The Tioga 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 4 – Steering Committee* outlines the individuals that comprised this team.

*Table 4 - Steering Committee*

| Tioga County Hazard Mitigation Plan Update Steering Committee | | |
|---|---|---|
| **Name** | **Organization** | **Position** |
| Scott Zubek | Tioga County GIS Department | Director |
| Dave Cohick | Tioga County Department of Emergency Services | Director |
| Ben Kerkeslager | Tioga County Department of Emergency Services | Environmental Planner |
| Erica Tomlinson | Tioga County Conservation District | District Manager |

| Name | Organization | Position |
|---|---|---|
| Jeff VanDusen | Westfield Township | Elected or Appointed Official |
| Michael T. Rearick | MCM Consulting Group, Inc. | Senior Consultant |
| Corbin Snyder | MCM Consulting Group, Inc. | Consultant |

In order to represent the county, the Tioga County Steering Committee developed a diversified list of potential local planning team (LPT) members. Members that participated in the 2017 hazard mitigation plan were highly encouraged to join the 2022 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: Tioga County Commissioners, Tioga County Planning Commission, Tioga County Conservation District, Develop Tioga, Tioga County Geographic Information Systems Department, Tioga County Department of Emergency Services, Pennsylvania Department of Conservation and Natural Resources, the Pennsylvania Emergency Management Agency, Mansfield University, all members of the Tioga County Mitigation Advisory Committee, and all thirty-nine municipalities. The invitations for membership in the LPT were disseminated by Tioga County GIS Department 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 5 – Local Planning Team* served on the 2022 Tioga 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 5 - Local Planning Team*

| Tioga County Hazard Mitigation Plan Local Planning Team | | |
|---|---|---|
| **Name** | **Organization** | **Position** |
| Scott Zubek | Tioga County Geographic Information Systems Department | Director |
| Dave Cohick | Tioga County Department of Emergency Services | Director |
| Doug Wicks | Tioga County Department of Emergency Services | Emergency Management Coordinator |

| Name | Organization | Position |
|---|---|---|
| Ben Kerkeslager | Tioga County Department of Emergency Services | Environmental Planner |
| Marti Shabloski | Tioga County Department of Emergency Services | Administrative Assistant |
| Kristin Hamilton | Develop Tioga | Executive Director |
| Erica Tomlinson | Tioga County Conservation District | District Manager |
| Jim Welch | Mansfield University | Environmental Health & Safety Director |
| Brian Plume | Department of Conservation and Natural Resources | Forest Fire Specialist Supervisor |
| Kaye Aumick | Tioga County Planning Commission | Planning Director |
| Ernest Szabo | Pennsylvania Emergency Management Agency | PEMA State Hazard Mitigation Planner |
| Roger Bunn | Tioga County Commissioners | County Commissioner |
| Cheryl Bubacz | Blossburg Borough | Elected or Appointed Official |
| Chester Mahosky | Bloss Township | Elected or Appointed Official |
| Jeff VanDusen | Brookfield Township | Elected or Appointed Official |
| Gary Phelps | Charleston Township | Elected or Appointed Official |
| Jeff VanDusen | Chatham Township | Elected or Appointed Official |
| Bill Plummer | Clymer Township | Elected or Appointed Official |
| Laurie Hess | Covington Township | Elected or Appointed Official |
| Gene Shalters | Deerfield Township | Elected or Appointed Official |
| Gerald Rice | Delmar Township | Elected or Appointed Official |
| Lisa Everett | Duncan Township | Elected or Appointed Official |
| David Miller | Elk Township | Elected or Appointed Official |
| Ray Gausline | Elkland Borough | Elected or Appointed Official |
| Tom Shaw | Farmington Township | Elected or Appointed Official |
| Kevin Sykora | Gaines Township | Elected or Appointed Official |
| Jason Pequignot | Hamilton Township | Elected or Appointed Official |
| Julie Hess | Jackson Township | Elected or Appointed Official |
| Frank Van Delinder | Jackson Township | Elected or Appointed Official |

| Name | Organization | Position |
|---|---|---|
| Carl Cox | Knoxville Borough | Elected or Appointed Official |
| Tim Short | Lawrence Township | Elected or Appointed Official |
| Penny Jeffers | Lawrenceville Borough | Elected or Appointed Official |
| Mansel O'Dell | Lawrenceville Borough | Elected or Appointed Official |
| Brian Ferris | Liberty Borough | Elected or Appointed Official |
| Brian Ferris | Liberty Township | Elected or Appointed Official |
| Christopher McGann | Mansfield Borough | Elected or Appointed Official |
| William Schlosser | Mansfield Borough | Elected or Appointed Official |
| Dan Rice | Middlebury Township | Elected or Appointed Official |
| Patti Moore | Morris Township | Elected or Appointed Official |
| Tom Shaw | Nelson Township | Elected or Appointed Official |
| Edward Seeley | Osceola Township | Elected or Appointed Official |
| Mike Gerow | Putnam Township | Elected or Appointed Official |
| James Nobles | Richmond Township | Elected or Appointed Official |
| Mike Bergstrom | Roseville Borough | Elected or Appointed Official |
| Mike Bergstrom | Rutland Township | Elected or Appointed Official |
| Lonnie Campbell | Shippen Township | Elected or Appointed Official |
| Thomas Robbins | Sullivan Township | Elected or Appointed Official |
| Steve Hazlett | Tioga Borough | Elected or Appointed Official |
| Amy Southard | Tioga Township | Elected or Appointed Official |
| Ken Jones | Tioga Township | Elected or Appointed Official |
| Mike Gee | Tioga Township | Elected or Appointed Official |
| Dennis Jackson | Union Township | Elected or Appointed Official |
| George Morris | Ward Township | Elected or Appointed Official |
| Scot Boyce | Wellsboro Borough | Elected or Appointed Official |
| Lori Nelson | Westfield Borough | Elected or Appointed Official |
| Jeff VanDusen | Westfield Township | Elected or Appointed Official |
| Corbin Snyder | MCM Consulting Group, Inc. | Consultant |
| Michael Rearick | MCM Consulting Group, Inc. | Senior Consultant |

## 3.3. Meetings and Documentation

Meetings with local elected officials and the local planning team were held as needed. Meetings were mostly held via conference call and virtual meeting rooms due to COVID-19. At each of the meetings, municipal officials were strongly encouraged to submit hazard mitigation project opportunity forms, complete their respective portions of the capability assessment, review and eventually adopt the multi-jurisdictional HMP. *Table 6 – HMP Process Timeline* lists the meetings held during the HMP planning process, which organizations and municipalities attended and the topic that was discussed at each meeting. All meeting agendas, sign-in sheets, presentation slides, any other documentation is located in Appendix C. It should be noted that as a result of the COVID-19 pandemic, most meetings were held virtually. As a result, the number of sign-in sheets decreased when compared to the 2017 HMP update. Participants are identified on the Local Planning Team meeting minutes found in Appendix C.

The draft plan was made available for public review on September 30, 2021. The draft was advertised on Tioga County's social media pages, newspapers, and was made available digitally on the Tioga County website at:
http://www.tiogacountypa.us/Departments/Emergency_Services/Pages/Hazard-Mitigation-Plan.aspx

The public comment period remained open until October 29, 2021. All public comments were submitted via an online survey or in writing to Scott Zubek at Tioga County GIS Department. All public comments have been included in this plan in Appendix C.

*Table 6 - HMP Process Timeline*

| Tioga County HMP Process - Timeline | | |
|---|---|---|
| **Date** | **Meeting** | **Description** |
| 03/23/2021 | Local Planning Team 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. Presentation on hazard identification, capability assessment and NFIP worksheets. Defined hazard mitigation planning and identified roles and responsibilities. Discussed the 2017 hazard mitigation plan and defined a timeline to complete the update. |
| 03/23/2021 | Municipality Kick-off meeting | Presentation on hazard identification, capability assessment and NFIP worksheets. |
| 04/22/2021 | Local Planning Team Meeting – Selection of Hazards | Tioga County LPT met via Zoom to discuss hazards profiled in the previous plan and identify any new hazards to be included in the plan update. |

| Date | Meeting | Description |
|---|---|---|
| 04/22/2021 | Local Planning Team Meeting – Risk Factor Assessment and Mitigation Strategy | Tioga County LPT met via Zoom to discuss hazards profiled in the previous plan and identify any new hazards to be included in the plan update. Additionally, the LPT determined a risk factor score for each of the selected hazards in the 2022 update. A municipal comparison document was then sent to all municipalities in Tioga County for their input during the next round of municipal meetings. |
| 06/01/2021 | Local Planning Team Meeting – Mitigation Strategy | Tioga County LPT met via Zoom to begin mitigation strategy development by discussing the goals and objectives to be included in this plan update. |
| 07/01/2021 | Local Planning Team Meeting – Mitigation Strategy | Tioga County LPT met via at Tioga County Department of Emergency Services to finalize the 2022 goals, objectives, and actions for mitigation strategy development. The LPT also reviewed all mitigation actions from the 2017 plan and finalized new actions for the plan update. |
| 07/01/2021 – 07/09/2021 | Meetings 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 and risk factor assessment municipal comparison documents. These meetings was held both in-person and via Zoom due to COVID-19. |
| 09/16/2021 | Local Planning Team meeting – Draft Plan review | The draft HMP was made available to all members of the LPT prior to the start of the public review period. All were invited to submit any changes to the document before it was released to the public. |
| 09/30/2021 | Tioga County Hazard Mitigation Plan – Draft Plan Public Review | The draft HMP was made available for all members of the public to review. All were invited to submit any comments via an online survey or provide comments to Tioga County GIS Department. |

## 3.4. Public and Stakeholder Participation

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

The tools listed below were distributed with meeting invitations, provided directly to municipalities to complete and return to Tioga 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 Emergency Management Agency.

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 2017 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 G. The previous mitigation actions were provided and reviewed at update meetings. New 2022 municipal project opportunity forms are included as well, located in Appendix G.
4. **National Flood Insurance Program Survey:** Collects data from county residents and measures their level of participation in the National Flood Insurance Program (NFIP) provided by FEMA.

Members of the public were encouraged to contact Tioga County Department of Emergency Services or MCM Consulting Group, Inc. with any comments or questions regarding this update. 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.

Tioga County invited all contiguous counties to review the 2022 draft hazard mitigation plan. A letter was sent to the emergency management coordinator in Bradford, Clinton, Lycoming,

Potter, and Sullivan counties in Pennsylvania, and Steuben County in New York on September 30, 2021. Copies of these letters are included in Appendix C.

## 3.5. Multi-Jurisdictional Planning

Tioga 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 7 – Municipality Participation in Worksheets, Surveys, and Forms* reflects the municipality participation by completing worksheets, surveys, and forms.

*Table 7 - Municipality Participation in Worksheets, Surveys, and Forms*

| 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** |
| Bloss Township | **X** | **X** | |
| Blossburg Borough | **X** | **X** | |
| Brookfield Township | **X** | **X** | **X** |
| Charleston Township | **X** | **X** | |
| Chatham Township | **X** | **X** | **X** |
| Clymer Township | **X** | **X** | X |
| Covington Township | **X** | **X** | |
| Deerfield Township | **X** | **X** | |
| Delmar Township | **X** | **X** | **X** |
| Duncan Township | **X** | **X** | |
| Elk Township | **X** | **X** | |
| Elkland Borough | **X** | **X** | **X** |
| Farmington Township | **X** | **X** | |
| Gaines Township | **X** | **X** | |
| Hamilton Township | **X** | **X** | |
| Jackson Township | **X** | **X** | **X** |
| Knoxville Borough | **X** | **X** | **X** |
| Lawrence Township | **X** | **X** | |
| Lawrenceville Borough | **X** | **X** | **X** |

| Municipality | Capability Assessment Survey | Risk Assessment Hazard Identification and Risk Evaluation Worksheet | Hazard Mitigation Opportunity Form Review and Updates |
|---|---|---|---|
| Liberty Borough | X | X | |
| Liberty Township | X | X | |
| Mansfield Borough | X | X | X |
| Middlebury Township | X | X | X |
| Morris Township | X | X | X |
| Nelson Township | X | X | X |
| Osceola Township | X | X | |
| Putnam Township | X | X | X |
| Richmond Township | X | X | X |
| Roseville Borough | X | X | X |
| Rutland Township | X | X | |
| Shippen Township | X | X | |
| Sullivan Township | X | X | X |
| Tioga Borough | X | X | |
| Tioga Township | X | X | X |
| Union Township | X | X | X |
| Ward Township | X | X | X |
| Wellsboro Borough | X | X | X |
| Westfield Borough | X | X | X |
| Westfield Township | X | X | X |

In March of 2020, Pennsylvania and the rest of the world experienced a pandemic event entitled COVID-19. Unfortunately, because of the pandemic, public meetings were unable to be held as normal during the hazard mitigation planning process. Members of the public were encouraged to submit any questions or comments about the project to Tioga County Department of Emergency Services or MCM Consulting Group, Inc. Additionally, all Tioga County residents were encouraged to complete an online community preparedness survey to both engage community members and to measure preparedness levels.

All municipalities within Tioga County adopted the 2017 Tioga County Hazard Mitigation Plan as the municipal hazard mitigation plan. The goal of the Tioga County Local Planning Team is to 100% participation by municipalities in adopting the 2022 Tioga County Hazard Mitigation Plan.

# 4. Risk Assessment

## 4.1. Update Process Summary

A key component to reducing future loss 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 a critical first step in the entire mitigation process, as it is an organized and coordinated way of assessing potential hazards and risks. The risk assessment identifies the effects of both natural and human-caused hazards and describes each hazard in terms of its frequency, severity, and county impact. Numerous hazards were identified as part of the process.

A risk assessment evaluates threats associated with a specific hazard and is defined by probability and frequency of occurrence, magnitude, severity, exposure, and consequences. The Tioga County risk assessment provides in-depth knowledge of the hazards and vulnerabilities that affect Tioga 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 Tioga County Emergency Operations Plan (EOP), local EOPs and other public and private emergency management plans.

The Tioga 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 Tioga County Local Planning Team reviewed and assessed the change in risk for all natural and human-caused hazards identified in the 2017 hazard mitigation plan. The mitigation planning team then identified hazards that were outlined within the Pennsylvania Hazard Mitigation Plan but not included in the 2017 Tioga County Hazard Mitigation Plan that could impact Tioga County. The team utilized the hazard identification and risk evaluation worksheet that was provided by the Pennsylvania Emergency Management Agency.

The Tioga County Steering Committee met with municipalities and provided guidance on how to complete the municipal hazard identification and risk evaluation worksheet. All municipalities in Tioga County, including Mansfield University, 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 Tioga County assessment data to estimate loss to particular hazards. Risk factor was then assessed to each of the twenty-one hazards 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 8 – Presidential & Gubernatorial Disaster Declaration* contains a list of all Presidential and Gubernatorial disaster declarations that have affected Tioga County and it's municipalities from 1955 through 2021, according to the Pennsylvania Emergency Management Agency.

*Table 8 - 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 | Severe storms, heavy rains, flooding | 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 |
| July, 1999 | Drought | Gubernatorial Declaration |

| Date | Hazard Event | Action |
|---|---|---|
| September, 1999 | Hurricane Floyd | Presidential Disaster Declaration |
| December, 1999 | Drought | Gubernatorial Declaration |
| September, 2003 | Hurricane Isabel/Henri | Presidential Disaster Declaration |
| September, 2004 | Tropical Depression Ivan | Presidential Disaster Declaration |
| September, 2005 | Hurricane Katrina | Gubernatorial 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 |
| October, 2010 | Hurricane Sandy | Presidential Emergency Declaration |
| January, 2011 | Severe winter storm | Gubernatorial Proclamation of Emergency |
| September, 2011 | Severe storms and flooding (Lee/Irene) | Gubernatorial Proclamation of Emergency |
| April, 2012 | Spring, winter storms | Gubernatorial Proclamation of Emergency |
| October, 2012 | Hurricane Sandy | Gubernatorial Proclamation of Emergency |
| June, 2013 | High winds, thunderstorms, heavy rain, tornado, flooding | Gubernatorial 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 |

| Date | Hazard Event | Action |
|---|---|---|
| February, 2014 | Severe winter storm | Presidential Proclamation of Emergency |
| March, 2017 | Severe winter storm | County and Municipal Declarations |
| July, 2017 | Flash flooding | County and Municipal Declarations |
| January, 2018 | Opioid crisis | Gubernatorial Proclamation of Emergency |
| March, 2020 | COVID-19 | Presidential Disaster Declaration |
| July, 2021 | Flash Flooding | Municipal Declarations |
| August, 2021 | Flash Flooding | Municipal Declarations |
| *Source: Pennsylvania Emergency Management Agency and Federal Emergency Management Agency* | | |

### 4.2.2. Summary of Hazards

The Tioga County Local Planning Team (LPT) was provided the Pennsylvania Standard List of Hazards to be considered for evaluation in the 2022 HMP Update. Following a review of the hazards considered in the 2017 HMP and the standard list of hazards, the local planning team decided that the 2022 plan should identify, profile, and analyze twenty-one profiled hazards. These twenty-one hazards include all of the hazards profiled in the 2017 plan. The list below contains the twenty-one hazards that have the potential to impact Tioga County as identified through previous risk assessments, the Tioga County Hazard Vulnerability Analysis and input from those who participated in the 2022 HMP update. Hazard profiles are included in Section 4.3 for each of these hazards.

***Identified Natural Hazards***

**Drought**

Drought is defined as a deficiency of precipitation experienced over an extended period of time, usually a season or more. Droughts increase the risk of other hazards, like wildfires, flash floods, and landslides or debris flows. This hazard is of particular concern in Pennsylvania due to the prevalence of farming and other water-dependent industries, water dependent recreation uses, and residents who depend on wells for drinking water.

**Earthquake**

An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10 to 20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of people and disrupt the social and economic functioning of the affected area. Most property damage and earthquake-

related deaths are caused by the failure and collapse of structures due to ground shaking which is dependent upon amplitude and duration of the earthquake. (FEMA, 1997).

**Extreme Temperature**

Extreme heat often results in the highest number of annual deaths of all weather-related hazards. In most of the United States, extreme heat is defined as a long period (2 to 3 days) of high heat and humidity with temperatures above 90 degrees. Extremely cold air comes every winter in at least part of the country and affects millions of people across the United States. The arctic air, together with brisk winds, can lead to dangerously cold wind chill values. People exposed to extreme cold are susceptible to frostbite and hypothermia in a matter of minutes.

**Flooding, Flash Flooding and Ice Jam Flooding**

Flooding is the temporary condition of partial or complete inundation of normally dry land, and it is the most frequent and costly of all-natural hazards in Pennsylvania. 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. 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.

**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, environmental, or human harm. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease, or pathogen.

**Landslide**

In a landslide, masses of rock, earth or debris move down a slope. Landslides can be caused by a variety of factors, including earthquakes, storms, fire, and human modification of land. Areas that are prone to landslide hazards include previous landslide areas, areas on or at the base of slopes, areas in or at the base of drainage hollows, developed hillsides with leach field septic systems, and areas recently burned by forest or brush fires.

**Pandemic and Infectious Diseases**

A pandemic is a global outbreak of disease that occurs when a new virus emerges in the human population, spreading easily in a sustained manner, and causing serious illness. An epidemic describes a smaller scale infectious outbreak, within a region or population, that emerges at a

disproportionate rate. Infectious disease outbreaks may be widely dispersed geographically, impact large numbers of the population, and could arrive in waves lasting several months at a time.

**Solar Flare**

According to the European Space Agency (ESA), solar flares are "a tremendous explosion on the Sun that happens when energy stored in 'twisted' magnetic fields (usually above sunspots) is suddenly released. In a matter of just a few minutes they heat material to many million degrees and produce a burst of radiation across the electromagnetic spectrum, including from radio waves to x-rays and gamma rays." Solar flares affect the ionosphere with magnetic energy disrupting satellites, communication equipment, and radio navigation.

**Subsidence, Sinkhole**

Land subsidence is a gradual settling or sudden sinking of the ground surface due to the movement of subsurface materials. A sinkhole is a subsidence feature resulting from the sinking of surficial material into a pre-existing subsurface void. Subsidence and sinkholes are geologic hazards that can impact roadways and buildings and disrupt utility services. Subsidence and sinkholes are most common in areas underlain by limestone and can be exacerbated by human activities such as water, natural gas, and oil extraction.

**Tornadoes, Windstorm**

A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. About 1,250 tornadoes hit the U.S. each year, with about sixteen hitting Pennsylvania. Damaging winds exceeding 50-60 miles per hour can occur during tornadoes, severe thunderstorms, winter storms, or coastal storms. These winds can have severe impacts on buildings, pulling off the roof covering, roof deck, or wall siding and pushing or pulling off the windows.

**Wildfire**

A wildfire is an unplanned fire that burns in a natural area. Wildfires can cause injuries or death and can ruin homes in their path. Wildfires can be caused by humans or lightning, and can happen anytime, though the risk increases in periods of little rain. In Pennsylvania, 98% of wildfires are caused by people.

**Winter Storm**

A winter storm is a storm in which the main types of precipitation are snow, sleet, or freezing rain. 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. Most deaths from winter storms are not directly related to the storm itself, but result from traffic accidents on icy

roads, medical emergencies while shoveling snow, or hypothermia from prolonged exposure to cold.

***Identified Human Caused Hazards***

**Civil Disturbance/Criminal Activity**

A civil disturbance is defined by FEMA as a civil unrest activity (such as a demonstration, riot, or strike) that disrupts a community and requires intervention to maintain public safety. Criminal activity is an act committed in violation of law that can lead to imprisonment.

**Dam Failure**

Dam failure is the uncontrolled release of water (and any associated wastes) from a dam. This hazard often results from a combination of natural and human causes, and can follow other hazards such as hurricanes, earthquakes, and landslides. The consequences of dam failures can include property and environmental damage and loss of life.

**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.

**Emergency Services**

Emergency medical services (EMS) and fire department services play a crucial role in the emergency response system, and the functionality of these emergency services directly impacts many of the other hazard profiles in this report. Both EMS and fire services face challenges from lack of funding and lower rates of volunteerism.

**Environmental Hazards**

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

- Hazardous material releases: at fixed facilities or as such materials are in transit and including toxic chemicals, infectious substances, biohazardous waste and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)).

- Air or Water Pollution; the release of harmful chemical and waste materials into water bodies or the atmosphere, for example (National Institute of Health Sciences, July 2009; Environmental Protection Agency, Natural Disaster PSAs, 2009).
- Superfund Facilities: hazards originating from abandoned hazardous waste sites listed on the National Priorities List (Environmental Protection Agency, National Priorities List, 2009).
- Manure Spills: involving the release of stored or transported agricultural waste, for example (Environmental Protection Agency, Environmental Impacts of…, 1998).
- Product Defect or Contamination; highly flammable or otherwise unsafe consumer products and dangerous foods (Consumer Product Safety Commission, 2003).

**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 painkillers, including oxycodone, hydrocodone, and a very strong painkiller, fentanyl, which is synthesized to resemble other opiates such as opium-derived morphine and heroin. The potency and availability of these substances, de-spite their high risk of addiction and overdose, have made them popular both as for-mal 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 enact-ed 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.

**Terrorism/Cyber Attack**

Terrorism is use of force or violence against persons or property with the intent to intimidate or coerce. Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber-attacks (computer-based); and the use of chemical, biological, nuclear, and radiological weapons. Cyber-attacks have become an increasingly pressing concern. Cyber-attack refers to acts of terrorism committed using computers, networks, and the internet. The most widely cited definition comes from Denning's Testimony before the Special Oversight Panel on Terrorism: "Cyber-attack/cyber terrorism…is generally understood to mean unlawful attacks and threats of attack against computers, networks, and the information stored therein when done to intimidate or coerce a government or its people in furtherance of political or social objectives. Further, to qualify as cyberterrorism/cyber-attack, an attack should result in violence against persons or property, or at least cause enough harm to generate fear".

**Transportation Accidents and Transportation of Hazardous Materials**

Transportation accidents are technological hazards involving the nation's system of land, sea, and air transportation infrastructure. A flaw or breakdown in any component of this system can and often does result in a major disaster involving loss of life, injuries, property and environmental damage, and economic consequences.

The Department of Homeland Security defines a hazardous materials release as "The improper leak, spillage, discharge, or disposal of hazardous materials or substances (such as explosives, toxic chemicals, and radioactive materials) poses a significant threat to human health and safety, campus property, and the surrounding environment."

**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.
- 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 (Unit-ed 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 de-forestation 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 are 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. 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. Some studies show increased insect activities during a similar rapid warming event in Earth's history. 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, potentially increasing the risk of disease.

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. 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 Tioga 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 4.3.3). 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 4.3.9). Climate change is also expected to result in more intense hurricanes and tropical storms. With the rise of atmospheric temperatures, ocean surface temperatures are rising, resulting in warmer and more moist 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 time period of prolonged dryness that contributes to the depletion of ground and surface water. Droughts are regional climatic events, so when such an event occurs in Tioga County, impacts are not restricted to the county and are often more widespread. The spatial extent of the impacted area can range from localized areas in Pennsylvania to the entire Mid-Atlantic region.

There are three types of drought:

**Meteorological Drought** – A deficiency of moisture in the atmosphere compared to average conditions. Meteorological drought is defined by the duration of the deficit and degree of dryness and is often associated with below average rainfall. Depending on the severity of the drought, it may or may not have a significant impact on agriculture and the water supply.

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

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

Leaving areas with little moisture, droughts are often one of the leading contributing factors to wildfires.

Droughts can have adverse effects on farms and other water-dependent industries. This can result in a local economic loss. Areas with extensive agriculture uses are particularly vulnerable to drought; 212,797 acres of Tioga County, or roughly 35% of the 725,760 total land acreage, are

held in farms (United States Department of Agriculture [USDA], 2017 Census). Acreage for farming has increased by 4% since the 2012 USDA Census and 399 farm owners are new and beginning enterprisers.

Public safety is an issue in terms of consumable water not being available, as well as water for fire protection and emergency services.

#### 4.3.1.2 Range of Magnitude

Over 60% of the annual precipitation of 37 inches is during the spring/summer. Average snowfall for the county has a wide range of between 42 and 60 inches. Rural farming areas of Tioga County are most at risk when a drought occurs. A drought can be a significant financial burden (especially on families as 97% of Tioga County farms are family-owned and run) and approximately 58% of the county farmland use is devoted to crop cultivation and 11% to livestock and poultry. (U.S. Census of Agriculture, 2017). Wildfires are often the most severe secondary effect associated with drought. Wildfires can devastate wooded and agriculture areas, threatening natural resources, structures near high wildfire loads, and farm production facilities. Prolonged drought conditions can have a lasting impact on the economy and can cause major ecological changes, such as increases in scrub growth, flash flooding and soil erosion.

*Table 9 – Drought Preparation Phases* shows the FEMA-defined levels of drought severity along with suggested actions, requests, and goals. Drought can cause municipalities to enforce water rationing and distribution.

*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 | Reduce shortages - relieve stressed sources, develop new sources if needed | Continue voluntary water conservation, impose | Reduce water use by 10-15% |

| | | | | |
|---|---|---|---|---|
| | and potential water shortages | | mandatory water use restrictions if needed | |
| **Phase** | **General Activity** | **Actions** | **Request** | **Goal** |
| **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: Although not a drought phase, local municipalities may, with the approval of the Pennsylvania Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply 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.

Long-term water shortages during severe drought conditions can have a significant impact on agribusiness, public utilities, and other industries reliant on water for production services. Tioga County also has a growing agritourism business that would be threatened by long-term drought.

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); and
- Soil moisture via the Palmer Drought Index (See *Table 10 – Palmer Drought Severity* Index) - a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature.

*Table 10 - 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 |
| **Severity Category** | **PDSI** |
| 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 |

Hydrologic drought events result in a reduction of stream flows, reduction of lake/reservoir storage, and a lowering of groundwater levels. These events have adverse impacts on public water supplies for human consumption, rural water supplies for livestock consumption and agricultural operations, water quality, natural soil water or irrigation water for agriculture, soil moisture, conditions conducive to wildfire events, and water for navigation and recreation.

The effects of a drought can be far-reaching in both the economic and environmental realms. Economic impacts include the reduced productivity of aquatic resources, mandatory water use restrictions, well failures, cutbacks in industrial production, agricultural losses, and limited recreational opportunities. Environmental impacts of drought include the following:

- Hydrologic effects – Lower water levels in reservoirs, lakes, and ponds; reduced stream flow; loss of wetlands; estuarine impacts; groundwater depletion and land subsidence; and effects on water quality, such as increases in salt concentration and water temperature;
- Damage to animal species – Lack of feed and drinking water; disease; loss of biodiversity, migration, or concentration; and reduction and degradation of fish and wildlife habitat;
- Damage to plant communities – Loss of biodiversity and loss of trees from urban landscapes and wooded conservation areas;
- Increased number and severity of fires;

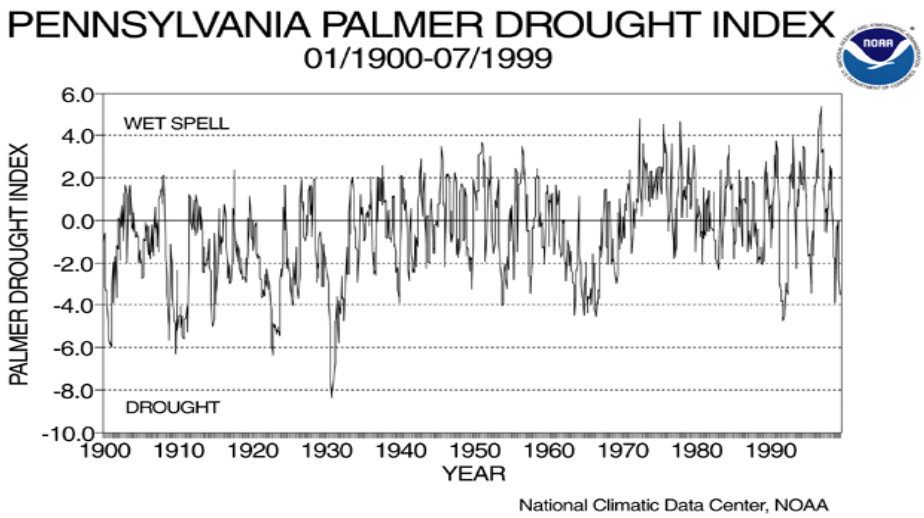
- Reduced soil quality;
- Air quality effects – Dust and pollutants; and
- Loss of quality in landscape.

#### 4.3.1.3 Past Occurrence

The Department of Environmental Protection (PA DEP) maintains the most comprehensive data on drought occurrences across the commonwealth. Descriptions of drought status categories (i.e., watch, warning, and emergency) are included in the "Range of Magnitude" section above. The declared drought status from 1980 to 2021 is shown in *Table 11 - Past Drought Events in Tioga County (PA DEP, 2020)*.

The National Oceanic and Atmospheric Administration (NOAA) has archived records showing extreme droughts for the commonwealth in 1931 and a prolonged event in the 1960s; see *Figure 7 - Pennsylvania Palmer Drought Index 1900-1999.*

*Figure 7 - Pennsylvania Palmer Drought Index 1900-1999*




Based on the county's more recent disaster history and other drought occurrence data, the worst drought event in Tioga County occurred in the summer of 1999. Extended dry weather spurred Governor Ridge to declare a drought emergency in fifty-five counties, including Tioga. During this event, precipitation deficits for that summer averaged 5 to 7 inches; the Susquehanna River hit record low flows, streams were empty, and wells dried up. Crop damages indicated losses of over $500 million statewide, and crop losses totaled 70% to 100%. There were also additional losses from the decline of milk production due to the drought (National Climatic Data Center [NCDC], 2011). Additionally, during this event, the state asked municipal and private water suppliers to cut local water use.

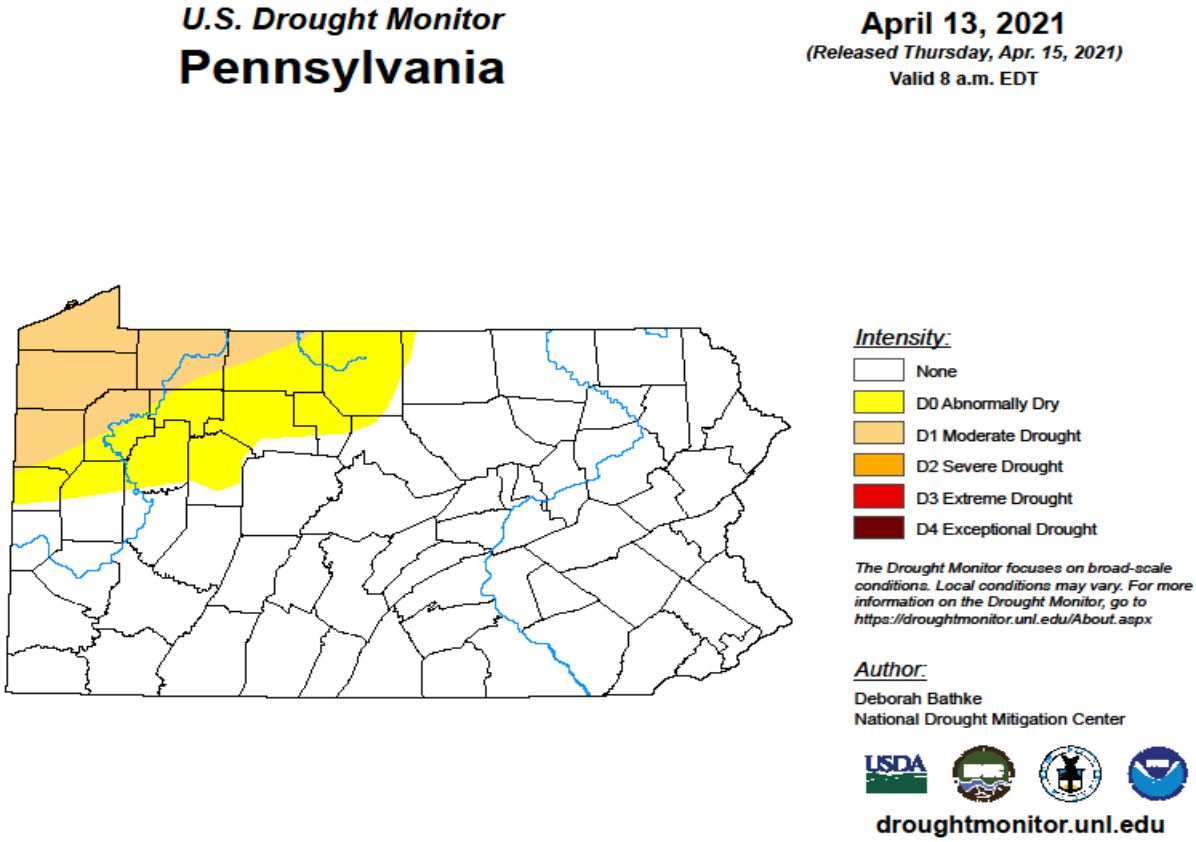
*Table 11 - Past Drought Events in Tioga County (PA DEP, 2011)*

| Past Drought Events in Tioga County (PA DEP, 2021) | | | |
|---|---|---|---|
| **Start Date** | **End Date** | **Drought Status** | **Event Duration** |
| 11/18/1980 | 4/20/1982 | Emergency | 2 years 5 months 3 days |
| 04/26/1985 | 12/19/1985 | Watch | 7 months 24 days |
| 070/7/1988 | 8/24/1988 | Watch | 10 months 9 days |
| 08/24/1988 | 12/12/1988 | Warning | |
| 12/12/1988 | 5/15/1989 | Watch | |
| 06/28/1991 | 7/24/1991 | Warning | 1 year 2 months 15 days |
| 07/24/1991 | 4/20/1992 | Emergency | |
| 04/20/1992 | 6/23/1992 | Warning | |
| 06/23/1992 | 9/11/1992 | Watch | |
| 09/01/1995 | 9/20/1995 | Warning | 3 months 18 days |
| 09/20/1995 | 11/8/1995 | Emergency** | |
| 11/08/1995 | 12/18/1995 | Warning | |
| 07/17/1997 | 11/13/1997 | Watch | 3 months 28 days |
| 12/03/1998 | 12/14/1998 | Watch | 1 year 5 months 3 days |
| 12/14/1998 | 4/15/1999 | Warning | |
| 04/15/1999 | 6/10/1999 | Watch | |
| 6/10/1999 | 7/20/1999 | Warning | |
| 07/20/1999 | 9/30/1999 | Emergency** | |
| 09/30/1999 | 5/5/2000 | Watch | |
| 08/24/2001 | 5/13/2002 | Watch | 8 months 20 days |
| 090/5/2002 | 11/7/2002 | Watch | 2 months 3 days |
| 4/11/2006 | 6/30/2006 | Watch | 2 months 20 days |
| 08/06/2007 | 9/5/2007 | Watch | 5 months 6 days |
| 10/05/2007 | 1/11/2008 | Watch | |

| Start Date | End Date | Drought Status | Event Duration |
|---|---|---|---|
| 11/07/2008 | 1/26/2009 | Watch | 2 months 20 days |
| 9/16/2010 | 11/10/2010 | Watch | 1 month 26 days |
| 08/05/2011 | 9/2/2011 | Watch | 29 days |
| 04/24/2015 | 7/10/2015 | Watch | 2 months 17 days |
| 08/10/2016 | 8/16/2016 | Watch | 3 months |
| 08/16/2016 | 9/6/2016 | Warning | |
| 09/06/2016 | 11/9/2016 | Watch | |
| 09/10/2020 | 01/07/2021 | Watch | 3 months, 27 days |
| **Gubernatorial Disaster Declaration | | | |

Pennsylvania had its warmest July on record in 2020, and 18 counties, including Tioga, entered Drought Watch status on September 10, 2020. At the writing of this plan, however, drought watches had been lifted for all commonwealth counties, but dry conditions were again creeping east across the commonwealth and had reached a small portion of the county (*Figure 8 - U.S Drought Monitor, Pennsylvania*, below). According to NOAA, Tioga County had its wettest February in 2021 in 127 years, while also recording its driest year in 127 years – thus far.

*Figure 8 - U.S. Drought Monitor, Pennsylvania*




#### 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. As Tioga County has experienced severe drought between 5% - 10% of the time between 1895 and 1995 (*Figure 9 – Palmer Drought Severity Index* – a 100-year data collection*)*, the report can be used to make a rough estimate of the future probability of drought in Tioga County, although it does not account for changes introduced by climate change. Drought conditions are expected to become more severe with climate change, as evaporation and transpiration will increase with higher temperatures (Sheffield & Wood, 2008; EPA, 2016).

*Figure 9 - Palmer Drought Severity Index*

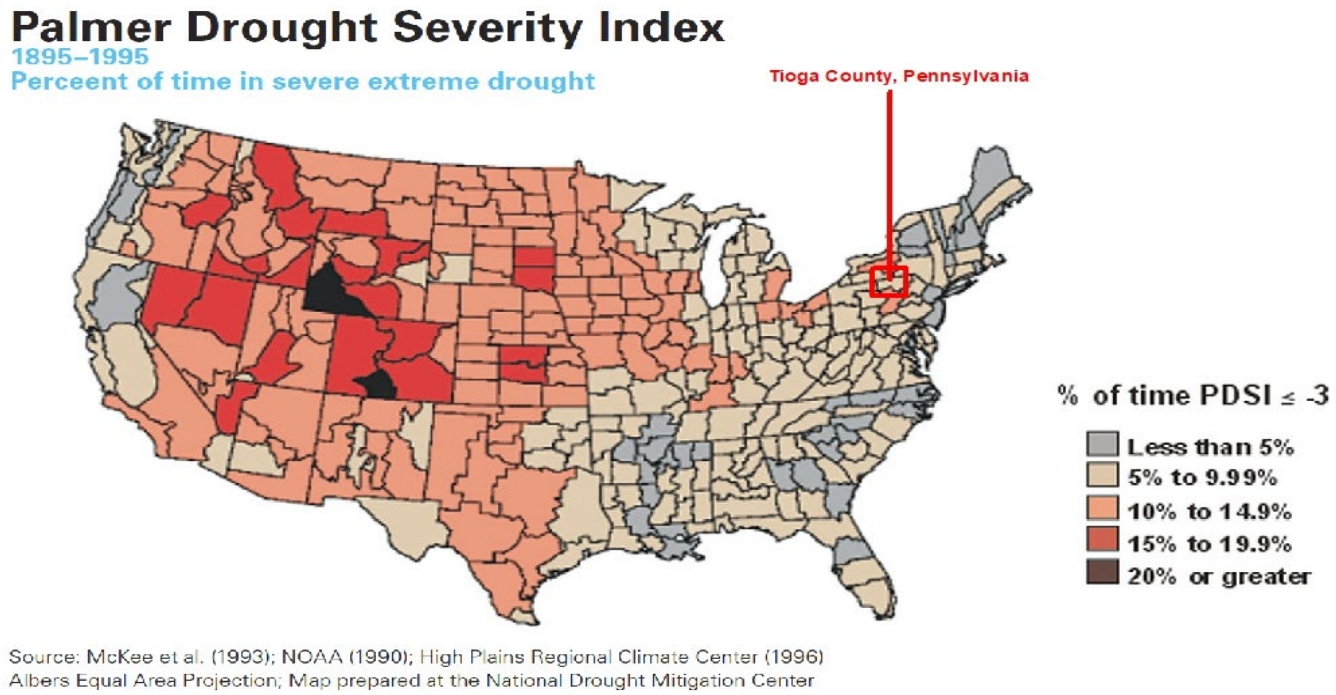
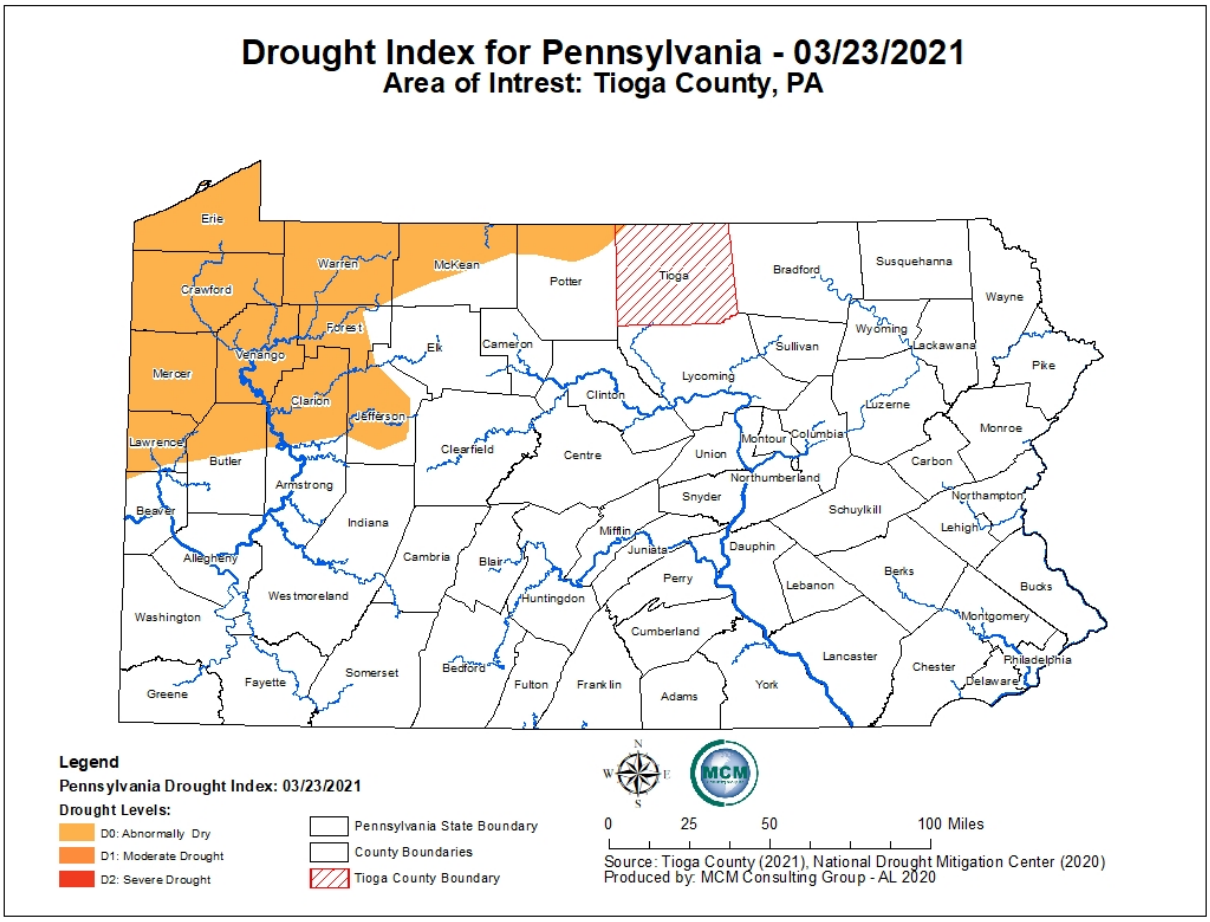



*Figure 10 – Current Drought Index for Pennsylvania* below shows that Tioga County is currently in normal conditions. The last of the 2020 Drought Watches was lifted in February 2021.

*Figure 10 - Current Drought Index for Pennsylvania*




The potential for a drought to occur in Tioga County is, nevertheless, high. Given the frequency of drought watches issued for Tioga County and its municipalities, the county can reasonably expect to be under a drought watch at least once per year. While some form of drought condition frequently exists in Tioga County, the impact depends on the duration of the event, severity of conditions, and area affected. The map above shows that Tioga County and most of Pennsylvania is currently in normal (non-drought) conditions.

#### 4.3.1.5 Vulnerability Assessment

Drought vulnerability depends on the duration and area of impact. However, other factors contribute to the severity of a drought. Unseasonably high temperatures, prolonged winds, and low humidity can heighten the impact of a drought.

Extended periods of drought can lead to lowered stream levels, altering the delicate balance of riverine ecosystems. Certain tree species are susceptible to fungal infections during prolonged periods of soil moisture deficit. Fall droughts pose a particular threat because groundwater levels are typically at their lowest following the height of the summer growing season.

Wildfire is the most severe secondary effect associated with drought. Wildfires can devastate wooded and agricultural areas, threatening natural resources and farm production facilities.

Prolonged drought conditions can cause major ecological changes, such as increases in scrub growth, flash flooding, and soil erosion.

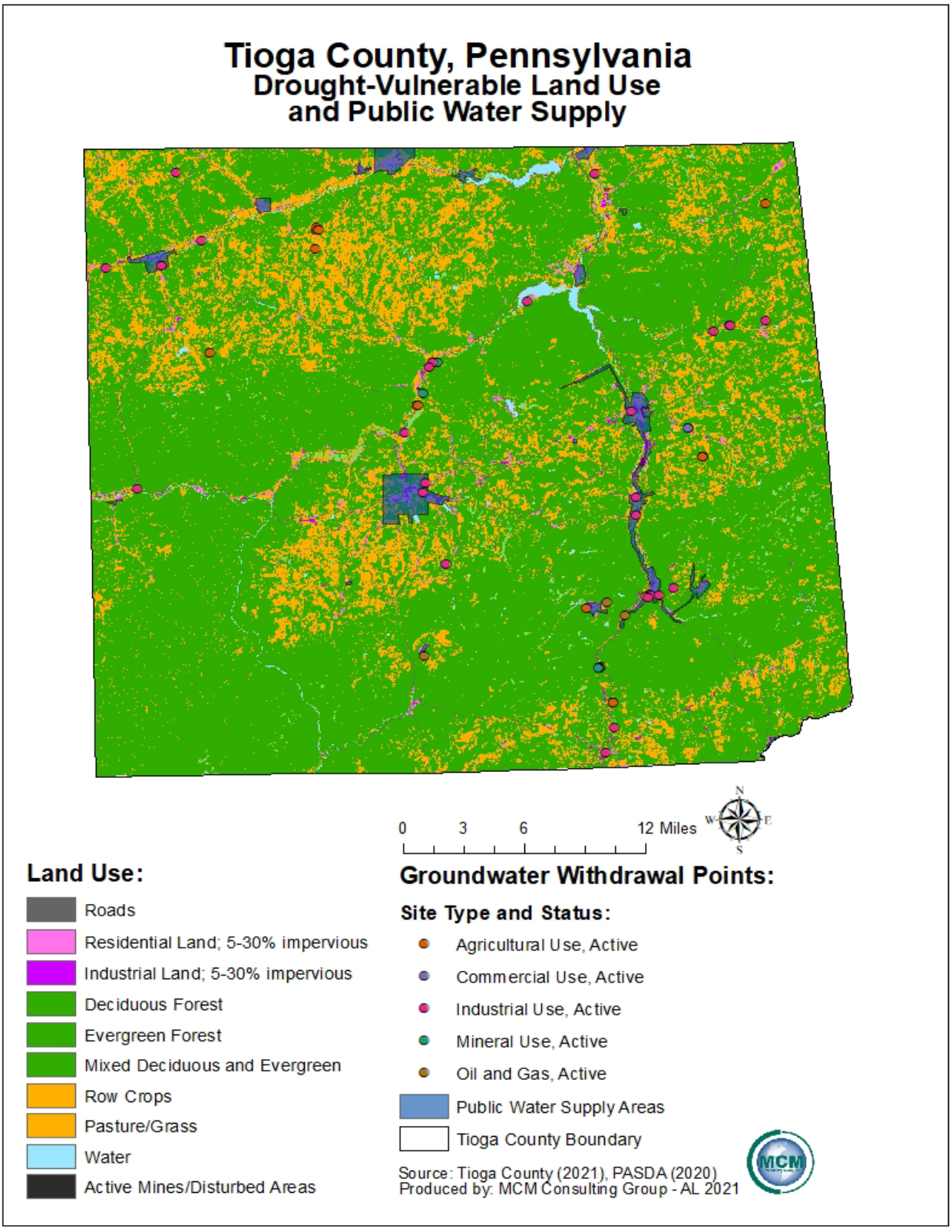
Droughts can have adverse effects on farms and other water-dependent industries. This can result in a local economic loss. The 2017 U.S. Census of Agriculture lists over 27,607 acres of prime agricultural land in Tioga County and there are multiple recreational sites across the county dependent on consistent water sources and replenishment. From a societal perspective, public safety is an issue in terms of consumable water not being available, as well as water for fire protection and emergency services.

The most significant losses resulting from drought events are typically found in the agriculture and aquaculture sectors. The 1999 Gubernatorial Proclamation was issued in large 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 20% 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. The 2017 Census of Agriculture reports there were 1,056 farms in Tioga County, at an average size of 202 acres. Tioga County ranks 22$^{nd}$ of sixty-seven counties (up from the ranking of 27$^{th}$ reported in the 2017 hazard mitigation plan) in the commonwealth for agricultural production, totaling just over $92 million annually (USDA, 2017). Agricultural production from crops, including nursery and greenhouse crops, accounts for $26 million in commerce annually. Production from livestock, poultry, and their products accounts for $66 million annually.

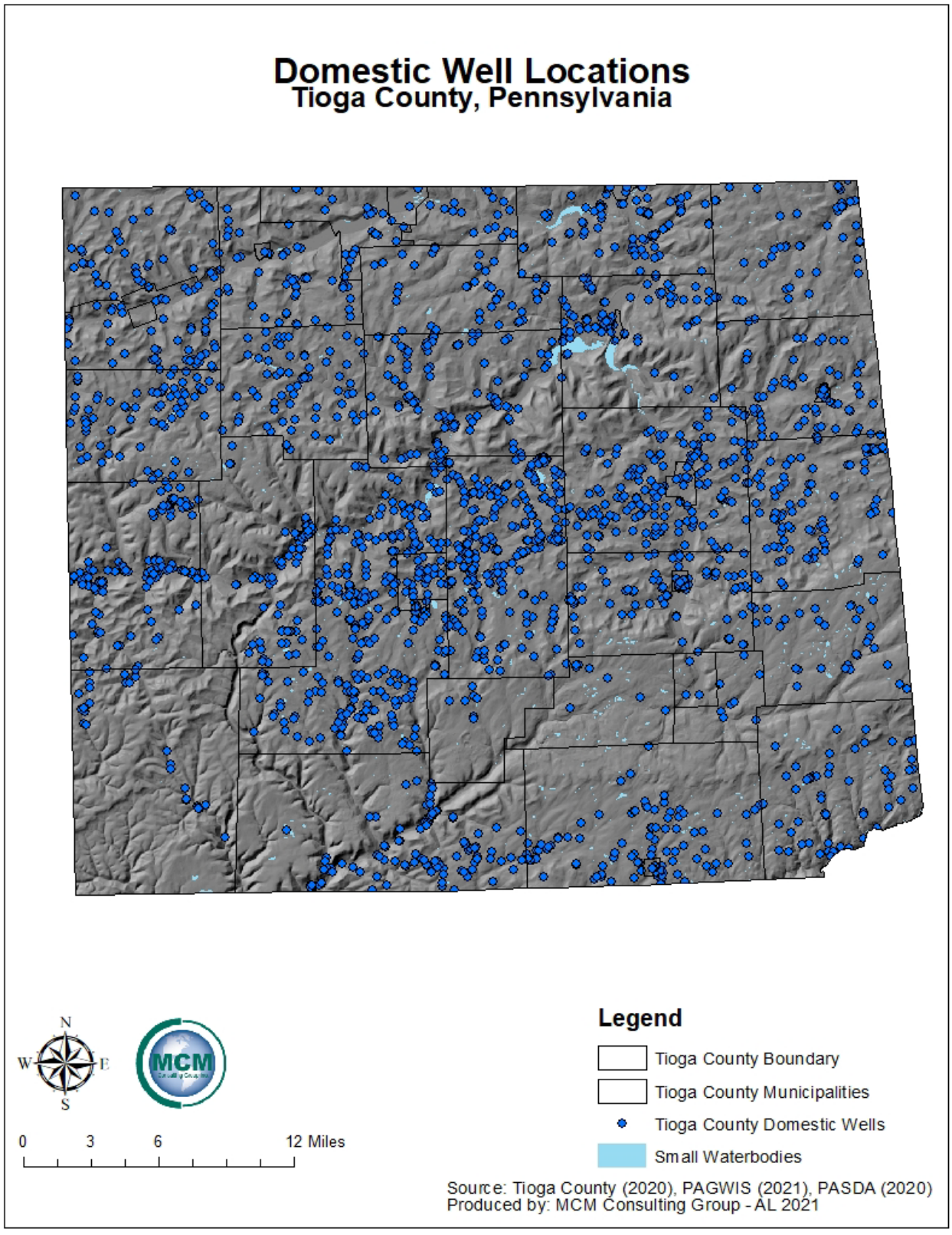
A map of properties with tillable agricultural land use, forestry, and other land in the county vulnerable to drought is shown below at *Figure 11 - Drought-Vulnerable Land Use and Public Water Supply.*

*Figure 11 - Drought Vulnerable Land Use and Public Water Supply*



Public or municipal water supplies are also vulnerable to the effects of drought because supply sources include rivers, reservoirs, and groundwater. Public water service areas cover only some of the land area in the county, as depicted in *Figure 11 – Drought-Vulnerable Land Use and Public Water Supply* and *Figure 12 - Domestic Well Locations - Tioga County.* The majority of the county relies on domestic wells for their fresh drinking water. Residents or water authorities that use private domestic wells are more vulnerable to droughts because their drinking water can literally dry up. There is a total of 2,412 domestic water wells in the county. It is important to note that the well data was obtained from the Pennsylvania Groundwater Information System (PaGWIS). PaGWIS relies on *voluntary submissions* of well record data by well drillers; as a result, it is not a complete database of all domestic wells in the county. This is the most complete dataset of domestic wells available.

*Figure 12 - Domestic Well Locations - Tioga County*



Through 2017, the USGS conducted many baseline water quality studies throughout Pennsylvania, but one for Tioga County had not yet been completed. In the spring of 2018, the county did submit an application for a grant to assist with completion of the study, but it was not awarded. The studies comprise a useful reference to get a general sense of the water quality and challenges associated with domestic water wells in the commonwealth.

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

https://www.epa.gov/sites/production/files/2017-10/documents/drought_guide_final_508compliant_october2017.pdf.

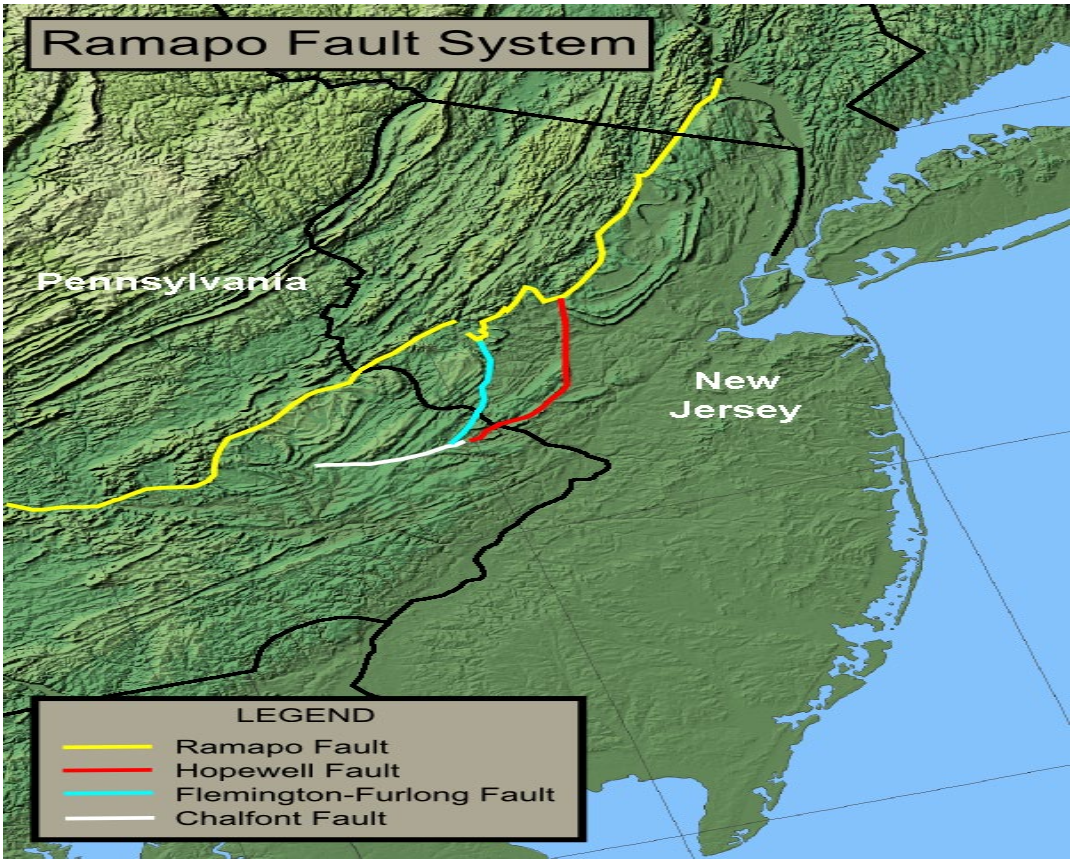
### 4.3.2. Earthquake

#### 4.3.2.1 Location and Extent

An earthquake is sudden movement of the earth's surface caused by the release of stress accumulated within or along the edge off the earth's tectonic plates, a volcanic eruption, or by a human induced explosion (DCNR, 2007). Earthquake events in Pennsylvania, including Tioga County, are usually mild events, impacting areas no greater than sixty-two miles in diameter from the epicenter. A majority of earthquakes occur along boundaries between tectonic plates, and some earthquakes occur at faults on the interior of plates. Today, Eastern North America, including Tioga County, Pennsylvania, is far from the nearest plate boundary. That plate boundary is the Mid-Atlantic Ridge and is approximately 2,000 miles to the east. The Ramapo Fault System runs through New York, New Jersey, and eastern Pennsylvania (See . *Their locations in Tioga County* are plotted on a map later in this profile.

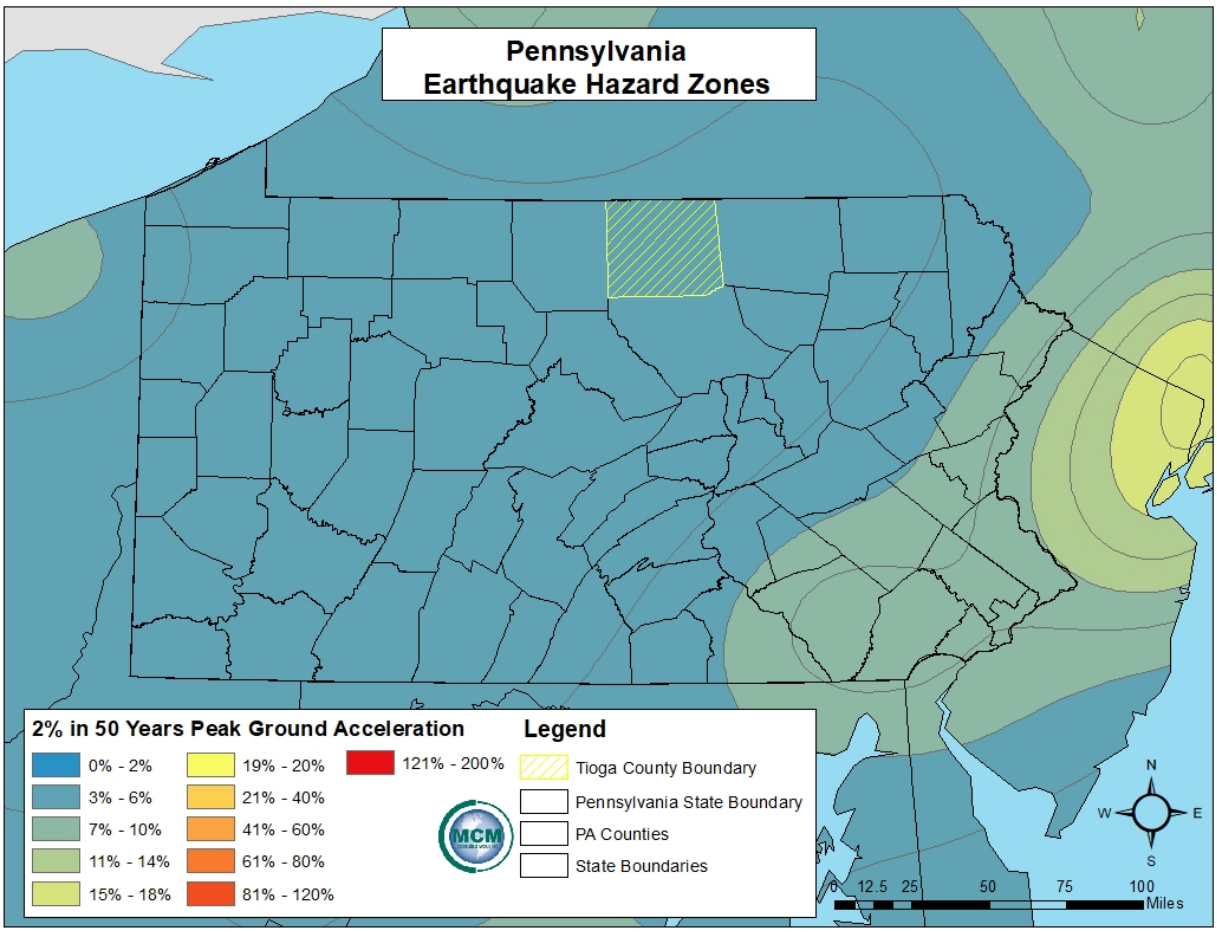
). This fault system is associated with some small earthquakes, and it is thought unlikely to produce large earthquakes.

