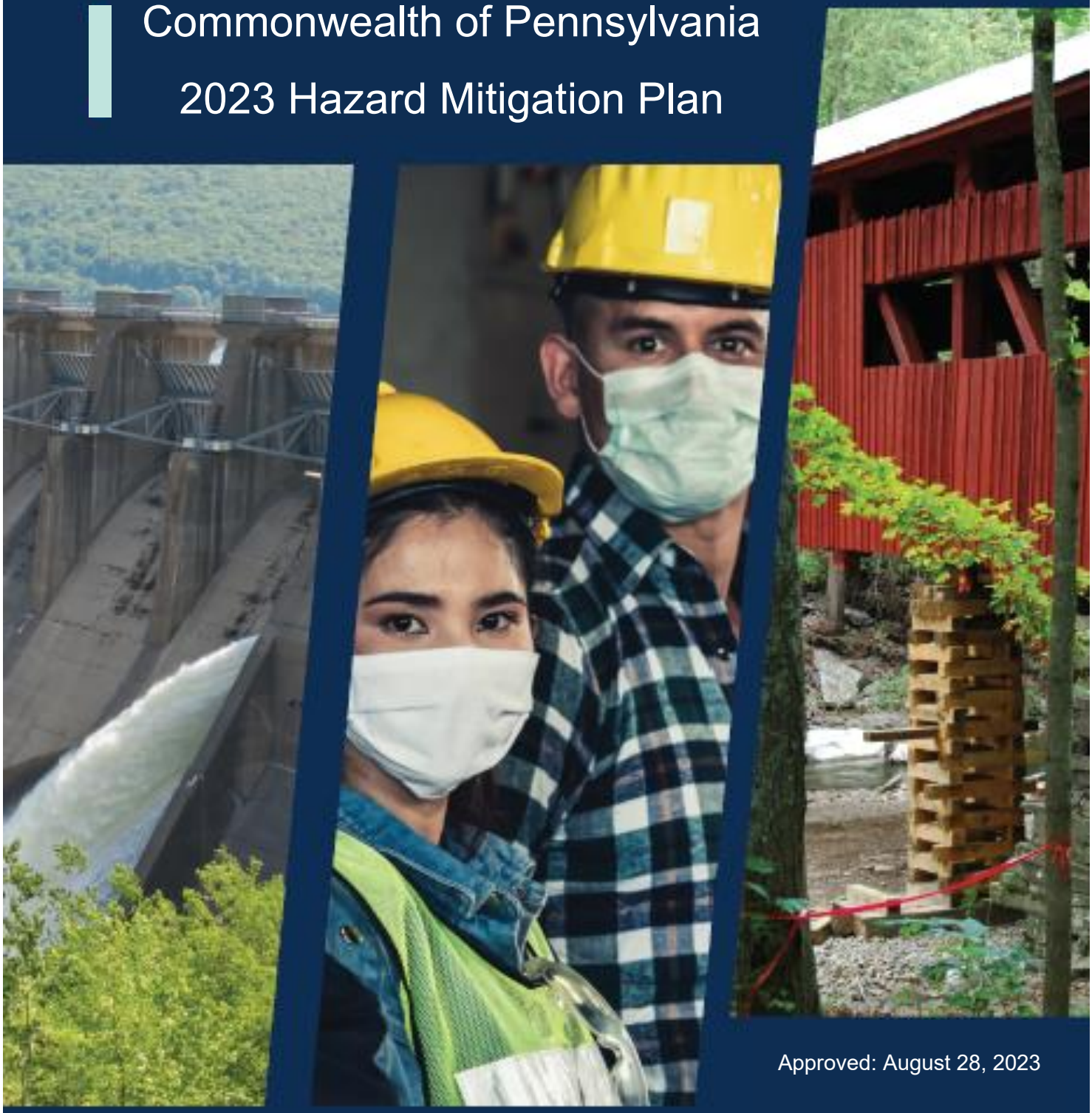
Commonwealth of Pennsylvania
2023 Hazard Mitigation Plan



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HIGHLIGHTED PLAN UPDATES 2023

From June 2022 - May 2023, Pennsylvania Emergency Management Agency (PEMA) led 65 state agencies participating in the 2023 PA Hazard Mitigation Plan Update (PA HMP), including 60 of the 67 counties, and over 100 nonprofits, watershed associations, and other interested entities.

Agency/Organization Participation

- 65 Agencies and Organizations represented
- 109 people participating from diverse Agencies and Organizations
- 37 individual meetings: in-person or remote (Teams, Zoom, conference call)
- 700+ outreach emails

With 37 meetings -both virtual and in-person- with large and small groups and over 700 outreach emails, PEMA and its contractor raised questions and discussions about:

219 Actions in 2023

- 123 out of 129 actions were carried over from 2018 to 2023.
- 96 new actions.
- 6 actions from the 2018 HMP Plan were moved to capability/removed.
- 39% actions led by PEMA (⬇19%)

From this process, stakeholders developed 96 new actions to achieve mitigation efforts and measure success.

The result is a 2023 Plan that provides more regional and local agencies with information and the steps to plan for potential hazards that will save lives and protect property in Pennsylvania.

INTRODUCTION

The Pennsylvania Hazard Mitigation Plan identifies dangers in the Commonwealth, assesses their impact on people and property and develops plans to reduce those risks. It also helps Pennsylvania to qualify for funding, comply with legal requirements, and improve community resilience after a disaster.

Planning Process

The **2023 State Hazard Mitigation Plan** includes the input of more people from a broader range of State agencies than the 2018 Plan. Compared to the 2018 update, there was a 30% increase in participation from the State Hazard Mitigation Team, and the involvement of stakeholders and the public increased by 71%.

Lead Agencies

- 24 agencies in 2018
- 41 agencies in 2023 Update
- 71% increase from 2018 to 2023
- 129 agencies and organizations supporting

This means that more organizations and individuals are now aware of the planning process and the resources that are available for mitigation. Moreover, a more diverse group of voices contributed to the mitigation strategies outlined in the plan, including analyses of historic property vulnerability and the effects of climate change.