*Figure 13 - Ramapo Fault System*



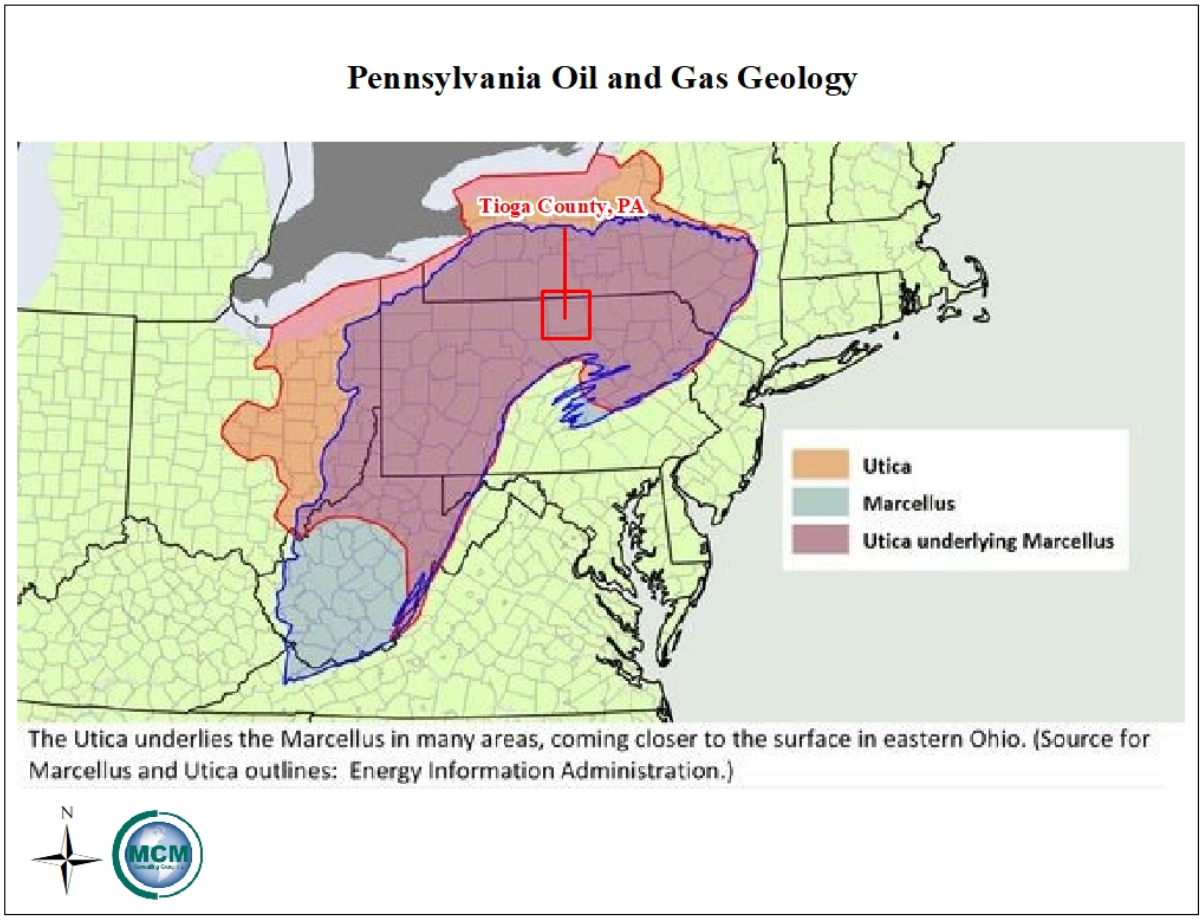

When the supercontinent of Pangaea broke apart about 200 million years ago, the Atlantic Ocean began to form. Since then, many faults have developed. Locating all of the faults would be an idealistic approach to identifying the region's earthquake hazard; however, many of the fault lines in this region have no seismicity associated with them. The best way to determine earthquake history for Tioga County is to conduct a probabilistic earthquake-hazard analysis with the earthquakes that have already happened in and around the county. ***Error! Reference source not found.*** shows that Tioga County is in a low hazard zone (3-6%) for earthquake activity according to the USGS (2014), suggesting a low probability of earthquake occurrence. However, the map shown as *Figure 16 - Pennsylvania Earthquake Activity (Earthquake Epicenters Within 200 Miles of Tioga County),* shows one earthquake epicenter inside the county boundary.

*Figure 14 - Pennsylvania Earthquake Hazard Zones*




Natural gas extraction of the Marcellus/Utica Shale formation (see *Figure 15 - Pennsylvania Oil and Gas Geology*) has occurred in many regions of the commonwealth, including Tioga County. Hydraulic fracturing, or fracking, is used to extract the gas, and the process is thought to lead to an increase in seismic activity (Meyer, 2016).

*Figure 15 - Pennsylvania Oil and Gas Geology*




However, fracking does not appear to be linked to the increased rate of magnitude three and larger earthquakes (USGS 2014). In recent years, permits for extraction of the natural gas and oil in the commonwealth are issued for unconventional wells and have been issued by the Pennsylvania Department of Environmental Protection. Their locations in Tioga County are plotted on a map later in this profile.

#### 4.3.2.2 Range of Magnitude

Earthquakes result in the propagation of seismic waves, which are detected using seismographs. These seismograph results are measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. *Table 12 – Richter Scale* summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas. The Modified Mercalli Intensity Scale (*Table 13 – Modified Mercalli Intensity Scale)* is an alternative measure of earthquake intensity that is scaled by the impacts of the earthquake event. Earthquakes have many secondary impacts, including disrupting critical facilities, transportation routes, public water supplies and other utilities.

*Table 12 - Richter Scale*

| Richter Scale | |
|---|---|
| **Richter Magnitude** | **Earthquake Effects** |
| **Less than 3.5** | Not generally felt but recorded. |
| **3.5-5.4** | Often felt, but rarely causes damage. |
| **Under 6.0** | At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions. |
| **6.1-6.9** | Can be destructive in areas where people live up to about 100 kilometers across. |
| **7.0-7.9** | Major earthquake; can cause serious damage over large areas. |
| **8.0 or greater** | Great earthquake; can cause serious damage in areas several hundred kilometers across. |

*Table 13 - Modified Mercalli Intensity Scale*

| Modified Mercalli Intensity Scale | | | |
|---|---|---|---|
| **Scale** | **Intensity** | **Earthquake Effects** | **Richter Scale Magnitude** |
| **I** | **Instrumental** | Detected only on seismographs. | <4.2 |
| **II** | **Feeble** | Some people feel it. | |
| **III** | **Slight** | Felt by people resting, like a truck rumbling by. | |
| **IV** | **Moderate** | Felt by people walking. | |
| **V** | **Slightly Strong** | Sleepers awake; church bells ring. | <4.8 |
| **VI** | **Strong** | Trees sway; suspended objects swing; objects fall off shelves. | <5.4 |

| Scale | Intensity | Earthquake Effects | Richter Scale Magnitude |
|---|---|---|---|
| VII | Very Strong | Mild alarm, walls crack, plaster falls. | <6.1 |
| VIII | Destructive | Moving cars uncontrollable, masonry fractures, poorly constructed buildings damaged. | <6.9 |
| IX | Ruinous | Some houses collapse, ground cracks, pipes break open. | <6.9 |
| X | Disastrous | Ground cracks profusely, many buildings destroyed, liquefaction and landslides widespread. | <7.3 |
| XI | Very Disastrous | Most buildings and bridges collapse, roads, railways, pipes, and cables destroyed, general triggering of other hazards. | <8.1 |
| XII | Catastrophic | Total destruction, trees fall, ground rises and falls in waves. | >8.1 |

#### 4.3.2.3 Past Occurrence

The USGS reports a 1.4 magnitude earthquake originated four miles east of Wellsboro on August 22, 2016. This earthquake caused no damage and went largely unnoticed by residents. All earthquake events that occurred within 200 miles of Tioga County between 1770 and 2003 can be seen in *Figure 16 - Pennsylvania Earthquake Activity (Epicenters Within 200 Miles of Tioga County)*. Both *Figure 16 - Pennsylvania Earthquake Activity (Epicenters Within 200 Miles of Tioga County),* and the one at the following hyper-link show earthquake epicenters within close enough proximity to the county to produce some effects in the county:

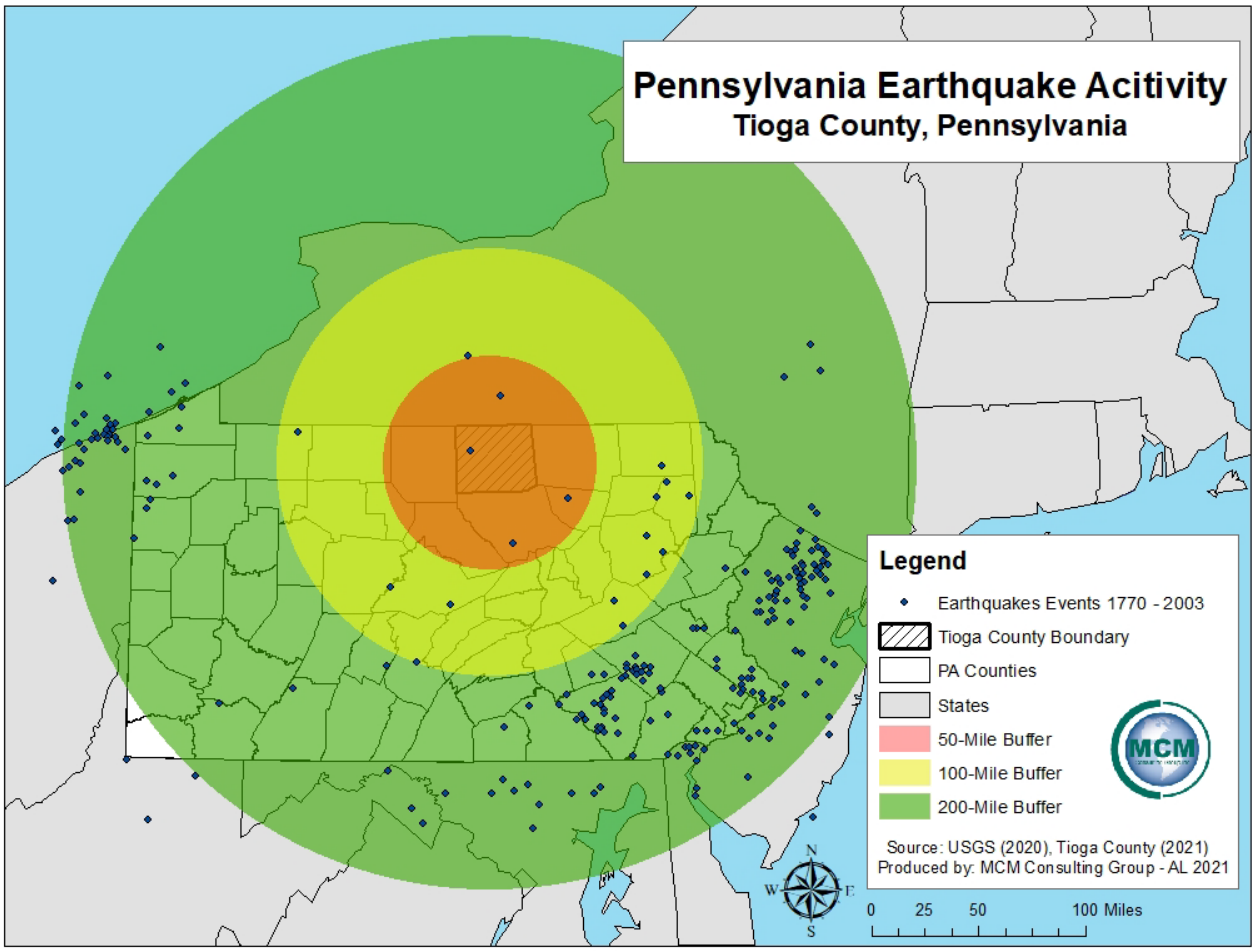
*http://elibrary.dcnr.pa.gov/GetDocument?docId=1751247&DocName=Map69_EQCatalog-Epicenter_Pa*

In July 2019, a 2.2 earthquake occurred just west of Reading, Pennsylvania. Parts of the county experienced some of the shock waves from these minor earthquakes and others that have occurred around the region. The strongest recorded earthquake in Pennsylvania history (5.2) occurred on September 25, 1998, in northwestern Pennsylvania and is known as the Pymatuning Earthquake for its epicenter near Pymatuning Lake. The effects of the earthquake were felt across the commonwealth and were blamed for many wells in the epicentral region drying up,

while new springs and old wells began to flow. A three-month date range revealed 120 dry household-supply wells on the ridge of Jamestown and Greenville, Pennsylvania. Declines of up to 100 feet were observed on a ridge where at least eighty of the wells resided. The degree of the damage varied. Some of the wells lost all power or could barely hold their yields and some of the water in wells turned black or began to smell of sulfur.

The most likely cause of the wells drying was because of the increase in hydraulic conductivity or "fracking" of shale rock under this area caused by the earthquake. The quake affected the existing faults and created new faults in the shale. https://en.wikipedia.org/wiki/1998_Pymatuning_earthquake - cite_note-:0-3 This created more permeability for the water to leak down from the hilltops on the ridge down to the valleys following the contours of the Meadville shale.

*Figure 16 - Pennsylvania Earthquake Activity (Epicenters Within 200 Miles of Tioga County)*




### 4.3.2.4 Future Occurrence

Earthquake activity and intensities are difficult to predict, but a probabilistic analysis of prior earthquakes can assist in gauging the likelihood of future occurrences. ***Error! Reference source***

***not found.*** shows that Tioga County is in a low hazard zone (3-6%) for earthquake activity according to the USGS (2014), suggesting a low probability of earthquake occurrence. However, according to the USGS, there has been a recent trend increasing the frequency of magnitude three and larger earthquakes in the central and eastern U.S. (*Table 14 – Recent Earthquake Trends in Central and Eastern United States*). This uptick in seismicity is considered to be due to hydraulic fracturing activities, and specifically occurs as a result of wastewater from the fracking process being injected into the earth (Meyer, 2016). Recent studies have moved towards being able to predict such induced seismicity by looking at uplift after injections, but more work needs to be done to confirm uplift as a reliable indicator of induced seismicity (Shirzei et al., 2016). It is important to note that seismicity can occur even after wells become inactive and injection rates decline (Shirzaei et al., 2016). *Figure 17 - Tioga County Unconventional Well Locations*, shows the current possible earthquake risk due to fracking activity.

*Figure 17 - Tioga County Unconventional Well Locations*

Isostatic Rebound is a hypothesis for earthquake occurrence that has been kicked around for a lot of years, according to Charles Scharnberger, a retired professor of geology at Millersville University, who monitors the seismic station there. Scharnberger said Pennsylvania earthquakes are more of a mystery but could have something to do with the westward shift of the North American tectonic plate. Though the plates meet in California, where most of the seismic activity occurs, that movement still causes stress, squeezing and pressure along the entire length of the plate, reverberating as far back as the East Coast. A 3.4 earthquake like the one in Mifflintown, Juniata County in 2019 is in the medium range for Pennsylvania and may occur every couple of years. According to the USGS, this was the strongest earthquake felt or originating in Pennsylvania that year. It was followed by a 1.3 aftershock.

The chances of a devastating earthquake are low, but do exist, according to Scharnberger, His calculations on the probability of a severe earthquake based on the historic record indicate it is about a one in 200 chance in any given year.

*Table 14 - Recent Earthquake Trends in Northeastern United States*

| **Earthquake Trends in Northeastern U.S.** *(USGS, 2020)* | |
|---|---|
| **Year** | **Number of Magnitude 3+ Earthquakes** |
| 2015 | 0 |
| 2016 | 3 |
| 2017 | 4 |
| 2018 | 0 |
| 2019 | 5 |
| 2020 | 3 |

#### 4.3.2.5 Vulnerability Assessment

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

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

earthquake. Infrastructure is more at risk on the east coast than the west coast because its buildings are older.

### 4.3.3 Extreme Temperatures

#### 4.3.3.1 Location and Extent

Pennsylvania and more specifically, Tioga County, can experience many different temperature extremes. High temperatures occur about ten days per year at any location in Pennsylvania, however, southern parts of the state, experiences more than twice this number. Freezing temperatures occur on an average of 100 or more days per year with longest freeze-free period at near sea level and northwest Pennsylvania (adjacent to Lake Erie). Extreme temperatures can be devastating – extreme heat can cause sunburn, heat cramps, heat exhaustion, heat stroke, and dehydration, while extreme cold can cause hypothermia and frostbite. Both can potentially cause long-lasting disabilities. January is typically the coldest month for Tioga County, with average temperatures of 14°F. *Figure 18 - Average Minimum Temperature Trends for Pennsylvania* shows the average minimum temperatures in Pennsylvania with Tioga County identified. July has typically been the warmest month for Tioga County, with an average temperature of 80°F. *Figure 19 - Average Maximum Temperature Trends for Pennsylvania* shows the average maximum temperatures in Pennsylvania with Tioga County identified. Temperatures can vary across Tioga County due to elevation changes in topography.

*Figure 18 - Average Minimum Temperature Trends for Pennsylvania*

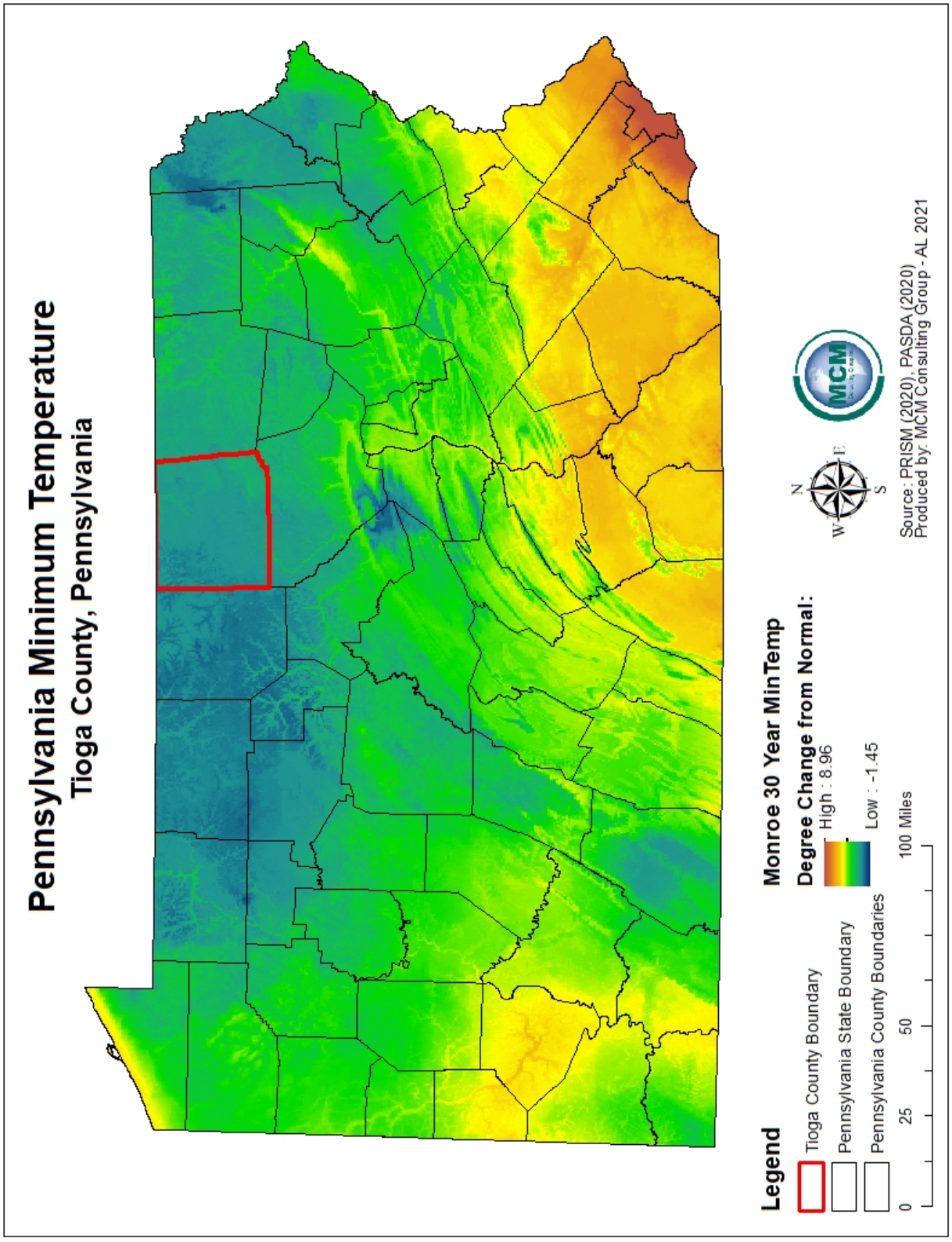
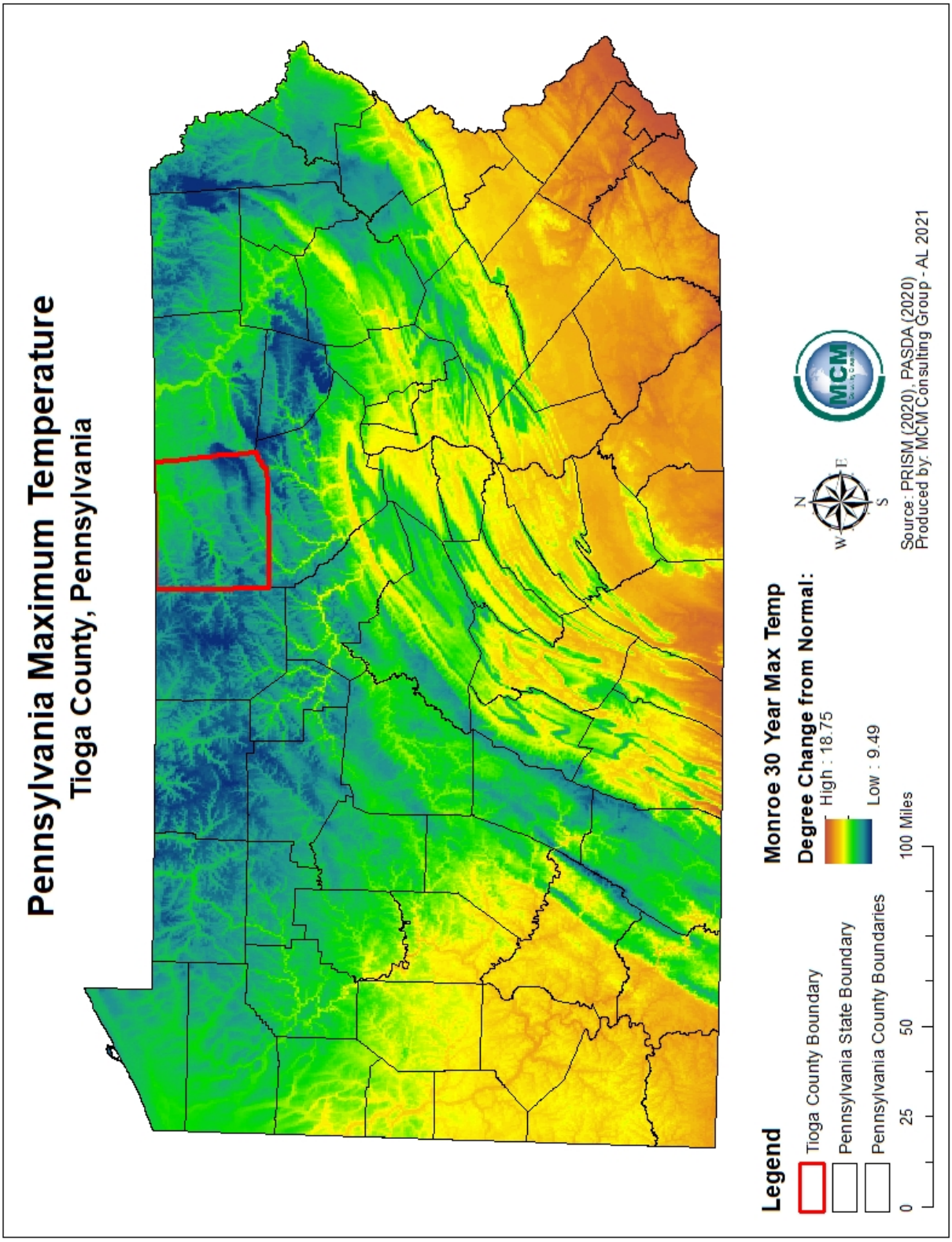


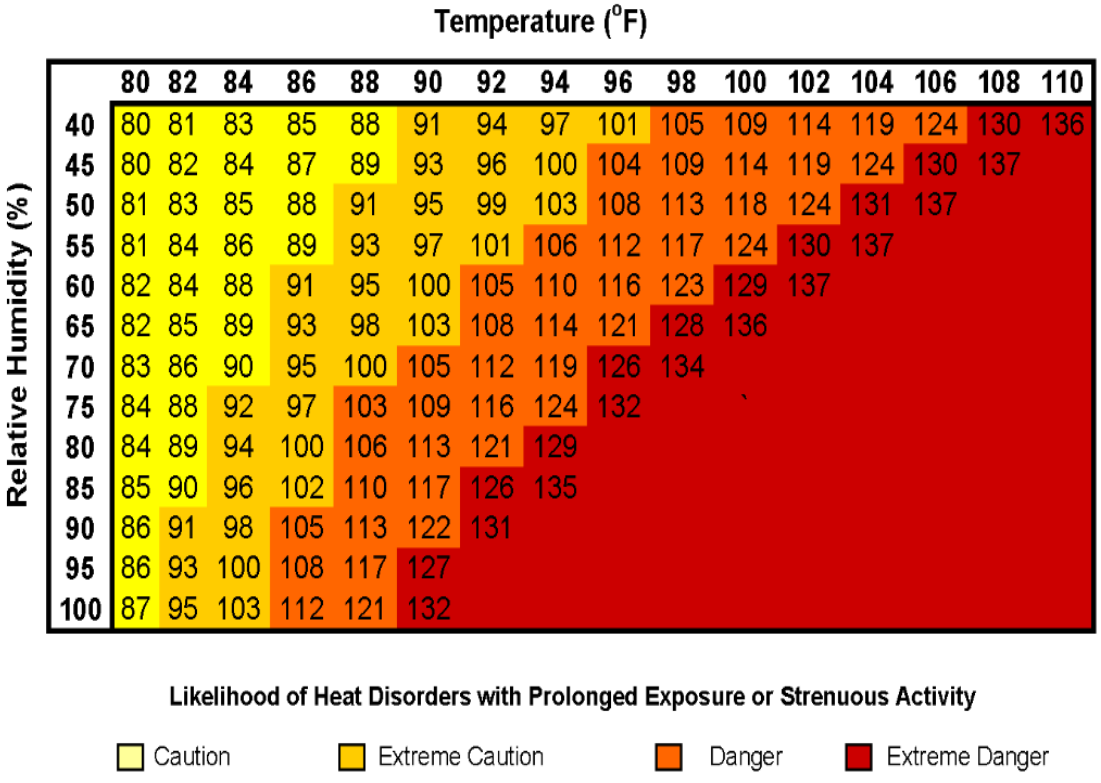
*Figure 19 - Average Maximum Temperature Trends for Pennsylvania*



#### 4.3.3.2 Range of Magnitude

When extreme temperature events occur, they typically impact the entirety of Tioga County, including the surrounding region. Extreme heat is described as temperatures that hover at least 10ºF above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined. Temperature advisories, watches, and warnings are issued by the National Weather Service relating impacts to the range of temperatures typically experienced in Pennsylvania. Heat advisories are issued when the heat index temperature is expected to be equal to 100°F, but less than 105°F. Excessive heat warnings are issued when heat indices will attain or exceed 105°F and are issued within twelve hours of the onset. Excessive heat watches are issued when there is a possibility that excessive heat warning criteria may be experienced within twenty-four to seventy-two hours, but their occurrence and timing are still uncertain. A potential worst-case extreme temperature scenario would be if widespread areas of the Commonwealth experienced 90°F or higher temperatures for an extended number of days. The heat could overwhelm the power grid and cause widespread blackouts, cutting off vital HVAC services for residents. It could create crisis management issues for senior citizens on fixed incomes and the homeless population. The heat index is a measurement that takes int account both the temperature and relative humidity and is calculated as shown in *Figure 20 - National Weather Service's Heat Index Matrix.*

*Figure 20 - National Weather Service's Heat Index Matrix*



*Source: (NOAA NWS, 2018)*

Extreme cold temperatures drop well below typical temperatures and are often associated with winter storm events. Wind can make the apparent temperature drop further, and exposure to such extreme cold temperatures can cause hypothermia, frost bite and death. Wind chill warnings are issued when wind chills drop to -25°F or lower. While this threshold applies to the entire state, the threshold for advisories varies based on regions. Wind chill advisories are issued in the south and western sections of Pennsylvania, when wind chill values drop to -10°F to -24°F. Wind chill advisories are issued in the southern-central to northern sections of the Commonwealth when wind chills drop to -15°F to -24°F. The National Weather Service created a wind chill chart which shows the time frostbite takes to set in depending on temperature and wind speed as shown in *Figure 21 - National Weather Service's Wind Chill Matrix*.

*Figure 21 - National Weather Service's Wind Chill Matrix*

**Wind Chill Chart**

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

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

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

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

*Source: (NOAA NWS, 2001)*

### 4.3.3.3 Past Occurrence

Tioga County has had more past occurrences of extreme cold incidents than extreme heat due to the geographic location of the county. *Table 15 - Past Extreme Temperature Occurrences for Tioga County* shows the past occurrence events associated with extreme temperature that have occurred in Tioga County. The data in the table was reported from early 2000s to the year 2019.

Due to the source used, no events have been documented before 2004 and after 2019, however, events most likely have occurred without being documented. Additionally, the source had no extreme heat temperature events listed, but these events have probably occurred. There was a total of nineteen extreme cold events that were experienced in Tioga County. There were no reports of death of injury related to the occurrences. However, numerous sources have provided information in regard to past occurrences and losses associated with extreme temperature in Tioga County and the Commonwealth as a whole. Due to the number of sources available with information, number of events and losses could vary slightly in number.

Data from the National Climatic Data Center reports that there have been eighty-five extreme temperature episodes in Pennsylvania from 2000 to present, resulting in a total of ninety-four deaths and 103 injuries. Out of the eighty-five events, fifty of them were extreme cold related with four deaths. The other thirty-five events were extreme heat related with ninety deaths and 103 injuries across the state. Specifically, with Tioga County, majority of the extreme cold temperature events that occur hit a wind chill of around -25°F to -30°F. The most recent event for Tioga County happened during January 30th, 2019 had a widespread wind chills of -25°F to -35°F from the northern mountains southward into the Laurel Highlands.

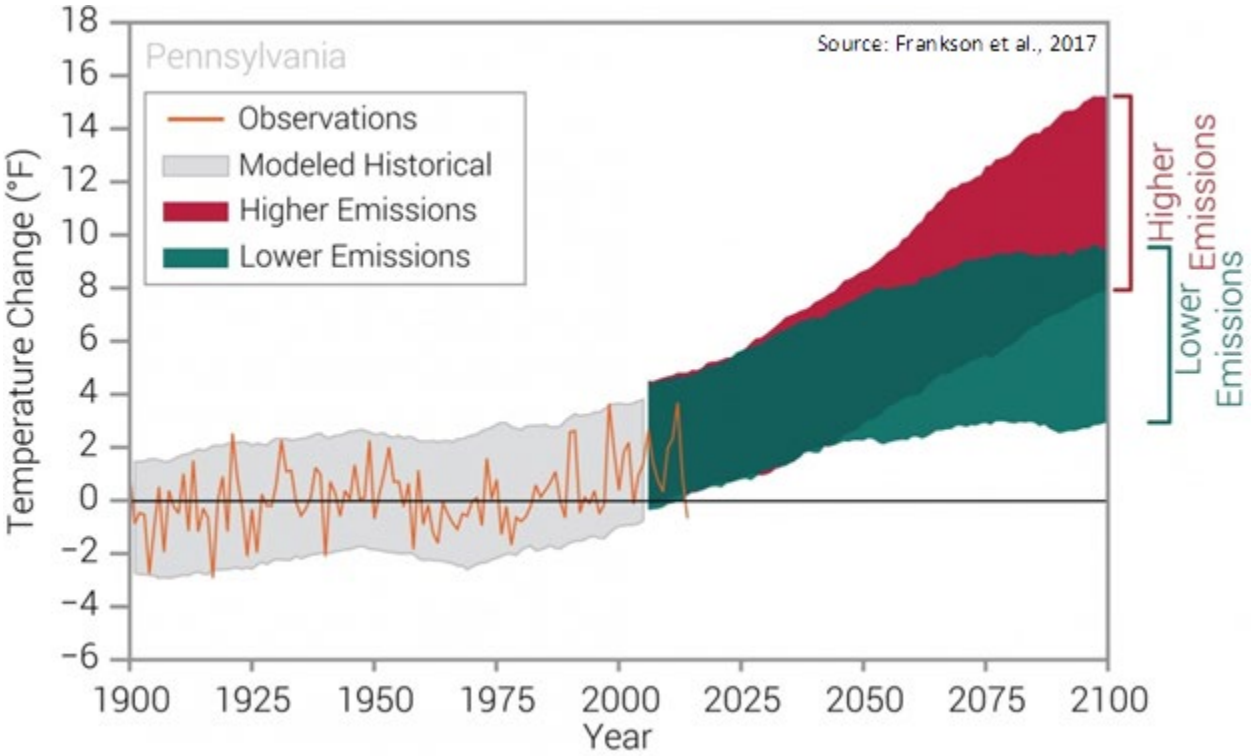
*Table 15 - Past Extreme Temperature Occurrences for Tioga County*

| Past Extreme Temperature Occurrences for Tioga County (NOAA, 2020) | | |
|---|---|---|
| **Location** | **Date** | **Type** |
| Tioga County | 12/20/2004 | Extreme Cold |
| Tioga County | 01/26/2007 | Extreme Cold |
| Tioga County | 02/03/2007 | Extreme Cold |
| Tioga County | 02/16/2007 | Extreme Cold |
| Tioga County | 03/06/2007 | Extreme Cold |
| Tioga County | 02/10/2008 | Extreme Cold |
| Tioga County | 12/21/2008 | Extreme Cold |
| Tioga County | 01/15/2009 | Extreme Cold |
| Tioga County | 03/02/2009 | Extreme Cold |
| Tioga County | 01/06/2014 | Extreme Cold |
| Tioga County | 01/28/2014 | Extreme Cold |
| Tioga County | 02/12/2015 | Extreme Cold |
| Tioga County | 02/15/2015 | Extreme Cold |
| Tioga County | 02/19/2015 | Extreme Cold |
| Tioga County | 02/23/2015 | Extreme Cold |
| Tioga County | 02/13/2016 | Extreme Cold |
| Tioga County | 01/05/2018 | Extreme Cold |
| Tioga County | 01/20/2019 | Extreme Cold |
| Tioga County | 01/30/2019 | Extreme Cold |

#### 4.3.3.4 Future Occurrence

Extreme temperatures will continue to impact Tioga County in the future. Anthropogenic climate change is causing extreme climatic events to occur more frequently, suggesting that extreme temperatures are becoming a more threatening hazard as the impacts of climate change intensify. The annual average temperature has increased by 1.2˚F across the continental United States from 1986 to present compared to the time period 1901 to 1960 and temperatures are expected to continue to rise. ***Error! Reference source not found.*** *for Pennsylvania* shows these projected changes in temperature for Pennsylvania based on climate models considering the possibilities of increased and decreased levels of greenhouse gas emissions. In recent years, record high temperatures have outnumbered record low temperatures 2:1 so it is expected that the risk of extreme heat will be amplified whereas the risk of extreme cold will be attenuated. The Northeastern United States is expected to experience twenty to thirty more days with temperatures above 90˚F, and twenty to thirty fewer days below freezing by approximately 2050. While there may be fewer extreme cold events, those that do occur are expected to reach record-setting low temperatures more often. Historically, Tioga County has had more extreme cold events than extreme heat events due to the geographic location of the county; however, this balance is expected to shift somewhat in the coming years to include a greater proportion of extreme heat events.

*Figure 22 - Observed and Projected Temperature Change for Pennsylvania*




*Source: (Frankson et al., 2017)*

#### 4.3.3.5 Vulnerability Assessment

Extreme temperatures are usually a regional hazard when they occur. The very old (22.6% of sixty-five years or older individuals in Tioga) and the very young (5.2% of five years of younger in Tioga) are most vulnerable to extreme temperatures due to risk factors, mobility challenges, and disabilities. Extreme temperatures can increase the demand for utility services, often resulting in an increased cost to consumers. The increased expense can make it difficult for the consumer to afford the service. The increased demand for services may cause a decrease in availability of these services or failure of the system. A decrease or failure of the utility system during extreme temperature events puts a large population at great risk. Extreme temperature events can also drastically increase the volume of emergency calls, potentially overwhelming the public safety answering point. Extreme heat events can also contribute to drought conditions, which in turn increase the risk of wildfires.

### 4.3.4 Flood, Flash Flood, and Ice Jam

#### 4.3.4.1 Location and Extent

Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often in mountain streams and mountainous regions, and in urban areas where much of the ground is covered in impervious surfaces. Flash floods are relatively common in Tioga County and the severity of said flood events is dependent upon a combination of creek, stream, and river basin topography and physiography, hydrology, precipitation, and weather patterns. Present soil conditions, the degree of vegetative clearing, and the presence of impervious cover must also be considered when determining the severity of a flood or flood event.

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 later 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.

Floodplains are lowlands adjacent to rivers, streams, and creeks that are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. Flood recurrence intervals are explained in more detail in Section 4.3.4.4. However, in assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a 10% chance of occurring in a given year is smaller than the floodplain associated with a flood that has a 0.2% annual chance of occurring.

The National Flood Insurance Program (NFIP) publishes digital flood insurance rate maps (DFIRMs). These maps identify the 1% annual chance of flood area. Special flood hazard area (SFHA) and base flood elevations (BFE) are developed from the 1% annual chance flood event. As seen in *Figure 23 – Flooding and Floodplain Diagram*. Structures located within 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 the Tioga 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 16 – Flood Hazard High Risk Zones*. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Tioga County with vulnerable structures and functional needs facilities identified using the most current DFIRM data for Tioga County.

A large portion of Tioga County's municipalities are flood prone and Tioga County is located largely in the Tioga River and Pine Creek watersheds. Flood problems exist mostly in Charleston, Clymer, Middlebury, Liberty, Putnam, and Richmond townships. Flooding has also occurred in multiple boroughs, including Elkland, Mansfield, Lawrenceville, and Wellsboro boroughs. Flooding has occurred among the Tioga River and its tributaries in Tioga County.

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 functional needs 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 throughout the area. Most flood damage to property and structures located in the floodplain is caused by water exposure to the interior, high velocity water and debris flow.

*Figure 23 - Flooding and Floodplain Diagram*

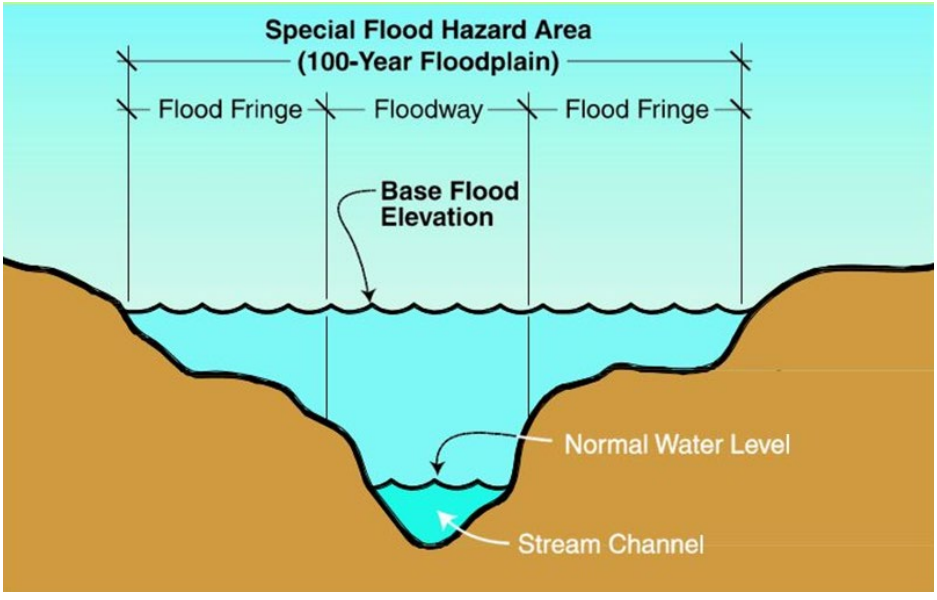


*Table 16 - Flood Hazard High Risk Zones*

| 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 has 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. |

#### 4.3.4.2 Range of Magnitude

The Tioga River Basin and the Cowanesque River Basin have caused significant flooding in Tioga County, specifically on the following rivers and their tributaries:

- Cowanesque River
- Tioga River
  - Mill Creek
  - Crooked Creek
  - Norris Brook
- Pine Creek

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and the rate of snowmelt. Water runoff is greater in areas with steep slopes and little to no vegetative ground cover. The mountainous terrain of Tioga County can cause more severe floods as runoff reaches receiving water bodies more rapidly over steep terrain. This is of particular concern for areas along the Pennsylvania Grand Canyon in Tioga County.

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 flood events. Additionally, small amounts of rain can cause floods in locations where the soil is still frozen, saturated from a previous wet period, or if the area is largely covered in impermeable surfaces such as parking lots, paved roadways, and other developed areas. The county occasionally experiences intense rainfall from a tropical storm in late summer and early fall, which can potentially cause flooding as well.

Severe flooding can cause injuries and deaths and can have long-term impacts on the health and safety of the citizens. Severe flooding can also result in significant property damage, potentially disrupting the regular function of functional needs 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 functional 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 the flood water releases and/or transport hazardous materials.

Flash floods can occur very quickly and with little warning. Flash floods can also be deadly because of the rapid rises in water levels and devastating flow velocities. The more developed areas in the county can be easily 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 secondary effects that could have long lasting impacts on the population, economy, and infrastructure within Tioga County. Power failures are the most common secondary effect associated with flooding. Coupled with a shortage of critical services and supplies, and power failures could cause a public health emergency. Critical infrastructure, such as sewage and water treatment facilities, can fail, causing sewage overflows and the contaminating of 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 for Tioga County is estimated by looking at the potential loss data and repetitive loss data, both analyzed in the risk assessment section of the hazard mitigation plan. In these cases, the severity and frequency of damage can result in permanent population displacement, and businesses may close if they are unable to recover from the disaster.

Estimation of potential loss is completed through FEMA's HAZUS software, a level two HAZUS scenario was performed for the entirety of Tioga County and there were no failed reaches within the scenario. The FEMA reports generated by the software at the end of the scenario were utilized to estimate the amount of damage and loss from a flood. The total building loss for a 100-year flood based on a HAZUS level two scenario is displayed in *Table 17 – HAZUS Building Economic Loss Figures*. The total business interruption values occurring from a

proposed 100-year flood based on FEMA HAZUS data is illustrated in *Table 18 – HAZUS Business Interruption Economic Loss Figures*. *Figure 19 – Loss by Occupancy Type* illustrates the breakdown of economic losses by either residential, commercial, industrial, or other use type.

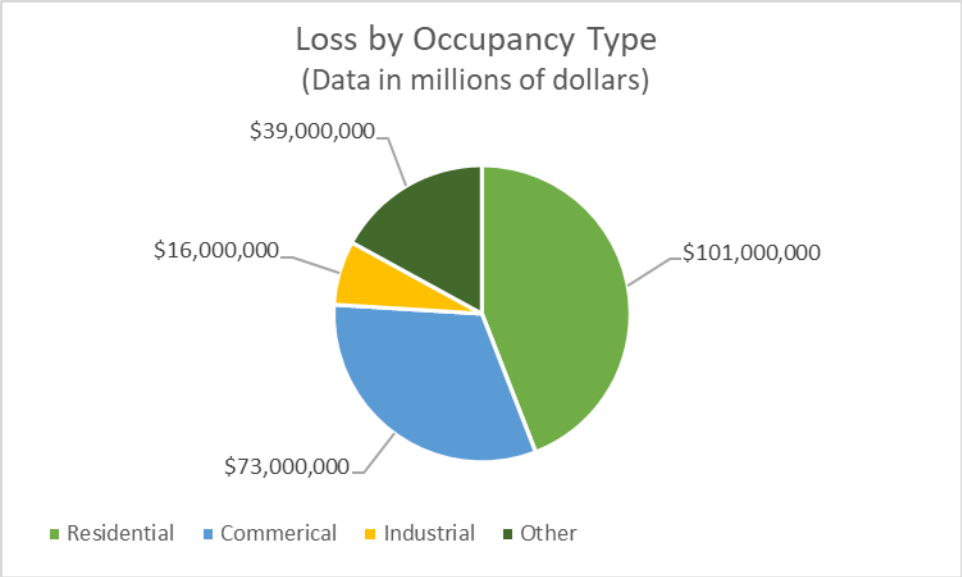
*Table 17 - HAZUS Building Economic Loss Figures*

| HAZUS Building Economic Loss Figures (HAZUS 2021) | | | | | |
|---|---|---|---|---|---|
| | **Residential** | **Commercial** | **Industrial** | **Other** | **Total** |
| **Building:** | $50,840,000 | $6,360,000 | $3,770,000 | $1,740,000 | $62,710,000 |
| **Content:** | $23,110,000 | $19,400,000 | $9,830,000 | $9,310,000 | $61,650,000 |
| **Inventory:** | $0 | $520,000 | $1,350,000 | $120,000 | $1,990,000 |
| **Subtotal:** | **$73,950,000** | **$26,270,000** | **$14,960,000** | **$11,170,000** | **$126,350,000** |

*Table 18 - HAZUS Business Interruption Economic Loss Figures*

| HAZUS Business Interruption Economic Loss Figures (HAZUS 2021) | | | | | |
|---|---|---|---|---|---|
| | **Residential** | **Commercial** | **Industrial** | **Other** | **Total** |
| **Income:** | $1,320,000 | $18,420,000 | $210,000 | $4,210,000 | $24,160,000 |
| **Relocation:** | $16,240,000 | $5,070,000 | $340,000 | $1,580,000 | $23,240,000 |
| **Rental Income:** | $6,500,000 | $3,280,000 | $60,000 | $190,000 | $10,040,000 |
| **Wage:** | $3,130,000 | $19,880,000 | $340,000 | $22,220,000 | $45,570,000 |
| **Subtotal:** | **$27,190,000** | **$46,660,000** | **$950,000** | **$28,200,000** | **$103,000,000** |

*Table 19 - Loss by Occupancy Type*




*Source: HAZUS Scenario for Tioga County (2021)*

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 sediments which improves soil fertility. However, human development often disrupts natural riparian buffers by changing land use and land cover, and the introduction of chemical or biological contaminants that often accompany human presence can contaminate habitats after flood events.

#### 4.3.4.3 Past Occurrence

Tioga County has experienced numerous flooding, flash flooding, and ice jam events in the past. The flooding and flash flooding were caused by a variety of heavy storms, tropical storms, and other issues. A summary of flood event history for Tioga County from January 1996 to September 2018 (data beyond 2018 was not available) is found in *Table 20 – Past Flood and Flash Flood Events*. Details of each event can be found in NOAA's National Center for Environmental Information (NCEI) database. Additional data was also acquired by examining Tioga County's Knowledge Center information from 2013 to 2021. *Figure 24 – Mutton Lane Creek Flooding September 2018* displays a flooding event that took place along Mutton Lane Creek as a result of Tropical Storm Florence. *Figure 25 – Heffner Hollow Flooding September 2018* also displays a flooding event as a result of Tropical Storm Florence.

*Figure 24 - Mutton Lane Creek Flooding September 2018*

*Image provided by the Tioga County Conservation District*

*Figure 25 - Heffner Hollow Flooding September 2018*

*Image provided by the Tioga County Conservation District*

*Table 20 - Past Flood and Flash Flood Events*

| Past Flood and Flash Flood Events (NCEI NOAA) | | | |
|---|---|---|---|
| **Event Location** | **Event Date** | **Event Type** | **Property Damage Estimate** |
| Tioga County (entire county) | 01/19/1996 | Flood | $0* |
| Tioga County (entire county) | 01/19/1996 | Flash Flood | $0* |
| Clymer Township | 04/30/1996 | Flash Flood | $0* |
| Middlebury Township | 05/11/1996 | Flash Flood | $0* |
| Wellsboro Borough | 11/08/1996 | Flash Flood | $2,500,000* |
| Tioga County (Southeast) | 12/01/1996 | Flash Flood | $0* |
| Tioga Borough | 06/23/1998 | Flash Flood | $0* |
| Deerfield Township | 06/13/2000 | Flash Flood | $0* |
| Tioga County (Northeast) | 06/25/2000 | Flash Flood | $0* |
| Wellsboro Borough | 08/09/2003 | Flash Flood | $50,000.00* |
| Tioga County (entire county) | 11/19/2003 | Flood | $0* |
| Wellsboro Borough | 11/19/2003 | Flash Flood | $0* |
| Tioga County (entire county) | 12/11/2003 | Flood | $0* |
| Elkland Borough | 07/17/2004 | Flash Flood | $0* |
| Tioga County (entire county) | 07/27/2004 | Flood | $0* |
| Wellsboro Borough | 08/30/2004 | Flash Flood | $0* |
| Tioga County (entire county) | 09/08/2004 | Flood | $0* |
| Tioga County (entire county) | 09/17/2004 | Flood | $0* |
| Tioga County (entire county) | 01/14/2005 | Flood | $0* |
| Tioga County (entire county) | 04/02/2005 | Flood | $0* |
| Tioga County (entire county) | 06/27/2006 | Flash Flood | $0* |
| Elkland Borough | 07/21/2006 | Flash Flood | $0* |
| Clymer Township | 03/15/2007 | Flood | $0* |
| Blossburg Borough | 08/30/2007 | Flash Flood | $0* |

| Event Location | Event Date | Event Type | Property Damage Estimate |
|---|---|---|---|
| Westfield Borough | 04/28/2011 | Flash Flood | $0* |
| Lawrenceville Township | 05/19/2011 | Flash Flood | $0* |
| Clymer Township | 05/19/2011 | Flash Flood | $0* |
| Lawrence Township | 09/07/2011 | Flood | $450,000.00* |
| Morris Township | 09/06/2012 | Flash Flood | $0* |
| Tioga Borough | 08/31/2013 | Flood | $0* |
| Middlebury Township | 03/12/2014 | Flood | $0* |
| Deerfield Township | 05/16/2014 | Flood | $0* |
| Richmond Township | 06/25/2014 | Flood | $0* |
| Mansfield Borough | 06/25/2014 | Flood | $0* |
| Liberty Township | 02/24/2016 | Flood | $0* |
| Stokesdale Township | 07/23/2017 | Flash Flood | $0* |
| Charleston Township | 07/23/2017 | Flash Flood | $0* |
| Putnam Township | 08/13/2018 | Flood | $0* |
| Roseville Borough | 09/17/2018 | Flood | $0* |
| Nelson Township | 09/17/2018 | Flood | $0* |
| Westfield Borough | 09/17/2018 | Flood | $0* |
| Middlebury Township | 09/17/2018 | Flood | $0* |
| Tioga County (entire county) | 09/21/2018 | Flood | $0* |
| | | **Total:** | **$3,000,000.00*** |

*Property Damage Values are estimated and are not exact figures. Data from NCEI and Knowledge Center

The National Flood Insurance Program (NFIP) 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 repair, on average, equaled or exceeded 25% 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 increased cost of compliance coverage. *Table 21 – Repetitive Loss Properties* illustrates the communities that have repetitive loss properties, the total building payments, the contents payments, and the number of losses and properties. There and eighteen repetitive loss properties in Tioga County.

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. *Table 23 – Severe Repetitive Loss Properties* illustrates the

communities within Tioga County that have severe repetitive loss properties, the total building payments, the contents payments, and the number of losses and properties. The data used in the table is based on data from PEMA.

Most municipalities in Tioga County participate in the NFIP. Information on each participating municipality can be found in *Table 24 – Municipal NFIP Policies & Vulnerability*.

*Table 21 - Repetitive Loss Properties*

| Repetitive Loss Properties (PEMA) | | | | | | |
|---|---|---|---|---|---|---|
| **Community Name** | **Community Number** | **Cumulative Building Payment** | **Cumulative Contents Payment** | **Sum of Total Paid** | **Losses** | **Properties** |
| Blossburg Borough | 420817 | $24,969.04 | $0 | $24,969.04 | 5 | 2 |
| Gaines Township | 421005 | $51,561.99 | $7,924.30 | $59,486.29 | 5 | 2 |
| Knoxville Borough | 420819 | $14,776.24 | $1,800.00 | $16,576.24 | 2 | 1 |
| Middlebury Township | 421179 | $65,956.88 | $27,933.75 | $93,890.63 | 4 | 2 |
| Osceola Township | 421182 | $32,192.52 | $1,877.18 | $34,069.70 | 3 | 2 |
| Putnam Township | 420824 | $16,644.51 | $0 | $16,644.51 | 2 | 1 |
| Richmond Township | 420825 | $18,014.13 | $1,039.82 | $19,053.95 | 3 | 2 |
| Shippen Township | 422100 | $295,906.09 | $97,107.72 | $393,013.81 | 14 | 4 |
| Union Township | 421184 | $49,260.97 | $0 | $49,260.97 | 3 | 2 |
| | **Total:** | **$569,282.37** | **$137,682.77** | **$707,965.14** | **41** | **18** |

*Table 22 - Summary of Type of Repetitive Loss Properties by Municipality*

| Summary of Type of Repetitive Loss Properties by Municipality | | | | | |
|---|---|---|---|---|---|
| Municipality | Type | | | | |
| | Non-Residential | 2-4 Family | Single Family | Condo | Other Residential |
| Blossburg Borough | 0 | 0 | 2 | 0 | 0 |
| Gaines Township | 0 | 0 | 2 | 0 | 0 |
| Knoxville Borough | 0 | 0 | 1 | 0 | 0 |
| Middlebury Township | 0 | 0 | 2 | 0 | 0 |
| Osceola Township | 0 | 0 | 2 | 0 | 0 |
| Putnam Township | 0 | 0 | 1 | 0 | 0 |
| Richmond Township | 1 | 0 | 1 | 0 | 0 |
| Shippen Township | 0 | 0 | 4 | 0 | 0 |
| Union Township | 1 | 0 | 1 | 0 | 0 |

*Table 23 - Severe Repetitive Loss Properties*

| Severe Repetitive Loss Properties (PEMA) | | | | | | |
|---|---|---|---|---|---|---|
| Community Name | Community Number | Cumulative Building Payments | Cumulative Contents Payments | Sum of Total Paid | Losses | Properties |
| Shippen Township | 422100 | $123,358.90 | $38,522.96 | $161,881.86 | 5 | N/A |

*Table 24 - Municipal NFIP Policies & Vulnerability*

| Municipal NFIP Policies (PEMA 2020) | | | | | |
|---|---|---|---|---|---|
| Community Name | Community Number | Contract Count | Policy Count | Total Coverage | Premium and Policy Fee |
| Bloss Township | 422094 | 1 | 1 | $77,000.00 | $843.00 |
| Blossburg Borough | 420817 | 45 | 45 | $4,904,300.00 | $66,778.00 |
| Brookfield Township | 421171 | 2 | 2 | $525,000.00 | $1,001.00 |
| Charleston Township | 421172 | 4 | 4 | $426,000.00 | $1,670.00 |
| Chatham Township | 421173 | 3 | 3 | $606,000.00 | $1,311.00 |
| Clymer Township | 421174 | 1 | 1 | $280,00.00 | $418.00 |
| Covington Township | 421175 | 12 | 12 | $1,638,000.00 | $12,067.00 |
| Deerfield Township | 421176 | 5 | 5 | $1,050,000.00 | $2,706.00 |

| Community Name | Community Number | Contract Count | Policy Count | Total Coverage | Premium and Policy Fee |
|---|---|---|---|---|---|
| Delmar Township | 421177 | 8 | 8 | $930,400.00 | $5,854.00 |
| Elk Township | 421154 | 1 | 1 | $350,000.00 | $446.00 |
| Elkland Borough | 420818 | 15 | 15 | $2,365,500.00 | $11,611.00 |
| Gaines Township | 421005 | 2 | 2 | $247,200.00 | $2,929.00 |
| Knoxville Borough | 420819 | 2 | 2 | $378,000.00 | $698.00 |
| Lawrence Township | 421006 | 7 | 7 | $1,125,600.00 | $4,954.00 |
| Lawrenceville Borough | 420821 | 1 | 1 | $70,000.00 | $234.00 |
| Liberty Borough | 420822 | 2 | 2 | $127,000.00 | $1,273.00 |
| Mansfield Borough | 420823 | 4 | 4 | $861,400.00 | $4,185.00 |
| Middlebury Township | 421179 | 16 | 16 | $3,133,200.00 | $13,359.00 |
| Osceola Township | 421182 | 9 | 9 | $825,400.00 | $4,929.00 |
| Putnam Township | 420824 | 19 | 19 | $1,521,000.00 | $18,490.00 |
| Richmond Township | 420825 | 17 | 17 | $4,064,900.00 | $15,234.00 |
| Roseville Borough | 420826 | 3 | 3 | $424,000.00 | $2,897.00 |
| Shippen Township | 422100 | 6 | 6 | $791,500.00 | $3,429.00 |
| Sullivan Township | 421183 | 6 | 6 | $520,000.00 | $2,875.00 |
| Tioga Borough | 420827 | 3 | 3 | $1,455,000.00 | $3,779.00 |
| Union Township | 421184 | 7 | 7 | $409,000.00 | $5,048.00 |
| Wellsboro Borough | 420829 | 13 | 13 | $4,329,900.00 | $9,870.00 |
| Westfield Township | 421185 | 16 | 16 | $1,453,500.00 | $12,158.00 |
| Westfield Borough | 422093 | 20 | 20 | $4,348,000.00 | $38,084.00 |
| | **Total:** | **252** | **252** | **$39,236,800.00** | **$249,100.00** |

#### 4.3.4.4 Future Occurrence

Flooding is a frequent problem throughout the Commonwealth of Pennsylvania. Tioga County will certainly be impacted by flooding events in the future, as Tioga County experiences some degree of flooding annually. The threat of flooding is compounded in the late winter and early spring months, as melting snow can overflow streams, creeks, and tributaries, increasing the amount of groundwater, clogging stormwater culverts and bridge openings. The NFIP recognizes the 1% annual chance flood, also known as the base flood of 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 in a given year or is likely once every one-hundred years. The digital insurance maps (DFIRMs) are used to identify areas subject to the 1% annual chance of 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 that has a 10% chance of being flooded every year. However, this label does not mean that this area cannot flood more than once every ten years. This label simply designates the probability of a flood of this magnitude every year. Further away from this area is the fifty-year floodplain. 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 2%. A summary of flood probability is shown in *Table 25 – Flood Probability Summary.*

*Table 25 - Flood Probability Summary*

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

#### 4.3.4.5 Vulnerability Assessment

**River and Stream Flooding:**

Tioga County is vulnerable to stream and river flooding events. Flooding puts the entire population at some level of risk, whether through flooding of homes, businesses, places of employment, roadways, sewer, or water infrastructure. Flooding can cause significant power outages and poor road conditions that can lead to heightened transportation accident risk.

Functional needs facilities and critical infrastructure are the most vulnerable buildings and services when river and stream flooding is considered. Functional needs facilities are facilities that if damaged would present an immediate threat to life, public health, and safety. Facilities that use and store hazardous materials pose a potential threat to the environment during flooding events if flooding causes a leak, inundation, or equipment failure. Appendix D of this hazard mitigation plan includes a flooding vulnerability map for each municipality in Tioga County, with vulnerable structures and functional needs facilities that are located within the special flood hazard area.

While the regulatory one-hundred-year floodplain is defined by the NFIP and FEMA as a useful tool to estimate flooding vulnerability, it is important to note that it is not always completely accurate.

**Flash Flooding:**

Flash flooding is a common occurrence in Tioga County and can occur anywhere in the county. A large portion of flash flooding occurs in populated areas that have increased impervious ground cover. During the risk assessment process, numerous resources were utilized to determine flash flooding locations in Tioga County. Municipalities were asked to identify locations within their municipality that were prone to frequent flash flooding. The National Climatic Data Center was also queried to determine flash flood vulnerable areas. This data is reflected in *Table 20 – Past Flood and Flash Flood Events* above.

Locations that are identified as vulnerable to flash flooding in Tioga County are as follows:

- Wellsboro Borough
- Elkland Borough
- Westfield Borough
- Middlebury Township

The most costly flood in recent history was a flash flood where the Tioga River and Canoe Camp Creek overflowed the night of September 7, 2011, incurring an estimated $449,652 in damages to public facilities and buildings.

Although the above locations were identified as vulnerable areas in Tioga County, they are not the only locations that are vulnerable to flash flooding. The Tioga County Hazard Mitigation Team will continue to work with municipalities to identify vulnerable flash flooding locations and identify vulnerable functional needs populations and critical facilities.

**Ice Jam Flooding:**

Ice jam flooding has affected Tioga County in the past. Areas along the Pine Creek and the Tioga River are the most vulnerable. The affected areas would see an increase in erosion to riverbanks and loss of vulnerable land.

There are recorded instances of ice jam flooding along the Locey Creek impacting the Middlebury area along Route 287 in the past.

The Tioga County Hazard Mitigation Team will continue to work with the municipalities to identify ice jam flooding locations and identify vulnerable functional needs population and facilities.

### 4.3.5. Invasive Species

#### 4.3.5.1 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 environment, the economy, and even human health can be impacted by an invasive species. Often, an invasive species spreads and reproduces quickly. They are not limited to organisms that come from a foreign country; invasive species can come from a different region in the United States. However, the main occurrence of invasive species is due to human activity. 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 but are not limited to:

- 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

The Governor's Invasive Species Council of Pennsylvania (PISC), the lead organization for invasive species threats, recognizes two types of invasive species: Aquatic and Terrestrial.

**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 instead of in an aquatic environment and whose introduction does or is likely to cause economic/environmental damage or harm to human health.

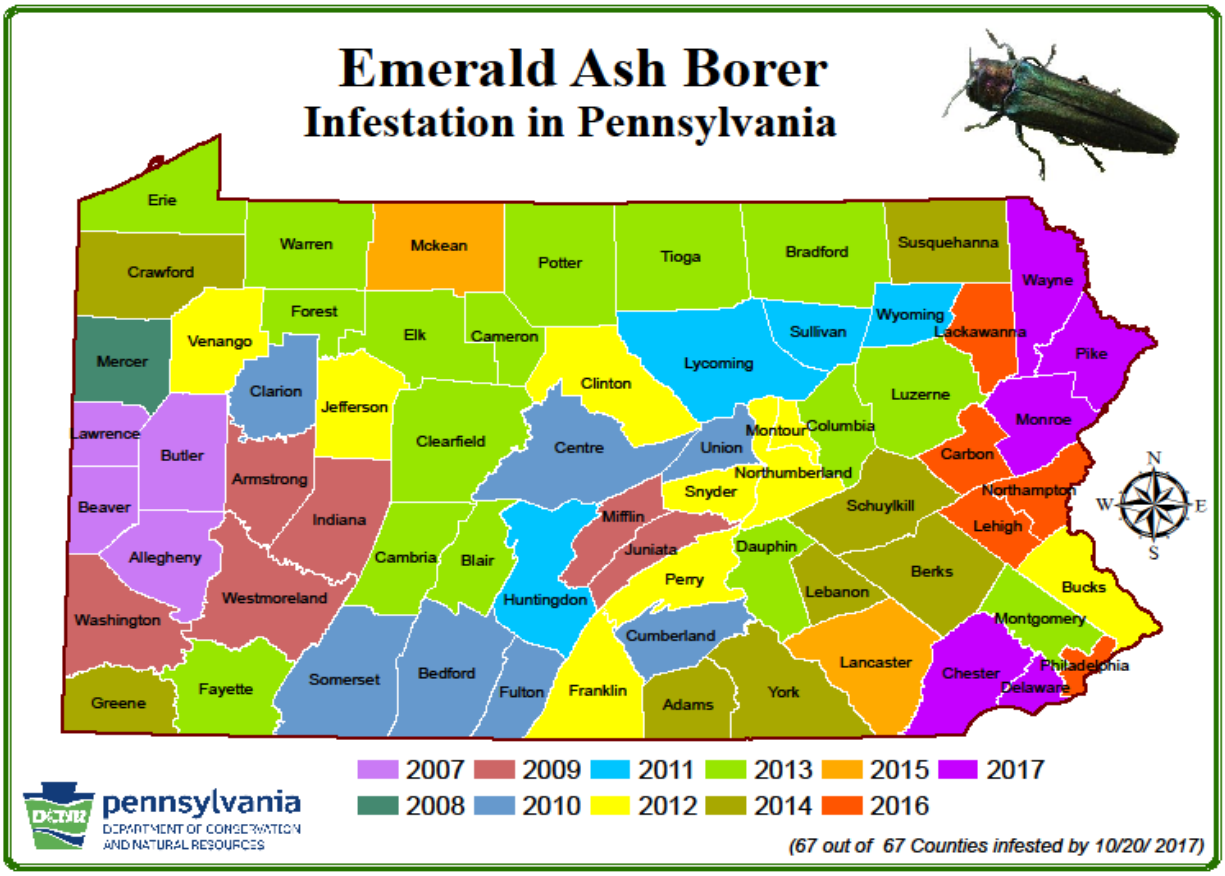
The location and extent of invasive threats is dependent on the preferred habitat of the species, as well as the species' ease of movement and establishment. For example, kudzu vine is an aggressive vascular plant. With wide ecological parameters and ease of spread, the vine is a more

widespread invasive species threat. Other species' spread has been limited by state agency activity, like the spotted lanternfly. First discovered in Berks County in 2014, this Asian plant hopper was placed under a quarantine by the Pennsylvania Department of Agriculture in thirteen counties. The spotted lanternfly has not been spotted or recorded for Tioga County yet, however, the presence of this species is likely to occur in the future. *Table 26 - Prevalent Invasive Species* lists invasive species that have been found in Tioga County.

#### 4.3.5.2 Range of Magnitude

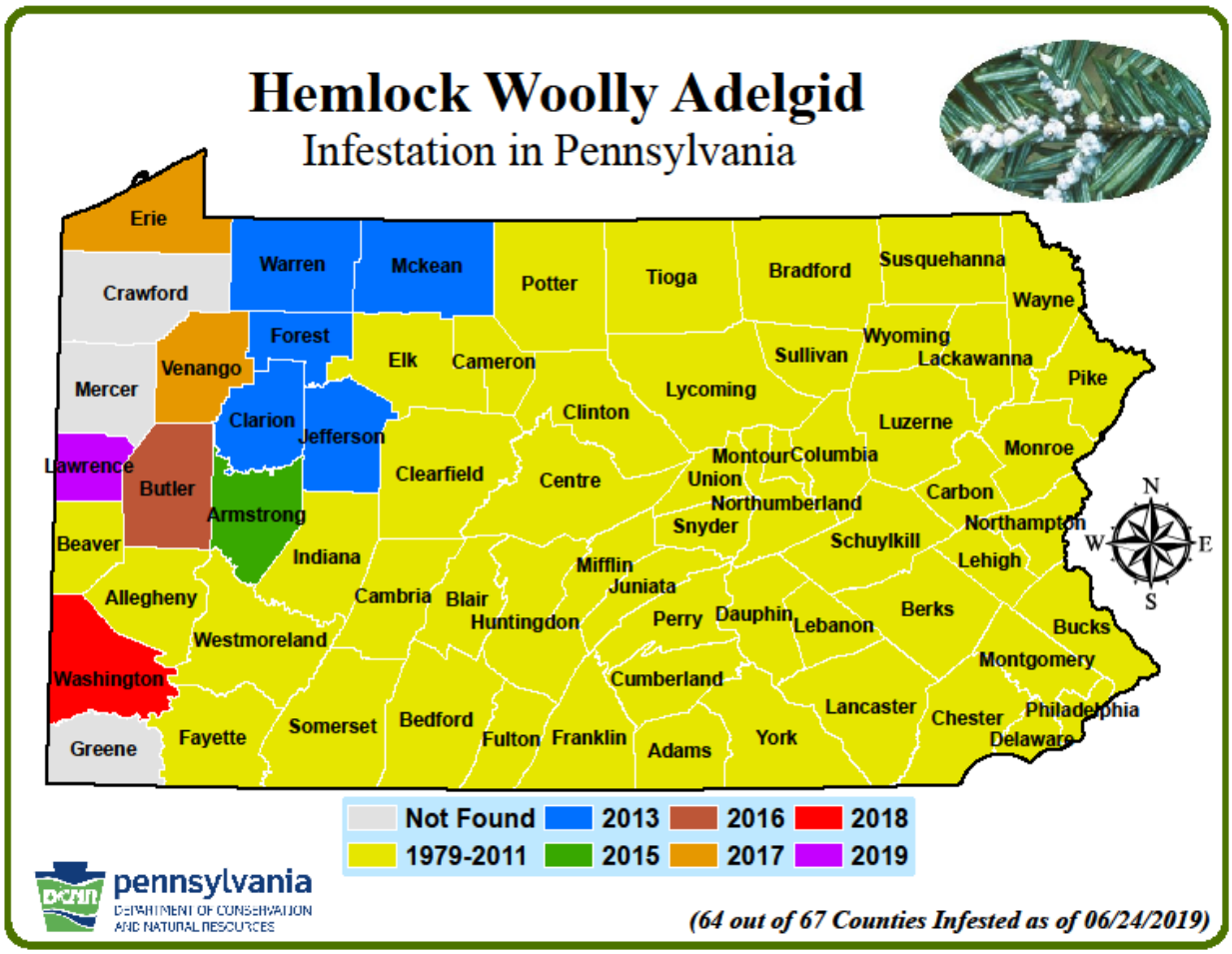
The magnitude of invasive species threats ranges from nuisance to widespread killer. Some invasive species are not considered agricultural pests, and do not harm humans or cause significant ecological problems. For example, Brown Marmorated Stink Bugs are not considered to be an agricultural pest and do not harm humans. Other invasive species can have many negative impacts and cause significant changes in the composition of ecosystems. For example, the Emerald Ash Borer creates a 99% mortality rate for any ash tree it infects. 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 Tioga County and the surrounding region. The Emerald Ash Borer has already become established in Tioga County (see *Figure 26 - Emerald Ash Borer Infestation in Pennsylvania*) and the surrounding region, and there is a high mortality rate for trees associated with this pest.

*Figure 26 - Emerald Ash Borer Infestation in Pennsylvania*



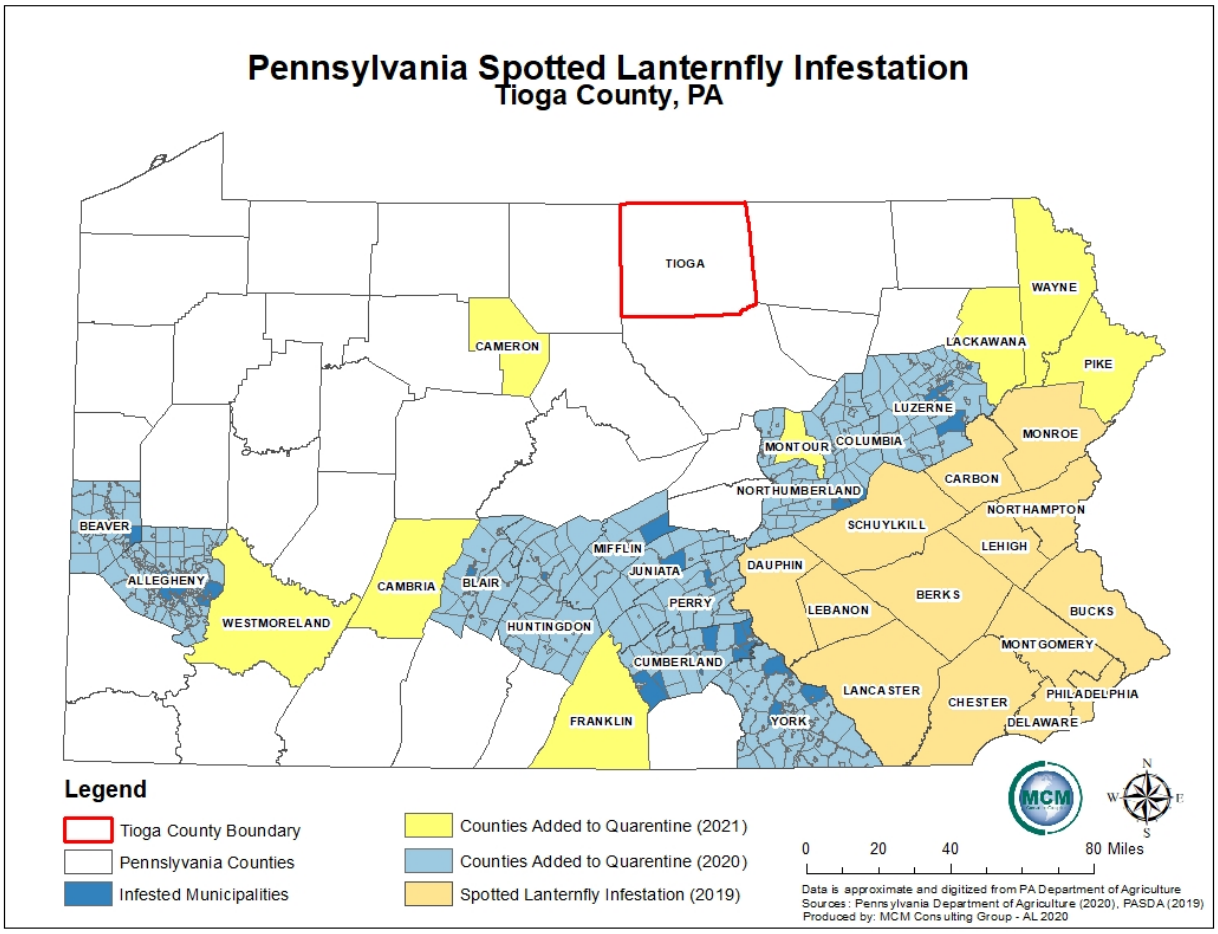

Another example of a negative invasive pest is the hemlock woolly adelgid. Hemlock woolly adelgid is a fluid-feeding insect that feeds on hemlock trees throughout eastern North America, including Pennsylvania. The egg sacs of these insects look like the tips of cotton swabs clinging to the undersides of hemlock branches. Hemlock woolly adelgid was introduced from Asia into the Pacific Northwest in 1924. It was most likely introduced into the northeastern United States in the 1950s and it was first discovered in Pennsylvania in 1967. This insect has been damaging hemlock ever since and it is spreading. To date, sixty-four counties in Pennsylvania, including Tioga County, have been infested with this insect. See *Figure 27 - Hemlock Woolly Adelgid Infestation in Pennsylvania*. Eastern hemlock (Pennsylvania's state tree) and Carolina hemlocks (found further south in the Smoky Mountain sections of the Appalachians) are more susceptible to hemlock woolly adelgid damage than Asian and western hemlock trees due to feeding tolerance and predators that protect the latter species. Hemlock woolly adelgid sucks fluid from the base of hemlock needles. It may also inject toxins into the tree as it feeds, accelerating needle drop and branch dieback. Although some trees die within four years, trees often persist in a weakened state for many years. Hemlocks that have been affected by hemlock woolly adelgid often have a grayish-green appearance (hemlocks naturally have a shiny, dark green color).

*Figure 27 - Hemlock Woolly Adelgid Infestation in Pennsylvania*




A final example of an invasive species is the Spotted Lanternfly. The Spotted Lanternfly is a harmful invasive pest with a healthy appetite for our plants and can negatively impact the quality of life and enjoyment of the outdoors. According to the Penn State Extension, the Spotted Lanternfly is a significant threat to Pennsylvania agriculture, landscapes, and natural ecosystems, including grape, tree-fruit, hardwood, and nursery industries, which collectively are worth nearly $18 billion to the state's economy, outdoor recreation, and biodiversity. The Spotted Lanternfly has not been identified to be in Tioga County but could make its appearance into the county in the near future. *Figure 28 – Pennsylvania Spotted Lanternfly Infestation* illustrates the counties in Pennsylvania that are in the quarantine zone for this pest.

*Figure 28 - Pennsylvania Spotted Lanternfly Infestation*




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 succumb to an infestation more easily. A worst-case example could be the Hemlock Woolly Adelgid causing reduced biodiversity, increased wildfire potential, and thermal harm to small stream cold water fisheries and habitats.

#### 4.3.5.3 Past Occurrence

Invasive species have been entering Pennsylvania since the arrival of European settlers, but not all occurrences required government action. Tioga County is known for its great number of geographic features. There are five main state game lands within Tioga County which include State Game Lands (SGL) 037, 208, 268, 313 and 335. SGL 037 has 13,138 acres and is located in uplands near Tioga and Hammond Lakes. SGL 208 is found near the confluence of Pine Creek and Long Run with 8,834 acres. SGL 268 has 3,049 acres and located on the East Branch of Stony Fork. SGL 313 offers 409 acres of waterfowl habitat. Lastly, SGL 335 has 1,169 acres near the headwaters of Tioga River. Additionally, there are three Pennsylvania state parks in Tioga County which include Hills Creek State Park, Colton Point State Park, and Leonard

Harrison State Park. Along with vast amounts of forest available in the county, there are a great number of waterways available in the county such as Tioga River, Cowanesque River, Cowanesque Lake, Tioga-Hammond Lakes, and Hills Creek Lake. Therefore, Tioga County has great amounts of forest and lakes available for species to potentially invade. Due to the vast area of forests and waterways, there are both many invasive terrestrial and aquatic species that have been widespread in Tioga County that are common problems throughout the Commonwealth. Some of the most popular problematic species in Tioga include:

- Multiflora Rose
- Japanese Knotweed
- Common Carp
- Eurasian Watermilfoil
- Common Crown-Vetch
- Zebra Mussel

The most recent problematic species are the Emerald Ash Borer and Hemlock Wooly Adelgid. In 2007, both the Emerald Ash Borer and Hemlock Wooly Adelgid were both newly spotted species that caused extreme damage. *Table 26 - Prevalent Invasive Species* lists problematic non-native species that are established in Tioga County. While all species listed here are not native to Tioga County, those species highlighted in red are considered to pose a severe ecological threat than some of the others (Rank 1), species highlighted in yellow are considered to pose a significant ecological threat but not considered to spread as easily and aggressively (Rank 2), and species highlighted in green are considered to pose a lesser ecological threat (Rank 3).

*Table 26 - Prevalent Invasive Species*

| Prevalent Invasive Species (EDDMaps, 2021; iMapInvasives, 2021; PA DCNR, 2019) | | |
|---|---|---|
| **Scientific Name** | **Common Name** | **Type** |
| Corbicula fluminea | Asiatic Clam | Animal |
| Lonicera spp | Bush Honeysuckle | Plant |
| Cirsium vulgare | Bull Thistle | Plant |
| Cirsium arvense | Canada Thistle | Plant |
| Cyprinus carpio | Common Carp | Animal |
| Phragmites australis ssp. australis | Common Reed | Plant |
| Tanacetum vulgare | Common Tansy | Plant |
| Agrilus planipennis | Emerald Ash Borer | Insect |
| Myriophyllum spicatum | Eurasian Watermilfoil | Plant |
| Alliaria petiolata | Garlic Mustard | Plant |
| Fallopia sachalinensis | Giant Knotweed | Plant |
| Frangula alnus | Glossy Buckthorn | Plant |
| Lymantria dispar | Gypsy Moth | Insect |
| Adelges tsugae | Hemlock Woolly Adelgid | Insect |

| Scientific Name | Common Name | Type |
|---|---|---|
| Berberis thunbergii | Japanese Barberry | Plant |
| Lonicera japonica | Japanese Honeysuckle | Plant |
| Polygonum cuspidatum | Japanese Knotweed | Plant |
| Microstegium vimineum | Japanese Stiltgrass | Plant |
| Persicaria perfoliata | Mile-A-Minute Vine | Plant |
| Lonicera morrowii | Morrow's Honeysuckle | Plant |
| Rosa multiflora | Multiflora Rose | Plant |
| Celastrus orbiculata | Oriental Bittersweet | Plant |
| Lythrum salicaria | Purple Loosestrife | Plant |
| Ailanthus altissima | Tree-of-Heaven | Plant |
| Dreissena polymorpha | Zebra Mussel | Animal |
| Elaeagnus umbellata | Autumn Olive | Plant |
| Cryptococcus fagisuga | Beech Bark Disease | Disease |
| Tussilago farfara | Colt's-foot | Plant |
| Potamogeton crispus L. | Curly-leaved Pondweed | Plant |
| Popillia japonica | Japanese Beetle | Insect |
| Poa pratensis | Kentucky Bluegrass | Plant |
| Phalaris arundinacea | Reed Canary Grass | Plant |
| Centaurea stoebe ssp. micranthos | Spotted Knapweed | Plant |
| Anthoxanthum odoratum | Sweet Vernal Grass | Plant |
| Myosotis scorpioides | True Forget-me-not | Plant |
| Cronartium ribicola | White Pine Blister Rust | Disease |
| Halyomorpha halys | Brown Marmorated Stink Bug | Insect |
| Ophiognomonia clavigignenti-juglandacearum | Butternut Canker | Disease |
| Hypericum perforatum | Common St. John's-wort | Plant |
| Holcus lanatus | Common Velvetgrass | Plant |
| Achillea millefolium | Common Yarrow | Plant |
| Discula destructiva | Dogwood Anthracnose | Disease |
| Euphorbia esula | Leafy Spurge | Plant |
| Harmonia axyridis | Multicolored Asian Lady Beetle | Insect |
| Hieracium aurantiacum | Orange Hawkweed | Plant |
| Rorippa nasturtium-aquaticum | Watercress | Plant |

#### 4.3.5.4 Future Occurrence

According to the Pennsylvania Invasive Species Council (PISC), the probability of future occurrence for invasive species threats is growing due to the increasing volume of transported goods, increasing efficiency and speed of transportation, and expanding international trade agreements. Expanded global trade has created opportunities for many organisms to be

transported to and establish themselves in new counties and regions. In 2017, Pennsylvania alone imported over $83 billion in goods from abroad, including agricultural, forestry, and fishery goods that commonly carry unknow pests. Climate change is contributing to the introduction of new invasive species. As maximum and minimum seasonal temperatures change, pests can establish themselves in previously inhospitable climates. This also gives introduced species an earlier start and increases the magnitude of their growth, possibly shifting the dominance of ecosystems in the favor of non-native species. In order to combat the increase in future occurrences, the PISC released the Invasive Species Management Plan in April 2010 and updated the plan in 2017. The plan outlines the Commonwealth's goals for managing the spread of nonnative invasive species and creates a framework for responding to threats through research, action, public outreach, and communication. More information can be found here: https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/GISC/Pages/default.aspx.

There are several invasive species that are found near Tioga County but have not yet been detected inside the county (see *Table 27 – Future 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 in the future. Once a species is established, it is more difficult to eradicate it from an ecosystem meaning prevention is very important. The species that are labeled in red are listed as a Rank 1 species, which indicates a severe ecological threat to the environment. Therefore, European Water Chestnut, Goatsrue, Japanese Hops, Oriental Lady's-thumb, and Spotted Lanternfly are all widespread and highly problematic in nearby counties but have not been reported in Tioga County (as shown highlighted in red in *Table 27 – Future Vulnerable Species*). The development of appropriate plans will assist the county in reducing the possibility of a future encounter with any of these species. It would be beneficial to the forests of Tioga County to work toward keeping these species out of the area.

*Table 27 - Future Vulnerable Species*

| **Future Vulnerable Species (EDDMaps, 2021; PA DCNR, 2019; iMapInvasives, 2021)** | | |
|---|---|---|
| **Scientific Name** | **Common Name** | **Type** |
| Lithobates catesbeianus | American Bullfrog | Animal |
| Brassica nigra | Black Mustard | Plant |
| Otiorhynchus sulcatus | Black Vine Weevil | Insect |
| Bromus tectorum L. | Cheatgrass | Plant |
| Solanum dulcamara | Climbing Nightshade | Plant |
| Trapa natans | European Water Chestnut | Plant |
| Convolvulus arvensis | Field Bindweed | Plant |
| Galega officinalis | Goatsrue | Plant |
| Humulus japonicus | Japanese Hop | Plant |
| Pristiphora erichsonii | Larch Sawfly | Insect |

| Scientific Name | Common Name | Type |
|---|---|---|
| Artemisia vulgaris | Mugwort | Plant |
| Carduus nutans | Musk Thistle | Plant |
| Polygonum caespitosum | Oriental Lady's-thumb | Plant |
| Ligustrum spp. | Privet | Plant |
| Trachemys scripta elegans | Red-eared Slider | Amphibian |
| Lycroma delicatula | Spotted Lanternfly (Lycorma) | Insect |
| Salix alba | White Willow | Plant |

#### 4.3.5.5 Vulnerability Assessment

Tioga 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 is significant acreage of wetlands, waterways, state parks, and game lands in Tioga 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.

Since there are large swatches of public land in Tioga County, there is a risk of future damage from invasive species that are present in the area. With 26,599 SGL acres in Tioga County (which takes up about 3.7% of the county), there is vulnerability to various land sites and waterways. If an invasive species were to invade the popular terrestrial areas or waterways in Tioga, great devastation would occur. The invasion from an invasive species could cause damage to the scenic and natural resources needed in the county. Additionally, tourism for the county is vulnerable to the invasive species as well and would be affected if the parks were destroyed. Therefore, a great amount of land and native wildlife within Tioga County are at risk with the presence of invasive species.

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 deer prefer. As such, the management of deer populations in Tioga County has a significant impact on the vulnerability of an ecosystem to invasive species, where overpopulation of deer favors invasive species.

The Governor's Invasive Species Council of Pennsylvania (PISC) has identified over 100 species threats that are or could potentially become significant in Pennsylvania. Of these threats, county and municipal leaders believe that the most significant are invasive forest pests like the Emerald

Ash Borer, Hemlock Woolly Adelgid, and plants like the Tree-of-Heaven which all been identified red in *Table 26 - Prevalent Invasive Species* for priority species in Tioga County.

Due to the past experiences with invasive plants in the county, there are five primary components which help with managing invasive plants to lower vulnerability:

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

**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.

It is best to act before a species can become established in the county, so forest management such as park rangers should be aware of invasive species found nearby Tioga County but not yet present in the county (priority species in *Table 27 – Future Vulnerable Species*). Public outreach and education are important for these species to improve identification and prevention of invasion. Without action, due to the instances and extent of the current infestations, it is reasonable to project that the county's vulnerability will increase.

### 4.3.6. Landslides

#### 4.3.6.1 Location and Extent

The large regions of Pennsylvania have a variety of different topography, with each area having a different susceptibility to landslides. Landslide are described as downward and outward movement of slope-forming soils, rock, and vegetation reactive to the force of gravity. Rockfalls, rockslides, rock topples, block glides, debris flows, mud flows, and mudslides are all forms of landslides. Natural causes of landslides include heavy rain, rapid snow melt, erosion, earthquake,

and changes in groundwater level. 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 or above average precipitation or snow melt events. Human activity can increase the likelihood of landslides by reducing vegetation cover, altering the natural slope gradient, or increasing the soil water content. Areas where this type of human activity is common are areas that were excavated along highways and other roadways.

Most landslides 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.

#### 4.3.6.2 Range of 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 Tioga 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 (PennDOT) and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in 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 $300,000.00 to $2 million each (DCNR, 2010). Areas that are susceptible to landslides are geologically prone to giving way after significant precipitation events.

#### 4.3.6.3 Past Occurrence

No comprehensive list of landslide incidents in Tioga County is available, as there is no formal reporting system in place. PennDOT and municipal maintenance departments are responsible for slides that inhibit the flow of traffic or damage to roads and bridges, but they generally only repair the road itself and right-of-way areas. The county has a record of one incident that occurred in the early 1970's during the construction of Route 15 in Tioga Township and another that took place in Heffner Hollow in September of 2018 (see *Figure 29 – Heffner Hollow Landslide* below). In addition, as a result of flooding that took place in April 2011, there was another incident that required repair to Route 15, section 144. Due to anecdotal evidence, there have been minor landslides in the past decade that did not result in deaths or serious damages around the county.

*Figure 29 - Heffner Hollow Landslide*

*Image provided by the Tioga County Conservation District*

*Figure 30 – Canoe Camp Creek Streambank Stabilization*, depicted below, shows progress being made on streambanks at Canoe Camp Creek to prevent landslides and other hazards that may result due to embankment failure.

*Figure 30 - Canoe Camp Creek Streambank Stabilization*

*Image provided by the Tioga County Conservation District*

#### 4.3.6.4 Future Occurrence

The entirety of Tioga County falls within a region defined by Pennsylvania Department of Conservation of Natural Resources (DCNR) as having high susceptibility in steep areas along stream beds, valleys, and bluffs. A large portion of the county sits along valleys, in bluffs, or along stream beds. Most of the major transportation corridors through and around Tioga County occur in areas where all three vulnerabilities are present. Road cuts are the most common development that puts an area at an increased probability of a landslide or erosion event. The Pennsylvania Department of Environmental Protection has an Erosion and Sediment (E & S) program that sets requirements for which development projects of a certain scale are intended to mitigate erosion, which are similar practices to prevent causing landslides.

#### 4.3.6.5 Vulnerability Assessment

Landslides are often precipitated by other natural causes such as earthquake or floods, and a serious landslide can cause millions of dollars in damage. 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 the proximity to watercourse and associated flat-lying areas. Surface water may permeate into areas that still have open fractures and the build-up of surface water in fractures could lead to unexpected flood events.

A comprehensive database of land highly prone to erosion and landslides is difficult to come by. Construction projects in Tioga County should be wary of erosion and the potential for landslides. There are several general factors that can be indicators of a landslide prone area. These include:

- 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 surface ground.

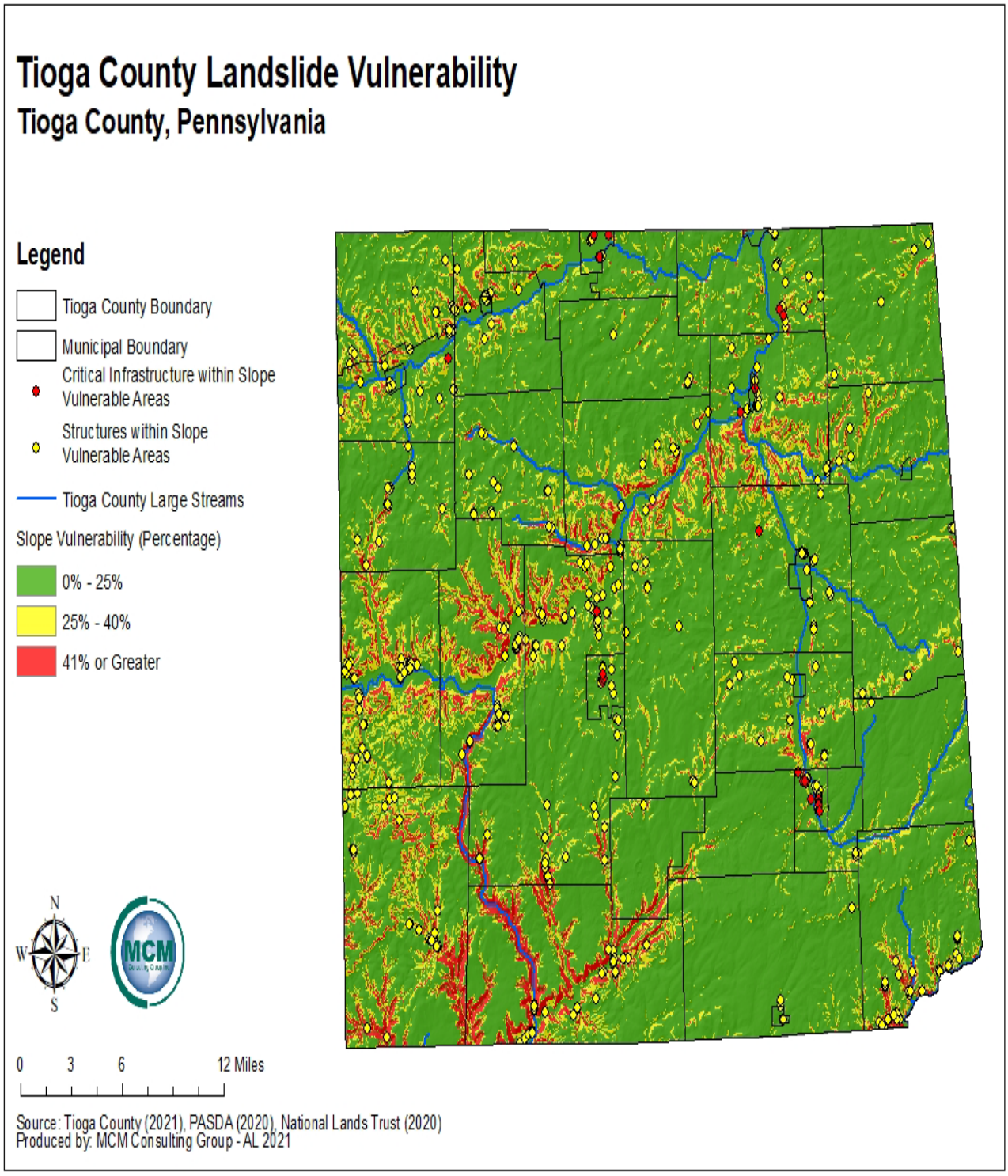
Tioga County has approximately 583 structures that are at risk to landslide vulnerability. These structures are within an area that has a high percentage of slope, which given specific sets of weather patterns, could result in a landslide. There are 1,248 critical infrastructure or functional needs facilities that fall within high percentage slope areas for Tioga County. *Figure 31 – Landslide Vulnerable Structures* shows structure within Tioga County that are within a high slope area where the slope percentage is severe. *Table 28 – Structure Vulnerability Data* illustrates the number of site structures per municipality, the number of structures in high slope areas, and the number of critical infrastructure sites in the high slope area.

*Table 28 - Structure Vulnerability Data*

| Structure Vulnerability Data (Tioga County, 2021) | | | |
|---|---|---|---|
| **Municipality** | **Number of Structures within Municipality** | **Number of Structures within Slope Vulnerable Area** | **Number of Critical Infrastructure within Slope Vulnerable Area** |
| Bloss Township | 423 | 0 | 0 |
| Blossburg Borough | 1184 | 24 | 10 |
| Brookfield Township | 674 | 10 | 0 |
| Charleston Township | 3342 | 16 | 0 |
| Chatham Township | 1072 | 17 | 0 |
| Clymer Township | 951 | 18 | 0 |
| Covington Township | 1475 | 18 | 0 |
| Deerfield Township | 877 | 11 | 0 |
| Delmar Township | 3633 | 70 | 1 |
| Duncan Township | 321 | 1 | 0 |
| Elk Township | 329 | 42 | 0 |
| Elkland Borough | 1298 | 9 | 3 |
| Farmington Township | 1034 | 6 | 0 |
| Gaines Township | 1512 | 58 | 0 |
| Hamilton Township | 607 | 2 | 0 |
| Jackson Township | 2135 | 4 | 0 |

| Municipality | Number of Structures within Municipality | Number of Structures within Slope Vulnerable Area | Number of Critical Infrastructure within Slope Vulnerable Area |
|---|---|---|---|
| Knoxville Borough | 536 | 9 | 0 |
| Lawrence Township | 1658 | 20 | 2 |
| Lawrenceville Borough | 427 | 0 | 0 |
| Liberty Borough | 221 | 4 | 0 |
| Liberty Township | 1456 | 4 | 0 |
| Mansfield Borough | 1225 | 6 | 0 |
| Middlebury Township | 1536 | 24 | 0 |
| Morris Township | 1299 | 34 | 0 |
| Nelson Township | 628 | 2 | 0 |
| Osceola Township | 750 | 1 | 0 |
| Putnam Township | 394 | 0 | 0 |
| Richmond Township | 2655 | 13 | 1 |
| Roseville Borough | 172 | 0 | 0 |
| Rutland Township | 903 | 4 | 0 |
| Shippen Township | 901 | 43 | 0 |
| Sullivan Township | 1722 | 8 | 0 |
| Tioga Borough | 450 | 0 | 0 |
| Tioga Township | 1141 | 25 | 2 |
| Union Township | 1405 | 47 | 0 |
| Ward Township | 778 | 1 | 0 |
| Wellsboro Borough | 2486 | 13 | 3 |
| Westfield Borough | 920 | 3 | 0 |
| Westfield Township | 1378 | 16 | 1 |

*Figure 31 - Landslide Vulnerable Structures*



### 4.3.7. Pandemic and Infectious Disease

#### 4.3.7.1 Location and Extent

**Pandemic & Epidemic**

An epidemic occurs when an infectious disease spreads more quickly than experts expect. It is characterized by very widespread growth or extent that spreads quickly and affects many individuals at the same time. When an epidemic occurs, it typically impacts a larger area than an outbreak would. The rise and decline in epidemic prevalence of an infectious disease is dependent on the transfer of an effective dose of the infectious agent from an infected individual to a susceptible one. After an epidemic has subsided, the affected host population contains a small proportion of susceptible individuals that reintroduction of the infection will not result in a new epidemic. Therefore, the host population develops an immunity to the epidemic disease, which is termed as herd immunity.

A pandemic is a disease outbreak that spreads across countries or continents, which affects the population of an extensive area. Extensive regions that could potentially be affected are several counties, countries or even continents at a time. When a pandemic is present, the event usually affects more people and takes more lives than an epidemic typically would. Pandemics are further described as an extensive epidemic. Generally, pandemic diseases cause sudden illness in all age groups on a global scale. Pandemics are continuous events in third-world countries but do not affect the United States as frequently. A pandemic is measured and defined by the spreading of a disease rather than the fatalities associated with it. There are various characteristics of a pandemic outbreak, such as large, rapid scale spread, overload of healthcare systems, inadequate medical supplies, disruption of economy/society, and medical supply shortages. While a pandemic may be characterized as a type of epidemic, an epidemic is not a type of pandemic. Pandemics travel more effectively than epidemics.

Each year, different strains of influenza are labeled as potential pandemic threats. Pandemics happen when novel (new) viruses emerge and can infect people easily and spread efficiently and are sustained from person to person. In the event of a pandemic taking place in the eastern United States, the entirety of Tioga County would likely be impacted. Strains of influenza, or the flu, are highly contagious as 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 country began planning for flu outbreaks.

The 2009 H1N1 flu virus resulted in seventy-eight deaths in Pennsylvania by the time the pandemic ended. Studies after the 2009 H1N1 influenza pandemic showed that the strain disproportionately impacted people younger than twenty-four years old. Schools have potential to become outbreak centers due to their large young adult populations, high levels of close social contact, and permeable boundaries. During a pandemic or disease outbreak, the population

affected may exceed the seasonal norm of 1/3 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.

On March 11, 2020, the World Health Organization (WHO) characterized the outbreak of a coronavirus disease as a pandemic. The virus was named "SARS-CoV-2" and the disease it causes is named "coronavirus disease 2019" (COVID-19). The virus mostly attacks the respiratory tract in humans but can cause further medical issues if the patient was previously considered high risk or immunocompromised. Both the upper respiratory tract, such as sinuses, nose, and throat) and lower respiratory tract, such as windpipe and lungs, are initially infected as a result of the disease. Lungs are typically the first targeted organ in the body for COVID-19. Other organs that could possible be infected by COVID-19 are the heart, brain, liver and gastrointestinal. Coronaviruses are common in humans and many different species of animals including camels, cattle, cats, and bats. The disease is believed to have started in Wuhan Province, China in late 2019 and spread around the globe. The original source of viral transmission to humans remains unclear, as does whether the virus became pathogenic before or after the spillover event. The intermediate animal that passed the virus from bats to people has not been identified, however researchers believe it to be a wild species that is sold as food in the wet markets within Wuhan at the Huanan Seafood Market. The overall origin of the virus remains uncertain during the writing of this plan. However, as the WHO digs into the origin of the COVID-19 pandemic, more clues and evidence leading to the origination of the virus is becoming clearer due to the high research and science technology available in today's medical fields. Public health officials say it is critical to determine the identification of the origin of the pandemic to take steps to avert future outbreaks and pandemics. Future prevention may take many years for completion. Currently, researchers of the WHO believe it to be a zoonotic disease with origination from an animal reservoir rather than bioterrorism or laboratory accidental.

**Infectious Disease**

Infectious diseases are illnesses caused by pathogenic organisms such bacteria, viruses, fungi, or parasites. There are various types of bacterial organisms that live on and within the human system but are considered harmless due the normal flora present. Organisms become harmful and cause disease when under certain conditions. The causes of infectious diseases vary. The sources of infectious disease occur from contaminated food or waterways, infected animals/livestock, infection from biological vectors such as mosquitoes, etc. Infectious diseases include influenza, rabies, Middle East Respiratory Syndrome (MERS), West Nile virus, Lyme Disease, Zika virus, and Ebola virus.

West Nile virus is contracted through a mosquito bite and is aided by warm temperatures and wet climates conducive to mosquito breeding, with most cases occurring between April and October. West Nile virus is a vector-borne disease. This means an animal, usually an insect or a tick, transmits parasitic microorganisms to people and animals, and therefore, the diseases they cause.

The disease causes headaches, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and death in its most serious form.

Lyme Disease, spread by the bite of infected blacklegged ticks, is a bacterial disease with symptoms including fever, headaches, and characteristic skin rash. Untreated, Lyme Disease can spread to joints, the heart, and the nervous system (CDC, 2016). To prevent the disease, it is recommended to use insect repellent, remove ticks promptly, apply pesticides, and reduce tick habitat.

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

Pandemic and infectious disease events cover a wide geographical area and can affect large populations, potentially including the entire population of the Commonwealth. The exact size and extent of an infected population is dependent upon how easily the illness is spread, the mode of transmission, and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in denser areas where there are large concentrations of people. The transmission rate of infectious disease will depend on the mode of transmission of a given illness. Pandemic events can also occur after other natural disasters, particularly floods, when there is the potential for bacteria to grow and contaminate.

#### 4.3.7.2 Range of Magnitude

**Pandemic & Epidemic**

Public health emergencies typically occur on a regional basis. The magnitude of pandemic or infectious disease threat in the Commonwealth will range significantly depending on the aggressiveness of the virus in question, factors within the community that are impacted (medical care access, population density, etc.), and the ease of transmission. For example, the West Nile virus has less than 80% of cases that are clinically asymptomatic. Therefore, approximately 20% of the cases result in mild infection, as known as West Nile fever. However, there is a small percentage of cases that will result in severe neurological disease and even death.

Pandemic influenza has a higher transmission rate from person-to-person compared to the West Nile virus disease. However, advances in medical technologies have greatly reduced the number of deaths caused by the influenza over time. In the early 1900s, flu pandemics could cause tens of millions of deaths, while the 2009 Novel H1N1, known as swine flu, caused fewer than

20,000 deaths world-wide, and many people infected with swine flu in 2009 recovered without needing medical treatment. However, the modern flu viruses are still quite dangerous. About 70% of those who were hospitalized during the 2009 H1N1 flu virus in the United States belonged to a high-risk group. However, with the COVID-19 pandemic, the transmission rates are much higher than any previous outbreaks related to other members of the coronavirus family such as SARS-CoV and MERS-CoV. In the past 100 years, the globe did not face a microbial pandemic similar in scale to the COVID-19 pandemic. As of the writing of this plan, the worldwide transmission of COVID-19 from human to human is spreading rapidly. The current data includes 134 million COVID-19 cases with more than 2.9 million patient deaths; however, it is difficult to make a projection of the final outcomes with the COVID-19 pandemic. Of the six global outbreaks of viral infections, three were caused by coronaviruses (SARS, MERS, and COVID-19), of which COVID-19 is characterized by the most efficient and aggressive transmission.

High risk populations for diseases/illnesses include children, the elderly, pregnant women, and patients with reduced immune system capability. The advancements of medical technology help with previous and current pandemics. The wireless thermometer gun has become increasingly popular and beneficial to the COVID-19 pandemic by giving opportunity to measure individual's body temperatures without being in close contact. Additionally, the wireless thermometer gun assists with pinpointing individuals that may be COVID infected if the individual has a fever, which helps reduce spread of the disease. This important medical equipment is being used as checkpoints during the pandemic at various public destinations such as hospitals, nursing home facilities, airports, etc. Other advances in medical technology instruments for COVID-19 include vaccination advancements (such as the new mRNA vaccines which have been seen with the Pfizer, Moderna, and Johnson & Johnson vaccines), virus DNA sequencing, and molecular testing techniques for COVID-19 diagnosis.

With the advancements made during pandemics, such as the COVID-19 pandemic, the global effects of various outbreaks have drastically declined over the past century. While there are limited secondary hazards related to public health emergencies, an outbreak can cause a variety of general secondary effects. Civil disorder is the most likely secondary hazard to result from a public health emergency. Further potential secondary effects could include: a shortage of medical supplies and personnel; hoarding of household paper and cleaning supplies; school, business, and government closings; government restrictions on travel; low attendance at places of employment; and, slowed productivity.

The seasonal flu is still present throughout the country during a pandemic. A pandemic illness is not identical to a seasonal flu, as explained in *Table 29 – Pandemic and Seasonal Flu Differences*. The seasonal flu is less of a concern than what a pandemic potentially is. Predictability and regularity are factors into the reasoning behind less of a concern when dealing

with seasonal flu. However, a pandemic is considered to be more severe than seasonal flu due to lack of these factors.

*Table 29 - Pandemic and Seasonal Flu Differences*

| Pandemic and Seasonal Flu Differences | | |
|---|---|---|
| | **Seasonal Flu** | **Pandemic** |
| **What is it?** | Influenza (flu) is a contagious respiratory illness caused by flu A and B viruses that infect the human respiratory tract. | A flu pandemic is a global outbreak of a new flu A virus in people that is very different from current and recently circulating seasonal flu A viruses. |
| **Occurrence?** | Epidemics of seasonal flu happen every year. Fall and winter is the most common time for flu in the United States. | Flu pandemics happen rarely. Five have happened within the last 100 years. |
| **Transmission?** | Flu viruses are thought to spread mainly from person to person through droplets made when someone with flu coughs, sneezes, or talks near a person (within 6 feet). | Pandemic flu viruses spread in the same way as seasonal flu, but a pandemic virus is likely to infect more people because fewer people have immunity to the pandemic flu virus. |
| **Vaccination?** | Seasonal flu vaccines are made each year to vaccinate people against the seasonal flu. Typically, only one dose is needed. | Although the U.S. government maintains a limited stockpile of pre-pandemic flu vaccines, this inventory may not be widely available in the early stages of a pandemic. Two doses of pandemic flu vaccine are likely to will be needed. |
| **High Risk Group?** | Young children, people sixty-five years and older, pregnant women, and the immunocompromised are more likely to have serious flu complications. | In some past pandemics, healthy and young adults, along with the immunocompromised and elderly were at high risk for developing severe flu complications. |
| *Source: (CDC, 2009)* | | |

The World Health Organization (WHO) developed an alert system to help inform the world about the seriousness of a pandemic. The alert system has six phases, with Phase 1 being the lowest risk and Phase 6 being the greatest risk of pandemic. The phases were developed in 1999,

but then revised in 2005 and 2009 to provide a global framework and aid countries in pandemic preparedness and response planning. The time after the first pandemic wave has been elaborated into post peak and post pandemic periods. These phases are listed below in *Table 30 - Pandemic Influenza Phases*.

*Table 30 - Pandemic Influenza Phases*

| Pandemic Influenza Phases | |
|---|---|
| **Phase** | **Characteristics** |
| **Phase 1** | No animal influenza virus circulating among animals has been reported to cause infection in humans. |
| **Phase 2** | An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat. |
| **Phase 3** | An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks. |
| **Phase 4** | Human-to-human transmission (H2H) of an animal or human-animal influenza virus able to sustain community-level outbreaks has been verified. |
| **Phase 5** | The same identified virus has caused sustained community level outbreaks in two or more countries in one WHO region. |
| **Phase 6** | The pandemic phase is characterized by community level outbreaks in at least one other country in a different WHO region in addition to the criteria defined in Phase 5. Designation of this phase will indicate that a global pandemic is under way. |
| **Post-Peak Period** | Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels. |
| **Possible New Wave** | Level of pandemic influenza activity in most countries with adequate surveillance rising again. |
| **Post-Pandemic Period** | Levels of influence activity have returned to the levels seen for seasonal influenza in most countries with adequate surveillance. |
| *Source: (WHO, 2009)* | |

#### 4.3.7.3 Past Occurrence

**Pandemic & Epidemic**

Several pandemic influenza outbreaks have occurred over the past 100 years that not only affected Tioga County but the United States as a whole. *Table 31 - Past Pandemic Events in the United States* illustrates the various past pandemic events that have occurred since the late 1800's. The worst recorded pandemic was the Spanish Flu, due to the amount of infection spread that was present in the world. The two most recent pandemics that have occurred in Tioga County and the United States are the swine flu/Novel H1N1 and COVID-19 pandemics, with COVID-19 having the highest transmission rates yet.

**Spanish Flu**

Prior to the COVID-19 world-wide pandemic, the 1918 influenza (Spanish Flu) pandemic was classified as the "Mother of all Pandemics". An estimated 1/3 of the world's population was infected and had clinically apparent illnesses during the 1918 - 1919 influenza pandemic. Pennsylvania was one of the most affected states in the country. The Spanish Flu claimed 500,000 lives in the United States, which included Tioga County. There is a lack of sources to provide with exact deaths experienced in Tioga from the Spanish Flu, however, a total of 60,000 deaths occurred in Pennsylvania from the Spanish Flu. Philadelphia itself lost about 12,000 lives and had about 47,000 reported cases in just over four weeks. In the first six months, there were about 16,000 deaths and half a million cases of the Spanish Flu in Philadelphia. Although Philadelphia had a great number of deaths, the 60,000 deaths would also include Tioga County's deaths, but the exact number is uncertain. The factors of high populations, crowded places, and unhygienic conditions is what caused higher deaths and cases across Pennsylvania. Therefore, Tioga County was drastically affected by the Spanish Flu Pandemic.

**Swine Flu/H1N1**

Tioga County was impacted by the H1N1 virus during 2009. The Pennsylvania Department of Health set up clinics throughout the county to administer vaccines. There is a lack of sources when determining the exact cases and deaths from swine flu in Tioga County. However, Pennsylvania as a total had 10,940 cases and 78 deaths from this pandemic. Within the total cases and deaths of Pennsylvania, Tioga County's numbers were included although exact numbers are uncertain.

**COVID-19**

This is an on-going pandemic at the time of the writing of this plan, so credible websites are used to provide the most up-to-date statistics. As of April 2021, Pennsylvania has an estimated 1,064,092 total cases and 25,380 deaths related to the COVID-19 pandemic occurred in the United States. The first cases in Pennsylvania were reported on March 6, 2020 in Delaware and Wayne counties. The first confirmed case of COVID-19 in Tioga County was on March 31st,

2020. As of April 2021, Tioga County alone has recorded 2,707 cases with 2,316 confirmed cases, 391 probable cases, and 9,046 negatives. Tioga County has a daily new case rate of 25.0% per 100,000, an infection rate of 0.97%, a positive test rate of 11.0%, and a vaccinated rate of 17.9%. A total of 101 deaths related to the COVID-19 pandemic have occurred in Tioga County. All municipalities in Tioga County indicated an increase in the pandemic section of the risk assessment valuations. The biggest peak of known cases for Tioga County was on December 13th, 2020, with the highest of cases in the county of fifty new cases a week. Over the winter of 2020-2021, much of Pennsylvania was experiencing a dangerous number of daily cases. The cases and deaths in Tioga County are still increasing. Therefore, exact numbers of deaths and cases are constantly changing. Pennsylvania is currently in vaccination Phase 1B, Tier 1, which include education workers. The Phase 1A included long-term care facility residents, health care personnel, individuals of ages 65 or older, and the high-risk individuals. Currently, between the three approved vaccines of Pfizer, Moderna, and Johnson & Johnson (newly approved vaccine) a total of 6,055,844 total vaccinations have been administered in Pennsylvania alone. During the writing of this plan, Tioga County specifically, a total of 2,275 individuals have been partially vaccinated which indicates that the person has received at least one COVID-19 vaccine but has not yet received the necessary number of vaccines at the recommended time intervals to be fully covered. At present, all COVID vaccines under EUA require two dosages. Therefore, the individual partially covered has only received one dose in the two-dose series. Meanwhile 5,035 individuals in Tioga County are fully vaccinated which indicates that the person has received the necessary number of COVID vaccines at the recommended time in intervals. Therefore, per 100,000 residents in Tioga County, 5,604.7 are vaccinated. To see more updated information, follow here: https://www.health.pa.gov/topics/disease/coronavirus/Pages/Cases.aspx.

*Table 31 - Past Pandemic Events in the United States*

| Past Pandemic Events in the United States | |
|---|---|
| **Year(s)** | **Common Name** |
| 1889 | Russian Flu |
| 1918 | Spanish Flu/H1N1 |
| 1957 | Asian Flu/H2N2 |
| 1968 | Hong Kong Flu/H3N2 |
| 2009 | Swine flu/Novel H1NI |
| 2020 | COVID-19 |
| *Sources: (WHO & CDC, 2020)* | |

### Infectious Disease

Not only has Tioga County experienced past pandemic events, but the county has also experienced past infectious disease events. The two major infectious disease events experienced across Tioga County and Pennsylvania as a whole are the West Nile Virus and Lyme Disease. Due to large rural and wooded areas within the county, these infectious diseases thrive in Tioga County. Both diseases are transmitted by the biological vector of an insect which is found throughout the county.

### West Nile Virus

West Nile virus reached the United States in 1999 and a year later was detected in Pennsylvania when mosquito pools, dead birds, and/or horses in nineteen counties tested positive for the virus. Tioga County is one of the counties in which the virus is found. A comprehensive network has been developed in Pennsylvania that includes trapping mosquitoes, collecting dead birds, and monitoring horses, people and, in past years, sentinel chickens. Although West Nile Virus positive cases are limited in Tioga County, 2018 had the most positive cases in Tioga County since 2015. *Table 32 - West Nile Virus Control Program in Tioga County Since 2015* outlines the West Nile Virus within Tioga County from 2015 to 2020.

*Table 32 - West Nile Virus Control Program in Tioga County Since 2015*

| West Nile Virus Control Program in Tioga County Since 2015 | | | | |
|---|---|---|---|---|
| **Year** | **Total Positives** | **Human Positives** | **Mosquito Positives** | **Bird Positives** |
| 2020 | 0 | 0 | 0 | 0 |
| 2019 | 0 | 0 | 0 | 0 |
| 2018 | 2 | 1 | 1 | 0 |
| 2017 | 0 | 0 | 0 | 0 |
| 2016 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 |
| *Source: (PA Department of Environmental Protection, 2020)* | | | | |

### Lyme Disease

Lyme Disease has been present in the United States and Tioga County for many years. More wooded areas, such as Tioga County, have higher cases due to ticks being the main biological vector. Lyme disease is found in all sixty-seven counties within Pennsylvania. Tioga County has an overall approximated 3,300 confirmed cases of Lyme disease according to the CDC. Tioga County experienced the highest number of positive cases in 2017 at eighty-five cases, compared to the lowest number of cases in 2013 at seventeen cases. However, it is possible that numbers have risen dramatically due to lack of testing in previous years. Lyme disease case counts are alarming and consistently rising over the past several years. Although, it should be noted that

information represented for each county "may vary with respect to the resources they have to devote to investigation of Lyme cases". It should also be noted that these figures represent a rough estimate of the Lyme disease burden in Tioga County. *Table 33 - Lyme Disease Data for Tioga County* outlines the Lyme Disease within Tioga County since 2013 to 2018. Data after 2018 was not available in this report.

*Table 33 - Lyme Disease Data for Tioga County*

| Lyme Disease Data for Tioga County | |
|---|---|
| **Year** | **Total Positives** |
| 2018 | 61 |
| 2017 | 85 |
| 2016 | 57 |
| 2015 | 40 |
| 2014 | 24 |
| 2013 | 17 |
| *Source: (PA Department of Environmental Protection, 2018)* | |

#### 4.3.7.4 Future Occurrence

**Pandemic & Epidemic**

The probability of a widespread pandemic public health emergency is every ten years or less with varying degrees of severity. Minor outbreaks of less serious communicable disease, such as influenza, occur much more frequently. Tioga County is expected to undergo pandemic influenza outbreaks every 11 - 41 years according to historical data. Exact timing of pandemic influenza outbreaks is unpredictable, and complete avoidance of the events is nearly impossible. Therefore, future occurrences of pandemics and infectious disease are unclear. Future pandemics may also emerge from other diseases, especially invasive pathogens for which Tioga County and Pennsylvania as a whole lack natural immunity. With the current pandemic of COVID-19, the future is still unknown in regard to the disease due to the novelty of the virus. Recently, the three approved COVID-19 vaccines of Pfizer, Moderna, and Johnson & Johnson vaccines have been offered to millions of Americans across the country, including Tioga County. The approval of the vaccines gives hope for the future of the current COVID-19 pandemic.

**Infectious Disease**

Pandemic future occurrences have several unknown circumstances; however, future infectious disease occurrences are likely to occur in the future. Infectious diseases such as West Nile Virus, Influenza, and Lyme Disease have been present in Tioga County for many years and are expected to continue in the future of Tioga County.

**West Nile Virus**

The best defense against West Nile virus in the future is to remove mosquito breeding locations – stagnant water sources. Another defensive measure to prevent future insect bites is wearing shoes, socks, long pants, and a long-sleeved shirt when outdoors for long periods of time, or when mosquitoes are most active. Also, mosquito repellent can be used whenever people are outside.

**Influenza**

It is estimated that 5% - 25% of Pennsylvanians get the flu each year, and 120 - 2,000 die from complications of influenza. The CDC recommends that everyone six months and older get a flu vaccine every season to prevent future cases from rising. People who are at a high risk of serious flu illness should take flu antiviral drugs as soon as they get sick.

**Lyme Disease**

Lyme disease is best combated using insect repellent, removing ticks promptly, applying pesticides, and reducing tick habitat to decrease the number of future cases from occurring. Once a person realizes they have been bitten by a tick, they should seek medical attention, as undetected Lyme Disease can seriously damage a body's musculoskeletal and nervous systems or result in death.

#### 4.3.7.5 Vulnerability Assessment

The vulnerability for Tioga County associated with the COVID-19 disease and pandemic is considered to be low vulnerability. When looking at specific vulnerability with COVID-19, the vulnerability for crowded living and working areas is medium, older age and health issues is medium, population density is medium, health system challenges are medium, unemployment and short income is low, and minorities/non-English speakers is very low. However, it is extremely difficult to predict a pandemic or an epidemic. The severity of the next pandemic cannot be predicted, but modeling studies suggest the impact of a pandemic on the United States could be substantial. In the absence of any control measures (vaccination or drugs), it is estimated that a "medium-level" pandemic could cause 89,000 - 207,000 deaths, 314,000-734,000 hospitalizations, 18 to 42 million outpatient visits, and another 20 - 47 million sick people in the United States. Between 15% - 35% of the U.S. population could be affected by a pandemic, and the economic impact could range between $71.3 - $166.5 billion. This data for the current COVID-19 pandemic has fluctuated widely but, at the time of the writing of this plan, was on pace for greater than a "medium level" pandemic. The COVID-19 pandemic has severely affected populations over the age of sixty-five, especially those in nursing homes – disproportionately; it has also severely affected different races disproportionately, e.g., non-Hispanic American Indian and Black people. The CDC reports that long-standing systemic

health and social inequities have put some members of racial and ethnic minority groups at increased risk of getting COVID-19 or experiencing severe illness, regardless of age.

Elderly individuals, children and immune deficient individuals are most vulnerable to disease. Nursing facilities, personal care facilities, daycares, schools, and hospitals are considered more vulnerable since there are normally groups of these functional-needs population present at the facilities. The spread of disease has increased due to the vulnerability and density of these populations. Congregate living facilities, including correctional institutions and dormitories would also be at an increased risk due to the difficulties in adhering to the social distancing required to help stop the spread of a pandemic. During the COVID-19 pandemic, nursing homes and personal care homes in Pennsylvania suffered staggering numbers of cases and deaths and several county jails and state correctional institutions reported wide community spread. Specifically, in Tioga County, nursing and personal care homes facilitates were critically affected by COVID-19. A total of six facilities in the county have had COVID-19 cases, three of which are long-term care facilities. With this number of infected facilities, about 201 cases were reported among the elderly residents and 103 cases were reported among the employees within these facilities. A total of fifty-nine deaths occurred in these vulnerable individuals of elderly and facility employees. The three major long-term care facilities in Tioga County are Broad Acres Health and Rehabilitation Center with eight-three resident cases, twenty resident deaths, and fifty-two employee cases, Green Home Inc. with eighty-five resident cases, thirty-five resident deaths, and forty-seven employee cases, and Carleton Healthcare and Rehabilitation Center with no available data of reported cases or deaths.

Health-care workers and those working in direct-care situations (such as correctional institutions or those who cannot social distance due to their jobs) are more likely to be exposed to a pandemic disease. Those that work outdoors for extended periods of time in warm months may be more vulnerable to West Nile, Lyme Disease or the Zika virus.

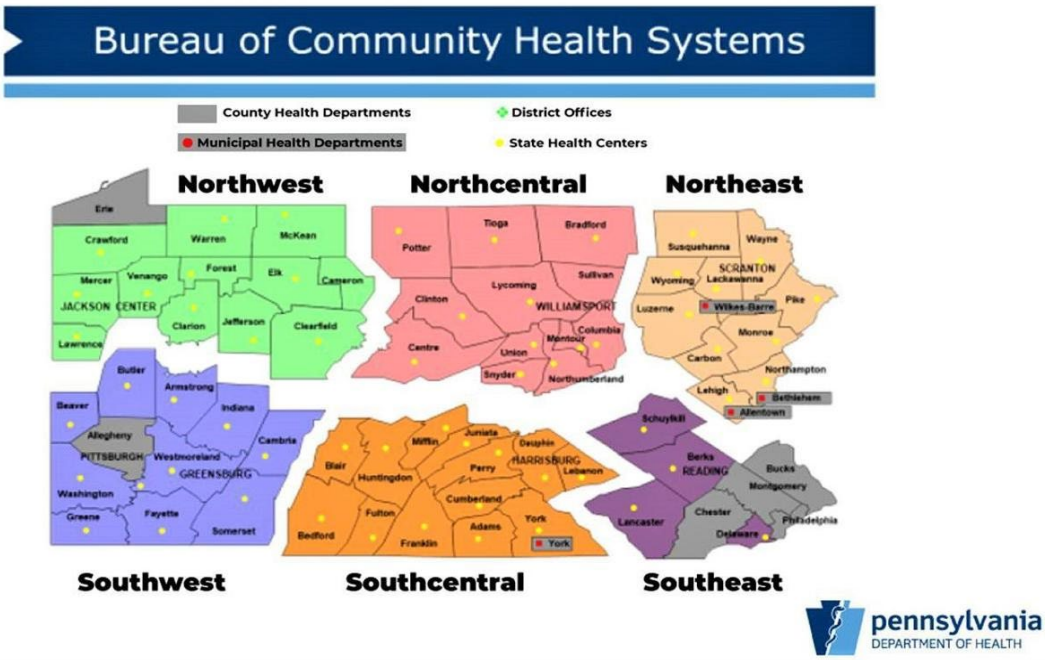
The number of hospitals and beds present in a county can affect the vulnerability impact on the county as well. The number of hospitals within the county and number of beds within the hospital determines the amount of care vulnerable and sick patients will receive in times of need. The vulnerable individuals will need access to hospitals and medical procedures as well. If sick and vulnerable patients are higher in number than beds available, the vulnerability rates within the county will rise. Within Tioga County, the top two major hospitals within the county contain numerous beds along with various medical and emergency centers. UPMC Wellsboro has 403 beds, and Laurel Health Medical Center (a division of UPMC) - Wellsboro 124 beds. It is important to plan preparedness activities that will permit a prompt and effective public health response.

During a public health emergency, the PA DOH may open emergency medicine centers called points of dispensing (PODs) to ensure that medicine, supplies, vaccines, and information reach

Pennsylvania residents during a public health emergency. An open POD is where the general public goes to receive free emergency medicine and supplies from public health officials, while a closed POD provides free emergency medicine and supplies to a specific community, like a university, including faculty, staff, and students. Dispensing of medications/vaccines is a core function of the Strategic National Stockpile's Mass Dispensing of Medical Countermeasures Plan.

PODs are coordinated with county emergency managers by the PA DOH with the six regional healthcare districts (see *Figure 32 - Pennsylvania Department of Health Districts).* Tioga County is in the northcentral district. At the time of the writing of this plan, POD planning for mass vaccinations against COVID-19 is occurring and hundreds of locations are offering the vaccinations of Pfizer, Moderna, and Johnson & Johnson vaccines.

*Figure 32 - Pennsylvania Department of Health Districts*




*Source: (PA DOH, 2019)*

### 4.3.8. Solar Flares

#### 4.3.8.1 Location and Extent

Solar flares are concentrated releases of magnetic energy that emanate from sunspots and can last for minutes or hours. Solar flares can cause coronal mass ejections 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, solar weather, or space 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).

#### 4.3.8.2 Range of Magnitude

Minor solar flares have no negative impacts on Earth thanks to the protection afforded by Earth's magnetic field and atmosphere, but 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. Geomagnetically 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). Electricity blackouts have many secondary effects, including limited water distribution capabilities, losing perishable foods and medicines, heating, and air conditioning as well as communication services. A solar EMP would also contribute to corrosion of oil and gas pipelines, disrupt high-frequency signals from global positioning system (GPS) satellites, and require aircrafts to avoid polar-routes to avoid communication malfunctions (Baker et al., 2008). Industries that are most impacted by severe space weather are: electric power, spacecraft, aviation, and other industries relying on GPS.

#### 4.3.8.3 Past Occurrence

From August 28 to September 4 of 1859, two severe solar storms resulted in widespread auroral displays in North and South America, Europe, Asia, Australia, and as far south as Hawaii and Cuba (Baker et al., 2008). The event is known as the Carrington Event, and resulted in the widespread disruption of telegraph lines, even setting fire to some telegraph offices (Phillips, 2014). The Carrington Event is estimated to be one of the strongest recorded geomagnetic storm events.

In March of 1989, a severe geomagnetic storm caused a widespread blackout (occurring within 90 seconds) in northeastern Canada's Hydro-Quebec power grid, resulting in over 6 million people being without electricity for 9 hours (Baker et al., 2008). On May 14 of 1921, a geomagnetic storm produced ground currents that are estimated to be half as strong as the Carrington event, but ten times stronger than the Hydro-Quebec event.

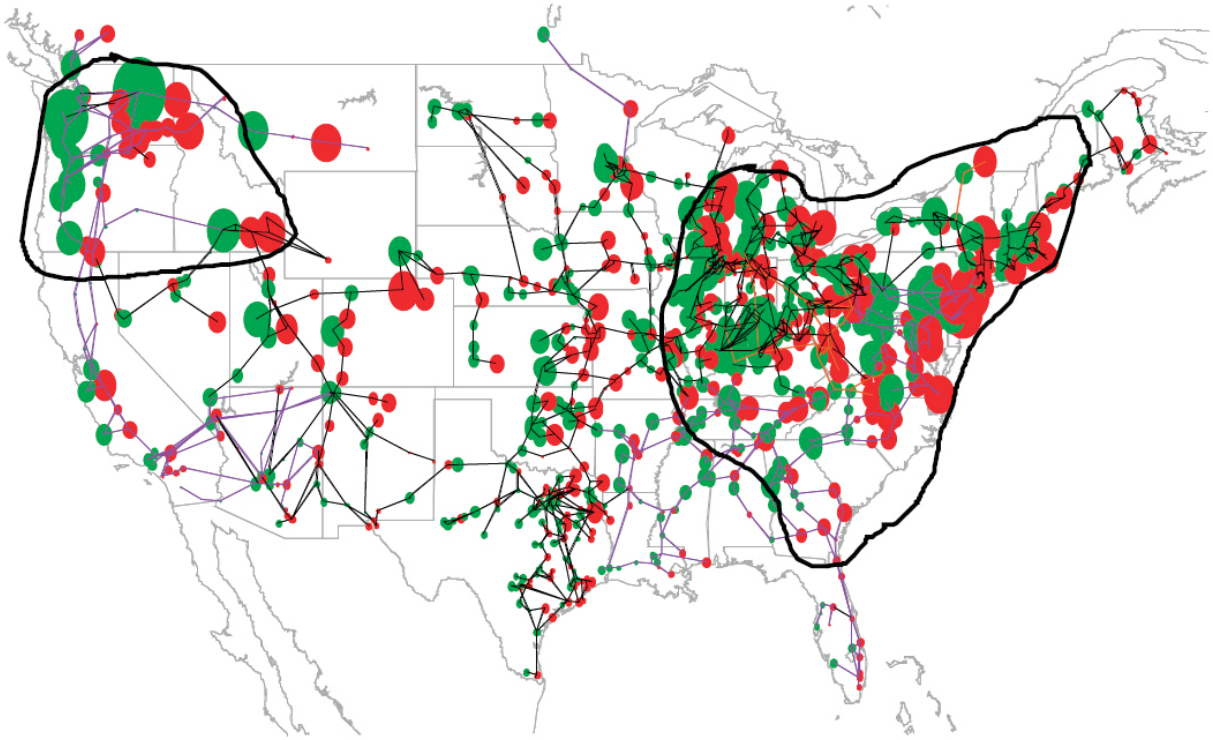
In July of 2012, a powerful solar storm produced an intense coronal mass ejection, estimated to be possibly stronger than the Carrington Event (Baker et al., 2013). Fortunately, due to the position of the event and the location of Earth in its orbit, the event missed Earth by as little as a week (Phillips, 2014). The STEREO-A spacecraft was, however, in the line of fire, and was able to record valuable data on the event (Baker et al., 2013).