2023 Plan Update Priorities

The updated plan acknowledges the mandate to consider the impact of climate change adaptation throughout the document and maximizes the efforts and collaboration of state agencies and stakeholders already doing State Hazard mitigation work.

7 New Objectives

- Flood Protection
- Climate Change (2)
- Pandemic/Infectious Disease
- Substance Use Disorder
- Equity – Historically Underserved and Marginalized Populations (2)

The updated plan added new objectives for mitigation actions such as acknowledging the lack of equity infused in previous Hazard and Mitigation efforts, identifies underserved and underrepresented groups, and considers new ways of engagement and funding to serve those groups and additional objectives.

COMMONWEALTH PROFILE

A **Commonwealth Economic State Profile has been added to the 2023 HMP Update** and is an important tool for hazard mitigation planning because it provides critical information that can help emergency managers and planners make informed decisions about:

1. Resource Allocation

Understanding the economic profile of a state helps emergency managers and planners decide where to allocate resources when there is a disaster.

For example: If a state has a lot of farms, it might be necessary to spend more money on protecting crops and livestock during a flood or hurricane.

2. Cost-Benefit Analysis

Cost-benefit analysis: Economic profiles can be used to conduct cost-benefit analyses of hazard mitigation measures.

For example: If a state has a high percentage of small businesses, it may be more cost-effective to provide incentives for them to relocate to less hazardous areas than to invest in costly infrastructure upgrades.

3. Recovery Planning

An economic profile can be useful when planning how to recover from a disaster. Emergency managers can prioritize helping the sectors of the economy and target assistance to areas most affected by the disaster.

4. Funding

Many hazard mitigation and disaster recovery programs are funded based on economic factors, such as a state's gross domestic product (GDP) or tax revenue. An accurate economic profile helps ensure a state receives the funding it needs to prepare for and recover from hazard events.

EXECUTIVE SUMMARY

Unemployment

Unemployment rates are **4.2% for Men** and **4% for Women.** Employment has recovered overall from the COVID-19 pandemic, yet some industries and racial groups have not experienced equal recovery.

(BLS, 2022)

Employment

Employment rates are **64% for Men** and **55% for Women.** **People in ages groups 24-34 and 35-44** are the largest labor blocks in the state yet at the same time have the highest unemployment rates.

(BLS, 2022)

Employment by Race/Ethnicity

White residents make up the majority of employed persons in the state, and Asian residents have the largest share of their total population employed and the lowest unemployment rate. Black or African American residents have the lowest share of their total population employed and the highest unemployment rate.

(BLS, 2023)

Gross Domestic Product (GDP)

In 2022, PA recorded the 6th highest numbers across the country for adjusted GDP with **$727.2 billion** and the **total personal income was $848.5 billion.**

(BEA, 2022)

Labor Force Participation

Multiple age groups 25-54 and 55+ are leaving the workforce. Stakeholders from different economic sectors are concerned about how this shortage affects their ability to operate normally and respond to hazards.

(BLS, 2022)

Major Industries

Education and Health Services is the top employment industry followed by:

- Trade, Transportation, and Utilities
- Professional and Business Services
- Manufacturing

Education and Health Services is a beneficial specialization for hazard mitigation efforts, particularly for responding to public health emergencies and disasters.

(BLS, 2023)

Digital Economy & Inequality

The digital divide is linked to inequalities in income, education, race, ethnicity, age, immigration status, and geography, and can make these groups more vulnerable to hazards.

RISK ASSESSMENT

In Pennsylvania, a total of **33 unique hazardous events** were identified in 2023 and further organized into two groups: **Human-caused and Natural-caused**. Hazards are compared and ranked according to six Risk Assessment Categories which notably include Climate Change as an added category in the 2023 plan.

5 Top Hazard Events

- All Hazards: 97
- Floods: 66
- Extreme Temperature: 16
- Pandemic/Infectious Disease: 14
- Utility Interruption: 10

Risk Assessment Categories

Risk Assessment Categories as defined in *Figure 1* help determine the degree of risks the Commonwealth and Pennsylvanians may face, identify which areas are most at risk, and provide guidance on how to develop mitigation actions.

Risk Assessment Categories + Definitions					
Probability	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**Climate Change**
What is the likelihood of a hazard event occurring in a given year?	Are injuries, damage, death, and economic impact anticipated to be minor, limited, critical, or catastrophic during the hazard event?	How large of an area could be impacted by a hazard? Are impacts localized or regional?	Is there usually some lead time associated with the hazard event? Have warning measures been implemented?	How long does the hazard event usually last?	How will climate change impact the other 5 ratings for the hazard?

Figure 1: Risk Assessment Categories & Definitions

Each county was asked to evaluate the potential hazards they are at risk to experience which is outlined in *Figure 2* below.

	Hazards *This chart combines overlapping findings from multiple Risk Assessments as seen in the full report.*	
	Human-Caused	**Natural-Caused**
HIGH RISK (ranked from 1-10 with 1 having the greatest amount of risk factors)	Substance Use Disorder (2) Cyber-terrorism (3) Transportation Incident (5) Hazardous Materials Release (6) Utility Interruption (10)	Flood, Flash Flood, Ice Jam (1) Winter Storms (4) Extreme Temperatures (7) Hurricane, Tropical Storm, Nor'easter (8) Pandemic and Infectious Disease (9)
MEDIUM RISK	Building or Structure Collapse Civil Disturbance Coal Mining Conventional Oil/ Gas Wells Dam Failure Gas and Liquid Pipeline Levee Failure Mass Food/Animal Feed Contamination Nuclear Incident Unconventional Oil/Gas Wells Urban Fire and Explosion Solar Weather Terrorism	Coastal Erosion Drought Invasive Species Landslide Lightning Strike Radon Exposure Subsidence, Sinkhole Tornado, Wind Storm Wildfire
LOW RISK	Conventional/Improvised Bombs	Earthquake Hailstorm

Figure 2: List of Hazards by Cause and Risk Profile

Three hazards that saw the largest overall risk increase were:

- Substance Use Disorder,
- Pandemic, and
- Building and Structure Collapse

Although the Pandemic hazard has been profiled in past HMPs, COVID-19 Pandemic caused massive disruptions in health, social, and economic sectors and necessitated additional focus in the 2023 HMP.