#### 4.3.8.4 Future Occurrence

Space weather is getting more attention as an infrastructure risk, due in part to a March 2020 report by the U.S. Geological Survey (USGS). Geomagnetic storms are caused by the dynamic

action of the Sun and solar wind on the space environment surrounding the Earth. Magnetic disturbance during such a storm generates electric fields in the Earth's crust and mantle. These electric fields can interfere with the operation of grounded electric power-grid systems. Geomagnetic storms occur only occasionally, but when sufficiently energetic they can produce blackouts (USGS). It is estimated that the probability of occurrence in the next ten years of an extreme space weather event at the scale of the Carrington Event is 12% (Riley, 2012). If a solar storm on the scale of the 1921 event impacted our modern electricity infrastructure, it could permanently damage an estimated 350 transformers, and cause blackouts for 130 million people (*Figure 33 – Potential Electricity Grid Failure*) (Baker et al., 2008).

*Figure 33 - 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.

#### 4.3.8.5 Vulnerability Assessment

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, which improves efficiency in many ways, but makes them more vulnerable to wide-ranging rolling failures as seen in *Figure 33 - Potential Electricity Grid Failure* (Baker et al., 2008).

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 60% - 70% reduction of GIC levels during severe solar storms (Baker et al., 2008).

The sun goes through cycles of high and low activity that repeat approximately every 11 years. Solar minimum refers to the several Earth years when the number of sunspots is lowest; solar maximum occurs in the years when sunspots are most numerous. During solar maximum, activity on the sun and the possibility of space weather effects on the Earth's environment is higher.

Based on the number of sunspots that formed, scientists considered the last solar cycle, No. 24, "weak". No current observations or data show any impending catastrophic solar event, but some scientists believe the latest data of the upcoming solar maximum point to a stronger cycle. The solar cycle forecast was made public at the annual Space Weather Workshop in April 2021, hosted by NOAA's Space Weather Prediction Center. A solar physicist with Space Systems Research Corporation and co-chair of the panel issuing predictions, said Cycle No. 25 should begin between mid-2019 and late 2020 and that it should reach its maximum between 2023 and 2026, when between 95 and 130 sunspots are projected. Average is between 140 and 220 sunspots.

At present, with scientists' limited understanding of the patterns, the historical record suggests that such powerful Earth-sun events occur at least once a century (*Phys.org*).

And, as this profile was being drafted, NASA's STEREO-A and ESA/NASA's SOHO spacecraft detected a coronal mass ejection, or CME, leaving the Sun on April 17, 2021, at 12:36 p.m. This CME did not impact Earth but did move toward and reach Mars two days after NASA's *Ingenuity Mars* helicopter became the **first aircraft in history** to make a powered, controlled flight on another planet. NASA tracks such solar eruptions because they can trigger particle and radiation events that pose a risk to astronauts and sensitive spacecraft electronics. As astronauts venture beyond Earth's protective magnetic field to the Moon and Mars, NASA's Moon to Mars

Space Weather Office at NASA Goddard Space Flight Center in Greenbelt, Maryland, in collaboration with the Community Coordinated Modeling Center, tracks solar activity to give advanced warning to spacecraft and crewed missions.

The CME caused no issues for concern and the *Ingenuity* team did not need to take any steps to protect the helicopter. However, NASA will continue to include space weather updates as a factor when making decisions around our technology – and one day, astronauts – on Mars.

The April 2021 CME demonstrates that as society's reliance on technological systems grows, so does vulnerability to space weather. The ultimate goal in studying space weather is an ability to foretell events and conditions on the Sun and in near-Earth space that will produce potentially harmful societal and economic effects, and to do this adequately far in advance and with sufficient accuracy to allow preventive or mitigating actions to be taken. 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).

### 4.3.9. Subsidence and Sinkhole

#### 4.3.9.1 Location and Extent

Subsidence is the sinking movement of the earth's surface; the result of this movement is commonly referred to as a sinkhole. There are two common causes of subsidence in Pennsylvania: 1) dissolution of carbonate rock such as limestone or dolomite and 2) mining activity. In the first case, water passing through naturally occurring fractures and bedding planes dissolves bedrock leaving voids below the surface. Eventually, overburden on top of those voids collapses, leaving surface depressions resulting in what is known as karst topography. This bedrock geology is found mostly in the south-central and eastern portions of Pennsylvania, and it is not a main component in the bedrock of Tioga County. Subsidence in the county is primarily a result of mining activity.

Areas which are underlain by coal or other minerals which are extracted through deep mining techniques may become susceptible to subsidence. This can be exacerbated by poor engineering practices at the time of withdrawal or progressive degradation in geological stability. Areas of Pennsylvania that have underlying mines are subject to subsidence and constitute a potential threat to the people living and working in those regions and areas. *Figure 34 – Abandoned Mined sites in Tioga County* illustrates the abandoned mine sites throughout the county and their locations in municipalities. *Figure 35 – Karst Features in Pennsylvania* shows a smaller scale overview of Pennsylvania's subsidence risk.

#### 4.3.9.2 Range of Magnitude

No two subsidence areas or sinkholes are exactly alike. Variations in size and shape, time period under which they occur (i.e. gradually or abruptly), and the proximity to development ultimately determines the magnitude of damage incurred. Events could result in minor elevation changes or deep, gaping holes in the surface. Subsidence and sinkhole events can be addressed before significant damage occurs.

Primarily, problems related to subsidence include the disruption of utility services and damages to private and public property including buildings, roads, and underground infrastructure. Isolated incidents of subsidence throughout the coal regions over the past years have affected houses, garages, and trees that have been swallowed up by subsidence holes. Lengths of local streets and highways, and countless building foundations have been damaged.

The worst care scenario in Tioga County would result from the long-term subsidence or sinkhole formations that were not recognized, and mitigation measures that were not implemented. In this case fractures or complete collapse of building foundations and roadways may result. If mitigation measures are not taken, the cost to fill in and stabilize sinkholes can be significant although sinkholes are limited in extent.

#### 4.3.9.3 Past Occurrence

The PA DCNR provides an online Sinkhole Inventory Database, which lists a total of 2,665 identified sinkholes in Pennsylvania as of 2009. However, none of these listed sinkholes are in Tioga County or the surrounding counties (DCNR, 2009). This is the most comprehensive list of incidents available, but the fact that no sinkholes are identified does not necessarily mean there are no sinkholes or historical subsidence hazards in a given county or area. Tioga County does not have any sinkhole events listed in their previous hazard vulnerability assessment or other plans. In addition, there is no anecdotal evidence of significant sinkholes occurring.

#### 4.3.9.4 Future Occurrence

Based on the amount of abandoned mined sites in Tioga County, the annual occurrence of subsidence and sinkhole events in the county where mining occured is considered likely.

#### 4.3.9.5 Vulnerability Assessment

Most of the mining that has occurred in Tioga County was strip mining, leaving these abandoned mine sites susceptible to subsidence events. The southern portion of Tioga County is subject to surface and subsurface sinkhole occurrence because of these mining practices. This is illustrated in *Figure 34 – Abandoned Mined Areas in Tioga County*. The frequency of subsidence incidences occurring in the county is expected to remain low. However, considering past mining activity that occurred in the county, subsidence cannot be ruled out as a potential hazard.

*Figure 34 - Abandoned Mined Areas in Tioga County*

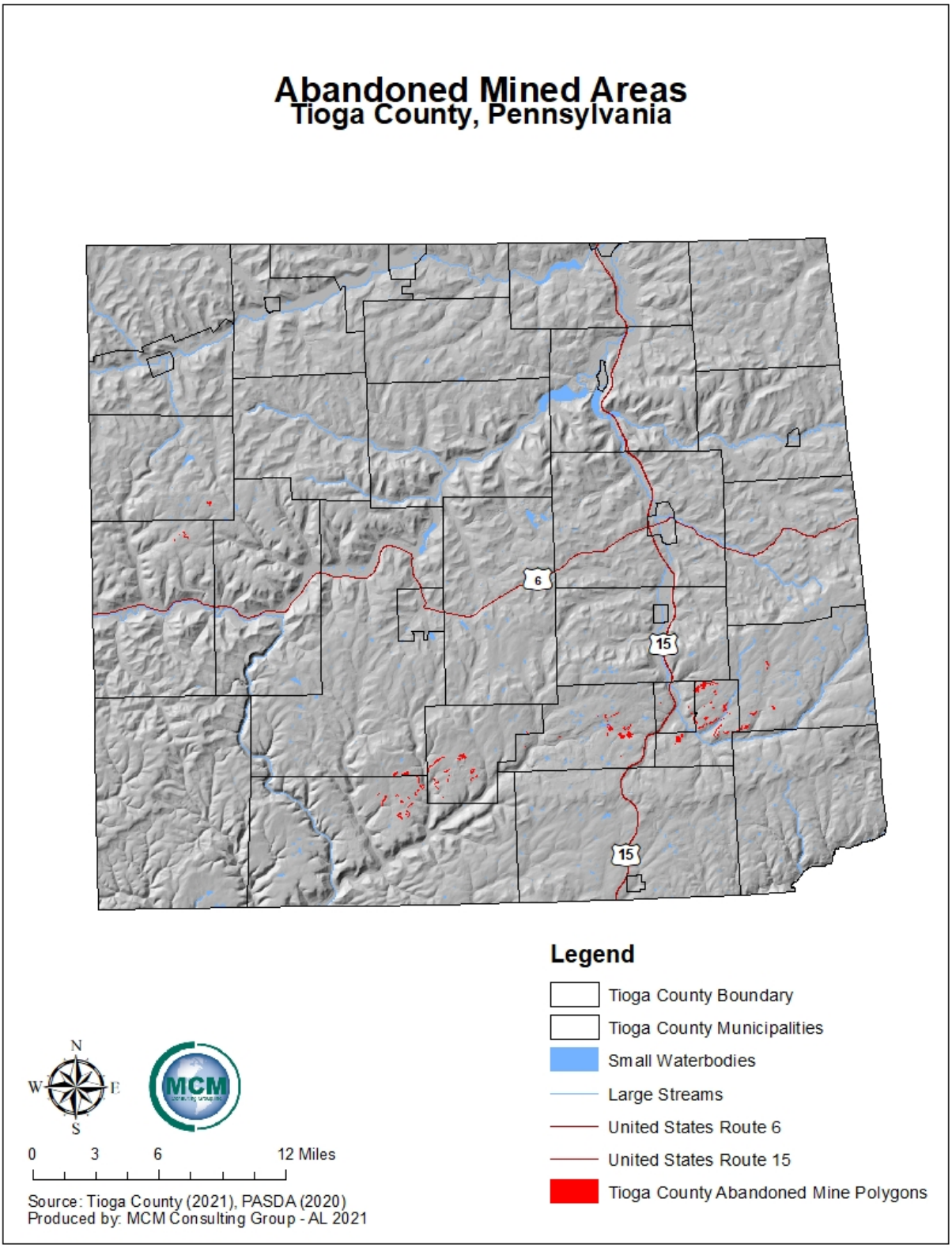
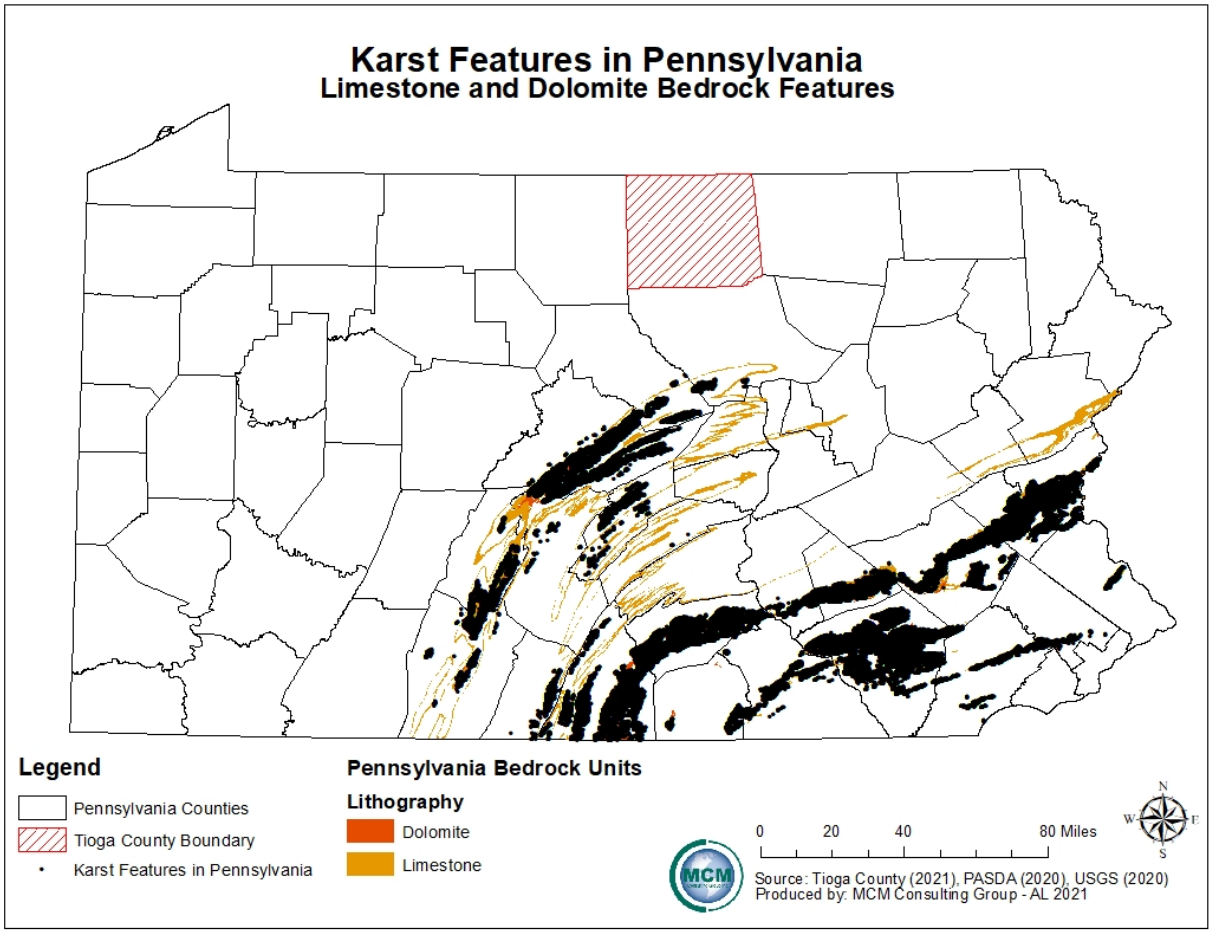


*Figure 35 - Karst Features in Pennsylvania*




### 4.3.10. Tornado/Windstorm

#### 4.3.10.1 Location and Extent

Tornadoes and windstorms can occur throughout Tioga County, though incidents are usually localized. Severe thunderstorms may result in conditions favorable for the formation of numerous or long-living tornadoes. Tornadoes are nature's most violent storm and can cause fatalities and devastation to neighborhoods within the county. Tornadoes can occur at any time during the day or night but are most frequent during late afternoon into early evening, the warmest hours of the day, and most likely during the spring and early summer months of March through June. Tornado movement is characterized in two ways: direction/speed of spinning winds and forward movement of the tornado, also known as the storm track. The rotational wind speeds can range from 100 to more than 250 mph. The speed of forward motion can range from 0 mph to 50 mph. On estimate, the maximum velocity of tornadoes is about 300 mph. Forward motion of the tornado path can be a few to several hundred miles in length. Widths of tornados vary from less than 100 feet to more than a mile wide. The National Centers for Environmental

Information (NCEI) reports that, “the maximum winds in tornadoes are often confined to extremely small areas and vary tremendously over short distances”, which explains why one house may be completely demolished by a tornado and a neighboring house could be untouched. Some tornadoes never touch the ground and are short lived, while others may touch the ground several times.

There are two main types of tornadoes: supercell and non-supercell. Supercell tornadoes are the most common and often the most dangerous type of tornado. A rotating updraft is key to the development of a supercell and eventually a tornado. Once the updraft is rotating and being fed by warm air flowing in, the tornado is formed. The other type of tornado is categorized as non-supercell, which is not as commonly found. One type of non-supercell tornado is the “Quasi-Linear Convective Systems” (QLCS). The QLCS tornadoes typically arise during the late night or early morning hours. These types of tornadoes are weaker and more short-lived compared to super cell thunderstorms. However, the QLCS are more difficult to detect effectively. Another type of non-supercell tornado is a landspout. These tornadoes are narrow and rope-like funnels that form when the thunderstorm cloud is still growing with no rotating updraft which causes the spinning motion to appear near the ground more. Waterspouts are similar non-supercell tornadoes to the landspout but not likely to be found within Tioga County.

Windstorms may be caused by thunderstorms, hurricanes, and tornadoes, but the most frequent cause of windstorms in Pennsylvania is thunderstorms. Windstorms are defined as sustained wind speeds of 40 mph or greater, lasting for at least one hour, or winds of 58 mph or greater lasting for any duration. There are a wide variety of windstorm events that can take place in Tioga County: Straight-line wind, downdraft, macroburst, microburst, downburst, gust front, and derecho. Straight-line winds are the most common wind event. Straight-line winds are different than tornadic winds. A downdraft is a small-scale column of air that rapidly sinks toward the ground. A macroburst is the outward burst of strong winds that are near or at the surface with horizontal dimensions greater than 2 1/2 miles. Microburst winds may begin over a smaller area and then spread out to an even wider area, sometimes producing damage similar to a tornado. On the other hand, microbursts are smaller outward bursts of strong winds near or at the surface. Microbursts are less than 2 1/2 miles in horizontal dimension and are typically short-lived winds that last a maximum of ten minutes, with windspeeds reaching up to 100 mph. Microburst events can be wet or dry. Wet microbursts are typically associated with heavy precipitation at the surface. Dry microbursts do not have precipitation associated with them and are found in the western portion of the United States. Tioga County is more likely to experience a wet microburst instead of a dry microburst event. A downburst is typically used to describe the macro and microbursts. A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. The gust fronts are characterized by wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Derecho is a long-lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. A typical derecho contains various

downbursts and microbursts. If the wind damage is more than 240 miles and includes wind gusts of at least 58 mph, the event would then be classified as a derecho.

#### 4.3.10.2 Range and Magnitude

Each year, tornadoes account for $1.1 billion in damages and cause over eighty deaths nationally. 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. The damage caused by a tornado is a result of the high-wind velocity and windblown debris, also accompanied by lightning or large hail. The most violent tornadoes have rotating winds of 250 mph or more and are capable of causing extreme destruction and turning normally harmless objects into deadly projectiles.

The destruction caused by tornadoes may range from light to severe depending on the path of travel. Damages and deaths can be especially significant when tornadoes move through populated, developed areas. The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damages to structures of light weight construction such as mobile homes. 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. These scales classify U.S. tornadoes into six intensity categories based upon the estimated maximum winds occurring within the wind vortex (*Table 35 - Enhanced Fujita Scale*). Although F Scale has been used for many years, this scale has limitations associated with it. Limitations of the F-Scale include lack of damage indicators (DI), no account of construction quality and variability, and no definitive correlation between damage and wind speeds. The limitation is what led to a more accurate scaling method of the EF- Scale. The EF-Scale became effective on February 1st, 2007. Since its implementation by the National Weather Service in 2007, the EF-Scale has become the definitive metric for estimating wind speeds within tornadoes based upon damage to buildings and structures. Previously recorded tornadoes are reported with the older F-Scale values, but *Table 35 - Enhanced Fujita Scale* shows F-Scale categories with corresponding EF-Scale wind speeds.

*Figure 36 - Pennsylvania Wind Zones* identifies wind speed zones across the state. The figure identifies wind speeds that could occur across the state to be used as the basis for design and evaluation of the structural integrity of shelters and critical facilities. The majority of Pennsylvania falls within Zone III, meaning that design wind speeds for shelters and critical facilities should be able to withstand a three-second gust of up to 200 mph, regardless of whether the gust is the result of a tornado, hurricane, tropical storm, or windstorm incident. The western portion of the state falls within the Zone IV which indicates shelters can withstand up to 250 mph winds, while the eastern side falls within the Zone II where shelters can withstand up to only 160 mph. *Table 34 - Wind Zones and Counties Affected in Pennsylvania* identifies which

county is located in specific wind zones throughout Pennsylvania. As shown on *Figure 36* and *Table 34*, Tioga County is situated in Wind Zone III.

*Figure 36 - Pennsylvania Wind Zones*

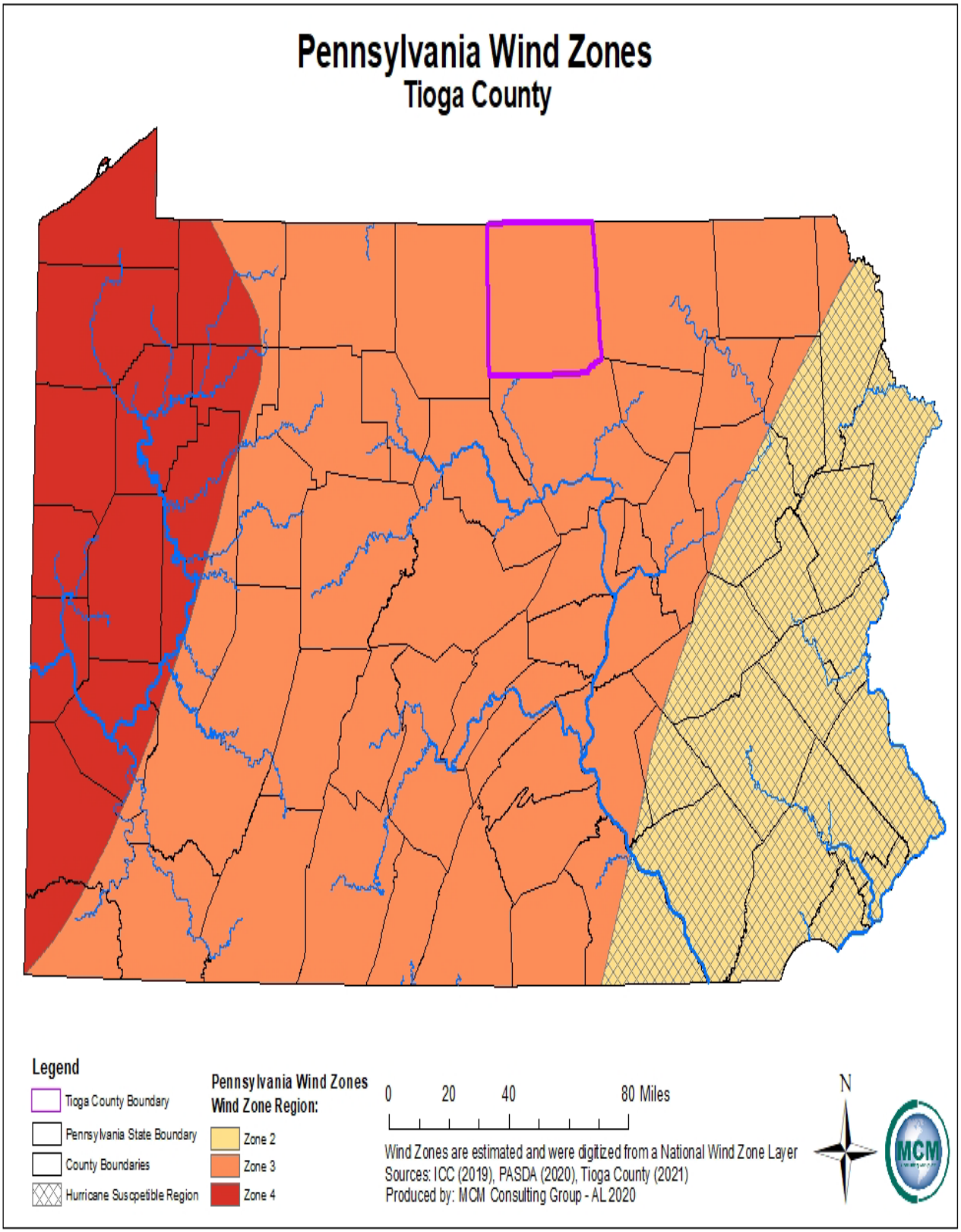


*Table 34 - Wind Zones and Counties Affected in Pennsylvania*

| Wind Zones and Counties Affected in Pennsylvania (NOAA, 2019) | |
|---|---|
| **Wind Zones with Speed** | **Counties Affected** |
| Zone I (130 mph) | N/A |
| Zone II (160 mph) | Berks, Bucks, Carbon, Chester, Delaware, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Monroe, Montgomery, Northampton, Philadelphia, Pike, Schuylkill, Wayne, York |
| Zone III (200 mph) | Adams, Armstrong, Bedford, Blair, Bradford, Cambria, Cameron, Centre, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Elk, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Jefferson, Lycoming, McKean, Mifflin, Montour, Northumberland, Perry, Potter, Snyder, Somerset, Sullivan, Susquehanna, **Tioga**, Union, Westmoreland, |
| Zone IV (250 mph) | Allegheny, Beaver, Butler, Clarion, Crawford, Erie, Forest, Lawrence, Mercer, Venango, Warren, Washington |

Since Tioga County falls within Zone III, shelters and critical facilities should be designed to withstand up to 200 mph winds, regardless of whether the gust is the result of a tornado, coastal storm, or windstorm event. Additionally, these structures should be able to withstand the wind speeds experienced in an EF3 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 tornadoes. Tornadoes 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. Since tornado incidents are typically localized, environmental impacts are rarely widespread. However, where these incidents occur, severe damage to plant species is likely. This includes loss of trees and an increased threat of wildfire in areas where dead trees are not removed.

Tornadoes/windstorms of all types have caused the following problems within Tioga County:

- Power failures lasting four hours or longer.
- Loss of communications networks lasting four hours or more.
- Residents requiring evacuation or provision of supplies or temporary shelter.
- Severe crop loss or damage
- Trees down or snapped off high above the ground/tree debris-fire fuel.
- Toppled high profile vehicles, including those containing hazardous materials.

*Table 35 - Enhanced Fujita Scale*

| Enhanced Fujita Scale (NWS, 2007) | | | |
|---|---|---|---|
| **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 tornadoes 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 projectiles generated. |
| **EF5** | >200 | F3-F6 | **Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized projectiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation. |

#### 4.3.10.3 Past Occurrence

Tioga County has experienced seven tornado events since 1970 and twelve wind incidents since 1999 (see *Table 36 – Tioga County Tornado History and Table 37 – Tioga County High Wind History*). Numerous sources provide information in regard to past occurrences and losses associated with tornadoes/windstorms in Tioga County and the Commonwealth as a whole. Due to the number of sources available with information, specific number of events and losses could vary slightly in number. Tornado data was only available from 1970 until 2019 while windstorm data was only available from 1999 until 2019 even though more past or recent events could have possibly occurred. Historically, the county has experienced both severe windstorms and tornadoes.

The most recent tornado impact on Tioga County occurred on May 29th, 2019, in the afternoon when an EF0 was reported within the county. The EF0 tornado touched down near Whitneyville in Tioga County and produced maximum winds of around 75 mph along a path that was about one mile long and a maximum path width of about fifty yards. There was significant damage to trees, a barn, and a trampoline that were observed along North Elk Run Road (Route 660). The most damaging tornado event to affect Tioga County was an F2 on May 2nd, 1983, which reported to have caused about $2.5 million in damages. This tornado started in Deerfield Township and ended its path in Nelson Township. The length of the tornado was about 9.8 miles and had a width of about thirty yards wide. Along the path, nine barns, ten buildings, one house, one mobile home, and one camper were completely demolished. All or part of the roof was off on five different buildings. There was minor damage to four houses, one barn, and one building. Two mobile homes were completely moved off their foundation. One pickup truck was thrown and severely damaged while another was damaged by a falling tree. Many trees were uprooted or broken off. There were four cattle that were lost on one farm. Farther northeast at Lawrenceville, witnesses saw and heard the funnel cloud pass overhead, but the only damage in this area was to some treetops. North of the tornado track, golf ball size hail was reported at Osceola. A total of five out of the seven tornado events in Tioga County documented property damage.

The most recent wind incident in Tioga County occurred on February 24th, 2019, when a 52-mph wind event was reported. This wind event resulted in west-northwest winds that developed across central Pennsylvania. Gusts over 60 mph were observed across portions of central Pennsylvania, as were scattered power outages and downed trees. The wind gusts were near 60 mph that were observed across Tioga County from February 24th to the 25th of 2019. The most damaging wind incident to affect Tioga County was on December 12th, 2000, which is reported to have caused $13,900.00 in damages. This event was the only high wind event reported to have property damage.

See *Tables 36 – Tioga County Tornado History, Table 37 - Tioga County High Wind History*, and *Figure 37 - Past Tornado Occurrences in Tioga County* below for reference to the past tornado and wind occurrence events and data within the county.

*Table 36 - Tioga County Tornado History*

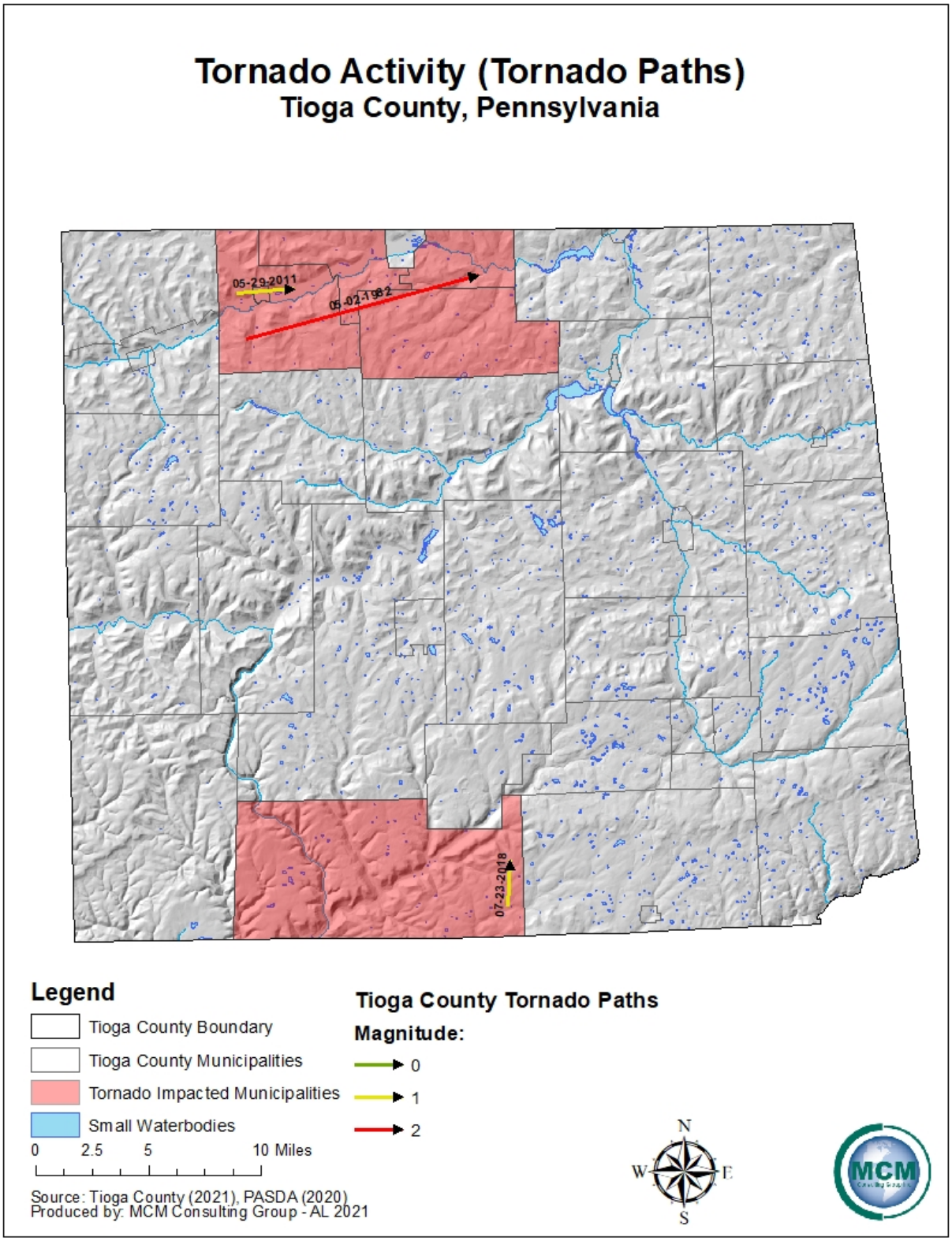
| Tioga County Tornado History (NOAA NCEI, 2020) | | | | | |
|---|---|---|---|---|---|
| **Location** | **Date** | **Magnitude (F/EF Scale)** | **Deaths** | **Injuries** | **Property Damage** |
| Tioga County | 08/30/1970 | F1 | 0 | 0 | $25,000.00 |
| Tioga County | 05/02/1983 | F2 | 0 | 0 | $2,500,000.00 |
| Tioga County | 07/08/1997 | F1 | 0 | 0 | $0.00 |
| Tioga County | 06/06/2005 | F0 | 0 | 0 | $0.00 |
| Knoxville | 05/30/2011 | EF1 | 0 | 0 | $25,000.00 |
| Nauvoo | 07/23/2018 | EF1 | 0 | 0 | $10,000.00 |
| Whitneyville | 05/29/2019 | EF0 | 0 | 0 | $25,000.00 |
| **Totals** | **-** | **-** | **0** | **0** | **$2,585,000.00** |

*Table 37 - Tioga County High Wind History*

| Tioga County High Wind History (NOAA NCEI, 2020) | | | | |
|---|---|---|---|---|
| **Location** | **Date** | **Mag. (knots)** | **Injuries** | **Property Damage** |
| Tioga County | 09/29/1999 | 60 kts. | 0 | $0.00 |
| Tioga County | 01/04/2000 | 50 kts. | 0 | $0.00 |
| Tioga County | 01/10/2000 | 50kts | 0 | $0.00 |
| Tioga County | 12/12/2000 | | 0 | $13,900.00 |
| Tioga County | 02/01/2002 | 63 kts. | 0 | $0.00 |
| Tioga County | 03/09/2002 | 50 kts. | 0 | $0.00 |
| Tioga County | 11/13/2003 | 60 kts. | 0 | $0.00 |
| Tioga County | 12/01/2006 | 45 kts. | 0 | $0.00 |
| Tioga County | 09/14/2008 | 50 kts. | 0 | $0.00 |
| Tioga County | 10/29/2012 | 50 kts. | 0 | $0.00 |
| Tioga County | 04/04/2018 | 52 kts. | 0 | $0.00 |
| Tioga County | 02/24/2019 | 52 kts. | 0 | $0.00 |

| Tioga County High Wind History (NOAA NCEI, 2020) | | | | |
|---|---|---|---|---|
| **Location** | **Date** | **Mag. (knots)** | **Injuries** | **Property Damage** |
| **Total** | **-** | **-** | **0** | **$13,900.00** |

*Figure 37 - Past Tornado Occurrences in Tioga County*



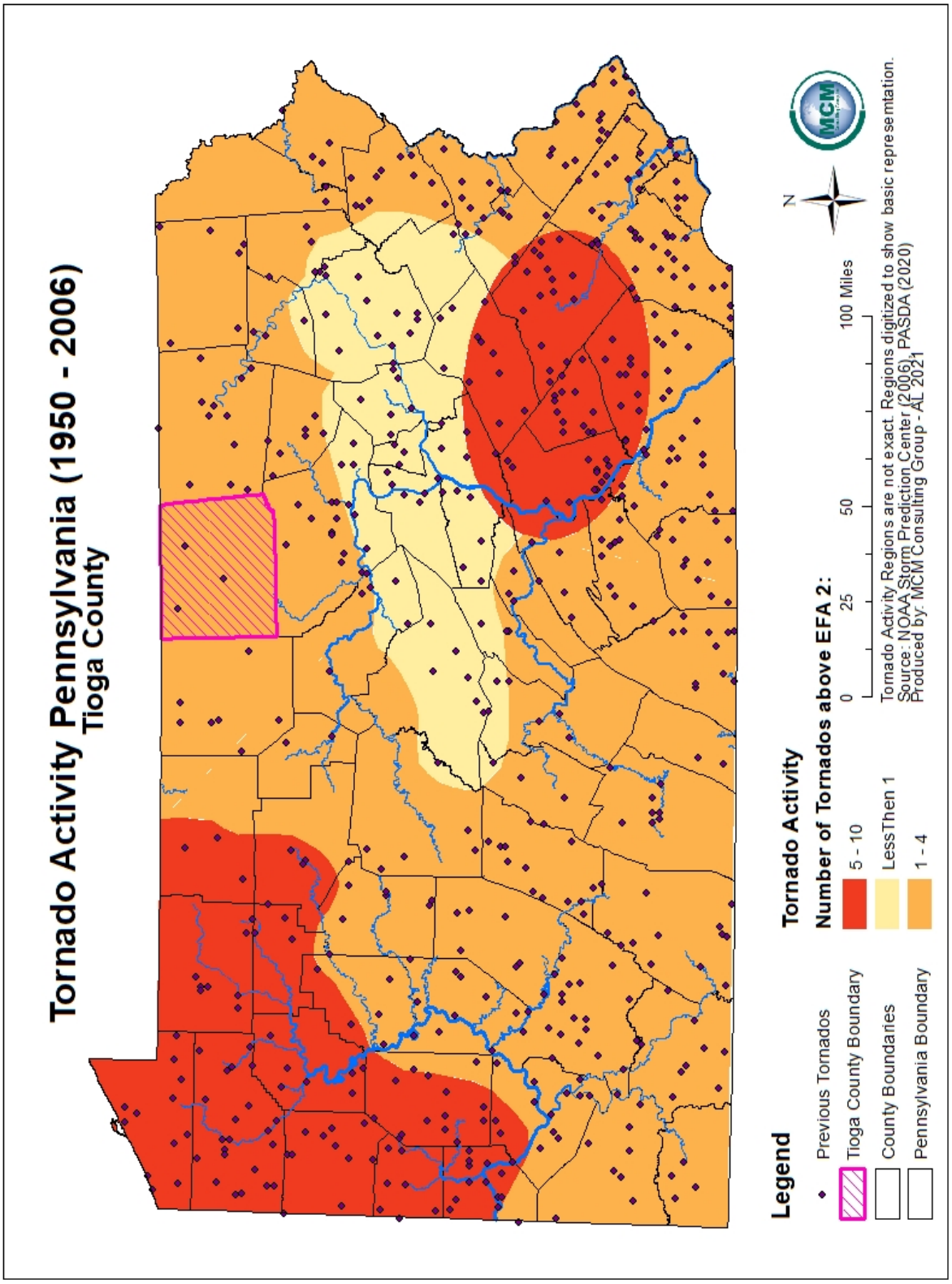
#### 4.3.10.4 Future Occurrence

The future probability of a disastrous tornado hitting Tioga County is ranked as possible. According to the National Weather Service, the Commonwealth of Pennsylvania has an annual average of ten tornadoes with two related deaths. While the chance of a tornado occurring in Tioga County is small, the damage that results when the tornado arrives could be devastating. An EF-5 tornado with a 0.019% 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. As the county's population continues to grow and as residential and commercial construction continues, the number of people and properties will be greatly affected by tornadoes and windstorms as they increase accordingly.

Based on historic patterns, tornadoes are unlikely to remain on the ground for long distances, especially in areas with hilly terrain, such as Tioga County. However, the high historical number of windstorms with winds at or over 50 knots indicates that the annual chance of a windstorm in the county is higher. The number of days when tornadoes occur in the United States has decreased; however, there has been an increase in tornado activity on those days. The tornado season has also been lengthening, with the season starting earlier than it has historically. Pennsylvania had, for example, a record number of tornadoes in April and May 2019 compared to any other April or May on record. Climate change is causing temperatures and air moisture to increase, and it is thought that these changes could result in an increase in frequency and intensity of tornadoes and severe windstorms; however, there is somewhat low confidence in these conclusions and there is still much uncertainty. Therefore, the number of future tornado/windstorm events could potentially increase due to many factors.

Based on historical incidents, there are three zones in Pennsylvania that can either experience less than one, one to four, and five to ten of EF2 or above tornadoes per 3,700 square miles. Communities in Tioga County, as shown in the *Figure 38 - Tornado Activity in Tioga County* below, are expected to have one to four tornadoes annually. The approximation of one to four tornadoes annually assists with determining the rate of future tornado occurrences within Tioga County. Future tornadoes will be similar to those that affected the county in past events. Windstorm events occur on a more frequent basis compared to tornadoes. Therefore, unlike tornadoes, this hazardous event has a highly likely probability for future events to occur within the county.

*Figure 38 - Tornado Activity in Tioga County*



#### 4.3.10.5 Vulnerability Assessment

Tornadoes can occur at any time of the year, though they are more likely during peak months, which are during the summer for the northern part of the United States, such as Pennsylvania. While the frequency of windstorms and minor tornadoes is expected to remain relatively constant, vulnerability increases in more densely developed areas. 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 tornadoes make them one of the most destructive natural hazards. There can be many secondary impacts of tornadoes and windstorms, including transportation accidents, hazardous material spills, flooding, and power outages. A proper warning system is vital for the public to be informed of what to do and where to go.

Dangers that accompany thunderstorms associated with tornadoes which increase the vulnerability of Tioga County:

- 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 $100 million in damages annually to property and crops.

Since high-wind incidents may affect the entire county, it is important to identify specific critical facilities and assets that are most vulnerable to the hazard. Critical facilities are highly vulnerable to high windstorms and tornado events. While many severe storms can cause exterior damage to structures, tornadoes can also completely destroy structures, along with their surrounding infrastructure and abruptly halting operations. Tornadoes are often accompanied by severe storms which can be threatening to critical facilities within the county. Many secondary effects from these disasters can jeopardize the operation of these critical facilities as well. Critical facilities are particularly vulnerable to power outages which can leave facilities functionless, potentially crippling infrastructure supporting the population of the county. A storm potentially has the ability to destroy structures, citizens, and their possessions that are often left at the will of the storm. The elderly, disabled, special needs, and non-English speaking residents are at risk when faced with tornadoes. Without assistance to evacuate or difficulty understanding public information, they may be unable to prepare themselves or their homes and other possessions to safely endure the storm.

The economy of Tioga County is highly vulnerable to tornadoes. While there may be limited impact on the financial and commercial systems of the economy, these storms, and the resulting damage can disrupt business long-term. The local economy is vulnerable due to possibility of being crippled by tornadoes 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 closures 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. Tioga County's environment is also vulnerable to tornado events. Most notably, hazardous materials spills can pollute ground water systems and vegetation. In the case of hazardous material spills caused by the event, the local environment can also be negatively impacted which requires extensive clean-up and mitigation efforts.

While the frequency of windstorms and minor tornadoes is expected to remain relatively constant, vulnerability increases in more densely developed areas. Since high wind events may affect the entire county, it is important to identify specific critical facilities and assets that are most vulnerable to this hazard. Due to their lightweight and often unanchored design, commercial trailers and mobile homes are also extremely vulnerable to high winds/tornadoes and will generally sustain the most damage. These structures represent a reasonable percentage of the occupied structures within the county. A majority of the mobile homes are found in Lawrence Township and Richmond Township, which makes these two municipalities more vulnerable to tornado events than others. Locations and numbers of mobile home parcels in Tioga County can be found in *Table 38 – Vulnerable Mobile Home Parcels in Tioga County*. While clearly an estimate, this enables the county to take a preliminary look at which jurisdictions are more vulnerable to mobile home damage.

*Table 38 - Vulnerable Mobile Home Parcels in Tioga County*

| Vulnerable Mobile Home Parcels in Tioga County (Tioga County GIS, 2021) | |
|---|---|
| **Municipality** | **Number of Mobile Homes Parcels** |
| Delmar Township | 38 |
| Lawrence Township | 145 |
| Middlebury Township | 22 |
| Putnam Township | 28 |
| Richmond Township | 53 |
| **Total** | **286** |

### 4.3.11. Wildfire

#### 4.3.11.1 Location and Extent

Most wildfires are caused by human carelessness, negligence, and ignorance. However, some are precipitated by lightning strikes and in rare instance, spontaneous combustion. Lightning-caused wildfires in Pennsylvania are also relatively rare. The Pennsylvania Department of Conservation and Natural Resources (PA DCNR) reports that 98% of wildfires are caused by people.

Wildfires can take place in less developed or completely undeveloped areas, spreading rapidly through vegetative fuels. This type of fire occurs any time of the year, but mostly during the spring and fall months. The greatest potential for wildfires is in the spring months of March, April, and May, and the autumn months of October and November; 83% of all Pennsylvania wildfires occur in these two time periods. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris. In the fall, dried leaves are also fuel for fires.

*Figure 39 - Seasonal Wildfire Percentage*

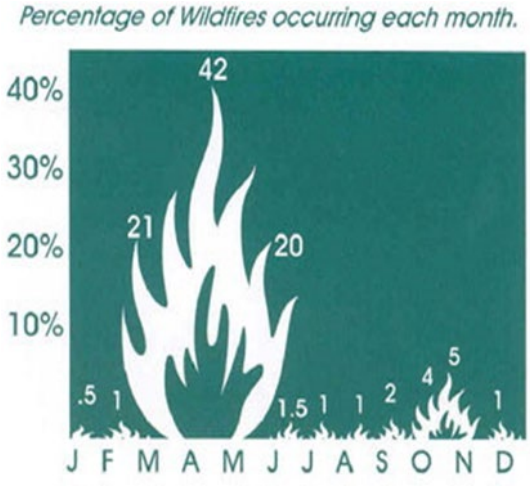



*Figure 39 – Seasonal Wildfire Percentage* shows the wildfire percentage occurrence during each month occurring in Pennsylvania. Any small fire, if not quickly detected and suppressed, can get out of control. Wildfires in Pennsylvania can occur in open fields, grass, dense brush, and forests.

The majority of Tioga County's land cover is forest and the potential geographic extent of wildfires in the county is quite large. Under dry conditions or droughts, wildfires have the potential to burn forests as wells as croplands.

Tioga County is part of the Tioga State Forest District, PA DCNR District 16, and covers 161,890 acres in Bradford and Tioga counties.

#### 4.3.11.2 Range of Magnitude

Wildfire events can range from small fires that can be managed by local firefighters to large fires impacting many acres of land. Large events may require evacuation from one or more communities and necessitate regional or national firefighting support. The impact of a severe wildfire can be devastating. A wildfire has the potential to kill people, livestock, fish, and wildlife. Wildfires can destroy property, valuable timber, forage, and recreational, and scenic values. A worst-case scenario for wildfires occurred in Tioga County in 2008 when a wildfire destroyed 3,200 acres of land in Tioga and Lycoming counties. Most of the fire was in Tioga County, near Cedar Run, before it spread into Lycoming County.

In addition to the risk wildfires pose to the general public and property owners, the safety of firefighters is also a concern. Although loss of life among firefighters does not occur often in Pennsylvania, it is always a risk. More common firefighting injuries include falls, sprains, abrasions, or heat-related injuries such as dehydration. Response to wildfires also exposes emergency responders to the risk of motor vehicle accidents and can place them in remote areas away from the communities that they are chartered to protect.

Significant potential environmental impacts from wildfires include severe erosion, silting of stream beds and reservoirs, and flooding due to ground-cover loss following a fire event.

Wildfire can also have a positive environmental impact in that they burn dead trees, leaves, and grasses to allow more open spaces for new vegetation to grow and receive sunlight. Another positive effect of wildfires is the growth of new shoots on trees and shrubs and its release of high heat which can open pinecones creating new seed pods.

The United States Forest Services utilizes the Forest Fire Assessment System to classify the dangers of a wildfire. *Table 39 – Wildland Fire Assessment System* identifies each threat classification and provides a description of the level.

*Table 39 - Wildland Fire Assessment System*

| **Wildland Fire Assessment System *(U.S. Forest Service)*** | |
|---|---|
| **Rank** | **Description** |
| **Low (L)** | Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting. |
| **Moderate (M)** | Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy. |
| **High (H)** | All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small. |
| **Very High (VH)** | Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels. |

| Rank | Description |
|---|---|
| **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. |

#### 4.3.11.3 Past Occurrence

Between 2000 and 2020, there were a total of 398 wildfire events reported to the PA DCNR Bureau of Forestry for District 16. This list of events comes directly from PA DCNR and is up to date with information from 2020. The largest number of wildfire events for any year was recorded in 2008 when there was a total of twenty-seven wildfire events which burned a total of 4,087.2 acres. In 2011, as illustrated below in *Table 40 – List of Wildfire Events for District 16*, there were no wildfire events or occurrences in District 16.

*Table 40 - List of Wildfire Events for District 16*

| Number of Wildfire Events for District 16 (PA DCNR, 2021) | | |
|---|---|---|
| **Year** | **Number of Wildfire Events** | **Number of Acres in Wildfire Events** |
| 2000 | 9 | 114.5 |
| 2001 | 13 | 101.5 |
| 2002 | 12 | 90.4 |
| 2003 | 8 | 35.6 |
| 2004 | 1 | 5.0 |
| 2005 | 16 | 142.5 |
| 2006 | 12 | 104.7 |
| 2007 | 19 | 38.9 |
| 2008 | 27 | 4,087.2 |
| 2009 | 16 | 894.6 |
| 2010 | 8 | 6.9 |
| 2011 | 0 | 0.0 |
| 2012 | 9 | 45.2 |
| 2013 | 7 | 7.6 |
| 2014 | 14 | 23.6 |
| 2015 | 23 | 135.7 |
| 2016 | 52 | 175.0 |
| 2017 | 39 | 66.0 |

| Year | Number of Wildfire Events | Number of Acres in Wildfire Events |
|---|---|---|
| 2018 | 31 | 40.0 |
| 2019 | 23 | 33.5 |
| 2020 | 59 | 29.9 |
| **Total:** | **398** | **6,178.3** |

In recent years, the number of prescribed burns in Pennsylvania has been increasing. This corresponds to an embrace of the need for fire in many natural ecosystems and management strategies for reducing vulnerability to wildfire; it also improves hunting opportunities in the Commonwealth of Pennsylvania. In July of 2020 there were numerous prescribed burns in state owned game lands.

Wildfire occurrence per municipality in Tioga County for 2016:

PA DCNR Forest Fire Specialist Supervisor Brian L. Plume provided the following information regarding wildfires in Tioga County for 2016. Listed below are all of the municipalities in Tioga County with the associated number of wildfires in each municipality.

- Bloss Township, Deerfield Township, Duncan Township, Elkland Borough, Knoxville Borough, Lawrenceville Borough, Nelson Township, Osceola Township, Putnam Township, Roseville Borough and Westfield Borough all experienced no wildfires in 2016.
- Blossburg Borough, Liberty Borough, Mansfield Borough, Shippen Township, Tioga Borough, Union Township, Ward Township, and Wellsboro Borough all experienced one wildfire in 2016.
- Chatham Township, Covington Township, Elk Township, Hamilton Township, Morris Township, Sullivan Township, Tioga Township, and Westfield Township each experienced two wildfires events 2016.
- Farmington Township, Gaines Township, Lawrence Township, and Middlebury Township all experienced three wildfires each in 2016.
- Brookfield Township, Clymer Township, Delmar Township, Richmond Township, and Rutland Township all experienced four wildfire events in 2016.
- Jackson Township experienced six wildfire events in 2016.
- Charleston Township and Liberty Township experienced seven wildfires each in 2016.

*Table 41 – Wildfire Acreage Loss* lists the number of wildfires and the acres burnt on a case-by-case basis in 2016. The data also lists the cause of the fires listed for each event:

*Table 41 - Wildfire Acreage Loss*

| Wildfire Acreage Loss | | |
|---|---|---|
| **Cause** | **Number of Wildfires** | **Acres Burnt** |
| Debris burning | 28 | 164.52 |
| False alarm | 14 | - |
| No report | 11 | - |
| Powerlines | 8 | 1.71 |
| Equipment | 5 | 6.1 |
| Miscellaneous | 4 | 1.79 |
| Campfire | 3 | 0.45 |
| Fireworks | 1 | 0.01 |
| Lightning | 1 | 0.01 |
| Smoker | 1 | 0.25 |

#### 4.3.11.4 Future Occurrence

Between 2003 and 2007, 18,132 acres of state forest have burned in Pennsylvania and at least 218 acres of land have burned in Tioga County. Previous events indicate that wildfire events will continue to occur yearly. Weather conditions like drought can increase the likelihood of wildfires occurring. Any fire, without the quick response of fire fighters, forestry personnel, or visitors to the forest, has the potential to become a wildfire.

The probability of a wildfire occurring in Tioga County is highly likely in any given year. However, the likelihood of one of those fires attaining significant size and intensity is unpredictable and highly dependent on environmental conditions and firefighting response.

Climate change is expected to bring an elongated wildfire season and more intense and long-burning fires (Pechony & Shindell, 2010). Unfortunately, in some regions of the United States, this is not a hypothetical, but a very real concern. Northern California has experienced unprecedented devastating wildfires in 2017, 2018, 2019, and 2020. The fires that have occurred in California are thought to be burning faster and hotter due to worsening drought conditions caused by increased climate change (Cvijanovic et al., 2017). Wildfire conditions in Pennsylvania are not nearly as severe as in Northern California, but the intensification is a signal that the changes brought on by climate change are not to be ignored. In Pennsylvania, higher air temperatures and earlier warming in the spring are expected to continue, resulting in more wildfire prone conditions in the summer and fall (Shortle et al., 2015).

#### 4.3.11.5 Vulnerability Assessment

The size and impact of a wildfire depends on its location, climatic 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.

Firefighters and other first responders can encounter life-threatening situations due to forest fires and wildfires. Traffic accidents during a response and the impacts of fighting the fire once on scene are examples of 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 related housing density and vegetative density. The dataset provides a way to 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 refers to areas where housing and wildland vegetation intermingle, and interface refers to areas where housing is in the vicinity of a large area of dense wildland vegetation. The WUI was the fastest-growing land use type in the United States between 1990 and 2010. Factors behind the growth include population shifts, expansion of cities into the wildlands, and the expansion of new vegetation growth. The primary cause has been the migration of people, not vegetation growth.

Pennsylvania is among the states with the largest WUI and the most housing units in a WUI designated area. Pennsylvanians desire the proximity of natural beauty in their daily lives, and the growth of the WUI housing noted above illustrates this. *Figure 40 – Wildland Urban Interface* shows the extent of Tioga County and the critical infrastructure facilities, functional needs facilities, and fire stations. A wildfire hazard is defined by conditions that affect wildfire ignition and/or behavior such as fuel, topography, and local weather. The many addressable structures in the Wildland Urban Interface and intermix sones are broken up by assessed parcel use codes.

There are seventeen fire departments that serve Tioga County, a list of which can be seen in *Table 54* of the Emergency Services profile. Each fire department conducts its own schedule of in-house training sessions for its members.

The response of firefighters is integral to the containment of wildfires in the county. The likelihood that some fire stations and services will close is of concern to the safety of communities in the county. *Figure 41 – Fire Station Locations* illustrates the position of fire stations and the location of state game lands, state forests, and natural areas within Tioga County. Many communities have already experienced the unfortunate fact that services have failed in the past. It is recommended that each municipality asses their own vulnerabilities by maintaining and building a relationship with their local providers to make the determination and begin to plan accordingly for if a local service were to shut down its operation. The statistics, response times, and call times associated with all units dispatched are easily obtainable from the local 911 center.

These departments must be supported to create and or discover new ways to not only recruit but also, retain volunteers. If left unattended, the issues will continue to devolve and worsen, and the

lack of response will grow, leaving the community more vulnerable to loss of life and loss of property to the threats of wildfires.

At the time of this writing, it is possible the continuing COVID-19 pandemic will impact the availability of firefighters and their response times. Many fire departments have created and begun to enforce new regulations regarding response to emergencies in the pandemic.

It is recommended that the entire community and county be educated on the perpetual need associated with providing these services. In addition, continued efforts to inform the state legislature could prove to be paramount in assuring these services remain in operation into the future. At the time of this writing, a flurry of bills had been introduced to both the House of Representatives and the Senate as the result of a two-year study initiated by Senate Resolutions (SR 6).

*Figure 40 - Wildland Urban Interface*

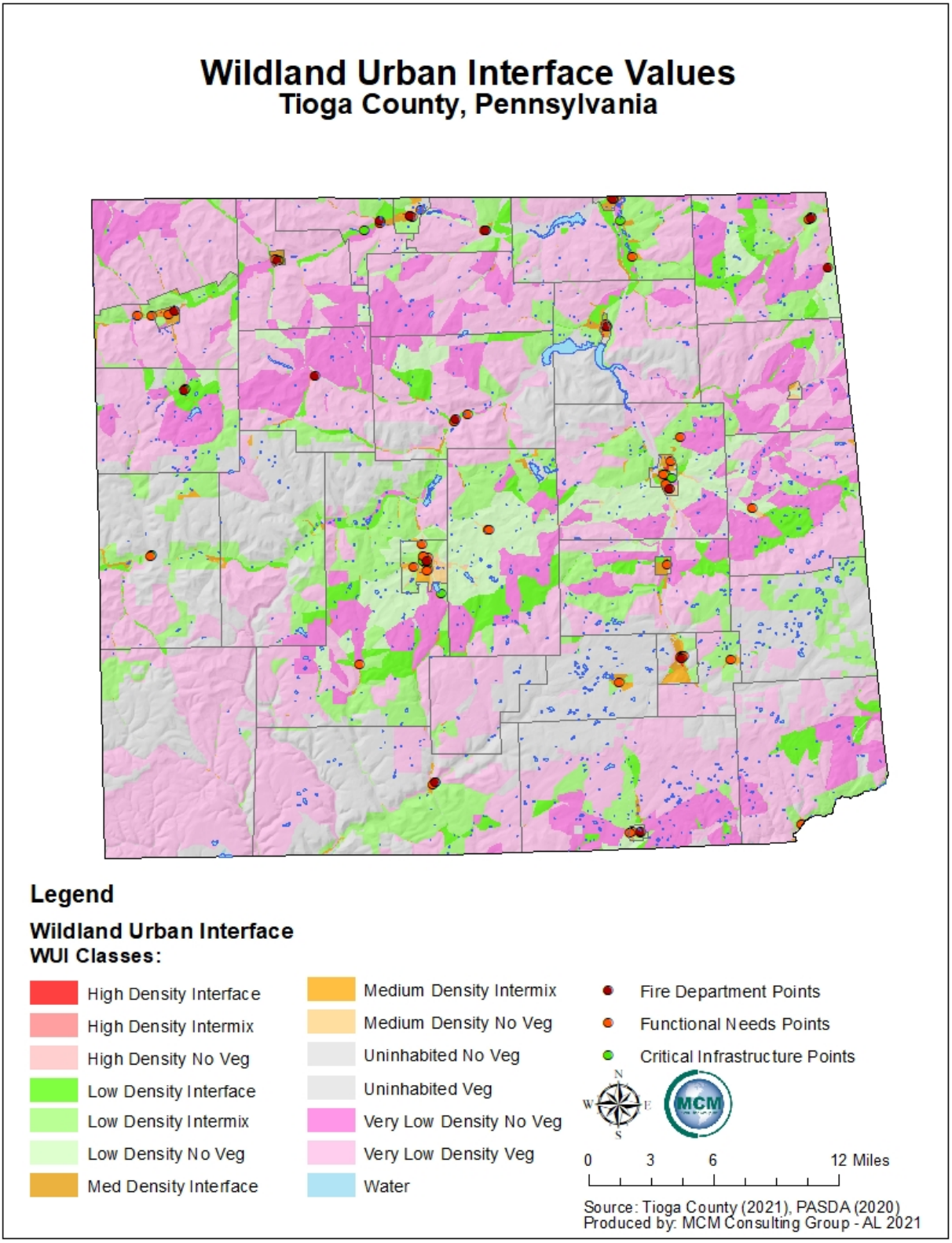
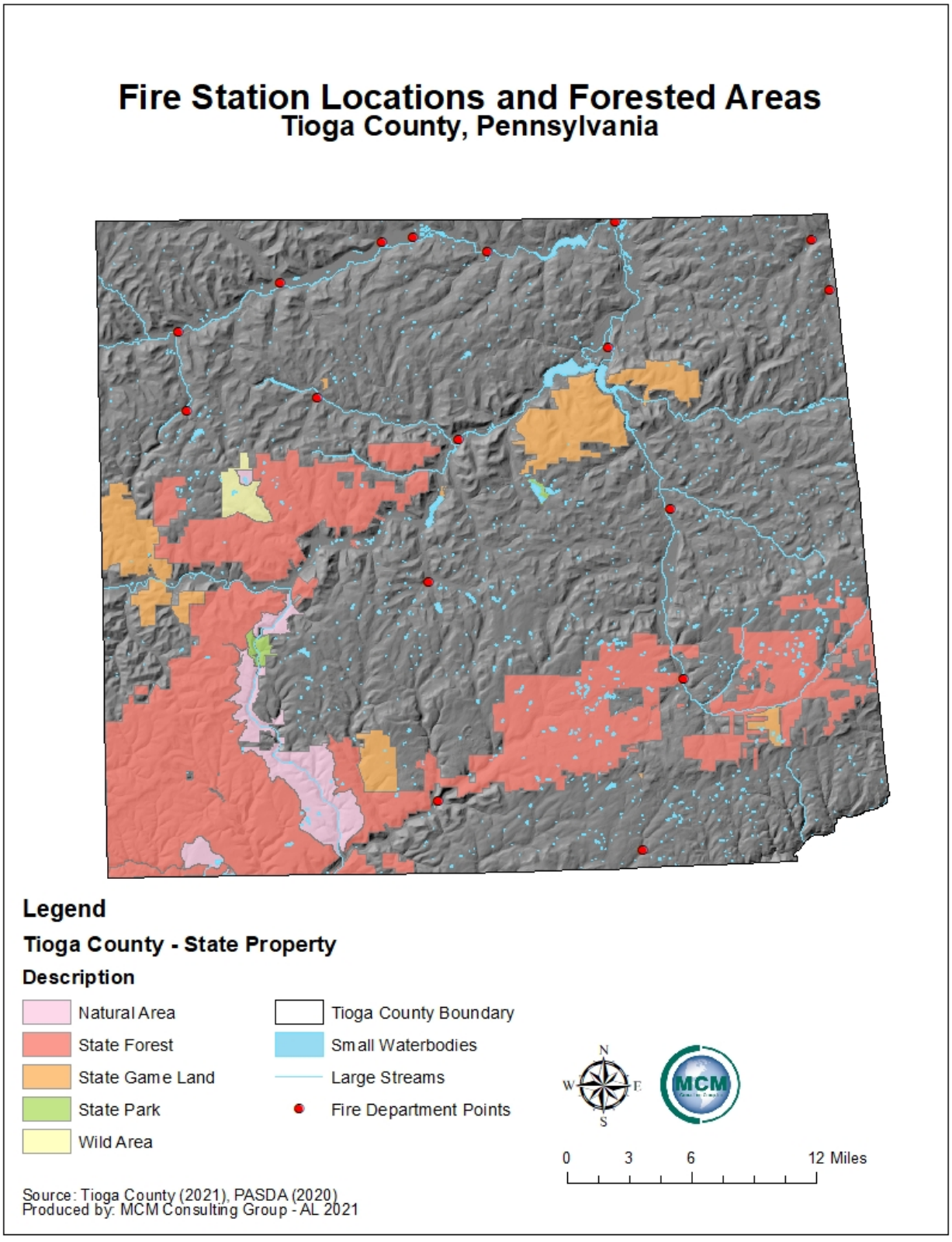


*Figure 41 - Fire Station Locations*



### 4.3.12. Winter Storm

#### 4.3.12.1 Location and Extent

There is an average of thirty-five winter weather events that impact Pennsylvania each year. Such winter storms are regional events, so each county in Pennsylvania share 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. The extent of a severe winter storm can be classified by meteorological measurements and by evaluating the societal impacts. Severe winter storms most frequently occur in Tioga County during the winter months (November through March) and can be caused by lake-effect conditions, warm air masses associated with the Gulf Stream, etc. Within Tioga County, there are slight variations in the average amount of snowfall that is received throughout different parts of the county because of terrain differences. Generally, the average annual snowfall in the county increases from southeast to northwest.

On occasion, Tioga 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, but typically make lighter snow (or even no snow) for counties in the west. There is usually a fairly consistent distinction between rain, mixed precipitation, and snow which moves along with the storm and generally parallel to the track of the surface low. The boundary typically pivots with the storm as the track changes direction. The mixed precipitation and rainfall are generated when warmer marine air is pulled into the storm. The heaviest snow in a Nor'easter falls to the north and west of the track of the surface low (NWS).

#### 4.3.12.2 Range of Magnitude

Winter storms consist of cold temperatures, heavy snow or ice, and sometimes strong winds. Descriptions of types of winter storms can be found in *Table 42 - Winter Weather Events*. Tioga County generally experiences one or more significant winter storm each year. The storms come in the form of snow, freezing rain, and sub-zero temperatures lasting for several days. Winter storms have caused power failures, loss of communications networks, road closings, disruption of EMS and fire response capabilities and losses of water supplies throughout the county. Power outages, sometimes caused by large amounts of snow or ice weighing on and breaking power lines, can result in a loss of heat for residential customers, potentially posing a threat to human life.

*Table 42 - Winter Weather Events*

| Winter Weather Events (NWS, 2009) | |
|---|---|
| **Weather Event** | **Classification/Description** |
| Heavy Snowstorm | Accumulations of 4 inches or more in a six-hour period, or 6 inches or more in a twelve-hour period. |
| Sleet Storm | Significant accumulations of solid pellets which form from the freezing of raindrops or partially melted snowflakes causing slippery surfaces posing hazards to pedestrians and motorists. |
| Ice Storm | Significant accumulations of rain or drizzle freezing on objects (trees, power lines, roadways, etc.) as it strikes them, causing slippery surfaces and damage from the sheer weight of ice accumulation. |
| Blizzard | Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile prevailing over an extended period of time. |
| Severe Blizzard | Wind velocity of 45 miles per hour, temperatures of 10°F or lower, a high density of blowing snow with visibility frequently measured in feet prevailing over an extended period time. |

NOAA's National Centers for Environmental Information (NCEI) has produced the Regional Snowfall Index (RSI) for significant snowstorms that impact the eastern two thirds of the United States. The RSI ranks snowstorm impacts on a scale from one to five, similar to the Fujita scale for tornadoes or the Saffir-Simpson scale for hurricanes. However, RSI differs from these others because population is included. The RSI is based on spatial extent of the storm, the amount of snowfall, and the combination of these elements with population. Including population information ties the index to societal impacts. The RSI is an evolution of the Northeast Snowfall Impact Scale (NESIS), which NCEI, then NCDC, produced. *Table 43 – NOAA's RSI Scale* shows the RSI categories one through five with their related description. The United States, as a whole, is divided up into six easternmost climate regions which include, Northern Rockies, Upper Midwest, Northeast, Ohio Valley, South, and Southeast. Tioga County, along with the Commonwealth, are located within the Northeast portion of the six.

*Table 43 - NOAA's RSI Scale*

| NOAA's RSI Scale (NOAA & NCDC, 2011) | | |
|---|---|---|
| **Category** | **RSI Value** | **Description** |
| 1 | 1-3 | Notable |
| 2 | 3-6 | Significant |
| 3 | 6-10 | Major |
| 4 | 10-18 | Crippling |
| 5 | 18.0+ | Extreme |

Long cold spells can cause rivers and lakes to freeze over. A subsequent thaw and rise in the water level break the ice into large chunks and can result in ice jams when the ice begins to flow. The ice jams can act as dams and result in flooding. Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up, and 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. *Table 44 – Monthly Snowfall Average* illustrates the snowfall average for each month experienced in Tioga County.

*Table 44 - Monthly Snowfall Average*

| Monthly Snowfall Average (NOAA, 2020) | |
|---|---|
| **Month** | **Tioga County** |
| January | 12.2” |
| February | 9.8” |
| March | 10.6” |
| April | 2.2” |
| May | 0.1” |
| June | 0.0” |
| July | 0.0” |
| August | 0.0” |
| September | 0.0” |
| October | 0.3” |
| November | 3.4” |
| December | 10.2” |
| Annual | 48.8” |

#### 4.3.12.3 Past Occurrences

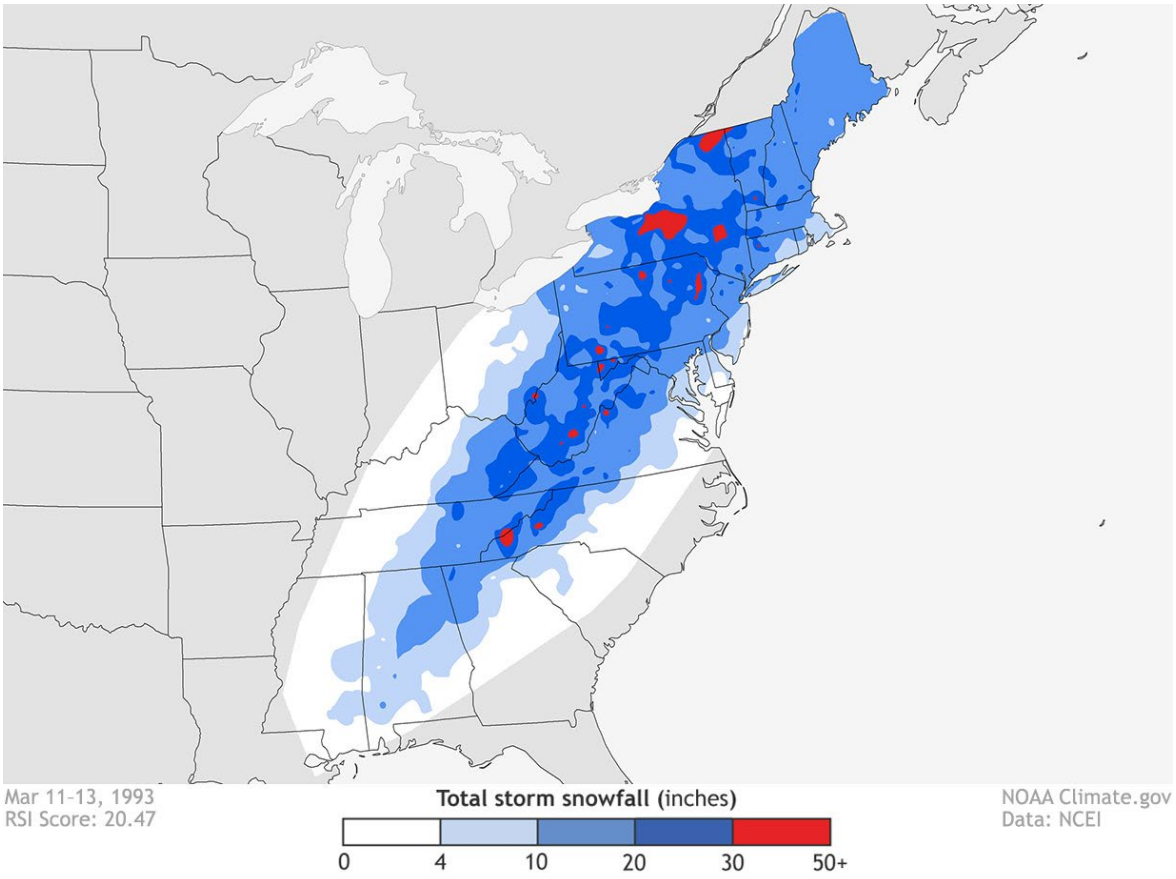
Due to a great number of various sources in regard to winter events in Tioga County, loss and impact information for these events may vary depending on the source. Tioga County and the Commonwealth of Pennsylvania have a long history of severe winter weather events. The sources used demonstrated significant events that have affected Tioga County since 1997 through 2019. With the sources used, other past events most likely occurred before the year 1997 date and after the year 2019, however, this information was not recorded in the sources. The National Climatic Data Center data on past occurrence for winter weather events is the only comprehensive list of data available for the county.

According to NOAA-NCEI, Tioga County underwent thirty-two winter storm events, thirty heavy snow events, and eleven ice storm events from 1997 to 2019. There was no available data

for sleet events in Tioga County. No direct deaths or injuries were reported for the following winter weather events in Tioga County, but detailed reports of each event can be found on NOAA's Storm Events Database at www.ncdc.noaa.gov/stormevents. Tioga County has been susceptible to an array of past winter weather events. In the past, this type of weather has had the ability to close businesses, close schools, and block/damage roadways throughout the county. The main transportation routes in the county (Interstates I-99, U.S. Route 6 and 15, State Routes 14, 49, 249, 287, 328, 349, 362, 414, 549, and 660) are normally opened immediately for emergency traffic, but secondary roads can remain impassable for long periods of time. The history of major winter storms and other related events in Tioga County since 1997 is outlined in the tables of ***Error! Reference source not found.*** (data available up to 2019), ***Error! Reference source not found.*** (data unavailable after 2014), and ***Error! Reference source not found.*** (data unavailable after 2008).

A severe winter event in the county's history and the Commonwealth as a whole was in the winter of 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 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. 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 fifteen to thirty 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. For Tioga County specifically, exact snowfall totals during that storm were not available, but the county noted this was one of the worst storms ever experienced. The year prior to the 1994 event, the country's so-called "Storm of the Century" clobbered the east coast. See *Figure 42 - Storm of the Century Total Storm Snowfall*.

*Figure 42 - Storm of the Century Total Storm Snowfall*




*Source: (NOAA, 1993)*

On March 12–14, 1993, a massive storm system bore down on nearly half of the U.S. population. Causing approximately $5.5 billion in damages ($9.9 billion in year 2020 dollars), America's "Storm of the Century", as it would become known, swept from the Deep South all the way up the East Coast. With a central pressure usually found in category three hurricanes, the storm spawned tornadoes and left coastal flooding, crippling snow, and bone-chilling cold in its wake.

However, more recently, winter storms are still continuously affecting Tioga County. The most recent winter storm event (based on ***Error! Reference source not found.*** and sources) was the December 1st, 2019 event. This winter storm event lasted over a span of two days. This particular winter storm event produced heavy snow and ice across the county. The storm total snow accumulation from this event in Tioga County was from eight to thirteen inches. Another recent winter storm event that occurred in Tioga County is from March 13th, 2017. This particular winter storm event was named Winter Storm Ezekiel which was an event that slammed the East Coast. In Tioga County, Lawrenceville recorded the highest snow accumulations with 13 inches total. Elkland and Mansfield both recorded snow accumulations of 11 inches while Middlebury

Township, Wellsboro, Cowanesque, and Blossburg posted between 7 - 9 inches. This storm in general produced seven to 15 inches of snow across Tioga County.

*Table 45 - Tioga County Winter Storm History*

| Tioga County Winter Storm History (NOAA NCEI, 2020) | | | | | |
|---|---|---|---|---|---|
| **Location** | **Date** | **Event** | **Location** | **Date** | **Event** |
| Tioga County | 02/13/1997 | Winter Storm | Tioga County | 01/10/2009 | Winter Storm |
| Tioga County | 01/02/1999 | Winter Storm | Tioga County | 01/27/2009 | Winter Storm |
| Tioga County | 01/08/1999 | Winter Storm | Tioga County | 10/15/2009 | Winter Storm |
| Tioga County | 01/14/1999 | Winter Storm | Tioga County | 02/25/2010 | Winter Storm |
| Tioga County | 02/18/2000 | Winter Storm | Tioga County | 02/01/2011 | Winter Storm |
| Tioga County | 12/13/2000 | Winter Storm | Tioga County | 03/23/2011 | Winter Storm |
| Tioga County | 03/24/2002 | Winter Storm | Tioga County | 16/26/2012 | Winter Storm |
| Tioga County | 01/05/2005 | Winter Storm | Tioga County | 02/04/2014 | Winter Storm |
| Tioga County | 01/22/2005 | Winter Storm | Tioga County | 02/01/2015 | Winter Storm |
| Tioga County | 02/21/2005 | Winter Storm | Tioga County | 01/23/2017 | Winter Storm |
| Tioga County | 03/23/2005 | Winter Storm | Tioga County | 02/09/2017 | Winter Storm |
| Tioga County | 12/16/2005 | Winter Storm | Tioga County | 03/13/2017 | Winter Storm |
| Tioga County | 12/13/2007 | Winter Storm | Tioga County | 02/07/2018 | Winter Storm |
| Tioga County | 02/01/2008 | Winter Storm | Tioga County | 11/15/2018 | Winter Storm |
| Tioga County | 12/11/2008 | Winter Storm | Tioga County | 01/19/2019 | Winter Storm |
| Tioga County | 12/19/2008 | Winter Storm | Tioga County | 12/01/2019 | Winter Storm |

*Table 46 - Tioga County Heavy Snow History*

| Tioga County Heavy Snow History (NOAA NCEI, 2020) | | | | | |
|---|---|---|---|---|---|
| **Location** | **Date** | **Event** | **Location** | **Date** | **Event** |
| Tioga County | 01/02/1996 | Heavy Snow | Tioga County | 01/02/2003 | Heavy Snow |
| Tioga County | 03/07/1996 | Heavy Snow | Tioga County | 02/16/2003 | Heavy Snow |
| Tioga County | 11/14/1997 | Heavy Snow | Tioga County | 03/30/2003 | Heavy Snow |
| Tioga County | 12/10/1997 | Heavy Snow | Tioga County | 12/14/2003 | Heavy Snow |
| Tioga County | 12/29/1997 | Heavy Snow | Tioga County | 02/03/2004 | Heavy Snow |
| Tioga County | 02/23/2998 | Heavy Snow | Tioga County | 03/16/2004 | Heavy Snow |
| Tioga County | 03/14/1998 | Heavy Snow | Tioga County | 10/25/2005 | Heavy Snow |
| Tioga County | 03/21/1998 | Heavy Snow | Tioga County | 02/13/2007 | Heavy Snow |
| Tioga County | 03/04/1999 | Heavy Snow | Tioga County | 03/16/2007 | Heavy Snow |
| Tioga County | 03/04/2001 | Heavy Snow | Tioga County | 04/15/2007 | Heavy Snow |
| Tioga County | 03/21/2001 | Heavy Snow | Tioga County | 02/20/2011 | Heavy Snow |
| Tioga County | 01/06/2002 | Heavy Snow | Tioga County | 03/06/2011 | Heavy Snow |
| Tioga County | 01/19/2002 | Heavy Snow | Tioga County | 04/22/2012 | Heavy Snow |
| Tioga County | 12/05/2002 | Heavy Snow | Tioga County | 12/14/2013 | Heavy Snow |
| Tioga County | 12/21/2002 | Heavy Snow | Tioga County | 01/02/2014 | Heavy Snow |

*Table 47 - Tioga County Ice Storm History*

| Tioga County Ice Storm History (NOAA NCEI, 2020) | | |
|---|---|---|
| **Location** | **Date** | **Event** |
| Tioga County | 03/14/1997 | Ice Storm |
| Tioga County | 01/15/2998 | Ice Storm |

| Location | Date | Event |
|---|---|---|
| Tioga County | 01/22/1998 | Ice Storm |
| Tioga County | 02/13/2000 | Ice Storm |
| Tioga County | 01/31/2002 | Ice Storm |
| Tioga County | 12/10/2002 | Ice Storm |
| Tioga County | 12/13/2002 | Ice Storm |
| Tioga County | 12/02/2007 | Ice Storm |
| Tioga County | 12/09/2007 | Ice Storm |
| Tioga County | 03/04/2008 | Ice Storm |
| Tioga County | 12/23/2008 | Ice Storm |

#### 4.3.12.4 Future Occurrence

There is a high probability of winter weather and winter storms occurring in Tioga County, with expected annual events across most of the Commonwealth. An analysis of the past occurrences indicates that this trend will continue annually in the future. Meanwhile, climate change is expected to bring changes to the future of winter storms impacting Pennsylvania. Climate scientists believe that extreme winter storms are expected to occur more frequently. There were 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. 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. Winters in 2000 and 2001 were mild in Pennsylvania and led to spring-like thunderstorms during the winter months rather than snowstorms. Such thunderstorms can be followed by cold fronts and winter storms resulting in temperature drops of 50˚F in a few short hours. Even though average temperatures are expected to be higher overall and there are expected to be fewer extreme cold days, those that do occur are expected to reach record-setting low temperatures more frequently. Winter storms are a regular, annual occurrence in Tioga County and should be considered highly likely.

#### 4.3.12.5 Vulnerability Assessment

Winter storms are a concern based on frequency of winter storm effects on Tioga County. Based on the information available, all communities in Tioga County are essentially equally vulnerable to the direct impacts of winter storms. Residents of the more rural areas of the county may be more susceptible to the vulnerability of delayed emergency medical assistance. Icy and snow-covered roads often result in increases in traffic incidents. 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. The

economic impacts from snow removal, road and infrastructure repair and other secondary effects can create a strain on the budgets and material resources of local municipalities.

Because of the frequency of winter storms, strategies have been developed to respond these events. Snow removal and utility repair equipment is present to respond to typical events. The use of auxiliary heat and electricity supplies such as wood burning stoves, kerosene heaters and gasoline power generators reduces the vulnerability of humans to extreme cold temperatures commonly associated with winter storms but can increase their vulnerability to other hazards. People residing in structures lacking adequate equipment to protect against cold temperatures or significant snow and ice are more vulnerable to winter storm events.

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.

Winter storm events often cause vulnerability in environmental impacts as well. 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 of even bring down large trees. An example of indirect effect to the environment is the treatment of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surface and ground waters. However, winter storms have a positive environmental impact as well; gradual melting of snow and ice provides excellent groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding to occur in the county.

### 4.3.13. Civil Disturbance and Criminal Activity

#### 4.3.13.1 Location and Extent

Civil disturbance refers to mass acts of disobedience where participants can become hostile to authority and there is a threat to maintaining public safety and order. Such disturbances can often be forms of protest in the face of socio-political problems. Riots have not been frequent occurrences throughout the history of the Commonwealth, however when they occur, they can cause significant property damage, injury and even loss of life. The scale and scope of civil disturbance events varies widely. Government facilities, local landmarks, prisons, and universities are common sites where crowds and mobs may gather.
Criminal activity refers to all criminality, including enemy attack, disinformation, sabotage, physical or information break of security, workplace or school violence, harassment, discrimination, and other crimes. Criminal activity is a very broad hazard category and similar to civil disturbance, the scale and scope of incidents or events vary widely.

#### 4.3.13.2 Range of Magnitude

Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories:

- **Casual Crowd**: A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
- **Cohesive Crowd**: A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.
- **Expressive Crowd**: An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.
- **Aggressive Crowd**: An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators and strikers, though not all demonstrators and strikers are aggressive.

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

- **Aggressive Mob**: An aggressive mob is one that attacks, riots, and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.
- **Escape Mob**: An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control and can be characterized by unreasonable terror.

- **Acquisitive Mob**: An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.
- **Expressive Mob**: An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent-up emotions in highly charged situations.

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

Tioga County's greatest likelihood for civil disturbance is in the borough of Wellsboro, the county seat. Citizens, property, and infrastructure could be affected if a large-scale disorder were to take place. Typically, government facilities, landmarks, prisons, and universities are common sites where crowds or mobs may gather. Tioga County is home to two colleges/universities within its borders: Mansfield University and the Pennsylvania College of Technology – North Campus, located in the Wellsboro School District Administration Building. Additionally, other universities such as the main campus of the Pennsylvania College of Technology and Lycoming College in Williamsport and three across the border in New York State are all located within an hour of Tioga County.

#### 4.3.13.3 Past Occurrences

The county has not experienced any significant civil disturbance events.

Following the death of George Floyd in Minneapolis, Minnesota in May 2020 at the hands of law enforcement, civil unrest erupted across the nation. A peaceful demonstration of support for *Black Lives Matter* (BLM) on Wellsboro's Main Street became less civilized on a Friday evening in July 2020: while approximately twenty-five local protesters silently held signs highlighting racial inequality, other local residents hurled insults and racial epithets (as well as words of support). The evening ended with Wellsboro police handcuffing and removing a man who had refused their instructions. As BLM demonstrators walked on the boulevards, a second crowd gathered in small groups along Main Street.

*Figure 43 - Counter-Protest on Main Street*


The crowd waved confederate flags and shouted comments. A small group of counter-protesters, holding signs reading "All Lives Matter" and similar sentiments, paraded silently on the sidewalks of Main Street in Wellsboro (see *Figure 43 – Counter-Protest on Main Street* above). (Westfield Free Press-Courier).

Other peaceful *Black Lives Matter (BLM)* marches and demonstrations took place in the county throughout the summer of 2020.

#### 4.3.13.4 Future Occurrence

While unlikely, civil disturbances may occur in Tioga County, and it is difficult to accurately predict the probability of future occurrence for civil disturbance events over the long-term. However, *Table 48 - Civil Disturbance Events Reported to PEMA 2012-2018*, depicts the range of potential civil disturbances in Pennsylvania and gives the county some background for consideration of future occurrences.

*Table 48 - Civil Disturbance Events Reported to PEMA 2012-2018 (Knowledge Center)*

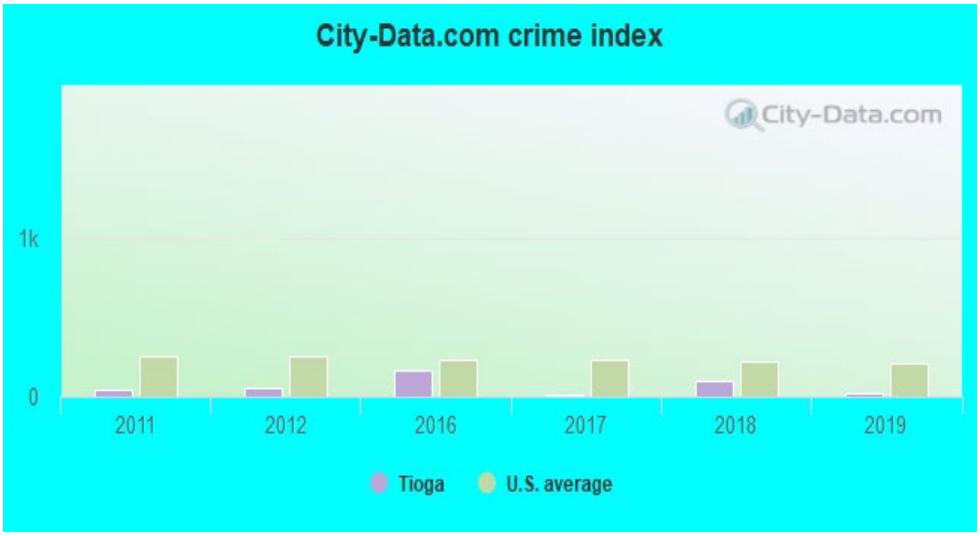
| Civil Disturbance Events Reported to PEMA 2012-2018) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Event Type** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** |
| Demonstration | 1 | 3 | 9 | 3 | 3 | 3 | 3 |

| Event Type | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|
| Juvenile Detention Center | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Prison Disturbance | 0 | 2 | 0 | 0 | 0 | 1 | 0 |
| Detainee Escape | 2 | 4 | 3 | 4 | 0 | 2 | 1 |
| Protest | 4 | 24 | 49 | 35 | 64 | 78 | 13 |
| Large Crowd Gathering | 0 | 1 | 0 | 4 | 2 | 3 | 2 |
| Riot | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| School Threat | 1 | 2 | 0 | 2 | 0 | 2 | 0 |
| Assault | 2 | 8 | 2 | 2 | 3 | 4 | 0 |
| Gun/Bomb Incident | 3 | 15 | 3 | 7 | 2 | 3 | 0 |
| *Civil Disturbance Totals* | ***13*** | ***59*** | ***66*** | ***58*** | ***74*** | ***96*** | ***20*** |

According to the Pennsylvania State Hazard Mitigation Plan, from 2012 to 2017, the commonwealth experienced an average of 74 civil disturbance events each year. While that number is relatively low and the occurrences in Tioga County are rare, the local planning team (LPT) decided civil disturbance should be regarded as a moderate-risk hazard due to the current political trends and frictions across the country.

Similar to civil disturbance, it is extremely difficult to predict when criminal activity may take place in Tioga County and throughout the Commonwealth of Pennsylvania. According to the City-Data.com crime index, the 2019 crime rate in Tioga County was 10.9 times lower than the U.S. average. (See *Figure 44 - City-Data.com Crime Index*.) In the last five years, Tioga County has seen decreasing violent crime but a rise of property crime. Read more at: https://www.city-data.com/crime/crime-Tioga-Pennsylvania.html.

*Figure 44 - City-Data.com Crime Index*




Overall, the local planning team has designated criminal activity as a moderate-risk hazard,

according to the risk factor score found on page 180.

#### 4.3.13.5 Vulnerability Assessment

All municipalities in Tioga County can be vulnerable to civil disturbance and criminal activity; however, the anticipated impact from such events is minimal. These events may be sparked for varying reasons and the seriousness of the event may well be exacerbated by how authorities handle the crowd. At the writing of this plan, the political temperature of the country as a whole continued to run high, making this hazard vulnerability one for consistent monitoring by public safety officials.

### 4.3.14. Dam Failure

#### 4.3.14.1 Location and Extent

A dam restricts the flow of water or underground streams and often creates reservoirs for water storage. The reservoirs created by these barriers not only suppress floods but also provide water for activities such as irrigation, human consumption, industrial use aquaculture, and navigability.

Dam failures occur usually as a secondary effect of massive rainfall and flooding, causing too much water to enter the spillway system. This type of failure occurs with little to no warning. Spring thaws, severe thunderstorms, and heavy rainfall are also contributing factors to dam failure. Depending on the size of the body of water where the dam is constructed, additional water may come from distant upstream locations. Water contributions may also come from dam failures in adjoining counties that are along the same riverine or water features.

Poor engineering or poor maintenance may also cause dam failures. The Pennsylvania Department of Environmental Protection (PA DEP) and the United States Army Corps of Engineers (USACE) award permits for dams and also share inspection responsibilities. Inspection results are characterized as either safe or unsafe.

The National Inventory of Dams (NID) is a registry that captures information about structures that are greater than or equal to 25 feet in height or that impound 50-acre-feet or more of water (an acre-foot is equal to 325,851 gallons of water); it includes structures above 6 feet in height where failure would potentially cause damage downstream. The dams are classified in terms of hazard potential as “High”, “Significant”, or “Low”, with high-hazard dams requiring emergency action plans (EAPs). There are twenty-one high and low hazard dams located in Tioga County that are both publicly and privately owned and are registered with the USACE in the NID. There are fifteen dams within the county that are high hazard and require an emergency action plan and there are six dams that are low hazard and do not require an emergency action plan. *Table 49 – High Hazard Dam Class and Category* lists the class and category of the dams located in Tioga County. Dam classes are based on potential life and economic loss in the event of a failure.

*Table 49 - High Hazard Dam Class and Category*

| High Hazard Dam Class and Category (PA DEP) | |
|---|---|
| **Class:** | **Description:** |
| A | Equal to or greater than 50,000-acre feet of impoundment and is equal or greater than 100 feet in height. |
| B | Less than 50,000 and greater than 1,000-acre feet of impoundment storage and is less than 100 and greater than 40 feet in height. |
| C | Equal to or less than 1,000-acre feet of impoundment storage and equal to or less than 40 feet in height. |
| **Category:** | **Description:** |
| 1 | Substantial potential loss – numerous homes or small businesses or a large business or school. |
| 2 | Few potential losses – a smaller number of homes or small businesses. |
| 3 | No expected losses – no permanent structures for human habitation or employment with significant damages to public or private property. |
| 4 | No expected losses – no permanent structures for human habitation or employment with minimal damage to public or private property. |

*Table 51 – Tioga County Dams* is an inventory of dams in Tioga County provided by the Pennsylvania DEP Bureau of Waterways Engineering and Wetlands and is broken down by classification, then municipality. *Table 50 – High Hazard Dams Municipal Summary* summarizes the high-hazard dams in Tioga County by municipality. The municipalities not listed do not have high-hazard dams.

*Table 50 - High Hazard Dams Municipal Summary*

| High Hazard Dams – Municipal Summary (PA DEP) | |
|---|---|
| **Municipality** | **Number of High Hazard Dams** |
| Charleston Township | 3 |
| Clymer Township | 2 |
| Delmar Township | 3 |
| Hamilton Township | 1 |
| Jackson Township | 2 |
| Lawrence Township | 1 |
| Liberty Township | 1 |
| Middlebury Township | 1 |
| Richmond Township | 2 |
| Tioga Township | 3 |
| Wellsboro Borough | 1 |
| Westfield Township | 1 |
| **Total:** | **21** |

*Table 51 - Tioga County Dams*

| Tioga County Dams (DEP & NID) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Class** | **Name** | **Owner Type** | **Owner** | **Primary Purpose** | **River / Stream** | **Municipality** | **Hazard** |
| A-1 | Cowanesque Dam | Federal | CENAB | Flood Control | Cowanesque River | Lawrence Township | H |
| | Tioga Dam | Federal | CENAB | Flood Control | Tioga River | Tioga Township | H |
| | Tioga Dam – Mansfield Levee | Federal | CENAB | Flood Control | Crooked Creek | Tioga Township | H |
| | Hammond Dam | Federal | CENAB | Flood Control | Charleston Creek | Tioga Township | H |
| B-1 | Hamilton Lake (PA-602) Dam | Local Government | Borough of Wellsboro | Flood Control | Charleston Creek | Charleston Township | H |
| | Beechwood Lake (PA-454) Dam | State | PA Fish and Boat Commission | Flood Control | East Beech Woods Creek | Clymer Township | H |
| | Lake Nessmuk (PA-601) Dam | State | PA Fish and Boat Commission | Flood Control | Morris Branch Marsh Creek | Delmar Township | H |
| C-1 | Kelsey Creek (PA-600) Dam | Local Government | Tioga County Commissioners | Flood Control | Kelsey Creek | Wellsboro Borough | H |
| | Eberle (PA-456) Dam | Local Government | Tioga County Commissioners | Flood Control | Closes Creek | Westfield Township | H |
| | Griffin (PA-455) Dam | Local Government | Tioga County Commissioners | Flood Control | West Beech Woods Run | Clymer Township | H |
| C-2 | Morris Run No 3 Dam | Local Government | Hamilton Township Municipal Authority | Water Supply | Morris Run | Hamilton Township | H |
| C* | Hills Creek Dam | State | DCNR | Recreation | Hills Creek | Charleston Township | H |
| | Lewis Pond | Private | Don Lewis | Recreation | - | Charleston Township | L |
| | Mackiewicz | Private | Charles Mackiewicz | Fish and Wildlife Pond | Blockhouse | Liberty Township | L |

| | Name | Owner Type | Owner | Primary Purpose | River / Stream | Municipality | Hazard |
|---|---|---|---|---|---|---|---|
| | Brown | Private | Russell Brown | Recreation | Tributary – Elkhorn Creek | Middlebury Township | H |
| | Browns Lake Dam | Private | Arlington Brown | Recreation | Watershed West Branch Stony Fork | Delmar Township | L |
| | Borg | Private | Herbert Borg | Fish and Wildlife Pond | Tributary Elk Creek | Richmond Township | H |
| | Brechbill Dam | Private | Ivan Brechbill | Fish and Wildlife Pond | Tributary Stony Fork | Delmar Township | L |
| | Hammond Lakes | Private | Tony Dreslim | Fish and Wildlife Pond | Hammond Creek | Jackson Township | L |
| | Collum Pond | Private | Wilton Collum | Stock or Small-Fish Pond | Harts Creek | Jackson Township | H |
| | Taylor Run Dam | Local Government | Municipal Authority of Mansfield | Other | Tributary Lambs Creek | Richmond Township | L |
| *undesignated category | | | | | | | |

The PA DEP defines a high-hazard dam as "Any dam so located as to endanger populated areas downstream by its failure". High-hazard dams receive two inspections each year – once by a professional engineer on behalf of the owner and once by a PA DEP inspector (DEP 2008).

#### 4.3.14.2 Range of Magnitude

The municipalities where these dams are located, and the communities downstream, are at the greatest risk for a dam failure. Flooding is the most common secondary effect of dam failure. If the dam failure is severe, a large amount of water will enter the downstream body of water and overflow the stream banks for miles. Environmental vulnerability is dependent on the contents of the water and the path it takes.

A catastrophic failure is characterized by the sudden, rapid, and uncontrolled release of water from a dammed impoundment. Seepages in earthen dams usually develop gradually, and if detected early, downstream residents have anywhere from a few hours to a few days to evacuate. Overtopping of a dam normally gives sufficient lead time for evacuation. Failures of concrete or masonry dams tend to occur suddenly, sending a wall of water and debris down a valley or inundation area quickly.

#### 4.3.14.3 Past Occurrence

There are no recorded dam failures in Tioga County. Smaller incidences in the county have occurred but have not had significant impacts in the county. The most destructive dam failure in US history took place in Johnstown, Pennsylvania (Cambria County) in 1889, claiming 2,209 lives. Another significant dam failure took place in Austin, Pennsylvania (Potter County) in 1911, claiming 78 lives.

#### 4.3.14.4 Future Occurrence

Although dam failures can occur at any time, given the right circumstances, the likelihood of a dam failure in Tioga County is considered to be unlikely.

The presence of structural integrity and inspection programs significantly reduces the potential for major dam failure events to occur. The PA DEP inventories and regulates all the dams that meet or exceed the following criteria (PA DEP, 2008):

- Impound water from a drainage area of greater than 100 acres
- Have a maximum water depth greater than 15 feet
- Have a maximum storage capacity of 50 acre-feet or greater

The construction, operation, maintenance, and abandonment of dams is reviewed and monitored by the PA DEP Division of Dam Safety. Dams are evaluated based on categories such as slope stability, undermining seepage, and spillway adequacy.

#### 4.3.14.5 Vulnerability Assessment

Property and populations located downstream from any dams or levees are vulnerable to dam failures. The Pennsylvania Code (§105.91 Classification of dams and reservoirs) classifies both dams by size and the amount of loss of life and economic loss expected in a failure event. Although the size of a dam may result in varying impacts, the hazard potential classification of category one dams is a more important reference indicator, since that will indicate the level of potential substantial loss of life and excessive economic loss.

Most dam failures are usually gradual, low volume releases that are unexpected, and do not cause loss of life or damage to the environment. There is always the possibility that a dam could fail, however the probability is unlikely in Tioga County. The Pennsylvania 2013 Standard State All-Hazard Mitigation Plan identified an estimated 11,850 people in Tioga County who are vulnerable to dam failure. *Figure 45 – Dam Locations and Classifications* shows the locations of dams within Tioga County by class.

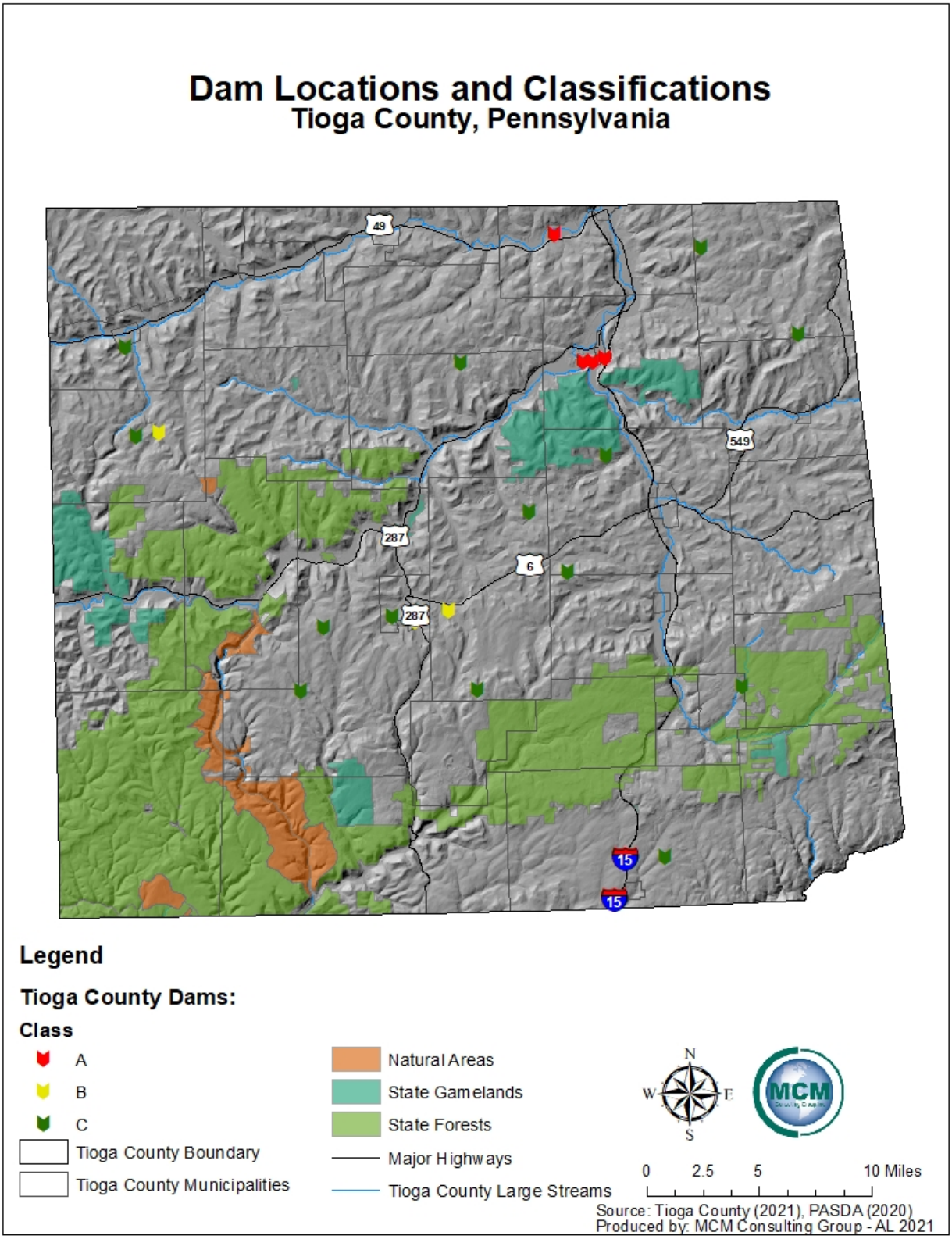
Emergency action plans are developed by owners of high hazard dams. These plans are then disseminated to first responders and other planning partners. Vulnerable populations are those residents and businesses located downstream from a high hazard dam within the inundation area.

The emergency action plan identifies a call list to notify downstream at-risk population. Emergency action plan exercises are held every five to seven years.

Dam failures can cause significant environmental effects, as the resulting flood from a dam failure is likely to disperse debris and hazardous materials downstream that can damage local ecosystems. Debris carried downstream can block roads, cause traffic accidents, disrupt traffic patterns, and delay the delivery of essential services along major traffic corridors. Debris flow can also cause landslides along steep slopes and embankments. The economic and financial impact from damage and recovery ranges from minimal to severe, depending on the magnitude of damage and scale of failure.

Of the fifteen high hazard dams that are located within Tioga County, the Cowanesque Dam has the largest drainage area with a total drainage area of 298 acres. The dams that were constructed most recently are the Cowanesque Dam and the Borg Private Dam, which were constructed in 1980 and 1984 respectively. The dam that is the oldest in the county is the Morris Run Number Three Dam which was completed in 1920. The dam with the highest height in the county is the Taylor Run Dam with a height of 151 feet. The largest owner of dams in Tioga County is the Tioga County Commissioners who own three dams within the county. A majority of the dams in Tioga County are owned by small municipalities, different state agencies, local individuals, or corporations. The county dams are also distributed evenly throughout the county and the municipalities, with an even mix of high and low hazard dams.

*Figure 45 - Dam Locations and Classifications*



### 4.3.15. Disorientation

#### 4.3.15.1 Location and Extent

Disorientation is the loss of one's sense of direction, position, or relationship with one's surroundings. This can be defined as mental confusion or impaired awareness. 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. Tioga County attracts several environmental tourists due to the natural beauty of the county. Tioga's biggest landmark attraction is the Grand Canyon of Pennsylvania which draws close to 200,000 visitors each year. Other popular attractions in Tioga County include Hills Creek State Park, Tioga and Susquehannock State Forests, and state game lands. All of these landmarks attract many individuals throughout the year. An increased number of visitors can cause an increase of disorientation incidents as a result. In the event of disorientation, 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 often focused in and around state forest or state park lands as they contain numerous miles of hiking and biking trials. In the event of illicit behavior, a manhunt may be necessary to find the evasive individual which can require many resources and much time.

Many municipalities in Tioga County have had occurrences of disorientation events, however, this hazard is most likely to occur in areas of vast, open wilderness. The majority of Tioga County's land is undeveloped, with large portions being forested and remote. There are many miles of hiking and biking trails in Tioga County, with most of these trails running through heavily forested areas. Each year, several people become lost or disoriented in wilderness areas throughout the county.

#### 4.3.15.2 Range of Magnitude

A wide variety of factors can contribute to the outcome of a search and rescue mission, but the most common dangers associated with disorientation are lack of food, water, and shelter. Tioga County generally has an abundance of water during summer months, and shelter is less of a necessity than during the winter months when extreme low temperatures can pose a larger threat. Age, physical fitness, and familiarity with the area can also have a bearing on the outcome. All ranges of population, from age to social status, would have a vulnerability to disorientation. Tioga County has a great total of 1,137 square miles. Tioga is the fourth largest county in Pennsylvania by land area and the fifth largest by total area, which gives abundant opportunities for disorientation to happen repeatedly within the county. Of the 1,137 square miles, approximately 1,134 square miles are land while 3.2 square miles are water. Disorientation occurs on both land and water within the county.

### 4.3.15.3 Past Occurrence

Each year, several people become lost in Tioga County's wilderness areas. Wilderness search and rescue can require considerable resources. The past event information was taken from Corvena (formerly known as Knowledge Center) and contains information on past events that occurred from years 2014 to 2021. The incidents are either lost/disoriented, escape, or suicide related. The last disorientation event for Tioga County that resulted in a missing persons situation was documented on March 20th, 2021. *Table 52 – Past Missing Person Events* illustrates the number and dates of past reported missing persons events in Tioga County. This represents an estimation of disorientation events.

*Table 52 - Past Missing Person Events*

| Past Missing Persons Events (Corvena, 2021) | | |
|---|---|---|
| **Event Name** | **Event Location** | **Event Date** |
| Search/Rescue – Missing Person | Morris Township | 10/12/2014 |
| Search/Rescue – Silo Rescue | Rutland Township | 06/08/2015 |
| Search/Rescue – Lost Hunter | Tioga County | 12/01/2015 |
| Search/Rescue – Missing Juvenile | Tioga County | 04/12/2017 |
| Search/Rescue – Missing Boater | Tioga County | 05/07/2017 |
| Search/Rescue – Missing Endangered Person | Ward Township | 10/16/2020 |
| Search/Rescue – Missing Endangered Person | Jackson Township | 03/20/2021 |

### 4.3.15.4 Future Occurrence

With the significant size of natural lands in Tioga County, disorientation events will continue to occur in the future. During the warm summer months, as activities such as hiking, biking, and camping increase, so does the likelihood of individuals becoming disoriented. November also can has several search and rescue events due to lost hunters during the annual hunting season. Disorientation events are most likely to occur in state parks and state forests where outdoor recreation is most abundant, and the forest is most dense. Medical emergencies occur regularly in the county, especially with the elderly, which could result in disorientation. Although disorientation and search/rescue operations are expected to continue throughout the county, they can be mitigated with appropriate actions. Those partaking in recreational activities should always be aware of their surroundings. Maps and other resources would help enhance the capabilities of those engaged in recreational activities to navigate safely.

### 4.3.15.5 Vulnerability Assessment

Individuals are most likely to become disoriented in vast, open wilderness. Children and the elderly are more vulnerable to exposure to the elements. The elderly tend to be more vulnerable to disorientation often due to medically related issues. Many times, an individual with dementia

or Alzheimer's Disease will become disoriented in wilderness or residential areas. The most dangerous period to become lost and disoriented outdoors is during the winter months when heat and shelter are vital. Tioga County regularly experiences winter storms and temperatures below freezing, so individuals participating in outdoor recreational activities in the winter are at a higher risk for injury or illness due to disorientation. A majority of the county is forested and relatively rural, and *Figure 46 – State Parks, Gamelands, and Natural Areas* identifies areas within the county where disorientation is most likely to occur, such as state parks, state forest, and state game lands. Also, vulnerability in Tioga County is associated with numerous waterways that run through the county, which are illustrated in *Figure 46 – State Parks, Gamelands, and Natural Areas*. There are several hiking and biking trails in Tioga County which can lead to occurrences of disorientation. These trails are likely to be the focus of search and rescue operations should a person go missing. *Figure 47 – Tioga County Hiking and Biking Trails* illustrates these trails and their location.

*Figure 46 – State Parks, Gamelands, and Natural Areas*

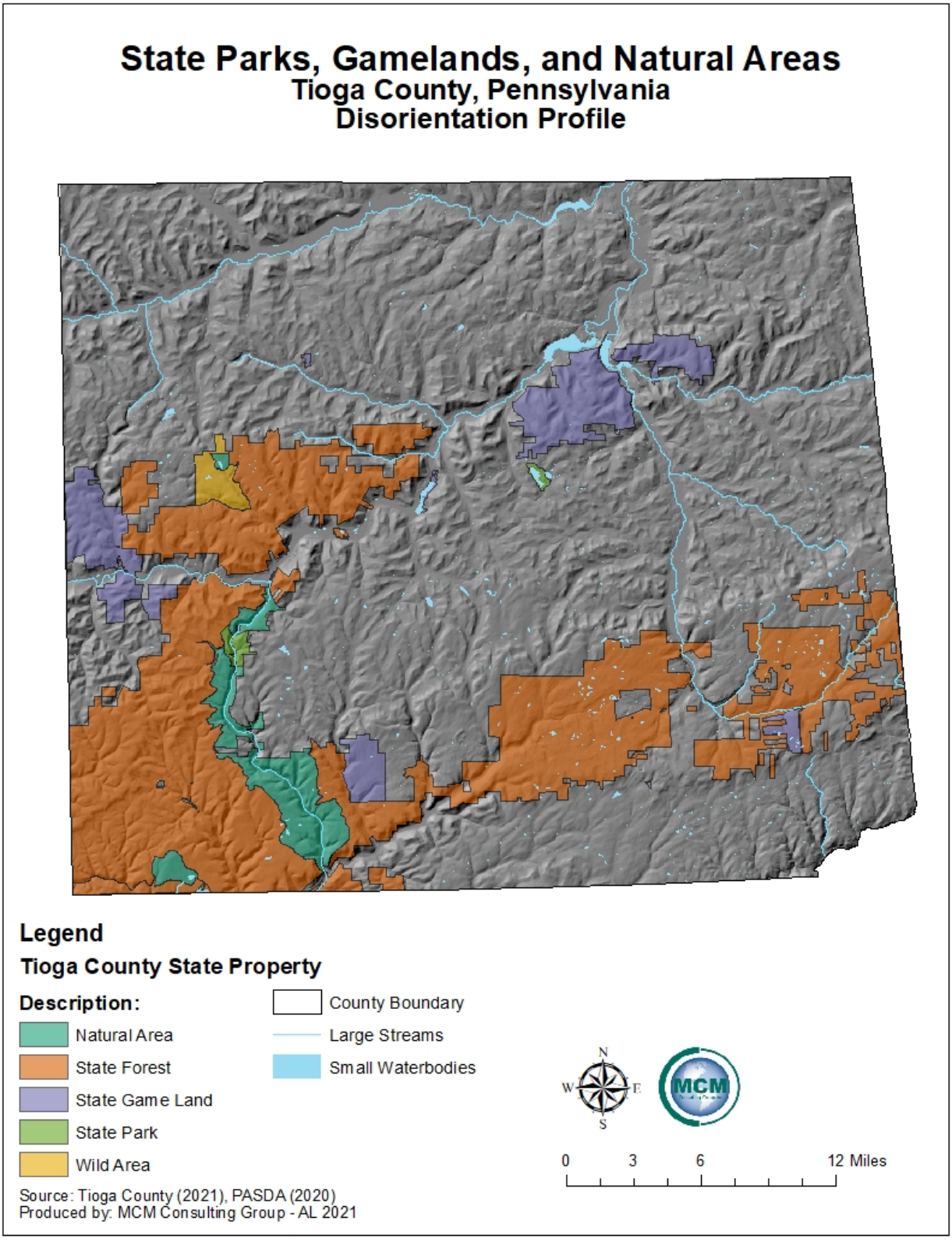
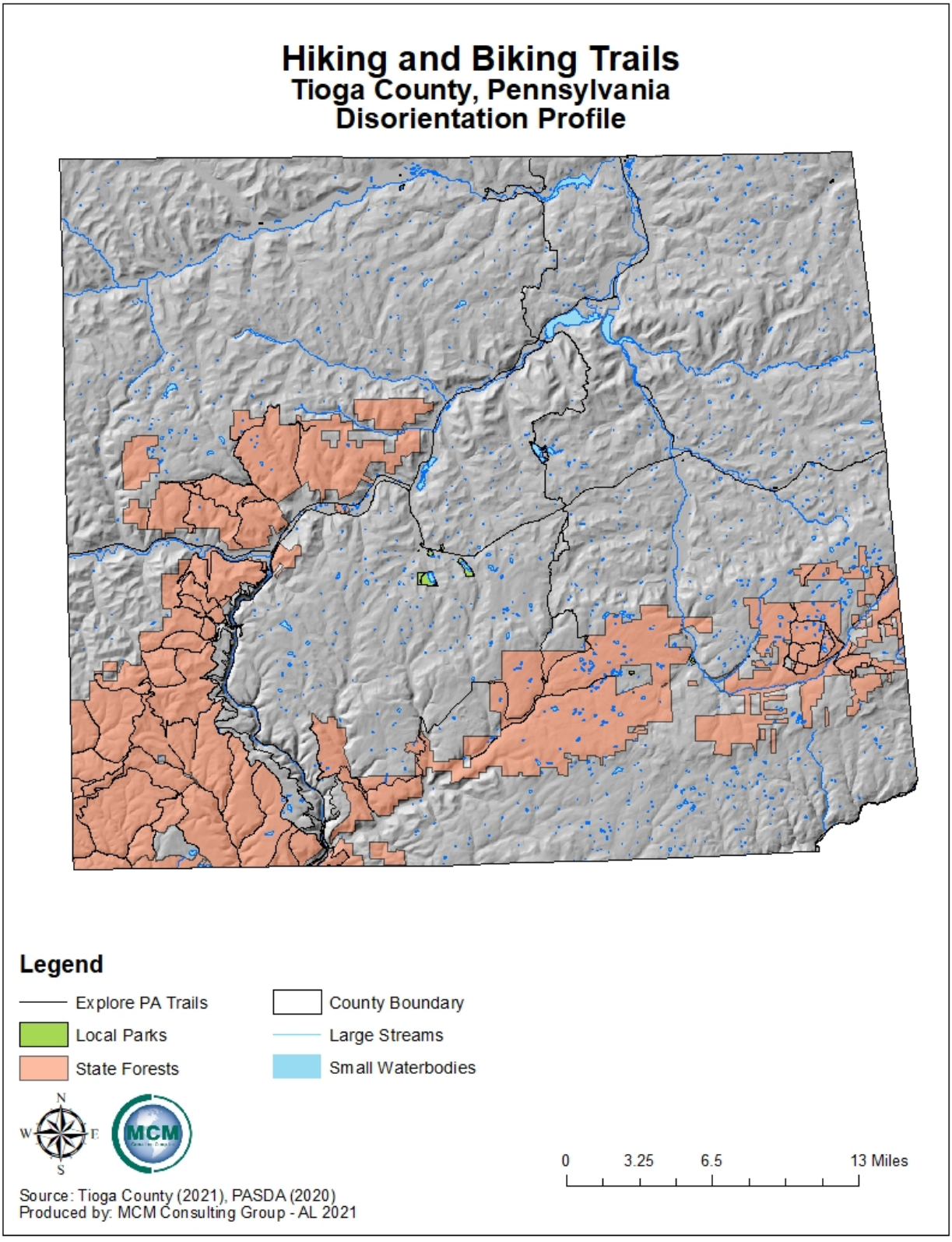


*Figure 47 - Tioga County Hiking and Biking Trails*



### 4.3.16. Emergency Services

#### 4.3.16.1 Location and Extent

Fire, emergency medical services (EMS), local emergency management coordinators (LEMC), and law enforcement service agencies are defined per municipality in Tioga County. In addition to the local services, the county hosts numerous special teams. Regional and state-wide services are also available.

Most areas are served by volunteers instead of career personnel, which adds to response time due to volunteer availability. Volunteers provide emergency services above and beyond their regular means of financial support and time constraints. Agencies struggle with the availability of personnel depending on the time of day and skills/resources needed. The number of responders in general has decreased due to funding issues and retention of personnel.

Additionally, the time and expense of training required for emergency service personnel (volunteers and paid) is another factor in decreasing numbers of volunteers. The initial training for fire, EMS, and law enforcement can take several months to complete. For those in emergency medical services, there is a regular schedule of continued education to maintain certification. In the fire service, after the initial training, there are specialty courses offered, which are recommended, but not required. For law enforcement, skills such as firearms proficiency must be maintained, and updates to new laws and regulations continues throughout the officer's career.

#### 4.3.16.2 Range of Magnitude

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

Two fundamental topics are the financial and economic variables that drive emergency service systems. These systems typically generate revenue through tax subsidies, memberships, direct sales, diversification into other lines of business, grants, or fundraising. They spend most of these revenues on direct and indirect labor, and benefits. The remaining dollars go into infrastructure, fuel, medical supplies, insurances, fleet maintenance, dispatch, and other essential items. The remaining amount is used for recapitalization or fund balance development. Replacing and properly equipping an emergency response vehicle can cost up to or over $1 million.

#### 4.3.16.3 Past Occurrence

There are no official records kept on shortages to emergency services. However, there has been a decrease in the number of new volunteers in the fire service. Most agencies are private

organizations that lack local funding and exist based on tax dollars, fund raising, and donations received from their community. The time demand for fund raising adds to the demands on the availability of volunteers. Past practices are not sustaining the needed funds or manpower.

Without financial support from the communities, services may not be able to remain in operation to serve the same communities they have served for decades. Recruitment and personnel retention are keys to success.

#### 4.3.16.4 Future Occurrence

Volunteerism is a significant component of the fire services in Tioga County. Most, if not all, members of the various community fire departments in the county are volunteers. A common problem with volunteerism in the fire services and emergency medical services is recruitment and retention of volunteers to keep both departments staffed. A decline in volunteerism has been seen within these services. With fewer volunteers to perform the tasks associated with fire and rescue operations, it is imperative for services to facilitate fundraising. Operational needs are impacted if there are fewer volunteers to raise funds. Without fundraising and community support these fire departments and volunteer EMS agencies will experience broader challenges. Municipalities can help offset some of the financial burdens to their local fire company by imposing a fire tax on its citizens.

Volunteerism and overall emergency services are low due to volunteers facing many challenges. Most volunteers must address their own needs by providing for family and, in many cases, are part of a two-income family. Limitations with time is another challenge many volunteers face due to the number of hours required to become certified as a first responder. Training is essential to provide for the general knowledge and safety of volunteers. With the limitation of time, many people find it personally challenging to dedicate time to a volunteer position. Volunteers are becoming less reliable, with many current volunteers getting older and becoming unable to perform at the same levels they once were.

Initially, fire departments were started to handle fires. Fire departments now preform many tasks other than fighting fire. Over time when other emergencies occurred, communities called upon the volunteer fire departments to handle various hazards such as vehicle accidents, commercial accidents, flooded basements, wire/trees down, trench rescue, hazardous material spills, traffic control, and sometime event standbys to support other agencies or events.

#### 4.3.16.5 Vulnerability Assessment

The likelihood that EMS agencies and fire services will fail is a concern for all Tioga County communities. Law enforcement agencies also have been experiencing personnel shortages. The perception of law enforcement in society changes as events occur. A negative perception of law enforcement can discourage individuals from pursuing a career in law enforcement. Becoming a law enforcement officer requires a commitment of time and finances for training at local, state,

or federal levels. The selection of law enforcement officers includes not only physical and mental aptitudes, but also a comprehensive physiological screening.

If any current public service agency fails to provide enough personnel to perform their required duties, then those duties must be provided for by another service agency that may be many miles away. This can put people and property in danger due to the increased response time. Many communities in Pennsylvania have already experienced the closure of services.

It is recommended that each municipality assess their own vulnerabilities by maintaining and building relationships with their local providers to begin to plan accordingly for if a local service were to shut down its operation. The statistics, response times, and all times associated with units dispatched are easily obtainable from the county 911 center. Consolidation of services is not a new concept for addressing the closure of services. Municipalities must weigh all the pros and cons for consolidation of emergency services with neighboring communities. In addition, continued support, and efforts to inform legislature could all prove to be paramount in assuring these services remain in operation into the future. At the time of the writing of this plan, a number of bills had been introduced in both the House of Representatives and the Senate as a result of a two-year study initiated by Senate Resolution 6 (SR6). The final report can be found here: http://pehsc.org/wp-content/uploads/2014/05/SR-6-REPORT-FINAL.pdf.

Emergency response agencies that currently provide services within Tioga County are identified in the following tables, *Table 53 – Tioga County Fire Departments* identifies the municipalities served. All fire departments in Tioga County are volunteer. *Table 54 – Tioga County EMS Agencies* identifies each emergency medical service agency and the municipalities served. *Table 55 – Tioga County Law Enforcement Agencies* identifies each police department to include the Pennsylvania State Police (PSP) and the municipalities served. *Figure 48 – Emergency Services Facilities* shows the geographical layout of the first responder services within Tioga County.

*Table 53 - Tioga County Fire Departments*

| Tioga County Fire Departments | |
|---|---|
| **Station Name** | **Department Number** |
| Morris Fire Department | 15 |
| Wellsboro Fire Department | 1 |
| Liberty Fire Department | 9 |
| Mansfield Fire Department | 2 |
| Tioga Fire Department | 7 |
| Millerton Fire Department | 12 |
| Lawrenceville Fire Department | 8 |
| Daggett Fire Department | 13 |
| Blossburg Fire Department | 4 |
| Middlebury Fire Department | 11 |
| Chatham Fire Department | 17 |

| Station Name | Department Number |
|---|---|
| Westfield Fire Department | 0 |
| Clymer Fire Department | 16 |
| Osceola Fire Department | 14 |
| Knoxville Fire Department | 6 |
| Elkland Fire Department | 3 |
| Nelson Fire Department | 18 |

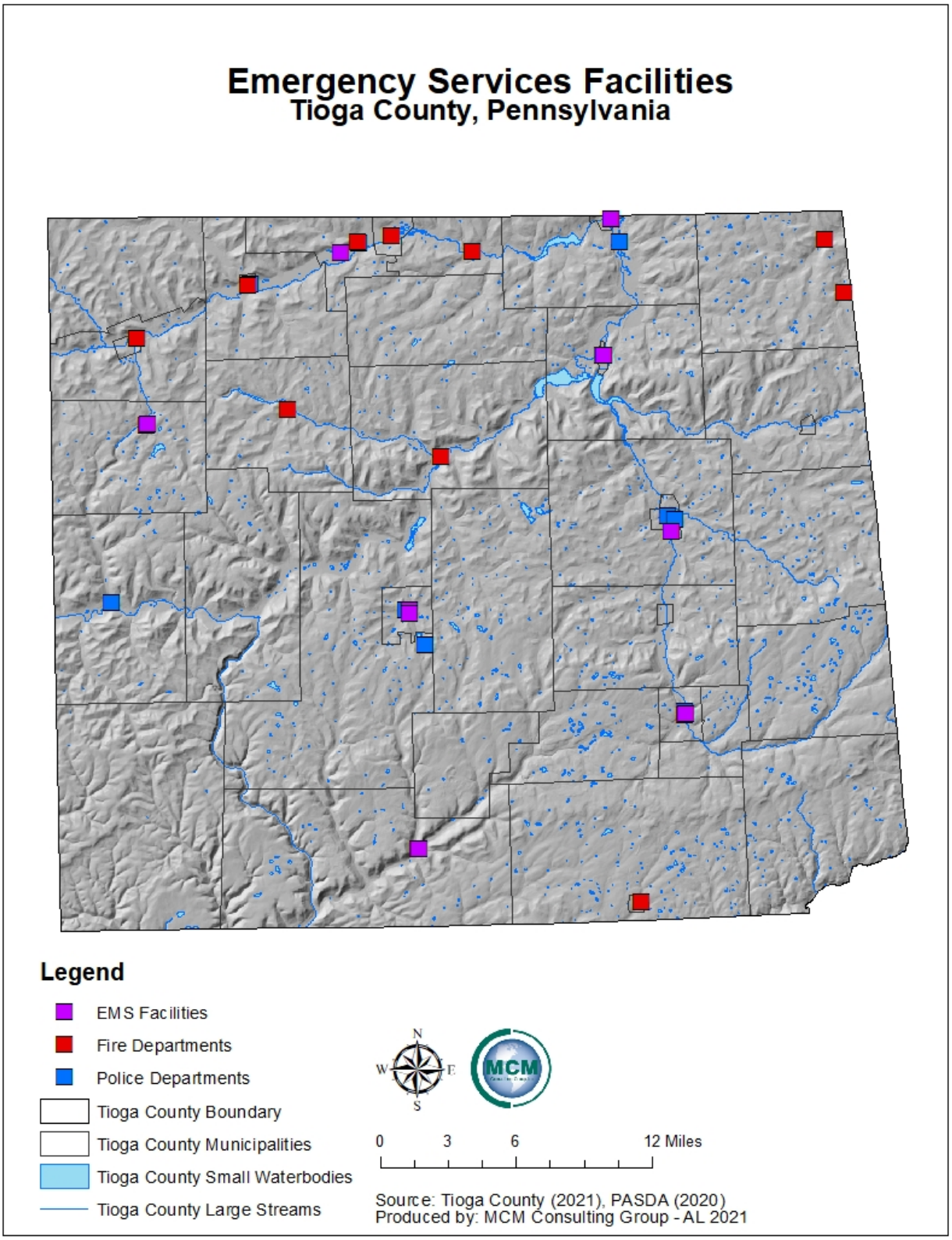
*Table 54 - Tioga County EMS Agencies*

| Tioga County EMS Agencies | |
|---|---|
| **Station Name** | **Radio ID** |
| Wellsboro Fireman's Ambulance | 1 |
| Mansfield Ambulance | 2 |
| Blossburg Ambulance | 4 |
| Tioga Ambulance | 7 |
| Lawrenceville Ambulance | 8 |
| Morris Ambulance | 15 |
| Clymer Ambulance | 16 |
| Valley Community Ambulance | 25 |
| Soldiers & Sailors Hospital | Medic 1 |

*Table 55 - Tioga County Law Enforcement Agencies*

| Tioga County Police Departments | |
|---|---|
| **Station Name** | **Department Number** |
| Blossburg Police Dept | 1 |
| Elkland Police Dept | 2 |
| Knoxville Police Dept | 3 |
| Lawrenceville Police Dept | 4 |
| Mansfield Police Dept | 6 |
| Tioga Police Dept | 8 |
| Wellsboro Police Dept | 9 |
| Westfield Police Dept | 11 |
| Gaines Police Dept | 23 |
| Lawrence Twp Police Dept | 26 |
| Nelson Twp Police Dept | 30 |
| Osceola Twp Police Dept | 31 |
| Department of Forestry | - |
| Mansfield University Police Dept | - |
| Tioga County Sheriff | - |
| Tioga County Probation | - |

*Figure 48 - Emergency Services Facilities*



### 4.3.17. Environmental Hazards

#### 4.3.17.1 Location and Extent

Environmental hazards in Tioga County mostly consists of hazardous materials releases at fixed facilities, Marcellus Shale gas well incidents, or due to transportation accidents. Activities associated with Marcellus gas well sites can cause fire and pollute streams and drinking water.