Counties gave higher risk ratings to hazards associated with climate change like **Drought**, **Extreme Temperatures**, **Flooding,** and **Severe Storms** than they did in the previous 2018 Plan.

Hazards such **Transportation Incidents, Landslide, Mass Food/Animal Feed Contamination, Subsidence/Sink Hole**, and **Levee Failure** were rated as an increased risk than previously in 2018.

CAPABILITY ASSESSMENT

All levels of government including local, regional, and state play an important role in the Commonwealth's mitigation efforts and work together cohesively to reduce the loss of life and property in Pennsylvania. The capability assessment provides an opportunity to highlight the positive mitigation measures already in place or being implemented throughout the Commonwealth, which should continue to be supported and enhanced if possible through future mitigation efforts.

Changing Capabilities

Workforce shortages have led to concern from stakeholders that capabilities have decreased across sectors, agencies, and programs as staffing issues impact their ability to operate and respond to disasters.

PA DEP assisted in creating the nation's second Climate Leadership Program, which produced 150 graduates in 2021 that were trained in climate change impacts and policy-driven solutions to mitigate them.

The number of communities that participate in NFIP has increased, yet the number of policies and total coverage have decreased by 24% and 17%, respectively.

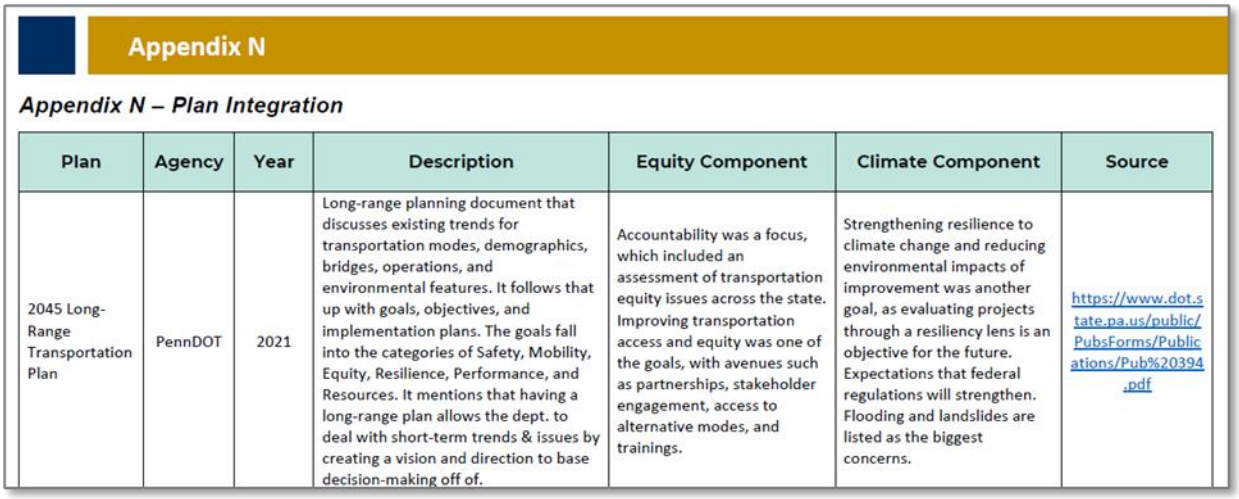
Recovery funds from the COVID-19 Pandemic have supported the creation of new programs. The Emergency Rental Assistance Program (ERAP) has administered over $1 billion in funding to help renters. The COVID-19 ARPA PA Broadband Infrastructure Program, beginning in May 2023, uses funding to targeted locations across Pennsylvania to

PennVEST has funded 24 stormwater management projects since 2018, providing $63,376,764 in total funding.

The 2022 DCED Action Plan utilizes $58 million in program allocations to increase the availability of affordable housing and provide assistance to homebuyers and individuals at risk of experiencing homelessness.

Pennsylvania became the sixth state in the country with full-county participation in the StormReady program, which assists communities in communication and safety training to increase preparedness and response.

Appendix N (below) has been updated to include how plans and programs have incorporated equity and climate change considerations.



Appendix N

Appendix N – Plan Integration

Plan	Agency	Year	Description	Equity Component	Climate Component	Source
2045 Long-Range Transportation Plan	PennDOT	2021	Long-range planning document that discusses existing trends for transportation modes, demographics, bridges, operations, and environmental features. It follows that up with goals, objectives, and implementation plans. The goals fall into the categories of Safety, Mobility, Equity, Resilience, Performance, and Resources. It mentions that having a long-range plan allows the dept. to deal with short-term trends & issues by creating a vision and direction to base decision-making off of.	Accountability was a focus, which included an assessment of transportation equity issues across the state. Improving transportation access and equity was one of the goals, with avenues such as partnerships, stakeholder engagement, access to alternative modes, and trainings.	Strengthening resilience to climate change and reducing environmental impacts of improvement was another goal, as evaluating projects through a resiliency lens is an objective for the future. Expectations that federal regulations will strengthen. Flooding and landslides are listed as the biggest concerns.	https://www.dot.state.pa.us/public/PubsForms/Publications/Pub%20394.pdf

MITIGATION STRATEGY

The mitigation strategy reflects an increase of responsibility for other organizations besides PEMA to take leadership in addressing hazard mitigation. **In the 2023 PA HMP, 41 different agencies and organizations are committed to lead mitigation actions.** Compared to 2018 (24 actions led by other agencies) this is a 171% increase.