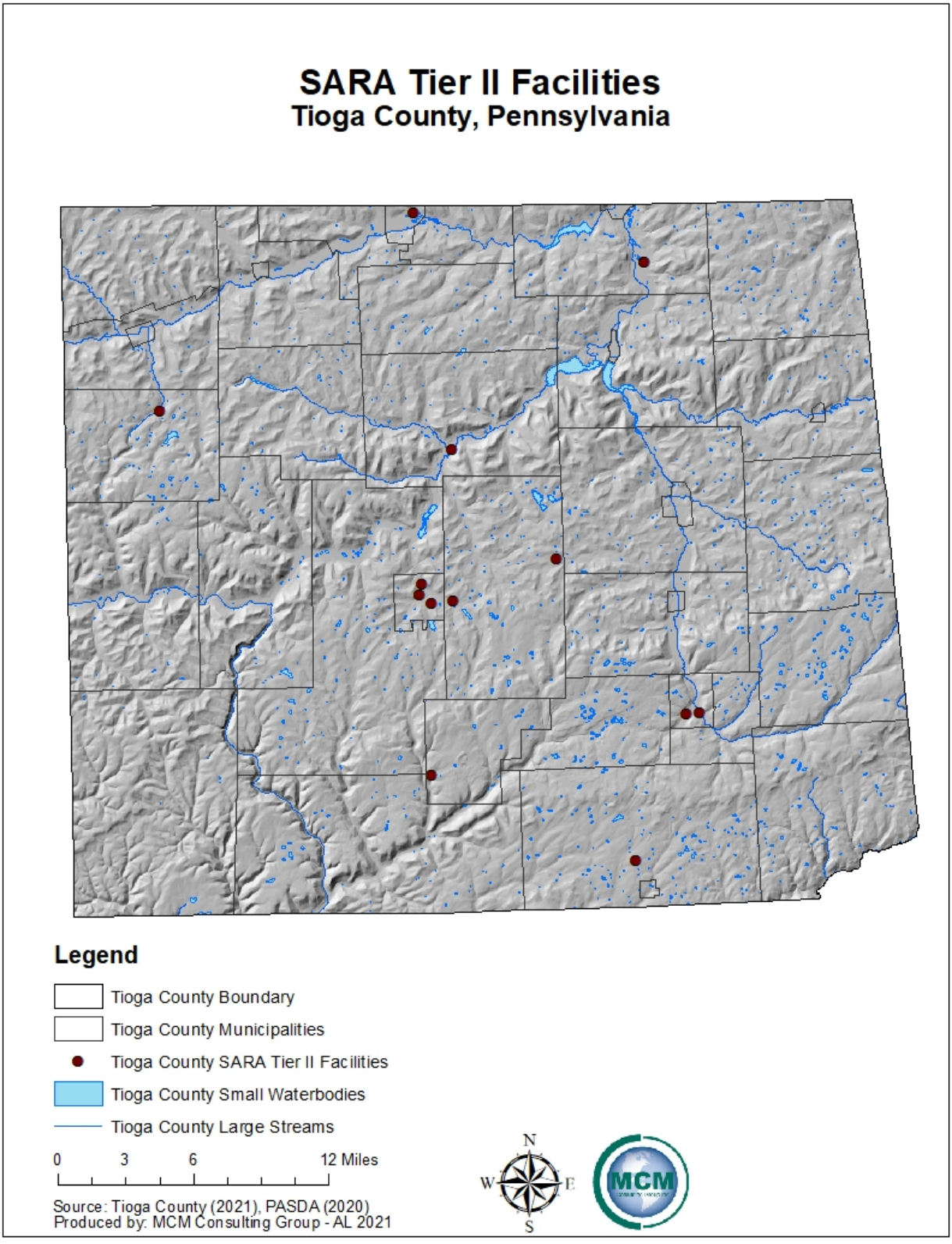
Hazardous materials fall into the following categories: flammable and combustible materials, compressed gases, explosive and blasting agents, radioactive materials, oxidizing materials, poisons, and corrosive liquids. Most hazardous materials incidents are generally unintentional and are associated with transportation accidents or accidents at fixed facilities. However, hazardous materials can be released as a criminal or terrorist act. Regardless of how a release happens, the result can be injury or death, and contamination to the air, water, and/or soil.

Facilities that use, manufacture, or store hazardous materials in Pennsylvania must comply with both Title III of the federal Superfund Amendments and Reauthorization Act (SARA), also known as the Emergency Planning and Community Right-to-Know Act (EPCRA), and the reporting requirements under the Hazardous Materials Emergency Planning and Response Act (1990-165) as amended for the commonwealth. Communities are kept abreast of the presence and release of chemicals at individual facilities with the community right-to know reporting requirements. The EPCRA was designed to ensure that state and local communities are prepared to respond to potential chemical accidents through local emergency planning committees (LEPCs). LEPCs are charged with developing emergency response plans for SARA Title III facilities; these plans cover the location and extent of hazardous materials; establish evacuation plans, response procedures, and methods to reduce the magnitude of a materials release; and establish methods and schedules for training and exercises.

There are thirteen facilities classified as using or storing extremely hazardous substances as defined by the EPA under SARA Title III in Tioga County. These facilities routes are shown in *Figure 49 - SARA Tier II Facilities.*

Transportation of hazardous materials along highways poses the greatest risk of release to Tioga County. Releases from rail transport are also a concern. The most traveled routes in the county are: U.S. Route 6, U.S. Route 15, PA Route 14, PA Route 49, PA Route 249, PA Route 287, PA Route 328, PA Route 349, PA Route 362, PA Route 414, PA Route 549, and PA Route 660. These major roads pass through the more populous areas of Tioga County. Similarly, rail lines pass through cities, borough and along major waterways where larger numbers of people could be vulnerable should a hazardous materials accident occur.

*Figure 49 - SARA Tier II Facilities*



Natural gas extraction from the Marcellus Shale formation exists at a depth of 5,000 to 8,000 feet and is located underneath the entire county. Activities associated with Marcellus Shale gas drilling can cause fires and pollute steams or drinking water. An additional hazard from oil and gas well drilling is stray methane gas in the subsurface, which can migrate into wells and homes. If the methane gas meets an ignition source it will ignite. Transportation of Marcellus Shale gas along pipelines, poses no greater threat to the environment or people as does any other natural gas pipeline. Pipelines are being constructed to connect each compressor station together as a gathering point, while major pipelines are being constructed to transfer the natural gas out of the county.

Marcellus Shale drilling has decreased within Tioga County. In 2008, there were fifteen shale wells drilled in the county; the next year, there were 123, and the year after that, there were 276. The year 2010 was the peak with the number of new wells dropping quickly to just thirty-three in 2013 and seventeen in 2016. Since then, the number of shale wells drilled has been very low in the county.

#### 4.3.17.2 Range of Magnitude

Whether its accidental or intentional, there are several potentially exacerbating circumstances that will affect the severity or impact of a hazardous materials release. Some of these conditions, or characteristics that can enhance or magnify the effects of a hazardous materials release, include the following:

- Weather conditions: Affect 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.

There is also concern of hazardous materials releases during a flood event, should the flood compromise the production or storage of chemicals. This type of situation could swiftly move toxic chemicals throughout a water supply and across great distances.

The severity of any given hazardous materials incident is dependent not only on the circumstances described above, but also with the type of materials released and the distance and related response time for emergency response teams. Areas within close proximity to a release are generally 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 resulting in extensive impacts on people and the environment.

Any type of drilling can cause stray methane gas in the subsurface; under certain conditions, to migrate to private water supply wells and ultimately into a building. This migration, if left

unmitigated, can build up to explosive concentrations. A proper well vent allows methane to vent to the atmosphere rather than build up to explosive levels. The risk of an explosion from stray methane varies from location to location based on site-specific conditions.

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

#### 4.3.17.3 Past Occurrence

The majority of incidents in the past have involved natural gas problems along the highways or leaks from a fixed source. Most of these are the result of leaks that have limited impact on people and the environment. Yearly the number of hazardous materials being produced, stored, and transported continues to increase. *Table 56 - Hazardous Materials Released in Tioga County* lists the various past occurrence material releases and spills in Tioga County from the year 2014 to current.

*Table 56 - Hazardous Materials Released in Tioga County*

| Hazardous Materials Released in Tioga County | | |
|---|---|---|
| **Date** | **Municipality** | **Event** |
| 04/03/2014 | Tioga, Wellsboro Borough | NRC # 1079018 Tioga Co |
| 11/04/2014 | Tioga, Bloss Township | Compressor Station Gas Flaring |
| 11/11/2014 | Tioga, Bloss Township | Gas Compressor Maintenance-Tioga Co |
| 12/11/2014 | Tioga, Liberty Township | Gas Well Flaring-Tioga Co |
| 12/17/2014 | Tioga, Bloss Township | Natural Gas Blow Down |
| 12/17/2014 | Tioga, Sullivan Township | Gas Well Compressor Blowoff |
| 01/19/2015 | Tioga, Liberty Township | Gas Well Flaring Operations |
| 02/10/2015 | Tioga, Bloss Township | Compressor Station Annual Test |
| 03/05/2015 | Tioga, Liberty Township | Gas Venting |
| 03/05/2015 | Tioga, Richmond Township | Gas Venting |
| 04/30/2015 | Tioga, Sullivan Township | Gas Blow Down |
| 05/18/2015 | Tioga, Elk Township | Gas Blow Down - Tioga County |
| 07/02/2015 | Tioga, Brookfield Township | Gas Leak at Well Site |
| 08/04/2015 | Tioga, Gaines Township | Gas Well Flaring - Tioga Co |
| 09/16/2015 | Tioga, Gaines Township | Gas Well Blowdown-Tioga Co |
| 12/18/2015 | Tioga, Mansfield Borough | NRC #1136164 Tioga |

| Date | Municipality | Event |
|---|---|---|
| 02/03/2016 | Tioga, Wellsboro Borough | NRC #1139673-Oil Spill-Tioga Co |
| 02/24/2016 | Tioga, Clymer Township | Gas Blow Down - Tioga County |
| 04/13/2016 | Tioga, Nelson Township | Hazmat-Mineral Oil Spill |
| 07/03/2016 | Tioga, Covington Township | Gas Well Leak |
| 08/25/2016 | Tioga, Elk Township | Gas Blow Downs |
| 10/01/2016 | Tioga, Delmar Township | Gas Well Flaring |
| 10/18/2016 | Tioga, Hamilton Township | NRC #1161836 - Unknown Spill |
| 07/11/2017 | Tioga, Chatham Township | Well Blow Downs |
| 07/18/2017 | Tioga, Chatham Township | Natural Gas Blow Down - Tioga County |
| 09/03/2017 | Tioga, Liberty Township | Diesel Fuel Spill |
| 11/12/2017 | Tioga, Duncan Township | Hazardous Materials Release |
| 12/28/2017 | Tioga, Lawrence Township | Hazmat |
| 05/05/2018 | Tioga, Covington Township | Natural Gas Leak |
| 09/25/2018 | Tioga, Richmond Township | Natural Gas Blow Down- Tioga County |
| 09/25/2018 | Tioga, Sullivan Township | Natural Gas Blow Down |
| 09/25/2018 | Tioga, Covington Township | Natural Gas Blow Down- Tioga County |
| 01/24/2019 | Tioga, Osceola Township | Diesel Fuel Spill |
| 03/11/2019 | Tioga, Union Township | NRC #1240101 - Sheen on a Small Stream |
| 04/22/2019 | Tioga, Sullivan Township | Gas Well Venting |
| 01/26/2020 | Tioga, Delmar Township | Fracking Water Spill |
| 04/21/2020 | Tioga County | Natural Gas Pipeline Blow Down |
| 05/17/2020 | Tioga, Richmond Township | Gas Pipeline Blow Down |
| 08/24/2020 | Tioga, Ward Township | Natural Gas Flaring |
| 09/02/2020 | Tioga, Ward Township | Natural Gas Blow Down |
| 03/23/2021 | Tioga, Covington Township | Natural Gas Blow Down |

Tioga County utilizes the reporting tool Corvena™ to track events related to environmental or hazardous material events. Reports to 911 of hazardous materials spills, to include Marcellus Shale drilling and pipeline emergencies, are tracked on Corvena™.

#### 4.3.17.4 Future Occurrence

Future occurrence of an environmental hazard occurring in Tioga County is likely, however it is difficult to predict. Traffic accidents involving hazardous materials can be caused by many different facets, such as weather conditions or drivers' errors. As natural gas drilling and pipeline activities continue to grow in Tioga County, the inherent dangers persist. The natural gas

production has increased dramatically in Pennsylvania since 2008. This has resulted in an increase to energy security, due to less dependence on fossil fuels from other parts of the world.

The Marcellus shale has been the predominant shale play in Pennsylvania, however, there is interest in the exploration and production of the Utica shale and Point Pleasant shale plays that are located well below the Marcellus shale play. The term "shale play" is used by the oil and gas exploration and development industry to identify areas of shale basins that appear to be suitable for shale gas development. There are more than a dozen geologic formations below the state's land surface that contain rich deposits of natural gas. As technology progresses, and oil and gas drilling companies are able to extract the natural gas from the multiple natural gas shales, the potential for environmental hazards due to this process exists.

#### 4.3.17.5 Vulnerability Assessment

There are many miles of roadways within Tioga County, including interstate future I-99, of which most are owned and maintained by PennDOT. Interstate future I-99 is a major route that traverses the Commonwealth of Pennsylvania and crosses into New York. Various materials and substances, to include hazardous materials are transported over the interstate highway and other highways through the county. The railway network also is vulnerable to hazardous materials incidents.

Jurisdictions where one or more TRI (EPA's Toxic Release Inventory) fixed facilities are in operation should be considered vulnerable to a release of hazardous material(s). These releases could be the result of severe weather conditions, power outages, acts of criminal activities or terrorism, and/or human error.

All communities in Tioga County are vulnerable, on some level, to environmental hazards resulting from oil and gas well activity; to include drilling, pipeline construction, and distribution. Tioga County has previously taken steps to protect residents and reduce the county's overall vulnerability to oil/gas well drilling emergencies, with the development of procedures for handling emergencies at Marcellus well sites. Individual gas well drilling operators should have an Emergency Response Plan for their wells in place, however, the county's plan can substitute in an emergency. The Well Control Emergency Plan defines a well control emergency as uncontrolled flow of oil, gas, condensate, brine, sand, gravel, rock, and/or steam from a wellbore. The emergency plan lists procedures on how to deal with a blowout or control incident with or without fire, environmental release, injury on a rig, or other miscellaneous incidents.

### 4.3.18. Opioid Epidemic

#### 4.3.18.1 Location and Extent

Pennsylvania and the United States at large have been experiencing an epidemic of opioid drug abuse. Opioid addiction occurs when an individual becomes physically dependent on opioids. Opioids are a class of drug that interact with receptors on nerve cells in the body and the brain.

The use of opioids is a broad term that includes opiates, which are drugs naturally extracted from certain types of poppy plants, and narcotics. Opioids can also be synthetically made to emulate opium. Both prescribed (e.g. fentanyl) and illicit (e.g. heroin) opioid drugs are highly addictive and typically result in increasing numbers of overdose deaths. Overdose deaths from opioids occur when a large dose slows breathing, which can be more likely when opioids are combined with alcohol and antianxiety drugs. While generally prescribed with good intention, opioids can be over-prescribed, resulting in addiction.

According to the Drug Enforcement Administration (DEA), opioids come in various forms such as tablets, capsules, skin patches, powder, chunks in various colors from white to brown/black, liquid form for oral use or injection, syrups, suppositories, and lollipops. The Centers for Disease Control and Prevention (CDC) define the following as the three most common types of opioids:

- **Prescription Opioids:** Opioid medication prescribed by doctors for pain treatment. These can be synthetic, oxycodone (OxyContin), hydrocodone (Vicodin), or natural (morphine).
- **Fentanyl:** A powerful synthetic opioid that is 50 to 100 times more powerful than morphine and used for treating severe pain. Illegally made and distributed fentanyl is becoming more prevalent.
- **Heroin:** An illegal natural opioid processed from morphine which is becoming more commonly used in the United States.

While other addictive substances such as methamphetamines and alcohol can be problematic for the health of individuals in Tioga County, this profile focuses on opioid drugs and the opioid epidemic. The opioid crisis was declared to be a public health emergency on October 26, 2017. While the declaration provides validation for the scope and severity of the problem, it was not accompanied by any release of funding for mitigating actions. On January 10, 2018, Governor Tom Wolf declared the opioid epidemic to be a statewide public health disaster emergency for Pennsylvania. The declaration is intended to enhance response and increase access to treatment.

#### 4.3.18.2 Range of Magnitude

Opioid addiction can lead to overdose, which can be fatal. Opioid addiction can affect others beyond the users themselves. The most dangerous side effect of an opioid overdose is depressed breathing. The lack of oxygen to the brain causes permanent brain damage, leading to organ failure, and eventually death. Opioid addiction can also be passed from mother to child in the womb. This condition, known as neonatal abstinence syndrome, has increased five-fold. According to the National Institute on Drug Abuse (NIDA). This results in an estimated 22,000 babies in the United States born with this condition. First responders such as paramedics, police officers, and firefighters are also affected by the opioid addiction crisis. First responders face exposure due to an increase of responses, particularly to synthetic fentanyl, consuming time and

resources. Two or three milligrams of fentanyl can cause an induced respiratory depression, arrest, and possibly death to occur.

According to the Centers for Disease Control and Prevention (CDC), more than 192 Americans die every day from an opioid overdose. In 2014, 2,732 overdose deaths were reported across Pennsylvania. This number increased to 3,264 reported overdose deaths in 2015, an increase of 19.5%. Reported overdose deaths increased again in 2016 to 4,627, an increase of 41.7% from 2015, then again to a total of 5,388 deaths in 2017. From 2015 to 2017, the increase in reported drug related deaths in Pennsylvania increased 65%. This increased the need for the gubernatorial disaster declaration in Pennsylvania on January 10, 2018. Heroin and fentanyl are the two drugs most often found in overdose deaths, and they are considered to be highly available and nearly ubiquitous in Pennsylvania.

#### 4.3.18.3 Past Occurrence

In 2020, there was an estimated total of 81,000 drug-related overdose deaths in the United States. This number is the highest number of overdose deaths ever recorded in a 12-month period, according to the recent provisional data from the Centers for Disease Control and Prevention. Opioid deaths in Tioga County have been fairly infrequent. In 2015, Tioga County had an average of 7.16 overdose deaths per 100,000 people, with three recorded overdose deaths occurring in the county. This is down from 2014, where the county had an average of 9.55 overdose deaths per 100,000 people with four recorded deaths. This is below the statewide average of overdose deaths.

In 2020, the most commonly used opioids in Tioga County were cannabis and cocaine, as seen in *Table 57 – Drugs Present in 2020 Pennsylvania Overdose Deaths*. For the calendar year 2019 and the calendar year 2020, there were no recorded deaths in Tioga County. This is illustrated in *Figure 50 – Opioid Deaths in Pennsylvania 2019* and *Figure 51 – Opioids Deaths in Pennsylvania in 2020*.

*Table 57 - Drugs Present in 2020 Pennsylvania Overdose Deaths*

| Drugs Present in 2020 PA Overdose Deaths (DEA, 2020) | |
|---|---|
| **Drug Category** | **Percent Reported Among 2020 Decedents** |
| Cannabis | 25% |
| Cocaine | 20% |
| Heroin | 15% |
| Fentanyl | 14% |
| Methamphetamine | 10% |
| Prescription Opioids | 5.5% |
| Cathinones | 5.5% |
| Benzodiazepines | 5% |

#### 4.3.18.4 Future Occurrence

According to recent research, in states where medical marijuana has been permitted, overdose deaths from opioids have decreased about 25%, 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 being exposed to addicting opioids and substances (Miller, 2016).

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), however, it is difficult to know how much of an influence OIH has on the opioid epidemic. Some researchers think that OIH could be increasing patients' pain and in turn, increasing their dosages and dependence on opioid drugs, suggesting that patients should work with lower dosages of opioids (Servick, 2016).

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.

While Tioga County is below the statewide average for opioid overdose deaths, the problem is still present in the county and can still be devastating. The CDC offers a list of suggested actions and precautions that can be taken to prevent opioid overdose deaths in the future:

- Improve opioid prescribing to reduce exposure to opioids, prevent abuse, and stop addiction.
- Expand access to evidence-based substance abuse treatment, such as medication-assisted treatment, for people already struggling with opioid addiction.

- Expand access and use of naloxone, a safe antidote to reverse opioid overdoses.
- Promote the use of state prescription drug monitoring programs, which give health care providers information to improve patient safety and prevent abuse.
- Implement and strengthen state strategies that help prevent high-risk prescribing and prevent opioid overdose.
- Improve detection of the trends of illegal opioid use by working with state and local public health agencies, medical examiners and coroners, and law enforcement.

#### 4.3.18.5 Vulnerability Assessment

Opioid overdoses have resulted in many tragic deaths in Pennsylvania and many people have been affected by the epidemic through either a family member, a close friend, or a member of their community. Opioid addiction is a direct detriment to the personal well-being of addicts, a burden to their families and communities, and a strain to the emergency response system that cares for overdose victims.

While opioid addiction is often viewed as a criminal problem, an additional 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. In general, it is important to consider alternative approaches to pain treatment in order to avoid beginning a dependence on highly addictive prescribed opioids.

Fentanyl and related substances are hazardous materials which cause the environment and the people around the substance to be vulnerable. Contact with fentanyl can impact first responders and others that are related to the opioid user. Depending on the potency of the drug, it can take as little as the equivalent of few grams of table salt to cause health complications. There have been several reports nationally of first responders accidentally overdosing on fentanyl or carfentanyl through brief skin contact or the drug becoming airborne. It is best for first responders to err on the side of caution to avoid any potential exposure. The American College of Medical Technology (ACMT) and the American Academy of Clinical Toxicology (AACT) suggest that nitrile gloves provide sufficient protection for handling fentanyl, and for “exceptional circumstances where the drug particles or droplets are suspended in the air, an N95 respirator provides sufficient protection”. Other environmental structures such as streams, rivers, and lakes have been known to contain traces of opioids and other drugs within them. These traces come from human urine, feces, or medications that have been discarded in the bathroom. The Environmental Protection Agency (EPA) suggests that while the risks of pharmaceuticals found in wastewater, ambient water, and drinking water are low, further research is needed. State facilities are not at risk to the opioid crisis, but there are some occupation-specific risks that may make some employees more vulnerable. State employees working in direct patient care are vulnerable to fentanyl exposure. However, the physical plant and facilities of Tioga County are

not likely to experience losses from the opioid addiction crisis. Absenteeism associated with an opioid addiction in state facilities located in high-risk areas could lead to economic loss through lost productivity and increased medical costs.

The COVID-19 pandemic and the associated quarantine periods cause vulnerability in past, present, and future opioid users. In 2020 and 2021, the vulnerability associated with the opioid epidemic was at the highest it has ever been. The pandemic is the perfect form for anyone who is struggling with substance abuse due to the loss of a job, limited social interactions, increased depression/anxiety, and financial struggles. These factors from the pandemic can push a person who was getting their addiction under control back toward substance use. In other cases, the pandemic might be the trigger that actually makes someone consider initiating drug use, which could end up becoming an addiction. Additionally, the pandemic took away the attention that was being focused on the opioid crisis.

*Figure 50 - Opioid Deaths in Pennsylvania 2019*

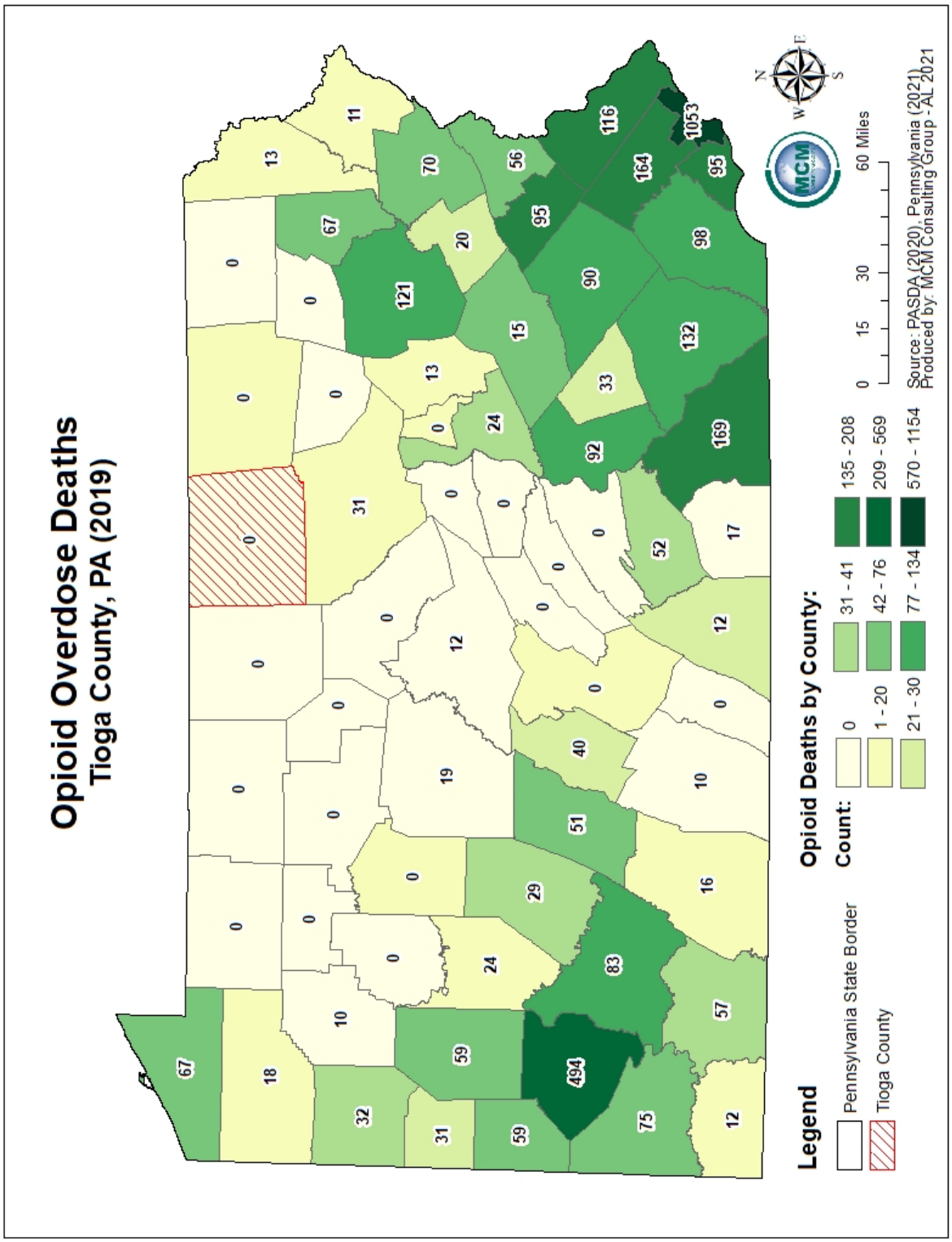
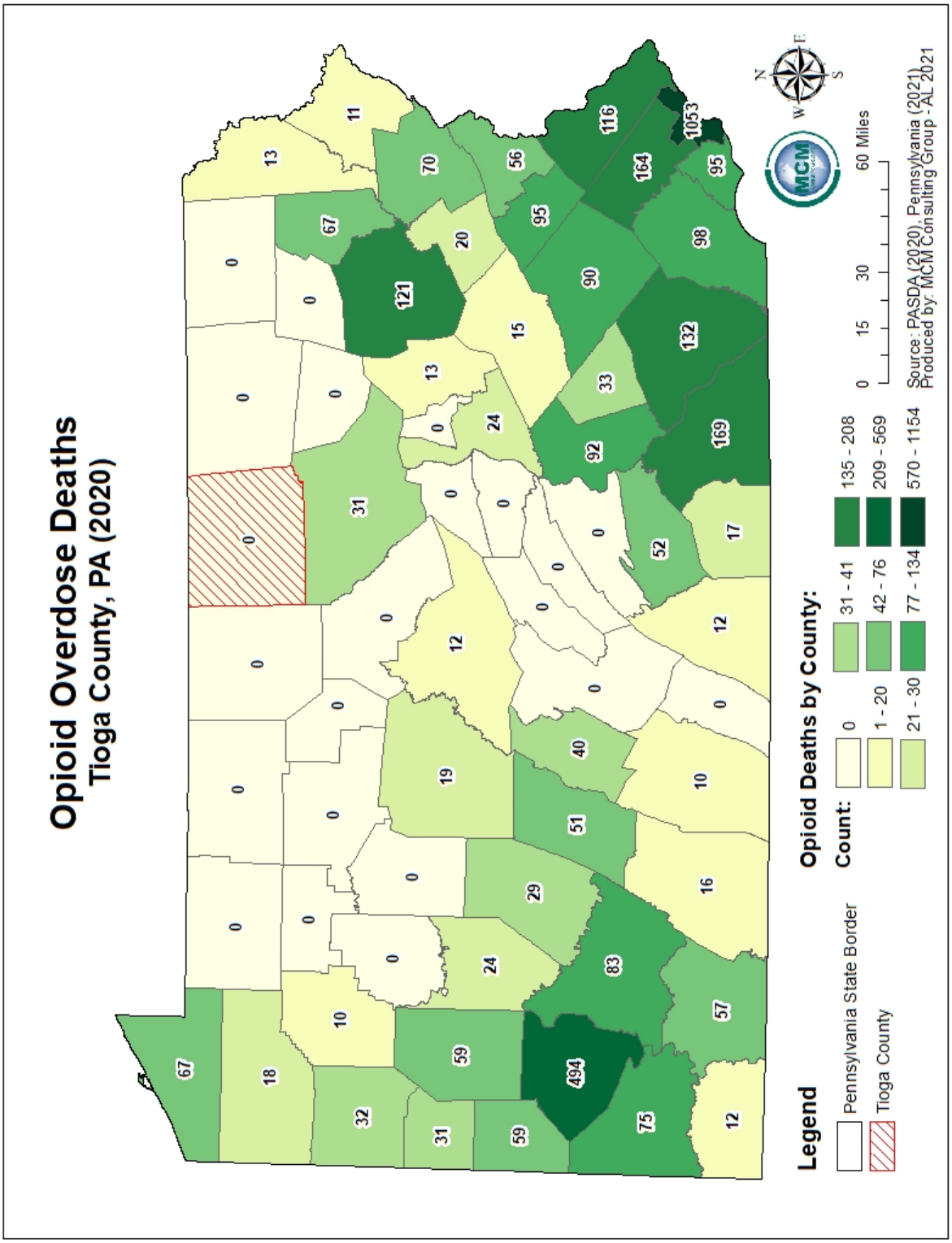


*Figure 51 - Opioid Overdose Deaths in Pennsylvania 2020*



### 4.3.19. Terrorism and Cyber Attack

#### 4.3.19.1 Location and Extent

Following several serious international and domestic terrorist incidents during the 1990s and early 2000s, citizens across the United States paid increased attention to the potential for deliberate, harmful actions of individuals or groups. The term "terrorism" refers to intentional, criminal, malicious acts. The functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations as "…the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives." (28 CFR §0.85).

Cyber-terrorism is the unlawful use of force and violence over technological methods to cause harm to financial security, identity information, personal information, and attacking personal computers, mobile phones, gaming systems, and other Bluetooth or wirelessly connected devices. Cyber-terrorism can be just as damaging to infrastructure as conventional terrorism, due to the large amount of business that is carried out over the internet, through wirelessly connected devices, or from employees of companies working remotely.

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

Critical facilities are either in the public or private sector and provide essential products and/or services to the general public. Critical facilities are often necessary to preserve the welfare and quality of life in the county, or fulfill important public safety, emergency response, and/or disaster recovery functions. Critical facilities identified in the county are hospitals and health care facilities, schools, childcare centers, fire stations, police departments, municipal buildings, and hazardous waste facilities. In addition to critical facilities, the county contains at risk populations that should be factored into a vulnerability assessment. These populations include not only the residents and workforce in the county, but also the tourists that visit the area on a daily basis, those that are traveling through the county on any major highway and marginalized groups such as LGBTQ persons and racial minorities.

Potential targets include:

- Commercial facilities
- Family planning clinics/organizations associated with controversial issues
- Education facilities
- Events attracting large amounts of people
- Places of worship
- Industrial facilities, especially those utilizing large quantities of hazardous materials
- Transportation infrastructure
- Historical Sites
- Government facilities

#### 4.3.19.2 Range of Magnitude

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

Terrorist methods can take many forms including:

- Active assailant
- Agri-terrorism
- Arson/incendiary attack
- Armed attack
- Assassination
- Biological agent
- Chemical agent
- Cyber-terrorism
- Conventional bomb or bomb threat
- Hijackings
- Release of hazardous materials
- Kidnapping
- Nuclear bomb
- Radiological agent

Active assailant incidents and threats can disrupt the learning atmosphere in schools, interfere with worship services, cause traffic to be re-routed, and use taxpayer assets including deploying police, EMS and/or fire units. Tioga County's school districts include (public schools K through

12th grade) Northern Tioga School District, Southern Tioga School District, and Wellsboro Area School District, several private schools, and Mansfield University.

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

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

Ransomware continues to be the leading threat, with Maze ransomware accounting for nearly half of all known cases in 2020. Cybercriminals have increasingly begun to steal proprietary – and sometimes embarrassing – data before encrypting it. The cybercriminal will then threaten to publicly release the stolen files if the victims do not provide financial transactions.

#### 4.3.19.3 Past Occurrence

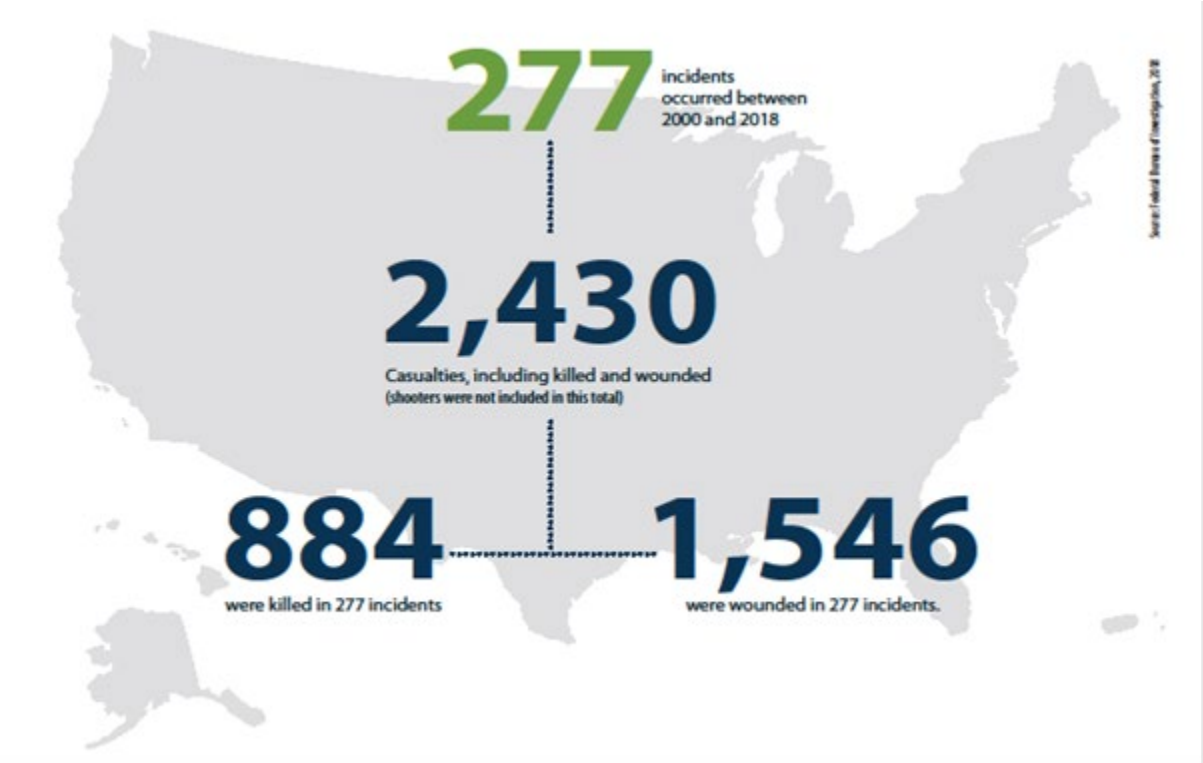
There have been no physical terrorist attacks in Tioga County, to date.

An active assailant (shooter), as defined by the U.S. Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area, in most cases, active assailants use firearms and there is not necessarily a pattern or method to their selection of victims. Throughout the year in 2020, there were a total of twenty-eight mass shooting incidents in the United States according to the FBI. Often these shooters are homegrown violent extremists (HVE's). Two significant events have occurred in Pennsylvania in recent history: one occurred on October 27, 2018, where eleven people were killed by a gunman in the Pittsburgh neighborhood of Squirrel Hill; the gunman was a homegrown violent extremist and attacked the congregation of the Tree of Life Synagogue in a shooting that targeted the Jewish population and was fueled by the gunman's anti-Semitic, anti-immigrant, and anti-refugee sentiments. Another event occurred in January of 2019, where a gunman killed two

people and permanently injured one inside P.J. Harrigan's bar in State College and later killed a homeowner and himself.

There have also been a number of active shooter events in the United States in recent years and they include those that occurred at Virginia Tech (April 2007), Sandy Hook Elementary School (December 2012), San Bernardino, California (December 2015), an Aurora, Colorado movie theater (July 2012) and a church in Charleston, South Carolina (June 2015). A 2014 study by the FBI concluded that there has been a significant recent increase in frequency of active shooter incidents, and that the vast majority (150 of 154 shooters between 2000 and 2013) were male (FBI, 2014). Of these 160 incidents, 45.6% took place in commercial environments, 24.3% took place in an educational environment, and the remaining 30.1% took place at other locations such as open spaces, military and other government properties, residential locations, houses of worship, and health care facilities (FBI, 2019). The annual report on the study may be found here: https://www.justice.gov/usao-mdpa/page/file/1272096/download. *Figure 52 – Active Shooter Incidents 2000 – 2018* illustrates a numerical breakdown of shooting events for those eighteen years.

*Figure 52 - Active Shooter Incidents 2000 - 2018 (FBI, 2019)*




Significant international terrorism incidents in the United States include the World Trade Center bombing in 1993, the bombing of the Murrow Building in Oklahoma City in 1995, and the September 11th, 2001 attacks on the World Trade Center and the Pentagon. One of the aircrafts hijacked in the September 11th attacks crash landed in Somerset County, Pennsylvania before it

reached its intended target. While fatalities and destruction at the intended target were avoided, all passengers on the flight perished.

While the largest scale terrorist incidents have often had international stimuli, many other incidents are caused by home grown actors who may have become radicalized through hate groups either in real life or via the internet, and who may struggle with mental health issues. Hate groups such as the Ku Klux Klan (KKK), Aryan Nation, and more recently, the Alt-Right, Antifa, Proud Boys, plus conspiracy theorist believers/promoters such as QAnon, have been part of domestic terrorism in different forms. Supporters of former President Donald Trump from one or more of these groups stormed the United States Capitol on January 6, 2021 to disrupt the certification of the 2020 presidential election, resulting in five deaths and evacuation of Congress.

Terrorist/cyber-attack activity in Tioga County as of April 2021 can be found in *Table 58 – Terrorist/Cyber Attack Activity History*; however, these incidents are not all inclusive of the history of terrorism or cyber-attacks, nor are they necessarily real terrorism as defined by the FBI. Entries vary due to recorder's selection of category and description.

*Table 58 - Terrorist/Cyber Attack Activity History*

| Terrorist/Cyber Attack Activity History | | | |
|---|---|---|---|
| **Date** | **Title** | **Severity** | **Total Incidents** |
| April 2021 | Policy Violations: 23<br>Unusual Network Activity: 1 | Informational: 24 | 24 |
| March 2021 | Policy Violations: 31<br>Unusual Network Activity: 0 | Informational: 31 | 31 |
| February 2021 | Policy Violations: 16<br>Unusual Network Activity: 1 | Informational: 17 | 17 |
| January 2021 | Policy Violations: 26<br>Unusual Network Activity: 4 | Informational: 29<br>Warning: 1 | 30 |

| Date | Title | Severity | Total Incidents |
|---|---|---|---|
| December 2020 | Policy Violations: 28 | Informational: 29 | 29 |
| | Unusual Network Activity: 1 | | |

#### 4.3.19.4 Future Occurrence

The likelihood of Tioga County being a primary target for a major international terrorist attack is small and unlikely. More likely terrorist activity in Tioga County includes bomb threats or other incidents at schools. Tioga County has five school districts consisting of eighteen public schools. Several private schools and Mansfield University are also located in Tioga County.

#### 4.3.19.5 Vulnerability Assessment

Tioga County should stay prepared for terrorism type incidents. The existence of industrial commerce, interstate highways and freight railroad activity create soft targets that could be used to interfere with the focus of day-to-day life that the county experiences. It is important to note that the use and exposure to biological agents can remain unknown for several days until the infected person(s), livestock, or crops begin to experience symptoms or show damages. Often such agents are contagious, and the infected person(s) must be quarantined, livestock culled, and/or crops destroyed.

Although previous events have not resulted in what are considered significant terrorist attacks, the severity of a future incident cannot be predicted with a total level of certainty. One of the major concerns with agroterrorism is that acts can be carried out with minimal planning, effort, or expense.

In a 2020 Cyberthreats Report by Acronis, a cyber protection company, there is an in-depth review of the current threat landscape and projections for the coming year. Based on the protection and security challenges that were amplified by the shift to remote work during the COVID-19 pandemic, Arconis warns 2021 will bring aggressive cybercrime activities as criminals pivot their attacks from data encryption to data exfiltration.

The major points illustrated in the report are as follows:

- Attacks against remote workers will increase due to the movement of workers to less secure working areas.
- Ransomware will look for new victims and will become more automated.
- Legacy IT and technical solutions will struggle to keep pace with ransomware and cybercrime attacks.

According to a study carried out on the data sourced from the Federal Bureau of Investigation, Pennsylvania is ranked second worst among states when it comes to handling cyber-attacks. The

study made by Information Network Associates – an international security consulting company – says an increase of 25% was witnessed in cyber-attacks between 2016 and 2017. This illustrates the amount of preparation that must occur in the commonwealth so that it can better respond to potential cybercrime attacks.

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

All communities in Tioga County are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities with schools and government infrastructure like the county seat, should be considered more likely to attract terrorist activity.

### 4.3.20. Transportation Accidents and Transportation of Hazardous Materials

#### 4.3.20.1 Location and Extent

There are approximately 2,200 miles of developed roads in Tioga County; with state and US highways contributing about 840 miles. Significant transportation routes such as US Route 6 and US Route 15, as well as state routes 14, 249, 287, and 660 course through the county. *Figure 53 – Major Highways and Railroads* shows the major transportation systems in Tioga County.

The Wellsboro & Corning Railroad (WCOR) is a short-line railroad and is the only active rail route in Tioga County. The rail line commences in Wellsboro and runs generally north northeast, paralleling PA Route 287 and terminates in Corning, New York. The WCOR has a total of forty-two owned or leased miles, with twenty-nine of those in Tioga County. Commodities transported on this line consist of agricultural products, chemicals, plastics, minerals, and stone. In Corning, New York, the line connects with Norfolk Southern's southern tier line.

Wellsboro Johnston Airport is the only public use airport in Tioga County. Private airports in Tioga County are: Baker Airport, H and H Airport/ Hughes Airport, Hi Line Lodge Airport, Malco Airport, and Sharrett's Airport. There is also Sabinsville-Consolidated Heliport. The locations of these airports and heliport are identified in *Figure 54 – Airports and Vulnerability Zones.*

There are eleven pipeline companies that transport hazardous materials in and through Tioga County. These companies and the product transported are:

- Dominion Energy, which transports natural gas and propane.
- DTE, which transports natural gas.
- Energy Transfer, which transports natural gas.

- Enterprise Products, which transports ethane and propane.
- EQT Production Company, which transports natural gas.
- Howard Energy Partners Northeast Gathering, which transports natural gas.
- National Fuel Gas Midstream Company, LLC, which transports natural gas.
- Stagecoach Gas Services, LLC, which transports natural gas.
- Tennessee Gas Pipeline Company, LLC, which transports natural gas.
- UGI Energy Services, which transports natural gas and propane.
- UGI Utilities, Inc., which transports natural gas and hydrogen sulfide.

#### 4.3.20.2 Range of Magnitude

Transportation accidents can result in death or serious injury and extensive property loss or damage. Inclement weather and higher traffic volumes and speeds increase the risk for automobile accidents.

Railroad accidents occur with less frequency than highway accidents. However, when these types of incidents occur, they often cause extensive property damage and have the potential to cause serious injury or death.

Aviation incidents most often occur near landing or take-off sites; the two-mile radius around each airport in Tioga County are considered high-risk areas.

Hazardous materials are transported along highways, railways, airways, and pipelines in Tioga County. In 2017 a commodity flow study was conducted in Tioga County. Of the 4,618 trucks observed during the study at the five observation locations, 107 were identified as placarded. Of these placarded loads Class 3 (Flammable Liquids) were observed the most, making up 62%. Class 2 (Flammable Gases), Class 9 (Miscellaneous), and Class 8 (Corrosive) each represented 10% (for a total of 30%) of the placards seen. The remaining 8% of placarded trucks was a combination of Class 4 (Flammable Solids), Class 5 (Oxidizing), and Class 6 (Toxic substances and Infectious substances). Neither Class 1 (Explosives), nor Class 7 (Radioactive) placards were observed during the survey. It should not be assumed that explosives or radioactive commodities are not present in Tioga County, just because these loads weren't observed during the commodity flow study timeframe.

#### 4.3.20.3 Past Occurrence

The most serious transportation concerns in Tioga County involve US Route 6 and US Route 15. *Table 59 – Transportation Incidents* depicts accidents that were reported to Tioga County 9-1-1 as they were entered into the Tioga County Knowledge Center™ database between January 2013 and April 2021.

There are several airplane incidents that have occurred in Tioga County, the most destructive of which occurred in 1967, when a commercial aircraft crashed on Barney Hill in Blossburg, killing all thirty-four people aboard the plane. Other recorded incidents include:

- In 2006 a small plane made an emergency landing in a field near an airport in Knoxville Borough (no reported injuries).
- In 2008 an ultralight aircraft crashed in Knoxville Borough (one reported injury).
- In 2017 an ultralight aircraft crashed in Clymer Township (one reported injury).

*Table 59 - Transportation Incidents*

| Transportation Accidents and Transportation of Hazardous Materials Incidents in Tioga County | | |
|---|---|---|
| **Date** | **Location** | **Description** |
| 09/04/2013 | Gaines Township | Public worker accident |
| 12/29/2013 | Delmar Township | Two-vehicle accident with road closure |
| 06/14/2014 | Middlebury Township | Road closure |
| 07/05/2014 | Tioga County | Vehicle accident with injury |
| 08/01/2014 | Shippen Township | Motor vehicle accident |
| 01/13/2015 | Deerfield Township | Tractor-trailer roll over with road closure |
| 03/06/2015 | Delmar Township | Fatal vehicle accident |
| 05/21/2015 | Liberty Township | PennDOT vehicle accident |
| 06/06/2015 | Osceola Township | Road closure |
| 07/16/2015 | Union Township | Motor vehicle accident |
| 08/01/2015 | Tioga County | Accident with road closure |
| 09/01/2015 | Delmar Township | Construction worker injury |
| 09/17/2015 | Morris Township | Head-on collision with road closure |
| 01/06/2016 | Richmond Township | Road closure |
| 01/23/2016 | Liberty Township | Road closure |
| 01/23/2016 | Tioga County | Road closure on US Route 15 |
| 02/05/2016 | Tioga County | US Route 6 road closure |
| 02/16/2016 | Blossburg Borough | Tractor trailer accident involving hazmat |
| 06/25/2016 | Tioga Township | Road closure |
| 08/03/2016 | Bloss Township | Road closure |
| 11/22/2016 | Tioga County | Vehicle accident involving an ambulance |
| 12/06/2016 | Covington Township | Road closure |
| 12/21/2016 | Tioga County | Fatal vehicle accident |
| 02/12/2017 | Richmond Township | Road closure |
| 03/07/2017 | Wellsboro Borough | Road hazard |
| 05/05/2017 | Liberty Township | Road closure |
| 05/15/2017 | Tioga County | Road closure |
| 06/03/2017 | Nelson Township | Multiple vehicle accident |
| 06/03/2017 | Liberty Township | Vehicle accident |
| 07/17/2017 | Tioga Township | Road Closure |

| Date | Location | Description |
|---|---|---|
| 07/17/2017 | Tioga Township | Vehicle accident |
| 07/30/2017 | Clymer Township | Ultra-light accident |
| 08/08/2017 | Deerfield Township | Road closure |
| 08/23/2017 | Liberty Township | Road closure |
| 09/03/2017 | Liberty Township | Diesel fuel spill |
| 10/16/2017 | Charleston Township | Vehicle accident |
| 11/04/2017 | Bloss Township | Road closure |
| 12/28/2017 | Delmar Township | Vehicle accident |
| 12/28/2017 | Lawrence Township | High pressure line blowing gas |
| 01/11/2018 | Morris Township | Road closure |
| 05/05/2018 | Covington Township | Natural gas leak |
| 05/09/2018 | Tioga Township | Truck fire with SR 15 closed |
| 05/28/2018 | Gaines Township | Road closure |
| 07/04/2018 | Tioga Township | Vehicle fire with a road closure |
| 08/27/2018 | Morris Township | Road closure |
| 09/26/2018 | Tioga Township | Road closure |
| 11/08/2018 | Lawrenceville Borough | Road closure |
| 11/09/2018 | Gaines Township | Vehicle accident with a road closure |
| 11/14/2018 | Deerfield Township | Multi-vehicle accident with entrapment |
| 01/11/2019 | Charleston Township | Vehicle accident with a road closure |
| 01/14/2019 | Delmar Township | Road closure |
| 01/15/2019 | Elkland Borough | Road closure |
| 01/19/2019 | Charleston Township | Vehicle accident |
| 01/24/2019 | Osceola Township | Diesel fuel spill |
| 01/29/2019 | Westfield Township | Road closure |
| 02/12/2019 | Richmond Township | Vehicle accident with a road closure |
| 02/28/2019 | Jackson Township | Road closure |
| 03/15/2019 | Middlebury Township | Road closure |
| 03/30/2019 | Chatham Township | Road closure |
| 04/22/2019 | Liberty Township | Road closure |
| 05/26/2019 | Lawrence Township | Road closure |
| 06/18/2019 | Mansfield Borough | Road closure |
| 07/14/2019 | Chatham Township | Motorcycle accident |
| 07/19/2019 | Westfield Borough | Road closure |
| 07/21/2019 | Lawrenceville Borough | Vehicle accident with a road closure |
| 08/09/2019 | Richmond Township | Road closure |
| 08/18/2019 | Tioga County | Road closure |

| Date | Location | Description |
|---|---|---|
| 09/09/2019 | Charleston Township | Vehicle accident with a road closure |
| 10/05/2019 | Rutland Township | Road closure |
| 10/06/2019 | Jackson Township | Road closure |
| 10/27/2019 | Covington Township | Road closure |
| 10/31/2019 | Tioga County | Road closure |
| 11/03/019 | Morris Township | Road closure |
| 11/14/2019 | Clymer Township | Road closure |
| 12/02/2019 | Tioga Township | Road closure |
| 12/07/2019 | Charleston Township | Vehicle accident with a road closure |
| 12/13/2019 | Morris Township | Road closure |
| 12/23/2019 | Knoxville Borough | Road closure |
| 01/05/2020 | Middlebury Township | Road closure |
| 01/25/2020 | Delmar Township | Vehicle accident with a road closure |
| 02/07/2020 | Liberty Township | Multiple tractor trailers jackknifed with road closure |
| 03/18/2020 | Delmar Township | Road closure |
| 03/20/2020 | Delmar Township | Road closure |
| 04/21/2020 | Tioga County | Natural gas pipeline blow-down |
| 04/21/2020 | Morris Township | Road closure |
| 05/01/2020 | Richmond Township | Vehicle accident |
| 05/17/2020 | Richmond Township | Gas pipeline blow-down |
| 06/14/2020 | Wellsboro Borough | Pedestrian accident |
| 06/15/2020 | Liberty Township | Tractor trailer accident with fire |
| 07/19/2020 | Shippen Township | Road closure |
| 07/29/2020 | Tioga Township | Road closure due to utilities down |
| 08/16/2020 | Westfield Borough | Road closure due to utilities down |
| 09/07/2020 | Middlebury Township | Road closure |
| 09/25/2020 | Deerfield Township | Road closure |
| 10/16/2020 | Charleston Township | Vehicle fire |
| 11/10/2020 | Tioga Township | Vehicle fire |
| 11/15/2020 | Delmar Township | Road closure |
| 11/22/2020 | Osceola Township | Fatal vehicle accident with a road closure |
| 12/25/2020 | Wellsboro Borough | Road closure |
| 02/03/2021 | Liberty Township | Road closure |
| 04/07/2021 | Nelson Township | Vehicle accident with a road closure |

*Table 60 – PennDOT Crash Report for Tioga County* shows crash statistics recorded by the Pennsylvania Department of Transportation between 2009 and 2019. *(NOTE: reports for years 2020 and 2021 were not available at the time of this report.)*

*Table 60 - PennDOT Crash Report for Tioga County*

| PennDOT Crash Report for Tioga County | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Train/Vehicle Accidents | | Total vehicle accidents for Pennsylvania | Vehicle accidents for Tioga County | | | | Pedestrian deaths |
| | Total | Deaths | | Total | Fatal Accidents | Injury Crashes | Total Deaths | |
| 2009 | 0 | 0 | 121,242 | 427 | 6 | 201 | 7 | 0 |
| 2010 | 0 | 0 | 121,312 | 552 | 13 | 250 | 13 | 0 |
| 2011 | 0 | 0 | 125,395 | 610 | 10 | 275 | 12 | 0 |
| 2012 | 0 | 0 | 124,092 | 511 | 8 | 214 | 10 | 0 |
| 2013 | 0 | 0 | 124,149 | 483 | 11 | 228 | 11 | 0 |
| 2014 | 1 | 0 | 121,317 | 407 | 10 | 189 | 10 | 0 |
| 2015 | 0 | 0 | 127,127 | 370 | 5 | 165 | 5 | 0 |
| 2016 | 0 | 0 | 129,395 | 427 | 12 | 165 | 13 | 0 |
| 2017 | 0 | 0 | 128,188 | 429 | 11 | 159 | 11 | 0 |
| 2018 | 0 | 0 | 128,420 | 455 | 4 | 171 | 5 | 1 |
| 2019 | 0 | 0 | 125,267 | 406 | 8 | 132 | 8 | 0 |

#### 4.3.20.4 Future Occurrence

Automobile accidents occur frequently, and typically occur more frequently than a rail or aviation accident. US Route 6 and 15 as well as State Routes 14, 249, 287, and 660 are the most traveled roadways in Tioga County and are also the most traveled by heavy freight vehicles which can often carry hazardous materials.

Transportation accidents are impossible to predict accurately; however, areas prone to these hazards can be located, quantified through analysis of historical records, and plotted on countywide and municipal base maps.

Transportation of hazardous materials using all modes of transport will continue to increase as industry and manufacturing progress continues.

#### 4.3.20.5 Vulnerability Assessment

The vulnerability for accidents; highway, railway, or aviation, are directly related to the population and traffic density within the county. The vulnerability increases if there are hazardous materials involved. Hazards associated with causing transportation accidents can be natural hazards that affect the environment such as winter storms or heavy rains causing slippery roadways or mud slides; to windstorms or tornadoes that cause high-profile vehicles or train cars to be toppled over.

Loss of roadway use, and public transportation services would affect commuters, employment, delivery of critical municipal and emergency services, and day-to-day operations within the county.

Studying traffic and potential transportation accident patterns could provide information on vulnerability of specific road segments and nearby populations. Increased understanding of the types of hazardous materials transported through the county will also support mitigation efforts. Maintaining a record of these frequently transported materials can facilitate development of preparatory measures for response to a release. *Figure 53 – Major Highways and Railroads Vulnerability* identifies a ¼-mile buffer along all highways and railroads within Tioga County.

Conducting commodity flow studies on a regular basis will assist Tioga County in knowing the greatest hazardous materials dangers. The commodity flow study should identify the container type and hazard class to assist emergency services when conducting training and pre-planning for hazardous materials involved in a transportation accident.

*Figure 53 - Major Highways and Railroads*

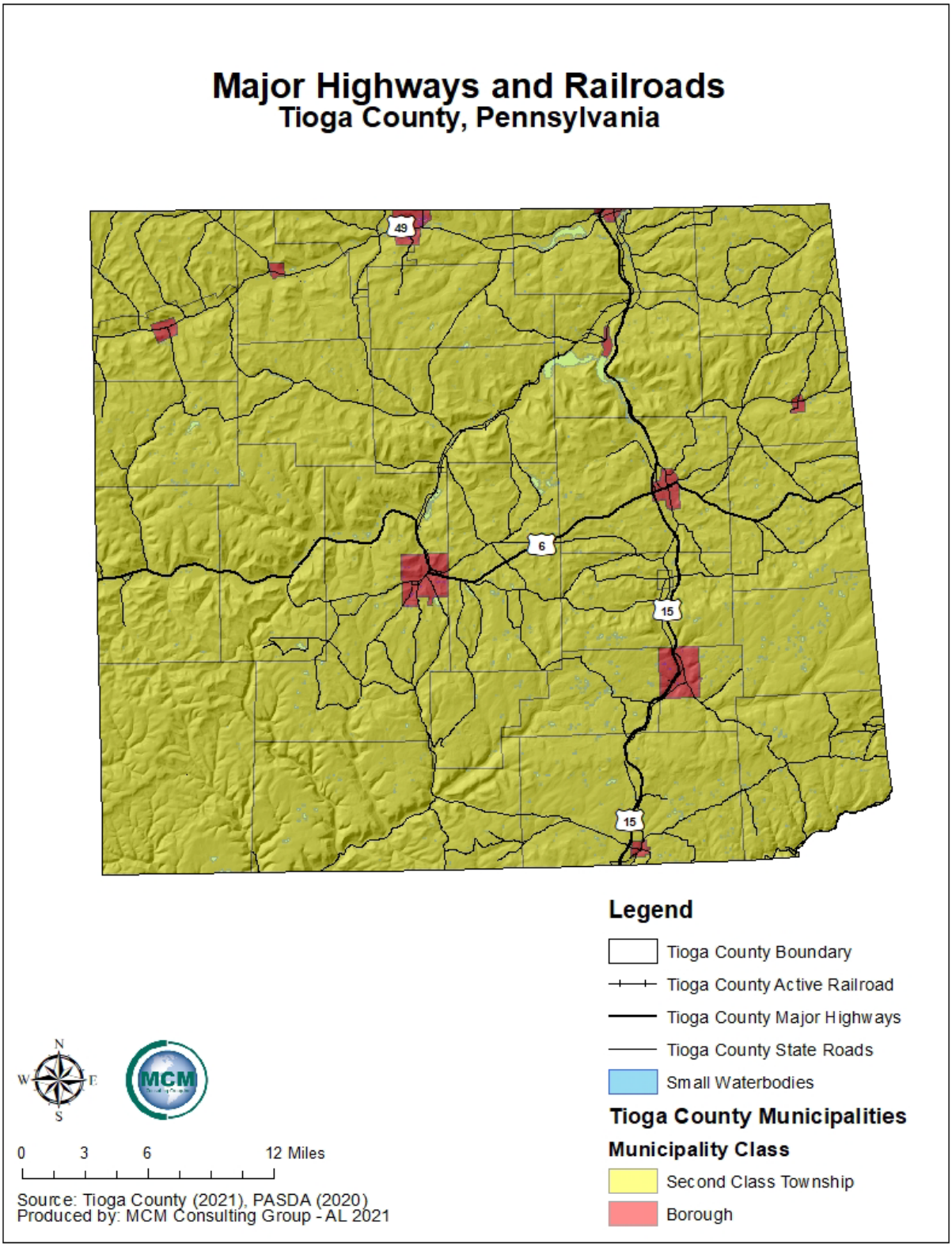


*Figure 54 - Airports and Vulnerability Zones*

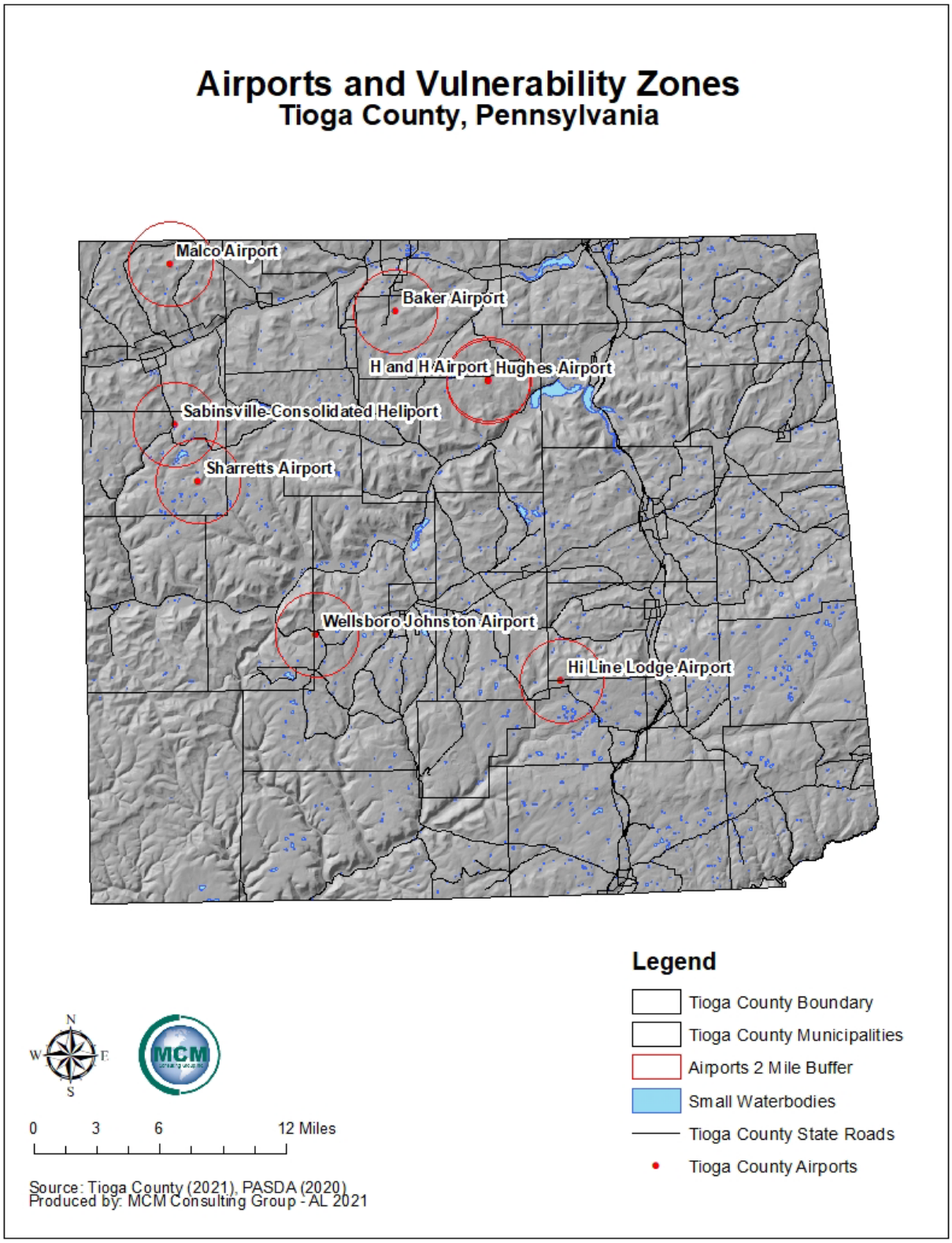
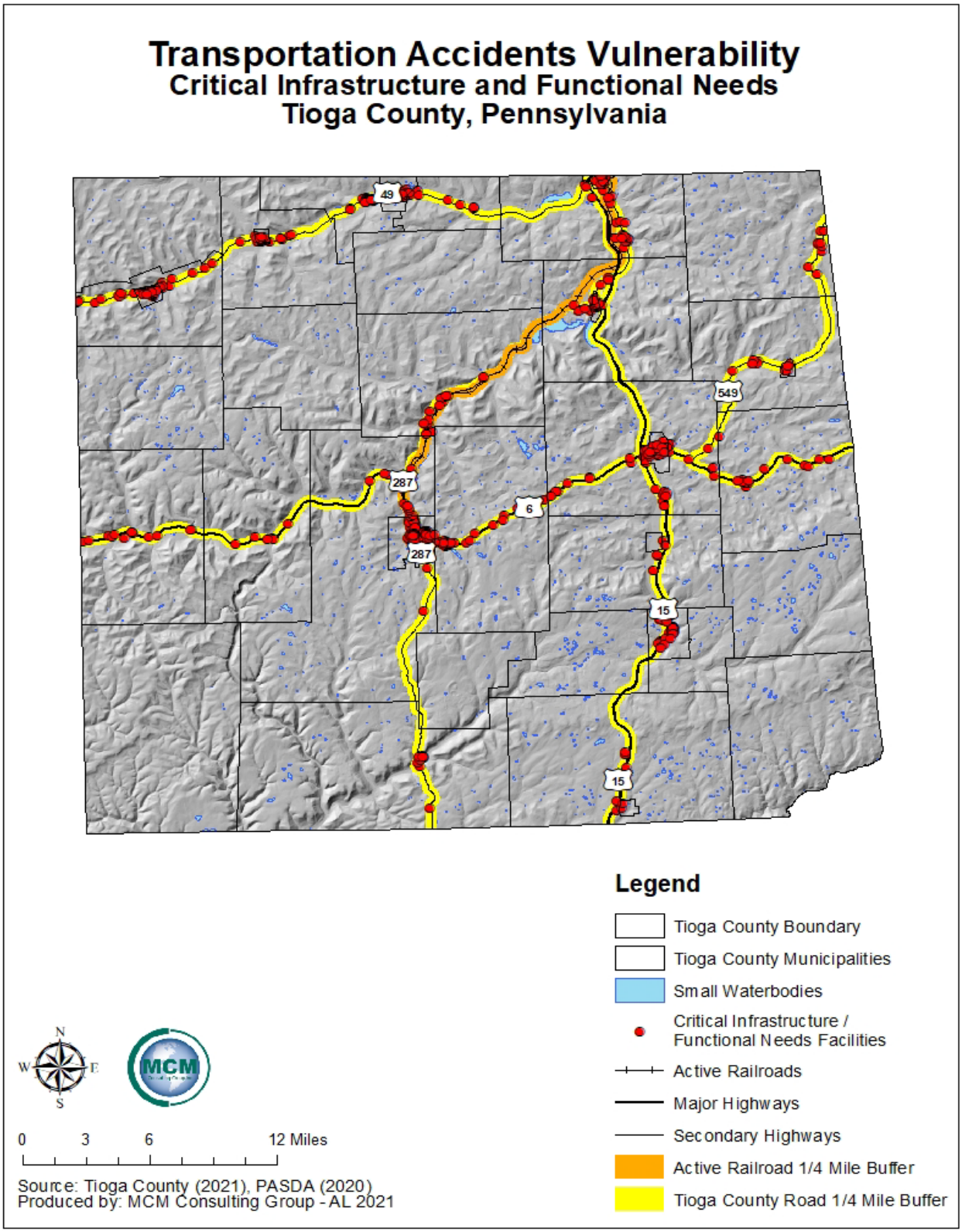


*Figure 55 – Transportation Accidents Vulnerability*



### 4.3.21. Utility Interruption

#### 4.3.21.1 Location and Extent

Utility interruptions can occur from an internal system failure, or as a secondary impact of another hazard, such as a windstorm or a traffic accident. Examples of other hazards include severe thunderstorms or winter storms that bring down power lines and cause widespread disruptions in electric service. Strong heat waves may result in rolling blackouts where power may not be available for an extended period of time. Space weather, specifically solar flares, pose an uncommon threat, especially on the northeastern seaboard and north central United States.

The age of utility infrastructure can also play an important role in interruptions, causing longer periods of outages in a larger area. Natural gas, water, telecommunications, and electric capabilities can all experience disruptions. Worker strikes at power generation facilities have also been known to cause minor power failures. Some other causes of minor power outages include falling tree limbs, vehicle accidents, or small animals that destroy wiring. Outages can also be caused by blown transformers or tripped circuit breakers. Major power outages are typically on a regional scale.

Utility providers in Tioga County are shown in *Table 61 – Tioga County Utility Providers*.

*Table 61 - Tioga County Utility Providers*

| Tioga County Utility Providers | |
|---|---|
| **Utility Provided** | **Name of Utility Provider** |
| Electricity | Penelec<br>Wellsboro Electric Company<br>Tri-County Rural Electric Coop |
| Telephone/9-1-1/Wireless | Frontier Communications<br>North Penn Telephone<br>Blue Ridge<br>AT&T<br>Indigo Wireless<br>Spring<br>T-Mobile<br>Verizon |
| Natural gas | Tennessee Gas Pipeline Company |
| Water | Blossburg Water Company<br>Lawrenceville Borough Water Department |

#### 4.3.21.2 Range of Magnitude

Utility interruptions do not typically lead to large-scale problems by themselves. Typically, human casualties are not a direct result from outages. Because many utility interruptions occur during storms or other severe weather events, they can have severe secondary consequences. Typical secondary effects from a power outage could include a delay in emergency response services due to poor communication, or a lack of potable water for drinking.

**Electricity**

Interruptions or power failures could have the following impacts:

- Public safety concerns;
- Food spoilage;
- Loss of heating or air conditioning;
- Basement flooding – due to sump pump failure;
- Loss of indoor lighting;
- Loss of internet service;
- Flashing traffic signals;
- Stopped elevators; and
- Interrupted retail sales.

Of all these, the loss of heating or air conditioning poses the greatest risk to the elderly and very young populations during times of extreme temperatures. Prolonged power outages also pose a risk to residents that rely on home-based medical equipment such as home-supply oxygen units.

**Fuel**

From natural gas to other products transported and delivered by way of pipelines to business and residences, interruptions pose loss of heating and manufacturing capabilities.

**Telecommunications**

Interruptions to telecommunications systems include impacts to 9-1-1 capabilities, telephone, and internet service. The greatest risk to the loss of this capability would be in reporting an emergency to a public safety answering point (PSAP). Extensive loss of telephone and internet service can be detrimental to government, business, and to residents. With much of the country now dependent on wireless networks, signals can be interrupted, and data can be captured – posing a range of security issues and concerns.

#### 4.3.21.3 Past Occurrence

Minor utility interruptions occur annually in Tioga County, most often in conjunction with winter and/or windstorms. Tioga County utilizes a database system called *CORVENA* (formerly *Knowledge Center*™) to track incidents. *Table 62 – Utility Interruptions in Tioga County* shows

interruptions to electric, natural gas, telecommunications, and water service from *CORVENA* entries.

*Table 62 - Utility Interruptions in Tioga County*

| Utility Interruptions in Tioga County | | |
|---|---|---|
| **Date** | **Event** | **Municipality** |
| 08/09/2014 | 9-1-1 phone outage | Delmar Township |
| 09/03/2014 | Phone outage | Liberty Borough |
| 09/27/2014 | Phone outage | Lawrence Township |
| 04/14/2015 | Compressor stations – ESD testing | Bloss Township |
| 08/06/2015 | Phone outage | Lawrence Township |
| 08/27/2015 | Gas pipeline blowdown | Clymer Township |
| 10/24/2015 | 9-1-1 phone outage | Lawrenceville Borough |
| 11/19/2015 | 9-1-1 phone outage | Lawrenceville area |
| 12/06/2015 | Gas pipeline blowdown | Charleston Township |
| 05/08/2016 | 9-1-1 phone outage | Tioga County |
| 05/21/2016 | Phone outage | Lawrenceville Borough |
| 10/22/2016 | Widespread power outage | Tioga County |
| 12/26/2016 | Widespread power outage | Tioga County |
| 01/16/2017 | Potable water outage | Tioga County |
| 02/24/2017 | 9-1-1 lines down | Tioga County |
| 08/26/2017 | 9-1-1 system outage | Chatham Township |
| 09/01/2017 | Phone outage | Lawrenceville Borough |
| 11/12/2017 | Phone outage | Wellsboro Borough |
| 11/16/2017 | Phone outage | Delmar Township |
| 01/02/2018 | Hospital water pipe break | Tioga County |
| 01/12/2018 | Ansonia power outage | Tioga County |
| 02/02/2018 | Phone outage | Delmar Township |
| 04/13/2018 | Frontier phone outage | Lawrenceville Borough |
| 07/04/2018 | Phone outage | Chatham Township |
| 07/17/2018 | Phone outage | Lawrenceville Borough |
| 07/19/2018 | Phone outage | Chatham Township |
| 08/05/2018 | 9-1-1 phone outage | Lawrenceville Borough |
| 08/18/2018 | Phone outage | Chatham Township |
| 08/18/2018 | Phone outage | Lawrence Township |
| 09/03/2018 | Phone outage | Lawrence Township |
| 09/06/2018 | Phone outage | Delmar Township |
| 09/12/2018 | Phone outage | Lawrenceville Borough |
| 10/09/2018 | Phone outage | Lawrence Township |

| Date | Event | Municipality |
|---|---|---|
| 10/30/2018 | Phone outage | Chatham Township |
| 11/20/2018 | Phone outage | Mansfield Borough |
| 02/05/2019 | Phone outage | Wellsboro Borough |
| 03/14/2019 | UPMC S+S | Wellsboro Borough |
| 03/14/2019 | Phone outage | Delmar Township |
| 03/17/2019 | Phone outage | Lawrenceville Borough |
| 03/22/2019 | Phone outage | Delmar Township |
| 04/03/2019 | Phone outage | Lawrenceville Borough |
| 04/03/2019 | Phone outage | Middlebury Township |
| 04/09/2019 | Power outage | Blossburg Borough |
| 06/04/2019 | Phone outage | Morris Township |
| 06/27/2019 | Phone outage | Lawrence Township |
| 06/29/2019 | Phone outage | Delmar Township |
| 07/07/2019 | Phone outage | Lawrence Township |
| 07/13/2019 | Phone outage | Richmond Township |
| 07/14/2019 | Phone outage | Lawrence Township |
| 07/17/2019 | Phone outage | Middlebury Township |
| 07/19/2019 | Phone outage | Delmar Township |
| 07/19/2019 | Phone outage | Mansfield Borough |
| 07/21/2019 | Phone outage | Tioga County |
| 08/07/2019 | Phone outage | Lawrence Township |
| 08/07/2019 | Phone outage | Lawrenceville Borough |
| 08/09/2019 | Phone outage | Charleston Township |
| 08/19/2019 | Phone outage | Lawrence Township |
| 08/21/2019 | Phone outage | Shippen Township |
| 09/05/2019 | Phone outage | Tioga County |
| 09/15/2019 | Road closure – utility emergency | Middlebury Township |
| 09/17/2019 | Phone outage | Lawrenceville Borough |
| 09/21/2019 | Phone outage | Delmar Township |
| 10/03/2019 | Power outage | Putnam Township |
| 10/09/2019 | Phone outage | Delmar Township |
| 10/11/2019 | Phone outage | Mansfield Borough |
| 10/16/2019 | Phone outage | Mansfield Borough |
| 10/22/2019 | Phone outage | Richmond Township |
| 10/28/2019 | Phone outage | Wellsboro Borough |
| 11/01/2019 | Phone outage | Middlebury Township |
| 12/02/2019 | Phone outage | Wellsboro Borough |

| Date | Event | Municipality |
|---|---|---|
| 12/04/2019 | Phone outage | Delmar Township |
| 12/06/2019 | Phone outage | Wellsboro Borough |
| 02/06/2020 | Phone outage | Westfield Township |
| 04/13/2020 | Phone outage | Wellsboro Borough |
| 05/04/2020 | Phone outage | Wellsboro Borough |
| 05/17/2020 | Phone outage | Delmar Township |
| 06/12/2020 | Phone outage | Wellsboro Borough |
| 08/23/2020 | Phone outage | Tioga County |
| 10/15/2020 | Phone outage | Charleston Township |
| 10/16/2020 | Water shortage | Gaines Township |
| 11/16/2020 | Phone outage | Putnam Township |
| 03/26/2021 | Phone outage | Delmar Township |
| 04/03/2021 | Phone outage | Tioga County |

The Pennsylvania Public Utility Commission tracks the reliability of electric distribution companies (EDC) and outages. *Table 63 –2018 Winter Storms Riley and Quinn Power Outages by EDC* compares the customers affected by power outage in Pennsylvania during these storms and compares them to statistics from Nika 2014 and Sandy 2012. Some of the EDCs were not impacted by Winter Storm Quinn. PPL customers experienced power outages for a duration of eight days with Winter Storms Quinn and Riley, whereas during Sandy in 2012 the duration was nine days, and just over three days for Nika in 2014.

*Table 63 - 2018 Winter Storms Riley and Quinn Power Outages by EDC*

| 2018 Winter Storms Riley and Quinn Power Outages | | | |
|---|---|---|---|
| **EDC** | **Customers affected by storms Riley and Quinn 2018 (Percentage of total customers)** | **Customers affected by Nika 2014 (Percentage of total customers)** | **Customers affected by Sandy 2012 (Percentage of total customers)** |
| Met-Ed | 272,928 (49.22%) | 144,000 (26.00%) | 298,300 (54.00%) |
| PECO | 794,969 (46.76%) | 723,681 (42.00%) | 845,703 (54.20%) |
| Penelec | 90,856 (15.61%) | N/A | 96,847 (16.40%) |
| PCLP | 2,101 (47.44%) | N/A | 4,487 (100.00%) |
| PPL | 261,341 (18.67%) | 92,283 (7.00%) | 523,936 (37.50%) |
| Total | 1,422,195 | 959,964 | 1,769,273 |

*Source Winter Storm Riley and Quinn Report 2019*

#### 4.3.21.4 Future Occurrence

Utility interruptions are difficult to predict, even though minor interruptions may occur several times a year to all utilities. Even so, utility interruptions occur more frequently as a secondary factor to severe weather events or transportation accidents.

Space weather is getting more attention as an infrastructure risk, due in part to a March 2020 report by the U.S. Geological Survey (USGS). The report notes that geomagnetic storms caused by the dynamic action of the Sun and solar wind on the space environment surrounding the Earth can generate electric fields in the Earth's crust and mantle. These electric fields can interfere with the operation of grounded electric power-grid systems. Geomagnetic storms occur only occasionally, but when sufficiently energetic they can produce blackouts (USGS).

As utility infrastructure ages, interruption events could occur more frequently. Utility providers can reduce Tioga County's vulnerability to power outages by implementing improvement plans.

#### 4.3.21.5 Vulnerability Assessment

Resources such as electricity, communications, gas, and water supply are critical to ensure the health, safety, and general welfare of the citizenry. See *Figure 56 - Tioga County Utility Lines* for the locations of utilities throughout the county.

Power outages can cause even greater detriment to at-risk and vulnerable populations, such as the elderly or those with functional and access needs. All critical infrastructure is vulnerable to the effects of a power outage. The probability of a large-scale, extended utility failure is low; however, small-scale failures lasting short periods of time occur annually.

Long-term care facilities, senior centers, hospitals, and emergency medical facilities are all vulnerable to utility interruptions. Often back-up power generators are used at these facilities to off-set electrical needs during extremes of hot or cold temperatures. However, these back-up power generators must be maintained, and fuel supplies must be secured in advance of the utility interruption to ensure a seamless transition from the everyday power source to the emergency generator. When officials consider maintenance and supplies for a facility, tong-term use of back-up generators should be planned.

The *Acronis Cyberthreats Report 2020* contains an in-depth review of the current internet and wireless threat landscape and projections for the coming year. Based on the protection and security challenges that were amplified by the shift to remote work during the COVID-19 pandemic, Acronis warns 2021 will bring aggressive cyber-crime activities as criminals pivot their attacks from data encryption to data exfiltration.

The major points illustrated in the report are as follows:

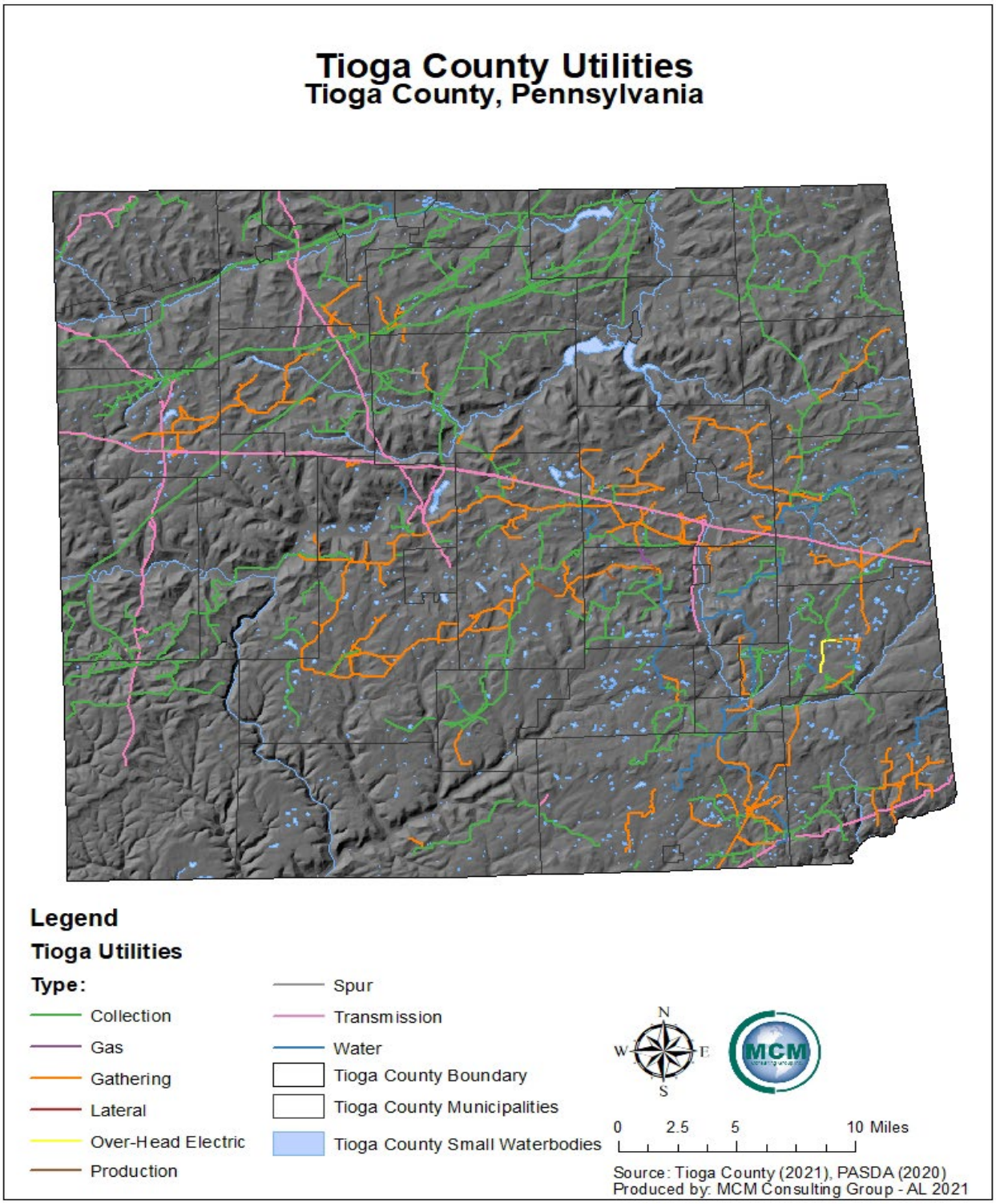
- Attacks against remote workers will increase due to the movement of workers to less secure working areas.

- Ransomware will look for new victims and will become more automated.
- Legacy IT and technical solutions will struggle to keep pace with ransomware and cyber-crime attacks.

According to a study carried out on the data sourced from the Federal Bureau of Investigation, Pennsylvania is ranked second worst among states when it comes to handling cyber-attacks. The study made by Information Network Associates – an international security consulting company – says an increase of 25% was witnessed in cyber-attacks between 2016 and 2017. This illustrates the amount of preparation that must occur in the commonwealth so that it can better respond to potential cybercrime attacks.

Tioga County currently has both 3G and 4G wireless network capability, and the tower sites and networks are at risk for temporary interruptions from weather and cyber threats; the risk is considered low, however, and any issues would be reported to multiple organizations for investigation, restoration and/or assistance.

*Figure 56 - Tioga County Utility Lines*



## 4.4. Hazard Vulnerability Summary

### 4.4.1. Methodology

Ranking hazards helps communities set goals and priorities for mitigation based on their vulnerabilities. A risk factor (RF) is a tool used to measure the degree of risk for identified hazards in a particular planning area. The RF can also assist local community officials in ranking and prioritizing hazards that pose the most significant threat to a planning area based on a variety of factors deemed important by the planning team and other stakeholders involved in the hazard mitigation planning process. The RF system relies mainly on historical data, local knowledge, general consensus from the planning team and information collected through development of the hazard profiles included in Section 4.3. The RF approach produces numerical values that allow identified hazards to be ranked against one another; the higher the RF value, the greater the hazard risk.

RF values were obtained by assigning varying degrees of risk to five categories for each of the hazards profiled in the HMP update. Those categories include *probability*, *impact*, *spatial extent*, *warning time and duration*. Each degree of risk was assigned a value ranging from one to four. The weighting factor agreed upon by the planning team is shown in *Table 64 – Risk Factor Approach Summary*. To calculate the RF value for a given hazard, the assigned risk value for each category was multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the following example equation:

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

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

*Table 64 - Risk Factor Approach Summary*

| Summary of Risk Factor Approach Used to Rank Hazard Risk. | | | | | |
|---|---|---|---|---|---|
| **RISK ASSESSMENT CATEGORY** | **DEGREE OF RISK** | | | | **WEIGHT VALUE** |
| | **LEVEL** | **CRITERIA** | | **INDEX** | |
| **PROBABILITY** *What is the likelihood of a hazard event occurring in a given year?* | **UNLIKELY** | LESS THAN 1% ANNUAL PROBABILITY | | 1 | 30% |
| | **POSSIBLE** | BETWEEN 1 & 10% ANNUAL PROBABILITY | | 2 | |
| | **LIKELY** | BETWEEN 10 &100% ANNUAL PROBABILITY | | 3 | |
| | **HIGHLY LIKELY** | 100% ANNUAL PROBABILTY | | 4 | |
| **IMPACT** *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?* | **MINOR** | VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES. | | 1 | 30% |
| | **LIMITED** | MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY. | | 2 | |
| | **CRITICAL** | MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK. | | 3 | |
| | **CATASTROPHIC** | HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE. | | 4 | |
| **SPATIAL EXTENT** *How large of an area could be impacted by a hazard event? Are impacts localized or regional?* | **NEGLIGIBLE** | LESS THAN 1% OF AREA AFFECTED | | 1 | 20% |
| | **SMALL** | BETWEEN 1 & 10% OF AREA AFFECTED | | 2 | |
| | **MODERATE** | BETWEEN 10 & 50% OF AREA AFFECTED | | 3 | |
| | **LARGE** | BETWEEN 50 & 100% OF AREA AFFECTED | | 4 | |
| **WARNING TIME** *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?* | **MORE THAN 24 HRS** | SELF-DEFINED | *(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)* | 1 | 10% |
| | **12 TO 24 HRS** | SELF-DEFINED | | 2 | |
| | **6 TO 12 HRS** | SELF-DEFINED | | 3 | |
| | **LESS THAN 6 HRS** | SELF-DEFINED | | 4 | |
| **DURATION** *How long does the hazard event usually last?* | **LESS THAN 6 HRS** | SELF-DEFINED | *(NOTE: Levels of warning time and criteria that define them may be adjusted based on hazard addressed.)* | 1 | 10% |
| | **LESS THAN 24 HRS** | SELF-DEFINED | | 2 | |
| | **LESS THAN 1 WEEK** | SELF-DEFINED | | 3 | |
| | **MORE THAN 1 WEEK** | SELF-DEFINED | | 4 | |

### 4.4.2 Ranking Results

Using the methodology described in Section 4.4.1, *Table 65 – Risk Factor Assessment* lists the risk factor calculated for each of twenty -one potential hazards identified in the 2022 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 65 - Risk Factor Assessment*

| Tioga County Hazard Ranking Based on RF Methodology. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard Risk | Hazard Natural (N) or Human-Caused (H) | RISK ASSESSMENT CATEGORY | | | | | Risk Factor (RF) |
| | | Probability | Economic Impact | Spatial Extent | Warning Time | Duration | |
| HIGH | Utility Interruption (H) | 4 | 3 | 4 | 4 | 3 | **3.6** |
| | Cyber Attack (H) | 4 | 3 | 3 | 4 | 4 | **3.5** |
| | Pandemic, Epidemic and Infectious Disease (N) | 3 | 4 | 4 | 1 | 4 | **3.4** |
| | Invasive Species (N) | 4 | 3 | 4 | 1 | 4 | **3.4** |
| | Emergency Services (H) | 4 | 3 | 4 | 1 | 4 | **3.4** |
| | Opioid Epidemic (H) | 4 | 3 | 4 | 1 | 4 | **3.4** |
| | Winter Storm (N) | 4 | 3 | 4 | 1 | 3 | **3.3** |
| | Wildfire (N) | 4 | 3 | 2 | 4 | 3 | **3.2** |
| | Drought (N) | 3 | 3 | 4 | 1 | 4 | **3.1** |
| | Flood (100 Year) (N) | 3 | 3 | 3 | 2 | 3 | **2.9** |
| | Dam Failure (N) | 1 | 4 | 3 | 3 | 4 | **2.8** |
| | Extreme Temperatures (N) | 3 | 2 | 4 | 2 | 3 | **2.8** |
| | Flash Flooding (N) | 4 | 2 | 2 | 4 | 2 | **2.8** |
| | Windstorm (N) | 3 | 2 | 3 | 4 | 2 | **2.7** |
| | Landslide (N) | 3 | 2 | 2 | 4 | 4 | **2.7** |
| | Environmental Hazards (H) | 3 | 2 | 2 | 4 | 4 | **2.7** |
| | Terrorism (H) | 2 | 2 | 3 | 4 | 4 | **2.6** |
| MODERATE | Disorientation (H) | 4 | 1 | 1 | 4 | 2 | 2.3 |
| | Transportation Accidents/Hazmat (H) | 4 | 1 | 1 | 4 | 2 | 2.3 |

| Tioga County Hazard Ranking Based on RF Methodology. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazard Risk | Hazard Natural (N) or Human-Caused (H) | RISK ASSESSMENT CATEGORY | | | | | Risk Factor (RF) |
| | | Probability | Economic Impact | Spatial Extent | Warning Time | Duration | |
| | Civil Disturbance/Criminal Activity (H) | 2 | 2 | 2 | 4 | 3 | 2.3 |
| | Ice Jam Flooding (N) | 2 | 2 | 2 | 4 | 3 | 2.3 |
| | Solar Flare (N) | 1 | 2 | 4 | 3 | 2 | 2.2 |
| | Tornado (N) | 2 | 2 | 2 | 4 | 1 | 2.1 |
| LOW | Earthquake (N) | 1 | 1 | 3 | 4 | 1 | 1.7 |
| | Subsidence and Sinkhole (N) | 1 | 1 | 1 | 4 | 4 | 1.6 |

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

A risk assessment result for the entire county does not mean that each municipality is at the same amount of risk to each hazard. *Table 66 – Countywide Risk Factor* shows the different municipalities in Tioga 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 4.3.21.

*Table 66 - Countywide Risk Factor by Hazard*

| Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR** | | | | | | | | | | |
| JURISDICTION | Utility Interruption (H) | Cyber Attack (H) | Pandemic, Epidemic, and Infectious Disease (N) | Invasive Species (N) | Emergency Services (H) | Opioid Epidemic (H) | Winter Storm (N) | Wildfire (N) | Drought (N) | Flood (100 Year) (N) |
| | *3.6* | *3.5* | *3.4* | *3.4* | *3.4* | *3.4* | *3.3* | *3.2* | *3.1* | *2.9* |
| Bloss Township | Not completed by municipality | | | | | | | | | |
| Blossburg Borough | = | = | > | < | = | > | = | > | > | > |
| Brookfield Township | Not completed by municipality | | | | | | | | | |
| Charleston Township | Not completed by municipality | | | | | | | | | |
| Chatham Township | Not completed by municipality | | | | | | | | | |
| Clymer Township | > | < | < | = | < | < | > | < | = | > |
| Covington Township | Not completed by municipality | | | | | | | | | |
| Deerfield Township | Not completed by municipality | | | | | | | | | |
| Delmar Township | Not completed by municipality | | | | | | | | | |
| Duncan Township | Not completed by municipality | | | | | | | | | |
| Elk Township | > | > | > | > | > | = | = | > | = | = |
| Elkland Borough | Not completed by municipality | | | | | | | | | |
| Farmington Township | Not completed by municipality | | | | | | | | | |
| Gaines Township | Not completed by municipality | | | | | | | | | |
| Hamilton Township | Not completed by municipality | | | | | | | | | |
| Jackson Township | = | = | = | > | = | = | = | = | = | > |
| Knoxville Borough | = | = | = | = | = | = | = | = | = | = |
| Lawrence Township | Not completed by municipality | | | | | | | | | |
| Lawrenceville Borough | > | = | = | = | = | = | = | = | = | = |
| Liberty Borough | Not completed by municipality | | | | | | | | | |
| Liberty Township | Not completed by municipality | | | | | | | | | |

| Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR** | | | | | | | | | | |
| JURISDICTION | Utility Interruption (H) | Cyber Attack (H) | Pandemic, Epidemic, and Infectious Disease (N) | Invasive Species (N) | Emergency Services (H) | Opioid Epidemic (H) | Winter Storm (N) | Wildfire (N) | Drought (N) | Flood (100 Year) (N) |
| | *3.6* | *3.5* | *3.4* | *3.4* | *3.4* | *3.4* | *3.3* | *3.2* | *3.1* | *2.9* |
| Mansfield Borough | = | > | = | = | > | = | > | < | = | = |
| Middlebury Township | Not completed by municipality | | | | | | | | | |
| Morris Township | = | = | = | = | = | = | = | = | = | = |
| Nelson Township | > | > | > | > | > | = | = | > | = | = |
| Osceola Township | Not completed by municipality | | | | | | | | | |
| Putnam Township | = | = | = | = | = | = | = | = | = | = |
| Richmond Township | = | < | = | = | = | = | = | = | = | > |
| Roseville Borough | = | = | = | = | = | = | = | = | = | = |
| Rutland Township | Not completed by municipality | | | | | | | | | |
| Shippen Township | Not completed by municipality | | | | | | | | | |
| Sullivan Township | = | = | = | = | = | = | = | = | = | = |
| Tioga Borough | Not completed by municipality | | | | | | | | | |
| Tioga Township | = | = | = | = | = | = | = | = | = | = |
| Union Township | = | < | = | = | = | = | = | = | = | > |
| Ward Township | = | = | = | = | = | = | = | = | = | = |
| Wellsboro Borough | = | = | = | = | = | = | = | = | = | = |
| Westfield Borough | = | = | = | = | = | = | = | = | = | = |
| Westfield Township | Not completed by municipality | | | | | | | | | |
| Mansfield University | = | = | = | = | = | = | = | = | = | = |

| Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR** | | | | | | | | | | |
| JURISDICTION | Dam Failure (N) | Extreme Temperatures (N) | Flash Flooding (N) | Windstorm (N) | Landslide (N) | Environmental Hazards (H) | Terrorism (H) | Disorientation (H) | Transportation Accidents/Hazmat (H) | Civil Disturbance/Criminal Activity (H) |
| | ***2.8*** | ***2.8*** | ***2.8*** | ***2.7*** | ***2.7*** | ***2.7*** | ***2.6*** | ***2.3*** | ***2.3*** | ***2.3*** |
| Bloss Township | Not completed by municipality | | | | | | | | | |
| Blossburg Borough | = | = | = | > | < | < | = | = | > | > |
| Brookfield Township | Not completed by municipality | | | | | | | | | |
| Charleston Township | Not completed by municipality | | | | | | | | | |
| Chatham Township | Not completed by municipality | | | | | | | | | |
| Clymer Township | < | < | > | > | < | < | < | > | > | < |
| Covington Township | Not completed by municipality | | | | | | | | | |
| Deerfield Township | Not completed by municipality | | | | | | | | | |
| Delmar Township | Not completed by municipality | | | | | | | | | |
| Duncan Township | Not completed by municipality | | | | | | | | | |
| Elk Township | = | > | > | > | > | = | = | = | = | = |
| Elkland Borough | Not completed by municipality | | | | | | | | | |
| Farmington Township | Not completed by municipality | | | | | | | | | |
| Gaines Township | Not completed by municipality | | | | | | | | | |
| Hamilton Township | Not completed by municipality | | | | | | | | | |
| Jackson Township | = | > | > | = | = | = | = | = | = | = |
| Knoxville Borough | = | = | = | = | = | = | = | = | = | = |
| Lawrence Township | Not completed by municipality | | | | | | | | | |
| Lawrenceville Borough | = | = | = | = | = | = | = | = | = | = |
| Liberty Borough | Not completed by municipality | | | | | | | | | |
| Liberty Township | Not completed by municipality | | | | | | | | | |
| Mansfield Borough | = | = | > | = | < | = | > | = | > | = |

| Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR** | | | | | | | | | | |
| JURISDICTION | Dam Failure (N) | Extreme Temperatures (N) | Flash Flooding (N) | Windstorm (N) | Landslide (N) | Environmental Hazards (H) | Terrorism (H) | Disorientation (H) | Transportation Accidents/Hazmat (H) | Civil Disturbance/Criminal Activity (H) |
| | ***2.8*** | ***2.8*** | ***2.8*** | ***2.7*** | ***2.7*** | ***2.7*** | ***2.6*** | ***2.3*** | ***2.3*** | ***2.3*** |
| Middlebury Township | Not completed by municipality | | | | | | | | | |
| Morris Township | = | = | = | = | = | = | = | = | = | = |
| Nelson Township | = | > | > | > | > | = | = | = | = | = |
| Osceola Township | Not completed by municipality | | | | | | | | | |
| Putnam Township | = | = | = | = | = | = | = | = | = | = |
| Richmond Township | > | = | > | = | = | = | = | = | = | = |
| Roseville Borough | = | = | = | = | = | = | = | = | = | = |
| Rutland Township | Not completed by municipality | | | | | | | | | |
| Shippen Township | Not completed by municipality | | | | | | | | | |
| Sullivan Township | < | = | = | = | = | = | < | = | = | = |
| Tioga Borough | Not completed by municipality | | | | | | | | | |
| Tioga Township | = | = | > | = | = | = | < | = | = | = |
| Union Township | < | = | = | > | = | = | < | = | = | = |
| Ward Township | = | = | = | = | = | = | = | = | = | < |
| Wellsboro Borough | = | = | = | = | = | = | = | = | = | = |
| Westfield Borough | = | = | = | = | = | = | = | = | = | = |
| Westfield Township | Not completed by municipality | | | | | | | | | |
| Mansfield University | = | = | = | = | = | = | = | = | = | = |

| Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR** | | | | | | | | | | |
| JURISDICTION | Ice Jam Flooding (N) | Solar Flare (N) | Tornado (N) | Earthquake (N) | Subsidence and Sinkhole (N) | | | | | |
| | ***2.3*** | ***2.2*** | ***2.1*** | ***1.7*** | ***1.6*** | | | | | |
| Bloss Township | Not completed by municipality | | | | | | | | | |
| Blossburg Borough | = | = | > | = | > | | | | | |
| Brookfield Township | Not completed by municipality | | | | | | | | | |
| Charleston Township | Not completed by municipality | | | | | | | | | |
| Chatham Township | Not completed by municipality | | | | | | | | | |
| Clymer Township | < | < | < | < | > | | | | | |
| Covington Township | Not completed by municipality | | | | | | | | | |
| Deerfield Township | Not completed by municipality | | | | | | | | | |
| Delmar Township | Not completed by municipality | | | | | | | | | |
| Duncan Township | Not completed by municipality | | | | | | | | | |
| Elk Township | Not completed by municipality | | | | | | | | | |
| Elkland Borough | Not completed by municipality | | | | | | | | | |
| Farmington Township | Not completed by municipality | | | | | | | | | |
| Gaines Township | Not completed by municipality | | | | | | | | | |
| Hamilton Township | Not completed by municipality | | | | | | | | | |
| Jackson Township | = | = | = | = | = | | | | | |
| Knoxville Borough | = | = | = | = | = | | | | | |
| Lawrence Township | Not completed by municipality | | | | | | | | | |
| Lawrenceville Borough | = | = | = | = | = | | | | | |
| Liberty Borough | Not completed by municipality | | | | | | | | | |
| Liberty Township | Not completed by municipality | | | | | | | | | |
| Mansfield Borough | = | = | > | = | > | | | | | |

| Calculated Countywide Risk Factor by Hazard and Comparative Jurisdictional Risk | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **IDENTIFIED HAZARD AND CORRESPONDING COUNTYWIDE RISK FACTOR** | | | | | | | | | | |
| JURISDICTION | Ice Jam Flooding (N) | Solar Flare (N) | Tornado (N) | Earthquake (N) | Subsidence and Sinkhole (N) | | | | | |
| | ***2.3*** | ***2.2*** | ***2.1*** | ***1.7*** | ***1.6*** | | | | | |
| Middlebury Township | Not completed by municipality | | | | | | | | | |
| Morris Township | = | = | = | = | = | | | | | |
| Nelson Township | = | = | = | = | > | | | | | |
| Osceola Township | Not completed by municipality | | | | | | | | | |
| Putnam Township | = | = | = | = | = | | | | | |
| Richmond Township | = | = | = | = | = | | | | | |
| Roseville Borough | = | = | = | = | = | | | | | |
| Rutland Township | Not completed by municipality | | | | | | | | | |
| Shippen Township | Not completed by municipality | | | | | | | | | |
| Sullivan Township | = | = | = | = | = | | | | | |
| Tioga Borough | Not completed by municipality | | | | | | | | | |
| Tioga Township | Not completed by municipality | | | | | | | | | |
| Union Township | < | = | > | = | = | | | | | |
| Ward Township | = | = | > | = | = | | | | | |
| Wellsboro Borough | = | = | = | = | = | | | | | |
| Westfield Borough | Not completed by municipality | | | | | | | | | |
| Westfield Township | = | = | = | = | = | | | | | |
| Mansfield University | = | = | = | = | = | | | | | |

### 4.4.3. Potential Loss Estimates

Based on various kinds of available data, potential loss estimates were established for 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.

**Flooding Loss Estimation:**

Flooding is a high-risk natural hazard in Tioga 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 Tioga County municipality is outlined in section 4.3.4 of the flooding hazard profile.

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

Using HAZUS-MH, total building-related losses from a 1%-annual-chance flood in Tioga County are estimated to equal $126.35 million with $73.95 million of that coming from residential homes. Total economic loss, including replacement value, content loss, functional loss, and displacement cost, from a countywide 1%-annual-chance flood are estimated to equal $229.35 million.

### 4.4.4. Future Development and Vulnerability

The 2019 estimated population for Tioga County is 40,591 which is 809 less than the 2010 census. There was an overall decrease of 1.7% in population based on the estimate. Six municipalities have seen population increases while the remaining had decreases in the period between 2010 and the 2019 estimate as identified in *Table 67 – Population Change in Tioga County from 2010-2019.*

*Table 67 - Population Change in Tioga County from 2010 - 2019*

| Population Change in Tioga County from 2010-2019 | | | | |
|---|---|---|---|---|
| **Municipality** | **2010 Census** | **2015 Estimates** | **2019 Estimates** | **Percent of Change 2010-2019 Estimate** |
| Bloss Township | 351 | 344 | 338 | -4.2% |
| Blossburg Borough | 1,538 | 1,513 | 1,482 | -3.6% |
| Brookfield Township | 421 | 413 | 404 | -4% |
| Charleston Township | 3,360 | 3,483 | 3,433 | +2.1% |
| Chatham Township | 588 | 596 | 584 | -0.7% |
| Clymer Township | 581 | 573 | 561 | -3.4% |
| Covington Township | 1,022 | 1,033 | 1,016 | -0.6% |
| Deerfield Township | 662 | 658 | 650 | -1.8% |
| Delmar Township | 2,856 | 2,852 | 2,797 | -2.1% |
| Duncan Township | 208 | 214 | 221 | +6.3% |
| Elk Township | 49 | 48 | 47 | -0.41% |
| Elkland Borough | 1,821 | 1,779 | 1,739 | -4.6% |
| Farmington Township | 637 | 663 | 661 | +3.8% |
| Gaines Township | 542 | 545 | 536 | -1.1% |
| Hamilton Township | 499 | 495 | 485 | -2% |
| Jackson Township | 1,887 | 1,878 | 1,867 | -1% |
| Knoxville Borough | 629 | 617 | 599 | -4.8% |
| Lawrence Township | 1,718 | 1,686 | 1,644 | -4.3% |
| Lawrenceville Borough | 581 | 617 | 612 | +5.3% |
| Liberty Borough | 249 | 239 | 234 | -6% |
| Liberty Township | 1,042 | 1,037 | 1,024 | -1.7% |
| Mansfield Borough | 3,625 | 3,215 | 2,917 | -2% |
| Middlebury Township | 1,285 | 1,300 | 1,281 | -0.3% |
| Morris Township | 606 | 596 | 582 | -4% |
| Nelson Township | 571 | 566 | 560 | -2% |
| Osceola Township | 659 | 643 | 630 | -4.4% |
| Putnam Township | 425 | 424 | 419 | -1.4% |
| Richmond Township | 2,396 | 2,325 | 2,285 | -4.6% |
| Roseville Borough | 189 | 190 | 184 | -2.6% |
| Rutland Township | 805 | 827 | 809 | +0.5% |
| Shippen Township | 527 | 522 | 515 | -2.3% |
| Sullivan Township | 1,453 | 1,464 | 1,450 | -0.2% |
| Tioga Borough | 666 | 661 | 647 | -2.9% |
| Tioga Township | 991 | 972 | 961 | -3% |
| Union Township | 1,000 | 1,007 | 993 | -0.7% |

| Population Change in Tioga County from 2010-2019 | | | | |
|---|---|---|---|---|
| **Municipality** | **2010 Census** | **2015 Estimates** | **2019 Estimates** | **Percent of Change 2010-2019 Estimate** |
| Ward Township | 166 | 176 | 174 | +4.8% |
| Wellsboro Borough | 3,263 | 3,278 | 3,227 | -1.1% |
| Westfield Borough | 1,064 | 1,057 | 1,036 | -2.6% |
| Westfield Township | 1,047 | 1,013 | 987 | -5.7% |
| **TOTAL** | **41,981** | **41,519** | **40,591** | **-1.7%** |

# 5. Capability Assessment

## 5.1. Update Process Summary

The capability assessment is an evaluation of Tioga 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 loss 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 Tioga 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 thirty-nine municipalities. Pennsylvania municipalities have their own governing bodies, pass and enforce their own ordinances and regulations, and purchase equipment and manage their own resources, including critical infrastructure. These capability assessments, therefore, consider the various characteristics and capabilities of municipalities under study.

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

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

## 5.2. Capability Assessment Findings

All thirty-nine municipalities in Tioga County 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 compliant 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 stormwater 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 Tioga 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 Tioga County adhere to the standards of the Pennsylvania Uniform Construction Code (Act 45). Thirty municipalities in Tioga County indicated that they have opted-in on building code enforcement according to capability assessment worksheets submitted by municipal representatives.

**Zoning Ordinance**

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

**Subdivision Ordinance**

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

use and land development regulation. The Tioga County Subdivision and Land Development Ordinance provides regulatory guidance for thirty-one of the thirty-nine municipalities.

**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. Six municipalities in Tioga County have adopted the county's stormwater management plan, with one municipality currently developing a stormwater management plan.

**Comprehensive Plan**

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

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

Tioga County recently updated their comprehensive plan in 2017 and is titled Tioga County Comprehensive Plan - 2030.

Article III of the MPC enables municipalities to prepare a comprehensive plan; however, development of a comprehensive plan is voluntary. Sixteen of the thirty-nine municipalities in Tioga County have adopted a comprehensive plan, while one municipality has one under development.

**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. Tioga County does not have any capital improvement plans in place.

**Participation in the National Flood Insurance Program (NFIP)**

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

The Pennsylvania DCED provides communities, based on their CFR, Title 44, Section 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP along with the Pennsylvania Flood Plain Management Act (Act 166). These suggested or model ordinances contain provisions that are more restrictive than state and federal requirements. Suggested provisions include, but are not limited to:

1. Prohibiting manufactured homes in the floodway.
2. Prohibiting manufactured homes within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
3. Special requirements for recreational vehicles within the special flood hazard area.
4. Special requirement for accessory structures.

5. Prohibiting new construction and development within the area measured 50 feet landward from the top-of bank of any watercourse within a special flood hazard area.
6. Providing the county conservation district an opportunity to review and comment on all applications and plans for any proposed construction or development in any identified floodplain area.

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

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

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

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

1. Reduce flood losses.
2. Protect public health and safety.
3. Reduce damage to property.
4. Prevent increases in flood damage from new construction.
5. Reduce the risk of erosion damage.
6. Protect natural and beneficial floodplain functions.
7. Facilitate accurate insurance rating.
8. Promote the awareness of flood insurance.

There are ten Community Rating System classes. Class 1 requires the most credit points and gives the largest premium reduction; Class 10 receives no premium reduction. CRS premium discounts on flood insurance range from 5% for Class 9 communities up to 45% for Class 1 communities. The CRS recognizes eighteen credible activities, organized under four categories: Public Information, Mapping and Regulations, Flood Damage Reduction and Flood Preparedness.

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

Thirty-three of the thirty-nine municipalities that reside in Tioga County have floodplain regulations in place that meet requirements set forth by the NFIP, of these twenty-three participate in the National Flood Insurance Program (NFIP). Currently, no municipalities have completed or started to complete the CRS program. Additional research will be conducted on the CRS program and mitigation actions will be developed in support of the CRS.

In an effort to spread awareness as well as capture participation levels, all municipalities were instructed to complete an NFIP survey provided by the Federal Emergency Management Agency. In total, twenty municipalities submitted an NFIP survey. These surveys can be found in Appendix C of this plan.

### 5.2.2. Administrative and Technical Capability

There are ten boroughs, and twenty-nine townships within Tioga 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 Commission

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 Tioga 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. There are twelve municipalities that have planners or engineers with land use, land development knowledge, and hazard knowledge. Nine municipalities in Tioga County have engineers or professional trained in building and or infrastructure construction practices.

### 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 Tioga County Planning Commission. There are no members of the Tioga County GIS Department that have completed Basic HAZUS-MH.

### Emergency Management Coordinator

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

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

- Prepare and maintain a current disaster emergency management plan.
- Establish, equip, and staff an emergency operations center.
- Provide individuals and organizations 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 Tioga County and its municipalities to have an emergency management coordinator.

The Tioga County Office of Emergency Management coordinates countywide emergency management efforts. Each municipality has a designated local emergency management coordinator who possesses a unique knowledge of the impact hazard events have on their community.

The Emergency Management Services Code (PA Title 35) requires that all municipalities in the Commonwealth have a local emergency operations plan (EOP) which is updated every two years. All thirty-nine municipalities have adopted the county EOP. The notification and resource section of the plan was developed individually by each municipality.

**Political Capability**

One of the most difficult capabilities to evaluate involves the political will of a jurisdiction to enact meaningful policies and projects designed to mitigate hazard events. The adoption of hazard mitigation measures may be seen as an impediment to growth and economic development. In many cases, mitigation may not generate interest among local officials when compared with competing priorities. Therefore, the local political climate must be considered when designing mitigation strategies, as it could be the most difficult hurdle to overcome in accomplishing the adoption or implementation of specific actions.

The capability assessment survey was used to capture information on each jurisdiction's political capability. Survey respondents were asked to identify examples of political 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. *Table 68 – Tioga County Community Political Capability* summarizes the results of political capability.

*Table 68 - Tioga County Community Political Capability*

| Tioga County Community Political Capability | | | | | | |
|---|---|---|---|---|---|---|
| **Municipality Name** | **Capability Ranking** | | | | | |
| | **0** | **1** | **2** | **3** | **4** | **5** |
| Bloss Township | | | | X | | |
| Blossburg Borough | | | | | X | |
| Brookfield Township | | | | X | | |
| Charleston Township | | | | X | | |
| Chatham Township | | | | X | | |
| Clymer Township | Not completed by municipality | | | | | |
| Covington Township | | | X | | | |
| Deerfield Township | | | | | X | |
| Delmar Township | | | | X | | |
| Duncan Township | | | X | | | |
| Elk Township | | | | | | X |
| Elkland Borough | | | X | | | |
| Farmington Township | | | | X | | |
| Gaines Township | Not completed by municipality | | | | | |
| Hamilton Township | | | | | | X |
| Jackson Township | | | | X | | |
| Knoxville Borough | Not completed by municipality | | | | | |
| Lawrence Township | Not completed by municipality | | | | | |
| Lawrenceville Borough | | | | X | | |
| Liberty Borough | | | | | | X |
| Liberty Township | | | | X | | |
| Mansfield Borough | | | | | X | |
| Middlebury Township | | | | | | X |
| Morris Township | | | | X | | |
| Nelson Township | Not completed by municipality | | | | | |

| Tioga County Community Political Capability | | | | | | |
|---|---|---|---|---|---|---|
| Municipality Name | Capability Ranking | | | | | |
| | 0 | 1 | 2 | 3 | 4 | 5 |
| Osceola Township | Not completed by municipality | | | | | |
| Putnam Township | | | | | | X |
| Richmond Township | | | | | X | |
| Roseville Borough | | | | | X | |
| Rutland Township | | | | X | | |
| Shippen Township | | | | X | | |
| Sullivan Township | | | | | X | |
| Tioga Borough | Not completed by municipality | | | | | |
| Tioga Township | | | | X | | |
| Union Township | | | | X | | |
| Ward Township | | | | X | | |
| Wellsboro Borough | | | | | X | |
| Westfield Borough | | | | X | | |
| Westfield Township | | | | X | | |

**Self-Assessment**

In addition to the inventory and analysis of specific local capabilities, the capability assessment survey required each local jurisdiction to conduct its own self-assessment of its capability to effectively implement hazard mitigation activities. As part of this process, county and municipal officials were encouraged to consider the barriers to implementing proposed mitigation strategies in addition to the mechanisms that could enhance or further such strategies. In response to the survey questionnaire, local officials classified each of the capabilities as either "L = limited" "M = moderate" or "H = high." *Table 69 – Capability Self-Assessment Matrix* summarizes the results of the self-assessment survey. Nineteen municipalities returned this section of the assessment completed.

*Table 69 - Capability Self-Assessment Matrix*

| Tioga County Capability Self-Assessment Matrix | | | | |
|---|---|---|---|---|
| Municipality Name | Capability Category | | | |
| | Planning and Regulatory Capability | Administrative and Technical Capability | Fiscal Capability | Community Political Capability |
| Bloss Township | L | L | L | L |
| Blossburg Borough | M | M | L | M |
| Brookfield Township | L | L | L | L |
| Charleston Township | M | M | M | M |

| Municipality Name | Capability Category | | | |
|---|---|---|---|---|
| | Planning and Regulatory Capability | Administrative and Technical Capability | Fiscal Capability | Community Political Capability |
| Chatham Township | L | L | L | L |
| Clymer Township | Not completed by municipality | | | |
| Covington Township | M | M | M | M |
| Deerfield Township | M | M | L | M |
| Delmar Township | M | M | M | M |
| Duncan Township | L | M | L | M |
| Elk Township | M | M | M | M |
| Elkland Borough | L | L | M | L |
| Farmington Township | L | L | L | M |
| Gaines Township | Not completed by municipality | | | |
| Hamilton Township | L | L | L | L |
| Jackson Township | M | L | M | M |
| Knoxville Borough | M | L | M | H |
| Lawrence Township | L | L | L | L |
| Lawrenceville Borough | M | M | M | M |
| Liberty Borough | L | L | L | L |
| Liberty Township | L | L | L | L |
| Mansfield Borough | M | M | L | H |
| Middlebury Township | L | L | L | L |
| Morris Township | M | M | M | M |
| Nelson Township | L | L | L | L |
| Osceola Township | M | M | M | M |
| Putnam Township | M | M | M | M |
| Richmond Township | M | M | L | M |
| Roseville Borough | L | M | M | M |
| Rutland Township | M | M | M | M |
| Shippen Township | L | L | L | L |
| Sullivan Township | M | L | M | M |
| Tioga Borough | M | M | M | M |
| Tioga Township | M | M | L | M |
| Union Township | L | L | L | L |
| Ward Township | L | L | L | L |
| Wellsboro Borough | H | M | N/A | M |
| Westfield Borough | L | L | L | L |
| Westfield Township | M | L | M | M |

**Existing Limitations**

Funding has been identified as the largest limitation for a municipality to complete mitigation activities. The acquisition of grants is the best way to augment this process for the municipalities.

The county and municipalities representatives will need to rely on regional, state, and federal partnerships for future financial assistance. Development of intra-county regional partnerships and intra-municipality regional partnerships will bolster this process.

### 5.2.3. Financial Capability

Fiscal capability is significant to the implementation of hazard mitigation activities. Every jurisdiction must operate within the constraints of limited financial resources. The following information pertains to various financial assistance programs relevant to hazard mitigation.

#### State and Federal Grants

During the 1960s and 1970s, state and federal grants-in-aid were available to finance a large number of municipal programs, including streets, water and sewer facilities, airports, parks, and playgrounds. During the early 1980s, there was a significant change in federal policy, based on rising deficits and a political philosophy that encouraged states and local governments to raise their own revenues for capital programs. The result has been a growing interest in "creative financing".

#### Capital Improvement Financing

Because most capital investments involve the outlay of substantial funds, local governments can seldom pay for these facilities through annual appropriations in the annual operating budget. Therefore, numerous techniques have evolved to enable local government to pay for capital improvements over a time period exceeding one year. Public finance literature and state laws governing local government finance classify techniques that are used to finance capital improvements. The techniques include revenue bonds; lease-purchase, authorities and special district; current revenue (pay-as-you-go); reserve funds; and tax increment financing. Most municipalities have very limited local tax funds for capital projects. Grants and other funding are 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

Tioga County conducts an education and outreach program. The Tioga County Office of Emergency Management conducts 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 Tioga 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 Tioga County.

Education and outreach on the NFIP are necessary. With new regulations in flood-plain management, updated digital flood insurance rate maps and new rates for insurance policies, education, and outreach on the NFIP would assist the program. The Tioga County Local Planning Team will identify actions necessary to complete this.

### 5.2.5. Plan Integration

The Tioga County Comprehensive Plan Update – 2030 – Existing Conditions was utilized for various sections of the 2022 Tioga County HMP Update. Trends and Features provided useful information on historical context, population and housing, land use, economic development, transportation, facilities, and utilities. The overview section was utilized in the development of the community profile section. Additionally, the future land use plan was utilized when developing section 2.4 of the community profile which provided valuable information on land use trends in Tioga County.

The Tioga County Comprehensive Plan Update – 2030 consists of three vision areas, each of which is accompanied by a set of goals and subsequent recommendations for various projects and actions that support updates and growth for programs identified in the comprehensive plan. Identified goals and actions in the comprehensive plan ranged from immediate, short-term, mid-term, long-term, and continuing. Each guiding principle from this plan provided numerous actions and projects that were integrated into the 2022 HMP mitigation strategy. The following are some of the goals and actions from the updated comprehensive plan, followed by the 2022 HMP mitigation actions that were developed or supported by the goals and actions from the 2030 comprehensive plan:

- An identified goal in the county comprehensive plan mentions the enhancement and maintenance of telecommunications networks serving the county. The 2022 HMP local planning team developed mitigation objective 2.3 which identifies the need for continued enhancement of both local and county capabilities performing external messaging such as mass notification to the public before, during, and after an incident.
- An identified goal of the county comprehensive plan mentions planning, development, and protection of water, land and related resources in a manner that fosters sustainable economic activity, sustains environmental quality, and ensures public health and safety of communities and the ecosystem. The 2022 HMP local planning team developed mitigation goal 4 which encourages the protection of natural resources and open space.

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 2022 Tioga County

HMP Update. 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.

**Tioga 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). Tioga 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 annually. 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 Tioga 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.

Tioga County Department of Emergency Services will consider the Tioga County Hazard Mitigation Plan during its annual review of the county EOP. Recommended changes to the HMP will then be coordinated with the hazard mitigation local planning team.

**Plan Interrelationships**

Ensuring consistency between these planning mechanisms is critical. In fact, Section 301 (4.1) of the Pennsylvania Municipalities Planning Code requires that comprehensive plans include a discussion of the interrelationships among their various plan components, "which may include an estimate of the environmental, energy conservation, fiscal, economic development and social consequences on the environment."

To that end, Tioga 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. Tioga 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 five goals and twenty-one objectives identified in the 2017 hazard mitigation plan. The 2022 Tioga County Hazard Mitigation Plan Update has six goals and twenty-one objectives. Objectives have been added and arranged in order to associate them with the most appropriate goal. These changes are noted in *Table 70 – 2017 Mitigation Goals and Objectives Review*. 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 thirty-four actions identified in the 2017 mitigation strategy. A review of the 2017 mitigation actions was completed by the local planning team. The results of this review are identified in *Table 71 – 2017 Mitigation Actions Review Worksheet.* Actions were evaluated by the local planning team with the intent of carrying over any actions that were not started or continuous for the next five years.