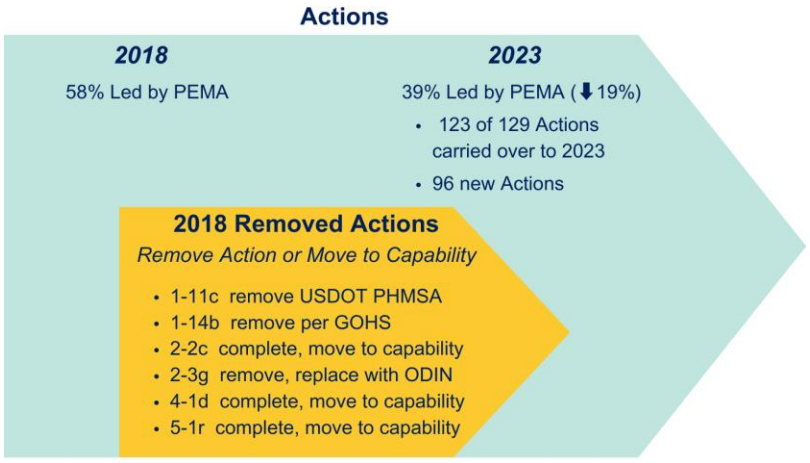
5 Top Agencies Leading Mitigation Actions in 2023 [142 actions]

- Pennsylvania Emergency Management Agency (PEMA) [85]
- Department of Environmental Protection (DEP) [26]
- Department of Conservation and Natural Resources (DCNR) [13]
- Department of Community and Economic Development (DCED) [11]
- Department of Health (DOH) [7]

The Mitigation Strategy for the 2023 State HMP serves as a blueprint for reducing or avoiding Pennsylvania's long-term vulnerabilities to hazards identified in the Risk Assessment including a series of broad goals, objectives, and actions developed to reduce loss of life and property.

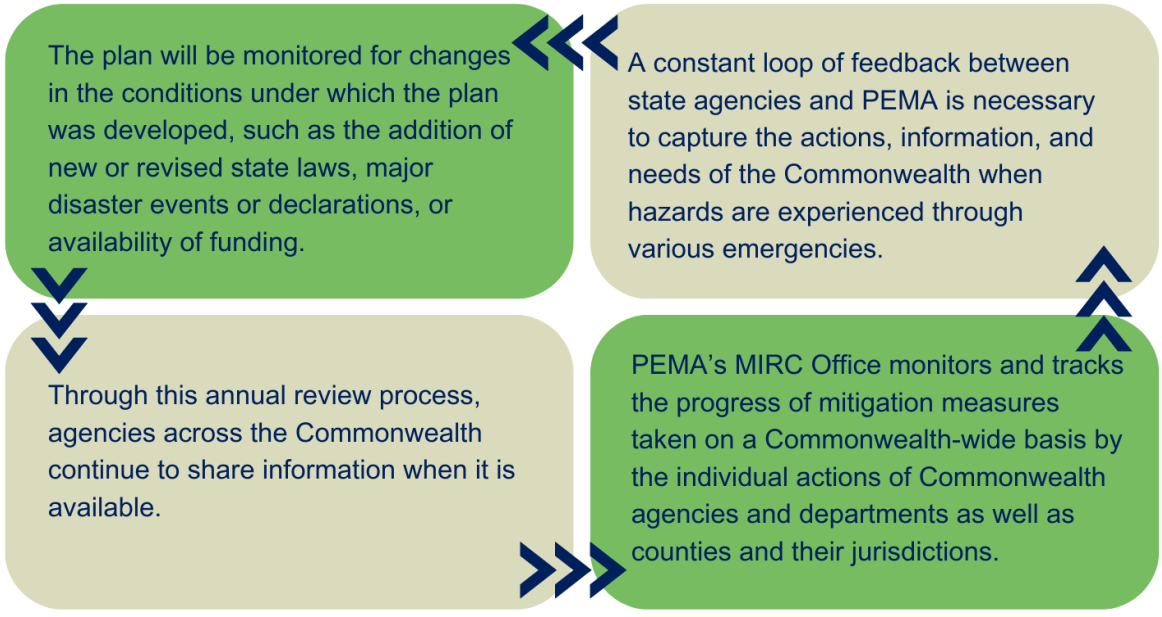
In total, **5 goals** are supported by **29 objectives**, with **a total of 219 actions.**

- **Goals** are broad policy statements representing desired long-term results.
- **Objectives** describe strategies or implementation steps to attain the identified goals.
- **Actions** are more specific than objectives, and have identified responsible parties, timeframes, potential funding sources, and measures of success.



PLAN MAINTENANCE

Plan maintenance steps are critical to maintaining the value and success in the Commonwealth's hazard mitigation efforts and can be simplified into the following steps:



PLAN ADOPTION

The State Hazard Mitigation Plan Update process began in June 2022, with the final updated 2023 plan expected to be released in October 2023. Between the time of publishing of this Executive Summary and October 2023, FEMA will conduct its review and likely require a number of revisions over the coming months to maintain the enhanced status of the Plan -as shown in *Figure 3*. We anticipate the plan being ready for Pennsylvania's adoption by October 2023.