*Table 70 - 2017 Mitigation Goals and Objectives Review*

| 2017 Mitigation Goals and Objectives Review | | |
|---|---|---|
| **GOAL Objective** | **Description** | **Review Comments** |
| **GOAL 1** | **Reduce the level of risk to life and public and private property from natural & human-caused disasters in Tioga County.** | The LPT decided that this goal should be changed to: "Reduce the level of risk to life and property from natural and human-caused disasters in Tioga County." |
| Objective 1.1 | Direct any new development away from high hazard areas and review existing regulations to ensure adequacy in reducing the amount of future development in high hazard areas. | The LPT decided that this objective should be included in the plan update. |

| GOAL Objective | Description | Review Comments |
|---|---|---|
| Objective 1.2 | Review all local and county comprehensive plans to ensure that designated growth areas are not in high hazard areas. | The LPT decided that this objective should be included in the plan update. |
| Objective 1.3 | Review all capital improvement plans to ensure that infrastructure improvements are not directed towards high-hazard areas. | The LPT decided that this objective should be included in the plan update. |
| Objective 1.4 | Evaluate and update existing floodplain ordinances to meet or exceed the NFIP standards. | The LPT decided this objective should be reworded to: "Evaluate floodplain ordinances to exceed NFIP standards to reduce flooding instances and reduce flood insurance premiums where possible." |
| Objective 1.5 | Continue to improve the enforcement of existing floodplain regulations. | The LPT decided that this objective should be included in the plan update. |
| Objective 1.6 | Recommend that flood insurance policies remain affordable through county and municipal government programs. | The LPT decided that this objective should be combined with Objective 1.4 above. |
| Objective 1.7 | Evaluate existing short- and medium-term public shelters to ensure they are not in high hazard areas. | This is more action-based. Remove |
| **GOAL 2** | **Reduce the potential impact to life and public and private property from natural and human-caused disasters in Tioga County.** | The LPT decided to reword this goal to: "Reduce the potential impact to life and property from natural and human-caused disasters in Tioga County." |
| Objective 2.1 | Protect Tioga County's functional populations, and most at-risk Critical Infrastructure and Key Resources (CIKR) through the implementation of cost-effective and technically feasible mitigation projects. | The LPT decided that this objective should be included in the plan update. |

| GOAL Objective | Description | Review Comments |
|---|---|---|
| Objective 2.2 | Establish and sustain a "Mitigation Advisory Committee (MAC)" to coordinate the planning, development, and implementation of mitigation actions and projects opportunities listed in the hazard mitigation plan for Tioga County and all participating municipalities. | The LPT decided to reword this objective to: "Continue to regularly meet as a Mitigation Advisory Committee (MAC) to coordinate the planning, development, and implementation of mitigation actions and projects opportunities listed in the hazard mitigation plan for Tioga County and all participating municipalities." |
| Objective 2.3 | Continue building the local and county capabilities for performing external messaging (i.e., mass notification) to the public before, during, and after an incident. | The LPT decided that this objective should be included in the plan update. |
| Objective 2.4 | Research possible mitigation projects to reduce flooding, reduce/eliminate sewage leakage, and inflow/infiltration problems. Some projects may include reservoirs, levees, floodwalls, diversions, channel modification, and storm sewers. | The LPT decided that this objective should be included in the plan update as it is continuous. |
| Objective 2.5 | Gather best practices on other successful hazard mitigation projects to utilize in future mitigation actions and projects. | The LPT decided that this objective should be included in the plan update as it is continuous. |
| Objective 2.6 | Implement structural and property protection projects to reduce the impacts from flooding including acquisition, elevation, and relocation. | Reword to: "Complete actions and projects to acquire, elevate, demolish or demolish/reconstruct properties, repetitive loss properties and severe repetitive loss properties." |
| **GOAL 3** | **Increase the level of capabilities to protect life safety and public and private property from natural and human-caused disasters in Tioga County.** | The LPT decided to reword this goal to: "Increase the level of capabilities to protect life safety and property from natural and human-caused disasters in Tioga County." |

| GOAL Objective | Description | Review Comments |
|---|---|---|
| Objective 3.1 | Identify potential funding opportunities to plan for, develop, and implement hazard mitigation projects. | The LPT decided this objective should be included in the plan update. |
| Objective 3.2 | Ensure adequate training and resources for emergency organizations and personnel. | The LPT decided this objective should be changed to: "Facilitate adequate training and resources for emergency organizations and personnel." |
| Objective 3.3 | Expand pre-disaster collaboration amongst all levels of government and continue building systems to share mitigation opportunities between them. | The LPT decided this objective should be included in the plan update. |
| **GOAL 4** | **Protect existing natural resources and open space, including parks and wetlands, within the floodplain and watershed to improve their flood control functions.** | The LPT decided to reword this goal to: "Protect existing natural resources and open space, including parks and wetlands to improve their flood control functions." |
| Objective 4.1 | Protect Tioga County's natural resources through the implementation of cost effective and technically feasible mitigation projects. | The LPT decided this objective should be included in the plan update. |
| Objective 4.2 | Protect Tioga County's natural resources through the implementation of recreation planning and storm water management planning. | The LPT decided this objective should be included in the plan update. |
| **GOAL 5** | **Increase public awareness of existing hazards and communicate the differences between individual and government responsibilities for taking action to mitigate those hazards.** | The LPT decided this goal should be reworded to: "Increase public awareness of existing hazards and communicate the differences between individual and municipal responsibilities for taking action to mitigate those hazards." |
| Objective 5.1 | Develop and distribute public awareness material about natural and human-caused hazards, risks, impacts, and the existing capabilities as well as | The LPT decided this objective should be reworded to: "Develop and distribute public awareness materials about |

| | | |
|---|---|---|
| | potential actions they and their government can take to mitigate those hazards. | natural and human-caused hazards, risks, impacts, and the existing capabilities as well as potential actions individuals and municipalities can take to mitigate those hazards." |
| **GOAL Objective** | **Description** | **Review Comments** |
| Objective 5.2 | Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness. | The LPT decided this objective should be included in the plan update. |
| Objective 5.3 | Encourage property owners to purchase flood insurance and provide easy access to information on how to do so. | The LPT decided this objective should be reworded to: "Educate residents and municipal officials about existing floodplain ordinances which meet or exceed the NFIP standards." |

*Table 71 - Tioga County Mitigation Actions Review Worksheet*

| 2017 Tioga County Mitigation Actions Review Worksheet | | | | | | |
|---|---|---|---|---|---|---|
| ***Existing Mitigation Actions (2017 HMP)*** | ***Status*** | | | | | ***Review Comments*** |
| | **No Progress/ Unknown** | **In Progress/Not Yet Complete** | **Continuous** | **Completed** | **Discontinued** | |
| **Action 1.1.1** - Encourage municipal offices to review regulations pertaining to their jurisdiction to make sure that adequate regulations are in place to reduce future development in high hazard areas in their jurisdiction. Planning department to review Subdivision and Land Development Ordinance. | | | X | | | The LPT decided to change this action to: "Continue to encourage…" |
| **Action 1.1.2** - Develop a countywide Firewise Plan. | X | | | | | The LPT decided that this action should be included in the plan update. |
| **Action 1.1.3 -** Develop a prevention and protection plan for the county. | | | | | X | The LPT decided this action is no longer applicable. |
| **Action 1.2.1 -** Planning department to work with the municipal offices to review their comprehensive plans to ensure that designated growth areas are not in high hazard areas identified in this plan. | | | X | | | Change to: "The planning department will continue to work with…" Change to Planning Commission. |
| **Action 1.2.2 -** Encourage applicable municipal offices to review their capital improvement plans to ensure that programmed infrastructure improvements are not in high hazard areas. | | | X | | | The LPT decided that this action should be included in the plan update. |

| *Existing Mitigation Actions (2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 1.2.3 -** Review the existing Tioga County Emergency Operations Plan (EOP and update where necessary based on the recommendations of the Hazard Mitigation Plan. Include participation from municipalities by ensuring that their EOPs are reviewed and updated annually. | | | X | | | The LPT decided to change this action to: "Continue to review…" |
| **Action 1.2.4** – Update the Tioga County Comprehensive Plan and integrate hazard mitigation principals. | | | | X | | This was completed in December of 2017. |
| **Action 1.3.1** – Review the Tioga County capital improvement plan annually to ensure that development does not occur in high hazard areas. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 1.4.1** – Establish a floodplain manager position in the county. | X | | | | | The LPT decided that this action should be updated to "Maintain the floodplain manager…" |
| **Action 1.5.1** - Enlist in the Community Rating System (CRS) program. | | | | | X | This is no longer relevant to Tioga County. After looking at cost/benefit analysis Tioga County does not have the resources to implement this action. |

| *Existing Mitigation Actions (2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 1.6.1** - County DES to arrange for training on the Community Rating System (CRS) for municipalities and insurance companies. | | | | X | | This was completed in 2017/2018. |
| **Action 1.6.2** - Tioga County will develop a one stop shop for NFIP information and other disaster program information that will support hazard mitigation planning for all hazards. | | X | | | | The LPT decided to change this action to: "Update existing ArcGIS online web map relating to NFIP program as it relates to Tioga County." |
| **Action 1.7.1** - Coordinate with ARC to ensure shelters have the ability to receive emergency power by determining the connections for generators at each shelter. | | | X | | | The LPT decided to change this to: "Continue to coordinate…" and spell out American Red Cross. |
| **Action 1.7.2** - Develop a shelter plan. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 2.1.1 –** Coordinate with Tioga County CART to develop evacuation plans and emergency shelter plans for pets. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 2.1.2** - Distribution of NOAA Weather Radios to Tioga County municipalities, schools, hospitals, nursing homes, day care centers, and SARA facilities. | | X | | | | The LPT decided to change this action to: "Continue to distribute NOAA…" |

| *Existing Mitigation Actions (2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 2.2.1** - The Tioga County Local Emergency Planning Committee (LEPC) should continue reviewing proposed emergency response plans from hazardous materials facilities in the area. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 2.2.2** - Continue to review Hazard Mitigation Questionnaires and pot-disaster reviews submitted by the municipalities. | | | X | | | The LPT decided to change this action to: "Continue to review feedback on hazard mitigation surveys submitted by municipalities." |
| **Action 2.2.3** - Continue to produce and submit Hazard Mitigation Project Opportunity Forms for high-risk structures/areas (especially post-disaster). | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 2.2.4** - Establish the Tioga County Mitigation Advisory Council. | | | X | | | The LPT decided to change this action to: "Continue to regularly meet as a MAC." |
| **Action 2.3.1** - Maintain the Tioga County 911 Center equipment. | | | X | | | New CAD system and radio equipment. The LPT decided to include this action in the plan update. |
| **Action 2.3.2** - Continue using and enhance in the future the Swift 911 systems in Tioga County. | | | X | | | "Continue to use, update and enhance the Swift 911 system in Tioga County." |

| *Existing Mitigation Actions*<br><br>*(2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 2.3.3** - Research the possibility of installing Emergency Alert Warning Sirens and equipment to reach all populated areas throughout the county. | X | | | | | Change to: "Continue to test the current Emergency Alert Warning Sirens and equipment to reach all populated areas throughout the county." |
| **Action 2.4.1** - Work with all appropriate partners to continue evaluating and updating (when possible) dams and their respective Emergency Action Plans. | | | X | | | Move this to under Goal 6. |
| **Action 2.4.2** - Assessment office to continue collecting and updating information for structures within the 1%-chance-annual-chance floodplain and structures that are not in the floodplain but are prone to flooding. This information will include map number, assessed value, and structure type. | | | X | | | Remove second "chance" in this action.<br><br>Change to special flood hazard area. |
| **Action 2.4.3** – Enlist in the Silver Jackets Program | | | | | X | The LPT decided this action is no longer relevant to Tioga County. |

| *Existing Mitigation Actions*<br><br>*(2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | **No Progress/ Unknown** | **In Progress/Not Yet Complete** | **Continuous** | **Completed** | **Discontinued** | |
| **Action 2.5.1** - Develop a strategy to address abandoned and blighted properties in the county. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 2.5.2 –** Develop a strategy for vegetative buffers. | | | X | | | Progress made in Island Park in Blossburg Borough.<br><br>The LPT decided that this action should be included in the plan update. |
| **Action 2.5.3** - Develop a strategy to improve ISO insurance ratings. | | | X | | | Change to: "Continue to educate fire companies about ISO ratings." |
| **Action 2.6.1** - Continue to target and prioritize at-risk structures for acquisition, relocation, and elevation. | | | X | | | Change to: "Continue to target flood prone properties for acquisition, relocation, elevation and demolition/reconstruction countywide, completing Hazard Mitigation Opportunity Forms when applicable, and meet with homeowners on the benefits of mitigation opportunity." |

| *Existing Mitigation Actions*<br><br>*(2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 2.6.2** - Continue to obtain repetitive loss information to be included in next revision of the Tioga County Hazard Mitigation Plan. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 2.6.3** - DES to work with municipalities and the county assessment office to collect information on the number, locations, and assessed value of all repetitive loss properties throughout the county in order to plan future mitigation activities and create and maintain a current inventory asset list of all structures within the 1%chance-annual-chance floodplain. | | | | | **X** | Combine with 2.6.2 and add "…and incorporate into hazard mitigation planning…"<br><br>Change to special flood hazard area. |
| **Action 2.6.4** - County to work to develop and update a database in existing hazard GIS system of information on all repetitive loss properties including maps to be used in future mitigation. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.1.1** - Stabilize stream banks where needed. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.1.2** - Clean and remove debris from ditches, streams, and culverts. | | | X | | | The LPT decided that this action should be included in the plan update. |

| *Existing Mitigation Actions*<br><br>*(2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 3.1.3** - Investigate and install storm drains, storm sewer, and stormwater basins, and other flood mitigation measures in areas of frequent stormwater inundation. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.1.4** - Replace, repair, or upgrade storm pipes, sluices, culverts, or bridge culverts where needed. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.1.5 -** Conduct a countywide commodity flow study. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.2.1 -** Encourage all municipal offices to review the statewide Uniform Construction Code to ensure the enforcement of these codes as a minimum standard. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.2.2 –** Conduct all-hazard training for emergency responders and conduct exercises to prepare for, and better-respond to all-hazards. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.2.3 -** Develop a Community Emergency Response Team (CERT) to better train community members to assist each other before, during, and after a disaster. | | X | | | | The LPT decided that this action should be included in the plan update. |

| *Existing Mitigation Actions*<br><br>*(2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 3.2.4 -** DES conduct annual tabletop and functional disaster exercises with local law enforcement, emergency managers, county and local officials, and other disaster response agencies. Types of exercises to include flood exercise, hazardous materials spill exercises, and bio terrorism exercises. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.2.5 -** DES to provide information about local regional, state, and federal training opportunities to fire departments, emergency medical services, ambulance services, and other emergency responders. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 3.3.1 -** Enhance the utilization of Knowledge Center situational awareness platform. | | | X | | | Change to WebEOC instead. |
| **Action 3.3.2 -** Develop mutual aid agreements. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 4.1.1 -** Work with municipalities to update their ordinances to address permitting of oil and gas wells. | X | | | | | The LPT decided that this action should be included in the plan update. |

| *Existing Mitigation Actions*<br><br>*(2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 4.1.2 -** Work with watershed associations, non-profits, and other partner organizations to address and identify solutions to acid mine drainage issues in the Tioga River and Pine Creek watersheds. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 4.2.1 -** Assist municipalities with source water protection. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 4.2.2 -** Work with DEP, conservation agencies, park and recreation organizations, wildlife groups, and other appropriate agencies to collect information of the number and location of natural resources areas throughout the country and then develop a GIS layer with the data. | | | X | | | Change to: "Continue to work with…"<br><br>Change "country to county" |
| **Action 4.2.3 -** Planning Department to consider creating and implementing a Storm Water Management Plan within the next five years. | X | | | | | The LPT decided that this action should be included in the plan update. |
| **Action 4.2.4 -** County to work with DEP, conversation agencies, etc., to research avenues for restoring degraded natural resources and open space to improve their flood control functions. | | | X | | | Change to conservation.<br><br>The LPT decided that this action should be included in the plan update. |

| *Existing Mitigation Actions (2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 4.2.5 -** Update and enforce stormwater management ordinance to address inflow/infiltration of stormwater into sanitary sewer from eaves and sump pumps connected to sanitary sewer. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 5.1.1 -** Provide opportunities for individuals to attend weather training courses (i.e., Skywarn). | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 5.1.2 -** Tioga County CART will conduct outreach and develop a plan to train animal owners on proper emergency actions for their animals. | | | X | | | Change to: "Tioga County CART will continue to conduct outreach…" |
| **Action 5.1.3 -** Tioga County will conduct outreach on continuity of business planning. | | | X | | | The LPT decided that this action should be included in the plan update. |
| **Action 5.1.4 -** Tioga county will provide outreach on children's programs that teach safety. | | | X | | | Change to: "Tioga County will continue to provide outreach…" |
| **Action 5.1.5 -** Tioga County will conduct outreach to non-government organizations to promote hazard mitigation education and awareness. | | | X | | | Change to: "Tioga County will continue to conduct outreach…" |
| **Action 5.1.6 -** Tioga County will coordinate and perform disaster training to civilians. | | | X | | | The LPT decided to include this action in the plan update. |

| *Existing Mitigation Actions*<br><br>*(2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 5.1.7 -** Tioga County to continue to provide hazard related information that is easily accessible on their website, including information about disaster preparedness and related activities. | | | X | | | The LPT decided to include this action in the plan update. |
| **Action 5.1.8 -** Tioga County will conduct outreach to school districts on disaster preparedness. | | | X | | | Change to: "Tioga County will continue to conduct…" |
| **Action 5.2.1 -** Work with the municipalities to hold a series of public meetings with owners of repetitive loss properties in high-risk areas. These meetings will also be used to identify high risk properties in the rural areas of the county and to determine potential participation in future acquisition and relocation of projects. | | | X | | | The LPT decided to include this action in the plan update. |
| **Action 5.2.2 -** Hold meeting to identify high-risk properties in the county and to determine potential participation in the future acquisition and relocation projects. | | | | | **X** | Remove this action as it is duplicative. |
| **Action 5.2.3 -** Tioga County will perform outreach to the public on hazard mitigation. | | | X | | | The LPT decided to include this action in the plan update. |

| *Existing Mitigation Actions (2017 HMP)* | *Status* | | | | | *Review Comments* |
|---|---|---|---|---|---|---|
| | No Progress/ Unknown | In Progress/Not Yet Complete | Continuous | Completed | Discontinued | |
| **Action 5.2.4 -** Develop the Tioga County Continuity of Government Plan. | | | X | | | "Continue to implement and maintain the Tioga County Continuity of Government Plan." |
| **Action 5.2.5 -** Develop the Tioga County Continuity of Operations Plan. | | | X | | | "Continue to develop…" |
| **Action 5.3.1 -** Tioga County DES to hold training sessions with the county municipalities and insurance companies on the National Flood Insurance Program (NFIP) requirements. | | | | | | The LPT decided to include this action in the plan update. |
| **Action 5.3.2 -** Perform outreach to county property owners or renters within the 1%-chance-annual-chance flood-plain regarding potential flood hazards. | | | | | | Change to special flood hazard area. |

## 6.2. Mitigation Goals and Objectives

Based on results of the goals and objectives evaluation exercise and input from the local planning team, a list of six goals and eighteen corresponding objectives was developed. *Table 72 – 2022 Goals and Objectives* details the mitigation goals and objectives established for the 2022 Tioga County Hazard Mitigation Plan.

*Table 72 - 2022 Goals and Objectives*

| 2022 Mitigation Goals and Objectives | |
|---|---|
| **GOAL Objective** | **Description** |
| **GOAL 1** | **Reduce the level of risk to life and property from natural and human-caused disasters in Tioga County.** |
| Objective 1.1 | Direct any new development away from high hazard areas and review existing regulations to ensure adequacy in reducing the amount of future development in high hazard areas. |
| Objective 1.2 | Review all local and county comprehensive plans to ensure that designated growth areas are not in high hazard areas. |
| Objective 1.3 | Review all capital improvement plans to ensure that infrastructure improvements are not directed towards high-hazard areas. |
| Objective 1.4 | Evaluate floodplain ordinances to exceed NFIP standards to reduce flooding instances and reduce flood insurance premiums where possible. |
| Objective 1.5 | Continue to improve the enforcement of existing floodplain regulations. |
| **GOAL 2** | **Reduce the potential impact to life and property from natural and human-caused disasters in Tioga County.** |
| Objective 2.1 | Protect Tioga County's functional populations, and most at-risk Critical Infrastructure and Key Resources (CIKR) through the implementation of cost-effective and technically feasible mitigation projects. |
| Objective 2.2 | Continue to regularly meet as a Mitigation Advisory Committee (MAC) to coordinate the planning, development, and implementation of mitigation actions and project opportunities listed in the hazard mitigation plan for Tioga County and all participating municipalities. |
| Objective 2.3 | Continue building the local and county capabilities for performing external messaging (i.e., mass notification) to the public before, during, and after an incident. |
| Objective 2.4 | Research possible mitigation projects to reduce flooding, reduce/eliminate sewage leakage, and inflow/infiltration problems. Some projects may include reservoirs, levees, floodwalls, diversions, channel modification, and storm sewers. |

| GOAL Objective | Description |
|---|---|
| Objective 2.5 | Gather best practices on other successful hazard mitigation projects to utilize in future mitigation actions and projects. |
| Objective 2.6 | Complete actions and projects to acquire, elevate, demolish or demolish/reconstruct properties, repetitive loss properties and severe repetitive loss properties. |
| **GOAL 3** | **Increase the level of capabilities to protect life safety and property from natural and human-caused disasters in Tioga County.** |
| Objective 3.1 | Identify potential funding opportunities to plan for, develop, and implement hazard mitigation projects. |
| Objective 3.2 | Facilitate adequate training and resources for emergency organizations and personnel. |
| Objective 3.3 | Expand pre-disaster collaboration amongst all levels of government and continue building systems to share mitigation opportunities between them. |
| **GOAL 4** | **Protect existing natural resources and open space, including parks and wetlands to improve their flood control functions.** |
| Objective 4.1 | Protect Tioga County's natural resources through the implementation of cost effective and technically feasible mitigation projects. |
| Objective 4.2 | Protect Tioga County's natural resources through the implementation of recreation planning and storm water management planning. |
| **GOAL 5** | **Increase public awareness of existing hazards and communicate the differences between individual and municipal responsibilities for taking action to mitigate those hazards.** |
| Objective 5.1 | Develop and distribute public awareness materials about natural and human-caused hazards, risks, impacts, and the existing capabilities as well as potential actions individuals and municipalities can take to mitigate those hazards. |
| Objective 5.2 | Target owners of properties within identified hazard areas for additional outreach regarding mitigation and disaster preparedness. |

| GOAL Objective | Description |
|---|---|
| Objective 5.3 | Educate residents and municipal officials about existing floodplain ordinances which meet or exceed the NFIP standards. |
| **GOAL 6** | **Participate in FEMA's High-Hazard Potential Dam Program (HHPD).** |
| Objective 6.1 | Educate Tioga County municipalities, property owners, and businesses about FEMA's HHPD program. |
| Objective 6.2 | Reduce long-term vulnerabilities from eligible high-hazard potential dams that pose an unacceptable risk to the public. |

## 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:

- Planning and regulations
- Structure and infrastructure
- Natural systems protection
- Education and awareness

**Planning 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 planning and regulations technique will protect and reduce the impact of specific hazards on new and existing buildings by improving building code standards and regulating new and renovation construction. The improved building codes will decrease the impact of risk hazards. Subdivision and land development enhancements will also augment this process. Ensuring that

municipalities participate in the National Flood Insurance Program and encourage participation in the Community Rating System will decrease the impact as well.

**Structure and infrastructure implementation**: These actions involve modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. The following are examples:

- Acquisitions and elevations of structures in flood prone areas
- Utility undergrounding
- Structural retrofits
- Floodwalls and retaining walls
- Detention and retention structures
- Culverts
- Safe rooms

Structure and infrastructure implementation is a technique that removes or diverts the hazard from structures or protects the structure from a specific hazard. The new or renovated structures are therefore protected or have a reduced impact of hazards.

**Natural Resource Protection**: These are actions that minimize damage and losses and also preserve or restore the functions of natural systems. They include the following:

- Erosion and sediment control
- Stream corridor restoration
- Forest management
- Conservation easements
- Wetland restoration and preservation

Natural resource protection techniques allow for the natural resource to be used to protect or lessen the impact on new or renovated structures through the management of these resources. Utilization and implementation of the examples above will protect new and existing buildings and infrastructure.

**Education and Awareness**: These are actions to inform and educate citizens, elected officials and property owners about hazards and potential ways to mitigate them and may also include participation in national programs. Examples of these techniques include the following:

- Radio and television spots
- Websites with maps and information
- Real estate disclosure
- Provide information and training
- NFIP outreach
- StormReady

- Firewise Communities

The education and awareness technique will protect and reduce the impact of specific hazards on new and existing buildings through education of citizens and property owners on the impacts that specific hazards could have on new or renovated structures. This information will allow the owner to make appropriate changes or enhancements that will lessen or eliminate the impact of hazards.

*Table 73 – Mitigation Strategy Technique Matrix* provides a matrix identifying the mitigation techniques used for all low, moderate, and high-risk hazards in the county. The specific actions associated with these techniques are included in *Table 74 – 2022 Mitigation Action Plan*.

*Table 73 - Mitigation Strategy Technique Matrix*

| Tioga County Mitigation Strategy Technique Matrix | | | | |
|---|---|---|---|---|
| **HAZARD** | **MITIGATION TECHNIQUE** | | | |
| | **Local Plans and Regulations** | **Structural and Infrastructure** | **Natural Systems Protection** | **Education and Awareness** |
| Drought | X | | X | X |
| Earthquake | X | X | | X |
| Landslides | X | X | | X |
| Flooding | X | X | X | X |
| Invasive Species | X | | X | X |
| Pandemic and Infectious Disease | X | | X | X |
| Solar Flare | X | X | | X |
| Disorientation | X | X | | X |
| Radon Exposure | X | X | | X |
| Extreme Temperatures | X | X | | X |
| Tornado/Windstorm | X | X | | X |
| Opioid Epidemic | X | X | | X |
| Wildfires | X | X | X | X |
| Winter Storms | X | X | | X |
| Subsidence and Sinkholes | X | X | | X |
| Civil Disturbance/Criminal Activity | X | X | | X |
| Dam Failure | X | | X | X |
| Emergency Services | X | | | X |
| Environmental Hazards | X | X | | X |
| Terrorism/Cyber Attack | X | | | X |
| Transportation Accidents/Transportation of Hazardous Materials | X | X | | X |

| HAZARD | MITIGATION TECHNIQUE | | | |
|---|---|---|---|---|
| | Local Plans and Regulations | Structural and Infrastructure | Natural Systems Protection | Education and Awareness |
| Utility Interruptions | X | X | | X |

## 6.4. Mitigation Action Plan

The Tioga County Hazard Mitigation Local Planning Team (LPT) immediately began work on the mitigation strategy section of the 2022 hazard mitigation plan (HMP) update after the risk assessment section was completed. The LPT started this section by reviewing the 2017 HMP mitigation strategy section. A review of the previous goals, objectives, actions and project opportunities documented in the 2017 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 both in-person and via virtual platforms. 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. Municipalities that were not able to attend meetings were contacted individually.

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 2022 Tioga County HMP are listed in the mitigation action plan. *Table 74 – 2022 Mitigation Action Plan* is the 2022 Tioga County Mitigation Action Plan. This plan outlines mitigation actions and projects that comprise a strategy for Tioga 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 74 – 2022 Mitigation Action Plan* is a matrix that identifies the county and/or municipalities responsible for mitigation actions in the new mitigation action plan.

*Table 74 - 2022 Mitigation Action Plan*

| Tioga County 2022 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 | Continue to encourage municipal offices to review regulations pertaining to their jurisdiction to make sure that adequate zoning regulations are in place to reduce future development in high hazard areas in their jurisdiction Planning department to review Subdivision and Land Development Ordinance. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **1.1.2** | Local Plans and Regulations | Develop a countywide Firewise Plan | Wildfire | **X** | | | 2022-2026 | Local and DCNR | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **1.2.1** | Local Plans and Regulations | The Planning Commission will continue to work with 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** | | 2022-2026 | Local | Tioga County Planning Commission |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **1.2.2** | Local Plans and Regulations | Encourage applicable municipal offices to review their capital improvement plans to ensure that programmed infrastructure improvements are not in high hazard areas. | All Hazards | | **X** | | 2022-2026 | Local | Tioga County Municipalities |
| **1.2.3** | Local Plans and Regulations | Continue to review the existing Tioga County Emergency Operations Plan (EOP) and update where necessary based on recommendations of the Hazard Mitigation Plan. Include participation from municipalities by ensuring that their EOP's are reviewed and updated annually. | All Hazards | **X** | | | 2022-2026 | EMPG/Local | Tioga County Department of Emergency Services and Municipalities |
| **1.3.1** | Local Plans and Regulations | Review the Tioga County capital improvement plan annually to ensure that development does not occur in high hazard areas. | All Hazards | | **X** | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **1.4.1** | Local Plans and Regulations | Maintain the floodplain manager position in the county. | Flooding, Flash Flooding, Ice Jam Flooding | | **X** | | 2022-2026 | Local | Tioga County Municipalities |
| **1.5.1** | Local Plans and Regulations | Enforce and update the municipal floodplain ordinances to reduce the impact of flooding. | Flood, Flash Flood and Ice Jam Flooding | | **X** | | Continuous | Local | Tioga County Municipalities |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **1.6.1** | Local Plans and Regulations | Tioga County will develop a one stop shop for NFIP information and other disaster program information that will support hazard mitigation planning for all hazards. | Flooding, Flash Flooding, Ice Jam Flooding | **X** | | | 2022-2026 | Local/FMA /EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **1.7.1** | Structure and Infrastructure | Continue to coordinate with American Red Cross to ensure shelters have the ability to receive emergency power by determining the connections for generators at each shelter. | Utility Interruption | | **X** | | 2022-2026 | Local and EMPG | Red Cross, Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **1.7.2** | Local Plans and Regulations | Develop a shelter plan. | All Hazards | | **X** | | 2022-2026 | Local and EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.1.1** | Local Plans and Regulations | Coordinate with Tioga County CART to develop evacuation plans and emergency shelter plans for pets. | All Hazards | | **X** | | 2022-2026 | Local and EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.1.2** | Structure and Infrastructure | Continue to distribution of NOAA Weather Radios to Tioga County municipalities, schools, hospitals, nursing homes, day care centers, and SARA facilities. | All Hazards | **X** | | | 2022-2026 | Local and EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **2.2.1** | Local Plans and Regulations | The Tioga County Local Emergency Planning Committee (LEPC) should continue reviewing proposed emergency response plans from hazardous materials facilities in the area. | Hazardous Materials | | **X** | | 2022-2026 | Local and EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.2.2** | Education and Awareness | Continue to review feedback on hazard mitigation surveys submitted by municipalities. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Mitigation Advisory Council |
| **2.2.3** | Structures and Infrastructure | Continue to produce and submit Hazard Mitigation Project Opportunity Forms for high-risk structures/areas (especially post-disaster). | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.2.4** | Local Plans and Regulations | Continue to regularly meet as a Tioga County Mitigation Advisory Council. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.3.1** | Structure and Infrastructure | Maintain the Tioga County 911 Center equipment. | All Hazards | **X** | | | 2022-2026 | Local/911 Funding | Tioga County 911 |
| **2.3.2** | Structure and Infrastructure | Continue to test the current Emergency Alert Warning Sirens and equipment to reach all populated areas throughout the county. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **2.3.3** | Structure and Infrastructure | Continue to use, update and enhance the Swift 911 system in Tioga County. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.3.4** | Local Plans and Regulations | Conduct training for Emergency Management Coordinators (EMC) on all emergency management operations. | All Hazards | **X** | | | 2022-2026 | Local/EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.4.1** | Local Plans and Regulations | Assessment office to continue collecting and updating information for structures within the special flood hazard area in addition to structures that are not in the floodplain but are prone to flooding. This information will include map number, assessed value and structure type. | Flooding, Flash Flooding and Ice Jam Flooding | | **X** | | 2022-2026 | Local/EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.5.1** | Local Plans and Regulations | Develop a strategy to address abandoned and blighted properties in the county. | All Hazards | | **X** | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **2.5.2** | Natural Systems Protection | Develop a strategy for vegetative buffers. | Flooding, Flash Flooding and Ice Jam Flooding | | **X** | | 2022-2026 | BRIC/FMA | Department of Environmental Protection, Tioga County Mitigation Advisory Council, and Tioga County Conservation District |
| **2.5.3** | Local Plans and Regulations | Continue to educate fire companies about ISO ratings. | All Hazards | | **X** | | 2022-2026 | Local | Tioga County Department of Emergency Services |
| **2.5.3** | Local Plans and Regulations | Establish a hazard mitigation workgroup that includes utility providers to investigate ways to decrease utility outages | Utility Interruptions | **X** | | | 2022-2026 | To Be Determined in the Future | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.6.1** | Local Plans and Regulations | Continue to target flood prone properties for acquisition, relocation, elevation and demolition/reconstruction countywide, completing Hazard Mitigation Opportunity Forms when applicable, and meet with homeowners on the benefits of mitigation opportunity. | All Hazards | **X** | | | 2022-2026 | HMGP/BRIC/FMA | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **2.6.2** | Local Plans and Regulations | Continue to obtain repetitive loss information to be included in next revision of the Tioga County Hazard Mitigation Plan. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.6.3** | Local Plans and Regulations | DES to work with municipalities and the county assessment office to collect information on the number, locations and assessed value of all repetitive loss properties throughout the county in order to plan future mitigation activities and create and maintain a current inventory asset list of all structures within the special flood hazard area and incorporate into hazard mitigation planning. | Flooding, Flash Flooding, and Ice Jam Flooding | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **2.6.4** | Local Plans and Regulations | County to work to develop and update a database in existing hazard GIS system of information on all repetitive loss properties including maps to be used in future mitigation | Flooding, Flash Flooding, and Ice Jam Flooding | **X** | | | 2022-2026 | Local | Tioga County GIS Department |
| **3.1.1** | Natural Systems Protection | Stabilize stream banks where needed. | Flooding, Flash Flooding, and Ice Jam Flooding | **X** | | | 2022-2026 | BRIC/FMA | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **3.1.2** | Natural Systems Protection | Clean and remove debris from ditches, streams, and culverts. | Flooding, Flash Flooding, and Ice Jam Flooding | **X** | | | 2022-2026 | Local | Tioga County Municipalities |
| **3.1.3** | Structure and Infrastructure | Investigate and install storm drains, storm sewer, and stormwater basins and other flood mitigation measures in areas of frequent stormwater inundation. | Flooding, Flash Flooding, and Ice Jam Flooding | **X** | | | 2022-2026 | Local/BRIC /FMA | Tioga County Municipalities |
| **3.1.4** | Structure and Infrastructure | Replace, repair, or upgrade storm pipes, sluices, culverts or bridge culverts where needed. | Flooding, Flash Flooding, and Ice Jam Flooding | **X** | | | 2022-2026 | Local/BRIC /FMA | Tioga County Municipalities |
| **3.1.5** | Local Plans and Regulations | Conduct a countywide commodity flow study. | Hazardous Materials Fixed and Transportation | | **X** | | 2022-2026 | HMEP | Tioga County LEPC |
| **3.1.6** | Structural and Infrastructure | Install emergency generators at critical facilities and other essential facilities to enhance capabilities during utility outages | Utility Interruptions | | **X** | | 2022-2026 | Local/BRIC /CDBG | Tioga County Mitigation Advisory Council |
| **3.1.7** | Education and awareness | Provide education material to the public regarding the risks of cyber-crimes. | Cyber Attack | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **3.1.8** | Education and awareness | Research recruitment and retention grants to assist first responders in Tioga County. | Emergency Services | **X** | | | 2022-2026 | Local/AFG/ State Fire Grant | Tioga County Department of Emergency Services |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **3.2.1** | Local Plans and Regulations | Encourage all municipal offices to review the statewide Uniform Construction Code to ensure the enforcement of these codes as a minimum standard. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Planning Commission |
| **3.2.2** | Education and Outreach | Conduct all hazard training for emergency responders and conduct exercises to prepare for and better respond to all hazards. | All Hazards | **X** | | | 2022-2026 | Local/EMPG/HMEP | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council/Tioga County Municipalities |
| **3.2.3** | Education and Outreach | Develop a Community Emergency Response Team (CERT) to better train community members to assist each other before, during, and after a disaster. | All Hazards | | **X** | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **3.2.4** | Education and Outreach | DES conduct annual tabletop and functional disaster exercises with local law enforcement, emergency managers, county and local officials, and other disaster response agencies. Types of exercises to include: Flood Exercise, Hazardous Materials Spill Exercises and Bio Terrorism Exercises. | All Hazards | **X** | | | 2022-2026 | Local/EMPG/HMEP/HSGP | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **3.2.5** | Education and Outreach | DES to provide information about local, regional, state, and federal training opportunities to fire departments, emergency medical services, ambulance services, and other emergency responders. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **3.3.1** | Education and Outreach | Enhance the utilization of WebEOC situational awareness platform. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services |
| **3.3.2** | Local Plans and Regulations | Develop mutual aid agreements. | All Hazards | | **X** | | 2022-2026 | Local | Tioga County Department of Emergency Services and Tioga County Municipalities |
| **4.1.1** | Local Plans and Regulations | Work with municipalities to update their ordinances to address permitting of oil and gas wells. | Hazardous Materials | | **X** | | 2022-2026 | Local | Tioga County Planning Commission |
| **4.1.2** | Local Plans and Regulations | Work with watershed associations, non-profits, and other partner organizations to address and identify solutions to acid mine drainage issues in the Tioga River and Pine Creek watersheds. | Flooding, Flash Flooding, and Ice Jam Flooding | | | **X** | 2022-2026 | Local | Department of Environmental Protection and Tioga County Mitigation Advisory Council and Tioga County Conservation District |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **4.2.1** | Local Plans and Regulations | Assist municipalities with source water protection. | Drought | | **X** | | 2022-2026 | Local | Department of Environmental Protection, Tioga County Mitigation Advisory Council, and Tioga County Conservation District |
| **4.2.2** | Natural Systems Protection | Continue to work with DEP, conservation agencies, park and recreation organizations, wildlife groups and other appropriate agencies to collect information of the number and location of natural resource areas throughout the county and then develop a GIS layer with the data. | All Hazards | | **X** | | 2022-2026 | To Be Determined in the Future | Department of Environmental Protection and Tioga County Mitigation Advisory Council Tioga County Conservation District |
| **4.2.3** | Local Plans and Regulations | Planning Department to consider creating and implementing a Storm Water Management Plan within the next five years. | Flooding, Flash Flooding, and Ice Jam Flooding | | **X** | | 2022-2026 | Local | Tioga County Planning Commission |
| **4.2.4** | Natural Systems Protection | County to work with DEP, conservation agencies, etc., to research avenues for restoring degraded natural resources and open space to improve their flood control functions. | Flooding, Flash Flooding, and Ice Jam Flooding | | **X** | | 2022-2026 | Local | Department of Environmental Protection, Tioga County Mitigation Advisory Council, and Tioga County Conservation District |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **4.2.5** | Local Plans and Regulations | Update and enforce stormwater management ordinance to address inflow/infiltration of stormwater into sanitary sewer from eaves and sump pumps connected to sanitary sewer. | Flooding, Flash Flooding, and Ice Jam Flooding | | **X** | | 2022-2026 | Local/BRIC Funding | Department of Environmental Protection, Tioga County Mitigation Advisory Council, and Tioga County Conservation District |
| **5.1.1** | Education and Outreach | Provide opportunities for individuals to attend weather training courses (i.e., Skywarn). | All Natural Hazards | **X** | | | 2022-2026 | Local | Tioga County Mitigation Advisory Council |
| **5.1.2** | Education and Outreach | Tioga County Animal Response Team will continue to conduct outreach and develop a plan to train animal owners on proper emergency actions for their animals. | All Hazards | **X** | | | 2022-2026 | EMPG/ Local/HGGP | Tioga County Animal Response Team |
| **5.1.3** | Education and Outreach | Tioga County will conduct outreach on continuity of business planning. | All Hazards | | **X** | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.1.4** | Education and Outreach | Tioga County will continue to provide outreach on children's programs that teach safety. | All Hazards | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council Tioga County Municipalities |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **5.1.5** | Education and Outreach | Tioga County will continue to conduct outreach to non-governmental organizations to promote hazard mitigation education and awareness. | All Hazards | **X** | | | 2022-2026 | Local/HMGP | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council Tioga County Municipalities |
| **5.1.6** | Education and Outreach | Tioga County will coordinate and perform disaster training to civilians. | All Hazards | **X** | | | 2022-2026 | To Be Determined in the Future | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.1.7** | Education and Outreach | Tioga County to continue to provide hazard related information that is easily accessible on their website, including information about disaster preparedness and related activities. | All Hazards | **X** | | | 2022-2026 | To Be Determined in the Future | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.1.8** | Education and Outreach | Tioga County will continue to conduct outreach to school districts on disaster preparedness. | All Hazards | **X** | | | 2022-2026 | To Be Determined in the Future | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.1.9** | Education and awareness | Provide education material to the public regarding the risks of cyber-crimes. | Cyber Attack | **X** | | | 2022-2026 | To Be Determined in the Future | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **5.1.10** | Education and awareness | Continue to encourage the public to adhere to CDC guidelines. | Pandemic and Infectious Disease | **X** | | | 2022-2026 | Local | Tioga County Government |
| **5.1.11** | Education and awareness | Conduct public outreach in reference to the spotted lantern fly via social media platforms. | Invasive Species | **X** | | | 2022-2026 | Local | Department of Conservation and Natural Resources and Tioga County Mitigation Advisory Council |
| **5.1.12** | Education and awareness | Educate community groups, employers, persons at high-risk for an overdose, and persons in contact with high-risk individuals about substance use disorder and treatment and recovery options. | Opioid Epidemic | **X** | | | 2022-2026 | Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.2.1** | Education and Outreach | Work with the municipalities to hold a series of public meetings with owners of repetitive loss properties in high-risk areas. These meetings will also be used to identify high-risk properties in the rural areas of the county and to determine potential participation in future acquisition and relocation projects. | All Hazards | **X** | | | 2022-2026 | FMA/BRIC /LOCAL/E MPG | Tioga County Mitigation Advisory Council |
| **5.2.3** | Education and Outreach | Tioga County will perform outreach to the public on hazard mitigation. | All Hazards | **X** | | | 2022-2026 | Local/HMG P | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **5.2.4** | Local Plans and Regulations | Continue to implement and maintain the Tioga County Continuity of Government Plan. | All Hazards | | **X** | | 2022-2026 | Local/EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.2.5** | Local Plans and Regulations | Continue to implement and maintain the Tioga County Continuity of Operations Plan. | All Hazards | | **X** | | 2022-2026 | Local/EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.3.1** | Local Plans and Regulations | Tioga County DES to hold training sessions with the county municipalities and insurance companies on the National Flood Insurance Program (NFIP) requirements. | Flooding, Flash Flooding, and Ice Jam Flooding | | **X** | | 2022-2026 | HMGP/Local | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **5.3.2** | Local Plans and Regulations | Perform outreach to county property owners or renters within the special flood hazard area regarding potential flood hazards. | Flooding, Flash Flooding, and Ice Jam Flooding | **X** | | | 2022-2026 | FMA/HMGP/Local/EMPG | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **6.1.1** | Local Plans and Regulations | Work with all appropriate partners to continue evaluating and updating (when possible) dams and their respective Emergency Action Plans. | Dam Failures | | **X** | | 2022-2026 | Local/EMPG | Tioga County Department of Emergency Services |

| Tioga County 2022 Mitigation Action Plan | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Action Number | Mitigation Actions | | | Prioritization | | | Implementation | | |
| | Category | Description/ Action Items | Hazard Vulnerability | High | Medium | Low | Schedule | Funding | Responsibility |
| **6.1.2** | Education and Awareness | Distribute educational pamphlets about the HHPD program. | Dam Failures | | **X** | | 2022-2026 | HHPD | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **6.1.3** | Education and Awareness | Utilize all municipal social media pages to disseminate important information regarding the HHPD program to Tioga County residents. | Dam Failures | | **X** | | 2022-2026 | HHPD | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |
| **6.2.1** | Local Plans and Regulations | Enhance local mitigation policies and programs that address high-hazard potential dams. | Dam Failures | | **X** | | 2022-2026 | HHPD | Tioga County Department of Emergency Services and the Tioga County Mitigation Advisory Council |

**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

HMERP: Hazard Mitigation Emergency Response Program by the Pennsylvania Emergency Management Agency

HHPD: High-hazard potential dam by the Federal Emergency Management Agency

*Table 75 - Municipal Hazard Mitigation Actions Checklist*

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **1.1.1** | **1.1.2** | **1.2.1** | **1.2.2** | **1.2.3** | **1.3.1** | **1.4.1** | **1.5.1** | **1.6.1** | **1.7.1** |
| Bloss Township | X | X | X | X | X | X | X | X | X | X |
| Blossburg Borough | X | X | X | X | X | X | X | X | X | X |
| Brookfield Township | X | X | X | X | X | X | X | X | X | X |
| Charleston Township | X | X | X | X | X | X | X | X | X | X |
| Chatham Township | X | X | X | X | X | X | X | X | X | X |
| Clymer Township | X | X | X | X | X | X | X | X | X | X |
| Covington Township | X | X | X | X | X | X | X | X | X | X |
| Deerfield Township | X | X | X | X | X | X | X | X | X | X |
| Delmar Township | X | X | X | X | X | X | X | X | X | X |
| Duncan Township | X | X | X | X | X | X | X | X | X | X |
| Elk Township | X | X | X | X | X | X | X | X | X | X |
| Elkland Borough | X | X | X | X | X | X | X | X | X | X |
| Farmington Township | X | X | X | X | X | X | X | X | X | X |
| Gaines Township | X | X | X | X | X | X | X | X | X | X |
| Hamilton Township | X | X | X | X | X | X | X | X | X | X |
| Jackson Township | X | X | X | X | X | X | X | X | X | X |
| Knoxville Borough | X | X | X | X | X | X | X | X | X | X |
| Lawrence Township | X | X | X | X | X | X | X | X | X | X |
| Lawrenceville Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield Borough | X | X | X | X | X | X | X | X | X | X |
| Middlebury Township | X | X | X | X | X | X | X | X | X | X |
| Morris Township | X | X | X | X | X | X | X | X | X | X |
| Nelson Township | X | X | X | X | X | X | X | X | X | X |
| Osceola Township | X | X | X | X | X | X | X | X | X | X |
| Putnam Township | X | X | X | X | X | X | X | X | X | X |
| Richmond Township | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **1.1.1** | **1.1.2** | **1.2.1** | **1.2.2** | **1.2.3** | **1.3.1** | **1.4.1** | **1.5.1** | **1.6.1** | **1.7.1** |
| Roseville Borough | X | X | X | X | X | X | X | X | X | X |
| Rutland Township | X | X | X | X | X | X | X | X | X | X |
| Shippen Township | X | X | X | X | X | X | X | X | X | X |
| Sullivan Township | X | X | X | X | X | X | X | X | X | X |
| Tioga Borough | X | X | X | X | X | X | X | X | X | X |
| Tioga Township | X | X | X | X | X | X | X | X | X | X |
| Union Township | X | X | X | X | X | X | X | X | X | X |
| Ward Township | X | X | X | X | X | X | X | X | X | X |
| Wellsboro Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield University | X | X | X | X | X | X | X | X | X | X |
| Tioga County | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **1.7.2** | **2.1.1** | **2.2.1** | **2.2.2** | **2.2.3** | **2.2.4** | **2.3.1** | **2.3.2** | **2.3.3** | **2.3.4** |
| Bloss Township | X | X | X | X | X | X | X | X | X | X |
| Blossburg Borough | X | X | X | X | X | X | X | X | X | X |
| Brookfield Township | X | X | X | X | X | X | X | X | X | X |
| Charleston Township | X | X | X | X | X | X | X | X | X | X |
| Chatham Township | X | X | X | X | X | X | X | X | X | X |
| Clymer Township | X | X | X | X | X | X | X | X | X | X |
| Covington Township | X | X | X | X | X | X | X | X | X | X |
| Deerfield Township | X | X | X | X | X | X | X | X | X | X |
| Delmar Township | X | X | X | X | X | X | X | X | X | X |
| Duncan Township | X | X | X | X | X | X | X | X | X | X |
| Elk Township | X | X | X | X | X | X | X | X | X | X |
| Elkland Borough | X | X | X | X | X | X | X | X | X | X |
| Farmington Township | X | X | X | X | X | X | X | X | X | X |
| Gaines Township | X | X | X | X | X | X | X | X | X | X |
| Hamilton Township | X | X | X | X | X | X | X | X | X | X |
| Jackson Township | X | X | X | X | X | X | X | X | X | X |
| Knoxville Borough | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **1.7.2** | **2.1.1** | **2.2.1** | **2.2.2** | **2.2.3** | **2.2.4** | **2.3.1** | **2.3.2** | **2.3.3** | **2.3.4** |
| Lawrence Township | X | X | X | X | X | X | X | X | X | X |
| Lawrenceville Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield Borough | X | X | X | X | X | X | X | X | X | X |
| Middlebury Township | X | X | X | X | X | X | X | X | X | X |
| Morris Township | X | X | X | X | X | X | X | X | X | X |
| Nelson Township | X | X | X | X | X | X | X | X | X | X |
| Osceola Township | X | X | X | X | X | X | X | X | X | X |
| Putnam Township | X | X | X | X | X | X | X | X | X | X |
| Richmond Township | X | X | X | X | X | X | X | X | X | X |
| Roseville Borough | X | X | X | X | X | X | X | X | X | X |
| Rutland Township | X | X | X | X | X | X | X | X | X | X |
| Shippen Township | X | X | X | X | X | X | X | X | X | X |
| Sullivan Township | X | X | X | X | X | X | X | X | X | X |
| Tioga Borough | X | X | X | X | X | X | X | X | X | X |
| Tioga Township | X | X | X | X | X | X | X | X | X | X |
| Union Township | X | X | X | X | X | X | X | X | X | X |
| Ward Township | X | X | X | X | X | X | X | X | X | X |
| Wellsboro Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield University | X | X | X | X | X | X | X | X | X | X |
| Tioga County | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **2.4.1** | **2.5.1** | **2.5.2** | **2.5.3** | **2.5.4** | **2.6.1** | **2.6.2** | **2.6.3** | **2.6.4** | **3.1.1** |
| Bloss Township | X | X | X | X | X | X | X | X | X | X |
| Blossburg Borough | X | X | X | X | X | X | X | X | X | X |
| Brookfield Township | X | X | X | X | X | X | X | X | X | X |
| Charleston Township | X | X | X | X | X | X | X | X | X | X |
| Chatham Township | X | X | X | X | X | X | X | X | X | X |
| Clymer Township | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **2.4.1** | **2.5.1** | **2.5.2** | **2.5.3** | **2.5.4** | **2.6.1** | **2.6.2** | **2.6.3** | **2.6.4** | **3.1.1** |
| Covington Township | X | X | X | X | X | X | X | X | X | X |
| Deerfield Township | X | X | X | X | X | X | X | X | X | X |
| Delmar Township | X | X | X | X | X | X | X | X | X | X |
| Duncan Township | X | X | X | X | X | X | X | X | X | X |
| Elk Township | X | X | X | X | X | X | X | X | X | X |
| Elkland Borough | X | X | X | X | X | X | X | X | X | X |
| Farmington Township | X | X | X | X | X | X | X | X | X | X |
| Gaines Township | X | X | X | X | X | X | X | X | X | X |
| Hamilton Township | X | X | X | X | X | X | X | X | X | X |
| Jackson Township | X | X | X | X | X | X | X | X | X | X |
| Knoxville Borough | X | X | X | X | X | X | X | X | X | X |
| Lawrence Township | X | X | X | X | X | X | X | X | X | X |
| Lawrenceville Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield Borough | X | X | X | X | X | X | X | X | X | X |
| Middlebury Township | X | X | X | X | X | X | X | X | X | X |
| Morris Township | X | X | X | X | X | X | X | X | X | X |
| Nelson Township | X | X | X | X | X | X | X | X | X | X |
| Osceola Township | X | X | X | X | X | X | X | X | X | X |
| Putnam Township | X | X | X | X | X | X | X | X | X | X |
| Richmond Township | X | X | X | X | X | X | X | X | X | X |
| Roseville Borough | X | X | X | X | X | X | X | X | X | X |
| Rutland Township | X | X | X | X | X | X | X | X | X | X |
| Shippen Township | X | X | X | X | X | X | X | X | X | X |
| Sullivan Township | X | X | X | X | X | X | X | X | X | X |
| Tioga Borough | X | X | X | X | X | X | X | X | X | X |
| Tioga Township | X | X | X | X | X | X | X | X | X | X |
| Union Township | X | X | X | X | X | X | X | X | X | X |
| Ward Township | X | X | X | X | X | X | X | X | X | X |
| Wellsboro Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield University | X | X | X | X | X | X | X | X | X | X |
| Tioga County | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **3.1.2** | **3.1.3** | **3.1.4** | **3.1.5** | **3.1.6** | **3.1.7** | **3.1.8** | **3.2.1** | **3.2.2** | **3.2.3** |
| Bloss Township | X | X | X | X | X | X | X | X | X | X |
| Blossburg Borough | X | X | X | X | X | X | X | X | X | X |
| Brookfield Township | X | X | X | X | X | X | X | X | X | X |
| Charleston Township | X | X | X | X | X | X | X | X | X | X |
| Chatham Township | X | X | X | X | X | X | X | X | X | X |
| Clymer Township | X | X | X | X | X | X | X | X | X | X |
| Covington Township | X | X | X | X | X | X | X | X | X | X |
| Deerfield Township | X | X | X | X | X | X | X | X | X | X |
| Delmar Township | X | X | X | X | X | X | X | X | X | X |
| Duncan Township | X | X | X | X | X | X | X | X | X | X |
| Elk Township | X | X | X | X | X | X | X | X | X | X |
| Elkland Borough | X | X | X | X | X | X | X | X | X | X |
| Farmington Township | X | X | X | X | X | X | X | X | X | X |
| Gaines Township | X | X | X | X | X | X | X | X | X | X |
| Hamilton Township | X | X | X | X | X | X | X | X | X | X |
| Jackson Township | X | X | X | X | X | X | X | X | X | X |
| Knoxville Borough | X | X | X | X | X | X | X | X | X | X |
| Lawrence Township | X | X | X | X | X | X | X | X | X | X |
| Lawrenceville Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield Borough | X | X | X | X | X | X | X | X | X | X |
| Middlebury Township | X | X | X | X | X | X | X | X | X | X |
| Morris Township | X | X | X | X | X | X | X | X | X | X |
| Nelson Township | X | X | X | X | X | X | X | X | X | X |
| Osceola Township | X | X | X | X | X | X | X | X | X | X |
| Putnam Township | X | X | X | X | X | X | X | X | X | X |
| Richmond Township | X | X | X | X | X | X | X | X | X | X |
| Roseville Borough | X | X | X | X | X | X | X | X | X | X |
| Rutland Township | X | X | X | X | X | X | X | X | X | X |
| Shippen Township | X | X | X | X | X | X | X | X | X | X |
| Sullivan Township | X | X | X | X | X | X | X | X | X | X |
| Tioga Borough | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **3.1.2** | **3.1.3** | **3.1.4** | **3.1.5** | **3.1.6** | **3.1.7** | **3.1.8** | **3.2.1** | **3.2.2** | **3.2.3** |
| Tioga Township | X | X | X | X | X | X | X | X | X | X |
| Union Township | X | X | X | X | X | X | X | X | X | X |
| Ward Township | X | X | X | X | X | X | X | X | X | X |
| Wellsboro Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield University | X | X | X | X | X | X | X | X | X | X |
| Tioga County | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **3.2.4** | **3.2.5** | **3.3.1** | **3.3.2** | **4.1.1** | **4.1.2** | **4.2.1** | **4.2.2** | **4.2.3** | **4.2.4** |
| Bloss Township | X | X | X | X | X | X | X | X | X | X |
| Blossburg Borough | X | X | X | X | X | X | X | X | X | X |
| Brookfield Township | X | X | X | X | X | X | X | X | X | X |
| Charleston Township | X | X | X | X | X | X | X | X | X | X |
| Chatham Township | X | X | X | X | X | X | X | X | X | X |
| Clymer Township | X | X | X | X | X | X | X | X | X | X |
| Covington Township | X | X | X | X | X | X | X | X | X | X |
| Deerfield Township | X | X | X | X | X | X | X | X | X | X |
| Delmar Township | X | X | X | X | X | X | X | X | X | X |
| Duncan Township | X | X | X | X | X | X | X | X | X | X |
| Elk Township | X | X | X | X | X | X | X | X | X | X |
| Elkland Borough | X | X | X | X | X | X | X | X | X | X |
| Farmington Township | X | X | X | X | X | X | X | X | X | X |
| Gaines Township | X | X | X | X | X | X | X | X | X | X |
| Hamilton Township | X | X | X | X | X | X | X | X | X | X |
| Jackson Township | X | X | X | X | X | X | X | X | X | X |
| Knoxville Borough | X | X | X | X | X | X | X | X | X | X |
| Lawrence Township | X | X | X | X | X | X | X | X | X | X |
| Lawrenceville Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield Borough | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **3.2.4** | **3.2.5** | **3.3.1** | **3.3.2** | **4.1.1** | **4.1.2** | **4.2.1** | **4.2.2** | **4.2.3** | **4.2.4** |
| Middlebury Township | X | X | X | X | X | X | X | X | X | X |
| Morris Township | X | X | X | X | X | X | X | X | X | X |
| Nelson Township | X | X | X | X | X | X | X | X | X | X |
| Osceola Township | X | X | X | X | X | X | X | X | X | X |
| Putnam Township | X | X | X | X | X | X | X | X | X | X |
| Richmond Township | X | X | X | X | X | X | X | X | X | X |
| Roseville Borough | X | X | X | X | X | X | X | X | X | X |
| Rutland Township | X | X | X | X | X | X | X | X | X | X |
| Shippen Township | X | X | X | X | X | X | X | X | X | X |
| Sullivan Township | X | X | X | X | X | X | X | X | X | X |
| Tioga Borough | X | X | X | X | X | X | X | X | X | X |
| Tioga Township | X | X | X | X | X | X | X | X | X | X |
| Union Township | X | X | X | X | X | X | X | X | X | X |
| Ward Township | X | X | X | X | X | X | X | X | X | X |
| Wellsboro Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield University | X | X | X | X | X | X | X | X | X | X |
| Tioga County | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **4.2.5** | **5.1.1** | **5.1.2** | **5.1.3** | **5.1.4** | **5.1.5** | **5.1.6** | **5.1.7** | **5.1.8** | **5.1.10** |
| Bloss Township | X | X | X | X | X | X | X | X | X | X |
| Blossburg Borough | X | X | X | X | X | X | X | X | X | X |
| Brookfield Township | X | X | X | X | X | X | X | X | X | X |
| Charleston Township | X | X | X | X | X | X | X | X | X | X |
| Chatham Township | X | X | X | X | X | X | X | X | X | X |
| Clymer Township | X | X | X | X | X | X | X | X | X | X |
| Covington Township | X | X | X | X | X | X | X | X | X | X |
| Deerfield Township | X | X | X | X | X | X | X | X | X | X |
| Delmar Township | X | X | X | X | X | X | X | X | X | X |
| Duncan Township | X | X | X | X | X | X | X | X | X | X |
| Elk Township | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **4.2.5** | **5.1.1** | **5.1.2** | **5.1.3** | **5.1.4** | **5.1.5** | **5.1.6** | **5.1.7** | **5.1.8** | **5.1.10** |
| Elkland Borough | X | X | X | X | X | X | X | X | X | X |
| Farmington Township | X | X | X | X | X | X | X | X | X | X |
| Gaines Township | X | X | X | X | X | X | X | X | X | X |
| Hamilton Township | X | X | X | X | X | X | X | X | X | X |
| Jackson Township | X | X | X | X | X | X | X | X | X | X |
| Knoxville Borough | X | X | X | X | X | X | X | X | X | X |
| Lawrence Township | X | X | X | X | X | X | X | X | X | X |
| Lawrenceville Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Borough | X | X | X | X | X | X | X | X | X | X |
| Liberty Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield Borough | X | X | X | X | X | X | X | X | X | X |
| Middlebury Township | X | X | X | X | X | X | X | X | X | X |
| Morris Township | X | X | X | X | X | X | X | X | X | X |
| Nelson Township | X | X | X | X | X | X | X | X | X | X |
| Osceola Township | X | X | X | X | X | X | X | X | X | X |
| Putnam Township | X | X | X | X | X | X | X | X | X | X |
| Richmond Township | X | X | X | X | X | X | X | X | X | X |
| Roseville Borough | X | X | X | X | X | X | X | X | X | X |
| Rutland Township | X | X | X | X | X | X | X | X | X | X |
| Shippen Township | X | X | X | X | X | X | X | X | X | X |
| Sullivan Township | X | X | X | X | X | X | X | X | X | X |
| Tioga Borough | X | X | X | X | X | X | X | X | X | X |
| Tioga Township | X | X | X | X | X | X | X | X | X | X |
| Union Township | X | X | X | X | X | X | X | X | X | X |
| Ward Township | X | X | X | X | X | X | X | X | X | X |
| Wellsboro Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Borough | X | X | X | X | X | X | X | X | X | X |
| Westfield Township | X | X | X | X | X | X | X | X | X | X |
| Mansfield University | X | X | X | X | X | X | X | X | X | X |
| Tioga County | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **5.1.11** | **5.1.12** | **5.2.1** | **5.2.3** | **5.2.4** | **5.2.5** | **5.3.1** | **5.3.2** | **6.1.1** | **6.1.2** |
| Bloss Township | X | X | X | | X | X | | X | X | X |
| Blossburg Borough | X | X | X | | X | X | | X | X | X |
| Brookfield Township | X | X | X | | X | X | | X | X | X |
| Charleston Township | X | X | X | | X | X | | X | X | X |
| Chatham Township | X | X | X | | X | X | | X | X | X |
| Clymer Township | X | X | X | | X | X | | X | X | X |
| Covington Township | X | X | X | | X | X | | X | X | X |
| Deerfield Township | X | X | X | | X | X | | X | X | X |
| Delmar Township | X | X | X | | X | X | | X | X | X |
| Duncan Township | X | X | X | | X | X | | X | X | X |
| Elk Township | X | X | X | | X | X | | X | X | X |
| Elkland Borough | X | X | X | | X | X | | X | X | X |
| Farmington Township | X | X | X | | X | X | | X | X | X |
| Gaines Township | X | X | X | | X | X | | X | X | X |
| Hamilton Township | X | X | X | | X | X | | X | X | X |
| Jackson Township | X | X | X | | X | X | | X | X | X |
| Knoxville Borough | X | X | X | | X | X | | X | X | X |
| Lawrence Township | X | X | X | | X | X | | X | X | X |
| Lawrenceville Borough | X | X | X | | X | X | | X | X | X |
| Liberty Borough | X | X | X | | X | X | | X | X | X |
| Liberty Township | X | X | X | | X | X | | X | X | X |
| Mansfield Borough | X | X | X | | X | X | | X | X | X |
| Middlebury Township | X | X | X | | X | X | | X | X | X |
| Morris Township | X | X | X | | X | X | | X | X | X |
| Nelson Township | X | X | X | | X | X | | X | X | X |
| Osceola Township | X | X | X | | X | X | | X | X | X |
| Putnam Township | X | X | X | | X | X | | X | X | X |
| Richmond Township | X | X | X | | X | X | | X | X | X |
| Roseville Borough | X | X | X | | X | X | | X | X | X |
| Rutland Township | X | X | X | | X | X | | X | X | X |
| Shippen Township | X | X | X | | X | X | | X | X | X |
| Sullivan Township | X | X | X | | X | X | | X | X | X |
| Tioga Borough | X | X | X | | X | X | | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **5.1.11** | **5.1.12** | **5.2.1** | **5.2.3** | **5.2.4** | **5.2.5** | **5.3.1** | **5.3.2** | **6.1.1** | **6.1.2** |
| Tioga Township | X | X | X | | X | X | | X | X | X |
| Union Township | X | X | X | | X | X | | X | X | X |
| Ward Township | X | X | X | | X | X | | X | X | X |
| Wellsboro Borough | X | X | X | | X | X | | X | X | X |
| Westfield Borough | X | X | X | | X | X | | X | X | X |
| Westfield Township | X | X | X | | X | X | | X | X | X |
| Mansfield University | X | X | X | | X | X | | X | X | X |
| Tioga County | X | X | X | X | X | X | X | X | X | X |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **6.1.3** | **6.2.1** | | | | | | | | |
| Bloss Township | X | X | | | | | | | | |
| Blossburg Borough | X | X | | | | | | | | |
| Brookfield Township | X | X | | | | | | | | |
| Charleston Township | X | X | | | | | | | | |
| Chatham Township | X | X | | | | | | | | |
| Clymer Township | X | X | | | | | | | | |
| Covington Township | X | X | | | | | | | | |
| Deerfield Township | X | X | | | | | | | | |
| Delmar Township | X | X | | | | | | | | |
| Duncan Township | X | X | | | | | | | | |
| Elk Township | X | X | | | | | | | | |
| Elkland Borough | X | X | | | | | | | | |
| Farmington Township | X | X | | | | | | | | |
| Gaines Township | X | X | | | | | | | | |
| Hamilton Township | X | X | | | | | | | | |
| Jackson Township | X | X | | | | | | | | |
| Knoxville Borough | X | X | | | | | | | | |
| Lawrence Township | X | X | | | | | | | | |
| Lawrenceville Borough | X | X | | | | | | | | |
| Liberty Borough | X | X | | | | | | | | |
| Liberty Township | X | X | | | | | | | | |

| Municipal Hazard Mitigation Actions Checklist | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **6.1.3** | **6.2.1** | | | | | | | | |
| Mansfield Borough | **X** | **X** | | | | | | | | |
| Middlebury Township | **X** | **X** | | | | | | | | |
| Morris Township | **X** | **X** | | | | | | | | |
| Nelson Township | **X** | **X** | | | | | | | | |
| Osceola Township | **X** | **X** | | | | | | | | |
| Putnam Township | **X** | **X** | | | | | | | | |
| Richmond Township | **X** | **X** | | | | | | | | |
| Roseville Borough | **X** | **X** | | | | | | | | |
| Rutland Township | **X** | **X** | | | | | | | | |
| Shippen Township | **X** | **X** | | | | | | | | |
| Sullivan Township | **X** | **X** | | | | | | | | |
| Tioga Borough | **X** | **X** | | | | | | | | |
| Tioga Township | **X** | **X** | | | | | | | | |
| Union Township | **X** | **X** | | | | | | | | |
| Ward Township | **X** | **X** | | | | | | | | |
| Wellsboro Borough | **X** | **X** | | | | | | | | |
| Westfield Borough | **X** | **X** | | | | | | | | |
| Westfield Township | **X** | **X** | | | | | | | | |
| Mansfield University | **X** | **X** | | | | | | | | |
| Tioga County | **X** | **X** | | | | | | | | |

# 7. Plan Maintenance

## 7.1. Update Process Summary

Monitoring, evaluating, and updating this plan, is critical to maintaining its value and success in Tioga 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 Tioga County HMP Local Planning Team decided to alter the current maintenance procedures. The 2022 HMP update establishes a review of the plan within thirty 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 2022 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 Tioga County is a responsibility of all levels of government (i.e., county and local), as well as the citizens of the county. The Tioga County Local Planning Team will be responsible for maintaining this multi-jurisdictional HMP. The local planning team will meet annually and following each emergency declaration to review the plan. Every municipality that has adopted this plan will also be afforded the opportunity to provide updated information or information specific to hazards encountered during an emergency or disaster. Each review process will ensure that the hazard vulnerability data and risk analysis reflect current conditions of the county, that the capabilities assessment accurately reflects local 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 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 Tioga 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 annual plan review will be distributed to appropriate representatives at both PEMA and FEMA. The following items will be completed during the annual review and reporting process:

- Review the risk assessment section and identify occurrences of hazards within the last year. Identify date, time, damage, fatalities and other specific information of the events. Also identify any new hazards that have occurred or increased risk within the county.

- Complete a review and update of capability assessment section. Identify any capability weaknesses.
- Complete a review of the mitigation strategy section. Review the goals and objectives identified in the 2022 HMP and determine if any updates are needed. Provide all mitigation actions and opportunities to the county and municipalities that are applicable. Have all entities complete an action review matrix and document all results in the report. Also, add any new actions that are identified. Complete a review of each mitigation opportunity and identify the status of each opportunity on the opportunity review spreadsheet. All information will be included in the annual review report.

Tioga County Department of Emergency Services will maintain a copy of these records and place them in Appendix I of this plan. Tioga 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

Tioga County Department of Emergency Services will ensure that the 2022 Tioga County Hazard Mitigation Plan is posted and maintained on the Tioga County website and will continue to encourage public review and comment on the plan. The Tioga County website that the plan will be located at is as follows:
http://www.tiogacountypa.us/Departments/Emergency_Services/Pages/Hazard-Mitigation-Plan.aspx

The public will have access to the 2022 HMP through their local municipal office, the Tioga County Planning Commission, or Tioga 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 Tioga County are encouraged to submit their comments to elected officials and/or members of the Tioga County HMP Local Planning Team. To promote public participation, the Tioga 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 Tioga 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 2022 Tioga County Hazard Mitigation Plan. Copies of the adopting resolutions are included in this plan in Appendix J. 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:** 2022 HAZUS Reports

**APPENDIX G:** 2022 Mitigation Project Opportunities

**APPENDIX H:** 2022 Mitigation Action Evaluation & Prioritization

**APPENDIX I:** Annual Review Documentation

**APPENDIX J:** Tioga County & Municipal Adoption Resolutions