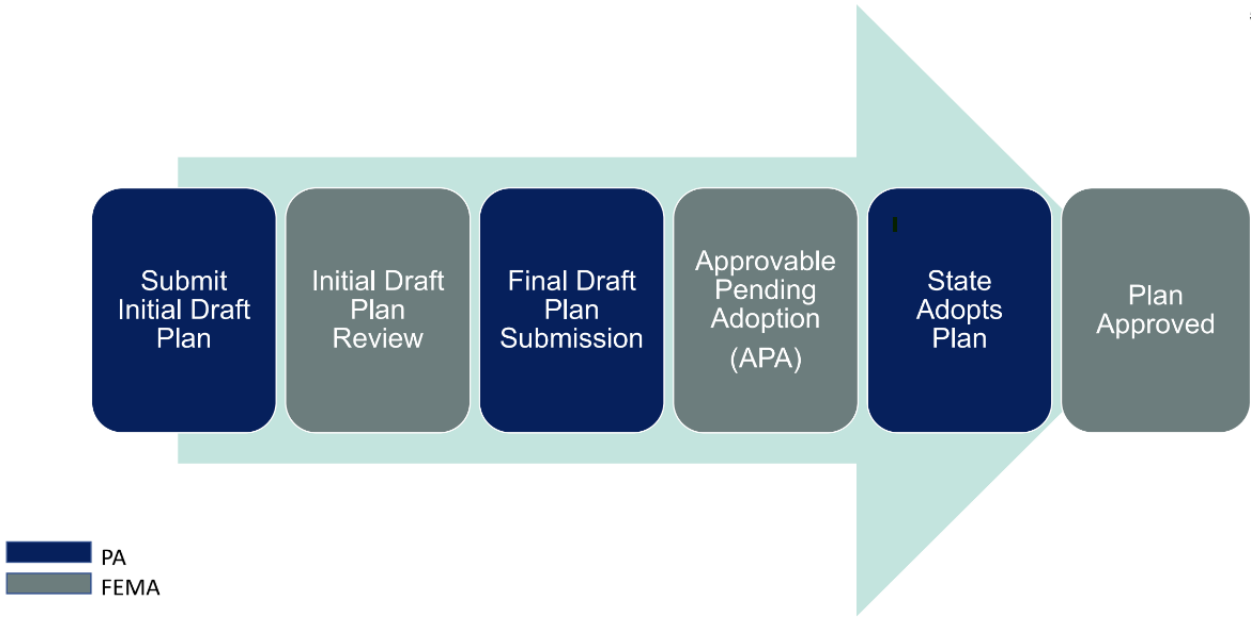


Figure 3: Plan Adoption Process Timeline (PA & FEMA)

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List of Acronyms

ARO	American Rivers Organization
ASFPM	Association of State Floodplain Managers
ATV	All-Terrain Vehicle
BOF	Bureau of Forestry
BRIC	Building Resilience Infrastructure and Communities
CAC	Community Assistance Contacts
CAP	Community Assistance Program
CAV	Community Assistance Visits
CDBG-DR	Community Development Block Grant-Disaster Recovery
CDC	Centers for Disease Control and Prevention
CDMS	Comprehensive Data Management System
CEUS	Central and Eastern United States
CFR	Code of Federal Regulation
COOP	Continuity of Operations Plan
CRCC	Commonwealth Response and Coordination Center
CRS	Community Rating System
DCED	Pennsylvania Department of Community and Economic Development
DCNR	Pennsylvania Department of Conservation and Natural Resources
DDAP	Pennsylvania Department of Drug and Alcohol Programs
DEP	Pennsylvania Department of Environmental Protection
DHS	U.S. Department of Homeland Security
DLI	Pennsylvania Department of Labor and Industry
DMA	Disaster Mitigation Act of 2000
DOH	Pennsylvania Department of Health
DRBC	Delaware River Basin Commission
DVMT	Daily vehicle miles traveled
EALs	Emergency Action Levels
EAP	Emergency Action Plan
EDA	U.S. Economic Development Agency
EF-Scale	Enhanced Fujita Scale
EMAP	Emergency Management Accreditation Program
EMPG	Emergency Management Performance Grant
EOC	Emergency Operations Center
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986
EPZ	Emergency Planning Zone
ESF	Emergency Support Function
FAC	Flood Advisory Committee
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
F-Scale	Fujita Scale

GIS	Geographic Information System
GSTF	Greatest Savings to the Fund
Hazus	Hazards United States Multi-Hazard (FEMA risk assessment software)
HIRA	Hazard Identification Risk Assessment
HM Toolkit	Commonwealth of Pennsylvania's All-Hazard Mitigation Planning and Project Identification Toolkit
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMPO	Hazard Mitigation Project Opportunity
HUD	United States Department of Housing and Urban Development
HVAC	Heating, Ventilating and Air Conditioning
ICC	Increase Cost of Compliance
ICPRB	Interstate Commission on the Potomac River Basin
KEMA	Keystone Emergency Management Agency
LEPC	Local Emergency Planning Committee
LiDAR	Light Detection and Ranging
LMRDP	Local Municipal Resources and Development Program
LUPTAP	Land Use Planning and Technical Assistance Program
MIRC Office	Mitigation, Insurance, and Resilient Communities Office
MPO	Model Plan Outline
NCEI	National Centers for Environmental Information
NEMIS	National Emergency Management Information System
NFIA	National Flood Insurance Act of 1968
NFIF	National Flood Insurance Fund
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NORMS	Normally occurring radioactive materials
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
NWS	NOAA-National Weather Service
PA MAPPS	PA Management Association for Private Photogrammetric Surveyors
PA SHPO	Pennsylvania State Historic Preservation Office
PACD	Pennsylvania Association of Conservation Districts
PAFPM	PA Association of Floodplain Managers
PAGs	Protective Action Guides
PASDA	Pennsylvania Spatial Data Access
PASSHE	Pennsylvania State System of Higher Education
pCi/L	pico Curies per Liter
PDM	Pre-Disaster Mitigation
PDMS	Post-Defueling Monitored Storage
PDSI	Palmer Drought Severity Index

PEMA	Pennsylvania Emergency Management Agency
PEMA-KC	PEMA-Knowledge Center (incident management software)
PennDOT	Pennsylvania Department of Transportation
PennFIRS	Pennsylvania Fire Information Reporting System
PENNVEST	Pennsylvania Infrastructure Investment Authority
PHFA	Pennsylvania Housing Finance Agency
PHGA	Peak Horizontal Ground Acceleration
PHMC	Pennsylvania Historical and Museum Commission
PHMSA	United States Department of Transportation – Pipeline and Hazardous materials Safety Administration
PISC	Governor's Invasive Species Council of Pennsylvania
PNP	Private Non-profit
PRA	Probabilistic Risk Assessment
PSATS	Pennsylvania State Association of Township Supervisors
PUC	Pennsylvania Public Utilities Commission
REC	Record of Environmental Consideration
RF	Risk Factor
RFC	Repetitive Flood Claims
RL	Repetitive Loss
SARA	Superfund Amendments and Reauthorization Act of 1986
SBA	United States Small Business Administration
SCC	State Conservation Commission
SEOP	Commonwealth's State Emergency Operation Plan
SHMO	State Hazard Mitigation Officer
SHMP	State Hazard Mitigation Plan
SHSS	State Homeland Security Strategy
SOG	Commonwealth of Pennsylvania's All-Hazard Mitigation Planning Standard Operating Guide
SPT	State Planning Team
SRBC	Susquehanna River Basin Commission
SRL	Severe Repetitive Loss
SHMP	State Hazard Mitigation Plan
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988
TDS	Total Dissolved Solids
THIRA	Threat and Hazard Identification and Risk Assessment
TRI	Toxic Release Inventory
UCC	Uniform Construction Code
UDP	Urban Development Program
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFS	United States Forest Service

1 Introduction

1. Introduction

1.1. Background

Hazard mitigation describes sustained actions taken to reduce or eliminate long-term risks to life and property from hazards and create successive benefits over time. Mitigation is effective both before and after disaster events. Mitigating in advance of a disaster is preferred to avoid impact. However, mitigation is often implemented after a disaster because that is where it finds its greatest political and community will for implementation. 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. Post-disaster mitigation happened during the process of recovery when re-building elevates and otherwise protects people and property from future risk. With careful selection, successful mitigation actions are cost-effective means of reducing risk of loss over the long-term. Mitigation will play a critical role both before and after disaster events as the Commonwealth aims to protect communities from current and future risk from climate change (FEMA, 2022a).

Hazard mitigation has been an inherent value of the Commonwealth since Pennsylvania's founding by William Penn. In Pennsylvania, natural, environmental and human-made hazards are managed through a system that is based on rights and responsibilities of individuals as well as local and state government. The Commonwealth has created efforts to make communities safer and sustainable for future generations through this system. The Pennsylvania Emergency Management Agency (PEMA) has been legislatively charged with coordinating Commonwealth government to prepare the State Hazard Mitigation Plan (SHMP).

Note that Pennsylvania is one of four states in the U.S. that is officially designated as a *Commonwealth*. Therefore, with exception of certain terms such as the *State Planning Team*, *State Critical Facilities*, and others where applicable, Pennsylvania is referred to as a Commonwealth within the body of this SHMP.

Natural and human-made disasters have led to increasing levels of deaths, injuries, property damage, and interruption of business and government services across the United States. This trend is projected to increase due to the impacts of climate change, therefore adding data, analysis, and action related to climate change was a key component of this plan update. The time, money and effort needed to recover from these disasters exhausts resources, diverting attention from important public programs and private agendas. Since 1953, there have been fifty-three Presidential Disaster Declarations and ten Presidential Emergency Declarations in Pennsylvania (FEMA, 2022b).

Accordingly, the Pennsylvania Hazard Mitigation State Planning Team (SPT), composed of government agency leaders, academia, and other organizations, has prepared this SHMP update. This all-hazard mitigation plan will guide the Commonwealth towards greater disaster resilience, while also respecting the character and needs of its local communities. This plan will consider mitigation, and how it is related to other similar efforts including adaptation, resiliency, sustainability, recovery, and climate response. While all of these efforts are different in nature, they have similar goals. As FEMA notes in the State Mitigation Planning Policy Guide (2022), Climate change increases the frequency, duration, and intensity of natural hazards, such as wildfires, extreme heat, drought, storms, heavy precipitation, and sea level rise. Communities feel the impacts of climate change now and may continue to as these trends will continue for decades. The American Planning Association (APA) Climate Change Report provides a framework of how these efforts are all interrelated, which is included in Table 1.1-1 (APA, 2022):

Table 1.1-1 Interrelated Frameworks (APA, 2022)

FRAMEWORK	DEFINITION	EXAMPLES
Hazard Mitigation	A series of actions that lessen the severity or intensity of a hazard when it strikes.	Greenspace preservation, crop rotation, sustainable design, water-efficient fixtures, renewable energy
Sustainability	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs	Promoting effective land-use planning, relocating critical infrastructure, improving building codes, purchase of flood insurance, elevation of structures
Emergency Response/ Recovery	The response during and after an event to restore or return to the previous condition and in many cases to produce a better state	Emergency response plans and training, disaster warning systems, pre-event public outreach and education
Climate Mitigation	Human intervention to reduce the sources or enhance the sinks of greenhouse gases	Reduction of fossil fuel consumption, increased energy efficiency and renewable energy production, development of carbon sinks
Climate Adaptation	The process of adjustment to actual or expected climate and its effects	Raising infrastructure and the base flood elevations of buildings in coastal areas, modifying road design standards
Climate Resilience	The ability to prepare and plan for, absorb, respond, recover from, and more successfully adapt to adverse events.	Development standards that anticipate and respond to the projected changing climate, regional grid self-sufficiency and optimization, critical services and business continuity planning

FEMA's State Mitigation Planning Policy Guide (2022) expands on the definitions to say community resilience is "the ability to prepare for anticipated hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions. Activities such as disaster

preparedness (which includes prevention, protection, mitigation, response, and recovery) and reducing community stressors (the underlying social, economic and environmental conditions that can weaken a community) are key steps to resilience."

In addition to the frameworks above, equity considerations were a central focus throughout the update process for this plan. There are a variety of terms that may be used to describe "disadvantaged communities," with different terms highlighting different types of disadvantages. Underinvested communities may be those that don't benefit from a lot of local, state, and government funding and therefore have disadvantages compared to those that do receive those benefits. For purposes of this HMP, **disadvantaged communities that are marginalized, overburdened, underserved, or socially vulnerable** are defined per FEMA's Memorandum for Building Resilient Infrastructure and Communities (BRIC) and Flood Mitigation Assistance (FMA) Grant Program Applicants and Sub applicants, Alternative Cost-Effectiveness Methodology for Fiscal Year 2022 BRIC and FMA Application Cycle (10/06/22). Communities that are considered disadvantaged meet one of the following criteria (FEMA, 2022c):

- An area at the census tract level with a score of greater than or equal to 0.6 on the Center for Disease Control's Social Vulnerability Index (SVI)
- Live in a geographic area within a tribal jurisdiction or an Insular Area as defined by 48 U.S.C. § 1469a
- A community of 3,000 or fewer individuals with residents having an average per capita annua income not exceeding 80 percent of the national per capita income, based on the best available data.
    - This criterion is only used for applications in the BRIC grant program

In addition to the guidance provided by this FEMA, the Justice 40 Initiative has created the goal that 40 percent of the benefits from specific federal investment go to disadvantaged communities. These investments include climate change, energy efficiency, affordable housing, critical infrastructure, pollution reduction, and workforce development. The Climate and Economic Justice Screening Tool (CEJST) has been developed as an online tool to help federal agencies identify disadvantaged communities. Census tracts that are overburdened and underserved are highlighted as being disadvantaged on the CEJST. The tool is available at https://screeningtool.geoplatform.gov/en/#10.17/41.9089/-78.085.

Pennsylvania Department of Environmental Protection (DEP) has an environmental justice tool as well that maps out environmental justice areas across Pennsylvania. DEP defines environmental justice areas as any census tract where 20 percent or more individuals live at or below the federal poverty line, and/or 30 percent or more of the population identifies as a non-white minority, based on data from the U.S. Census Bureau and federal guidelines for poverty. The map is available at: https://www.dep.pa.gov/PublicParticipation/OfficeofEnvironmentalJustice/Pages/PA-Environmental-Justice-Areas.aspx

Please note that Pennsylvania State Agencies are working together through the Grant Equity workgroup, to not only define these terms for Pennsylvania but also identify how to best support

applicable populations in grant application, administration, project implementation, and close out.

On an individual level, this plan update includes person-first terminology such as “individuals with substance use disorders” or “individuals experiencing homelessness.” When applicable, disasters that are not naturally occurring are referenced as “human-made.”

1.2. Purpose

This Hazard Mitigation Plan was developed to align with the FEMA identified purpose of:

- Risk-Informed Mitigation Strategies
- Cooperative Relationships and an Integrated State Planning Framework that Strengthens connections between the local and state plan
- Improve mitigation capabilities

The SPT has further expanded on these guiding principles to include:

- Identifying hazards present in the Commonwealth.
- Determining the areas impacted by identified hazards that affect the lives and property of Pennsylvania citizens.
- Assessing what has been and should be done to reduce or eliminate the impact of identified hazards on Pennsylvania citizens.
- Developing and implementing a hazard mitigation action plan to make Pennsylvania citizens safer in the future.
- Qualifying for pre-disaster and post-disaster grant funding.
- Complying with state and federal legislative requirements related to state hazard mitigation planning.
- Demonstrating a firm commitment to hazard mitigation principles and building capacity to improve and complete more mitigation projects.
- Fostering collaboration and cooperation through a robust and ongoing planning process.
- Improving community resiliency following a disaster event.
- Integrating the plans and programs developed by state agencies and generating efficiency across state partnerships.

1.3. Scope

Emergency Management Services Code, 35 Pa. C.S. Section 7503, as amended, gives specific authority to each political entity to prepare and implement plans that benefit the health and well-being of Pennsylvania citizens. While these plans represent “good common sense”, they also meet the federal statutory requirement for mitigation plans that enable communities to receive the full range of post-disaster assistance or mitigation grants.

This SHMP has been prepared using federal guidance as well as best mitigation practices employed successfully in areas of the Commonwealth and throughout the nation. We intend for plan scope to include anyone who lives, works, passes through, or is impacted by Pennsylvania. Additionally, should a disaster occur that requires a presidential disaster declaration, this plan

provides compliance with federal regulations that will enable expeditious availability of eligible mitigation funds.

1.4. Authority and References

Authority for this plan originates from the following federal sources:

- Code of Federal Regulations (CFR), Title 44, Parts 79.4, 201 and 206.
- Disaster Mitigation Act (DMA) of 2000, Public Law 106-390, as amended.
- National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq.
- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended.
- *Executive Order 12989 on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.* February 1994.
- *Executive Order 13985 on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government.* January 2021.
- *Executive Order 14008 on Tackling the Climate Crisis at Home and Abroad.* January 2021.
- *Executive Order 14030 on Climate-Related Financial Risk.* May 2021.
- *Interim Implementation Guidance for the Justice40 Initiative.* July 2021.

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

- Pennsylvania Emergency Management Services Code, Title 35, Chapter 73.
- Pennsylvania Floodplain Management Act of 1978. P.L. 851, No. 166.
- Pennsylvania Municipalities Planning Code Act of 1968, P.L. 805, No. 247 as reenacted and amended by Act 270 of 1988.
- Pennsylvania Stormwater Management Act of 1978, P.L. 864, No. 167.
- Pennsylvania Public Safety Emergency Telephone Act of 1990 (Act 78)
- Pennsylvania Radiation Protection Act, 1984-147 (Act 147)
- Pennsylvania Hazardous Material Emergency Planning and Response Act of 1990 (Act 165)
- Counterterrorism Planning, Preparedness and Response Act of 2002 (Act 227)

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

- *Climate Change Adaptation Policy*, January 2012.
- *Disaster Risk Reduction Minimum Codes and Standards (FP-204-078-2, September 2016).d*
- *Fire Management Assistance Grant Program and Policy Guide, (FP-104-21-0002, June 2021).*
- *Guide to Expanding Mitigation: Connecting Mitigation and Agriculture* (May 2020)
- *Guide to Expanding Mitigation: Connecting Mitigation and Arts and Culture* (May 2020)
- *Guide to Expanding Mitigation: Connecting Mitigation and Codes and Standards* (September 2021)

- *Guide to Expanding Mitigation: Connecting Mitigation and Communications Systems (*February 2021)
- *Guide to Expanding Mitigation: Connecting Mitigation and Electric Power (*September 2020)
- *Guide to Expanding Mitigation: Connecting Mitigation and Equity (*September 2020)
- *Guide to Expanding Mitigation: Connecting Mitigation and Municipal Financing* (September 2020)
- *Guide to Expanding Mitigation: Connecting Mitigation and Public Health* (May 2020)
- *Guide to Expanding Mitigation: Connecting Mitigation and the Whole Community* (February 2021)
- *Guide to Expanding Mitigation: Connecting Mitigation and Transportation* (September 2020)
- *Guide to Expanding Mitigation: Making the Connection to Cemeteries* (June 2021)
- *Guide to Expanding Mitigation: Making the Connection to Coast* (May 2022)
- *Guide to Expanding Mitigation: Making the Connection to People with Disabilities* (November 2021)
- *Guide to Expanding Mitigation: Making the Connection to Older Adults* (May 2022)
- *Guide to Expanding Mitigation: Making the Connection to Wildlife* (November 2021)
- *Hazard Mitigation Assistance Guidance*, February 2015.
- *Hazard Mitigation Assistance Guidance, Program Administration by States Pilot, Hazard Mitigation Grant Program (October 2017).*
- *Integrating Disaster Data into Hazard Mitigation Planning: A State and Local Mitigation Planning How-to-Guide*, February 2015
- *Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials*, March 2013.
- *Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning: State and Local Mitigation Planning How-To Guide*, May 2005.
- *Local Mitigation Planning Handbook*, March 2013.
- *Local Mitigation Planning Policy Guide (FP 206-21-0002)*, April 2022.
- *Mitigation Assistance: Building Resilient Infrastructure and Communities (FP-104-008-05, February 14, 2022).*
- *Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards*, January 2013.
- *National Mitigation Framework,* June 2016*.*
- *National Mitigation Investment Strategy.* August 2019.
- *National Preparedness Goal,* September 2015.
- *Pre-Disaster Recovery Planning Guide for State Governments*, November 2016.
- *Presidential Policy Directive (PPD) 8 National Preparedness*, March 2011.
- *PPD 21 Critical Infrastructure Security and Resilience,* February 2013.
- *Plan Integration: Linking Local Planning Efforts*, July 2015.
- *Public Assistance (PA) Program and Policy Guide, V4 (FP-104-009-2, June 2020).*
- *Rehabilitation of High Hazard Potential Dams (HHPD): Grant Program Guidance / High Hazard Potential Dam Rehabilitation Grant Program FEMA Policy (FP-104-008-7, July 2020).*

- *Restrictions on Grant Obligations to State, Tribal, and Local Governments without a FEMA approved Mitigation Plan (FP 306-112-1, August 19, 2013).*
- *State Mitigation Planning Policy Guide (FP 302-094-2)*, April 2022.
- *State Mitigation Planning Key Topics Bulletins: Mitigation Capabilities*, September 2016.
- *State Mitigation Planning Key Topics Bulletins: Mitigation Strategy*, October 2016.
- *State Mitigation Planning Key Topics Bulletins: Planning Process*, July 2016.
- *State Mitigation Planning Key Topics Bulletins: Risk Assessment*, June 2016.
- *Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide: Comprehensive Prepared Guide (CPG) 201, 3rd Edition,* May 2018.

The following policy guides published by the APA were used to plan for and prepare this document:

- *APA Policy Guide on Energy,* October 2012.
- *APA Policy Guide on Security,* March 2005.
- *APA Policy Guide on Water,* July 2016.
- *Climate Change Policy Guide,* January 2021.
- *Hazard Mitigation Policy Guide,* July 2020.
- *Housing Policy Guide,* June 2019.
- *Planning for Equity Policy Guide,* May 2019.
- *Surface Transportation Policy Guide,* May 2019.
- *The Sustainability Policy Framework,* January 2016.

The following Pennsylvania guides and reference documents were used prepare this document:

- *Commonwealth of Pennsylvania's All-Hazard Mitigation Planning Standard Operating Guide (SOG),* October 2020.
- *Hazard Mitigation Project Officer Handbook,* January 2022.
- *Pennsylvania Silver Jackets Interagency Flood Mitigation Program Guide*, March 2022.
- *Pennsylvania Threat and Hazard Identification and Risk Assessment*, December 2017.
- *Commonwealth of Pennsylvania 2019 State Disaster Recovery Plan*, July 2019

The following additional guidance document produced by the National Fire Protection Association (NFPA) was used to inform the Risk Assessment Hazard Descriptions in the SOG and this plan:

- *NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs*, 2019.

The *State Mitigation Plan Review Guide* notes several documents with principals that guide state hazard mitigation planning. These documents guide Pennsylvania SHMP, PEMA's overall work and mission, and the guidance followed for the SHMP update:

1.5. Statute Compliance Assurances

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C., Section 322, as amended, provides an approach to hazard mitigation planning. Section 322 continues the requirement for a state mitigation plan as a condition of disaster assistance. It also creates incentives for increased coordination and integration of mitigation activities at the state level through the establishment of criteria for two different levels of state mitigation plans, “standard” and “enhanced”. The Stafford Act and associated implementing regulations emphasize the need for state, local, and tribal entities to closely coordinate mitigation planning and implementation efforts. States that demonstrate an increased commitment to comprehensive mitigation planning and implementation through the development of an approved enhanced mitigation plan can increase the amount of funding available through the Hazard Mitigation Grant Program (HMGP). Section 322 also establishes the requirement for local mitigation plans (FEMA, 2021a).

As part of the process of implementing the mitigation planning provisions of the Stafford Act, FEMA prepares Interim Final Rules and Final Rules regarding hazard mitigation planning and hazard mitigation assistance. Interim rules were prepared on February 26, 2002; October 1, 2002; October 28, 2003; September 13, 2004; October 31, 2007; and December 19, 2014. Final Rules were published October 31, 2007; September 16, 2009; April 25, 2014; and October 2, 2015. The April 25, 2014 Final Rule changed the update period for state hazard mitigation plan from three to five years.

An additional summary of federal, state, and local disaster mitigation and emergency management laws is provided is Section 5.2.

The Commonwealth of Pennsylvania has created a SHMP that satisfactorily meets the requirements of the Stafford Act and has provided plan updates as required. This document follows the precedent for regulatory compliance and is consistent with the format and content prescribed under the implementing regulations of the amended Stafford Act legislation and subsequent regulations and guidance provided by FEMA. The Commonwealth of Pennsylvania will continue to comply with the Stafford Act and other applicable federal and state statutes when administering grant funding associated with this plan and will amend this plan as necessary under federal and state law. This document has been designed to be electronically available on the internet such that it can be widely distributed.

2 State Profile

2. State Profile

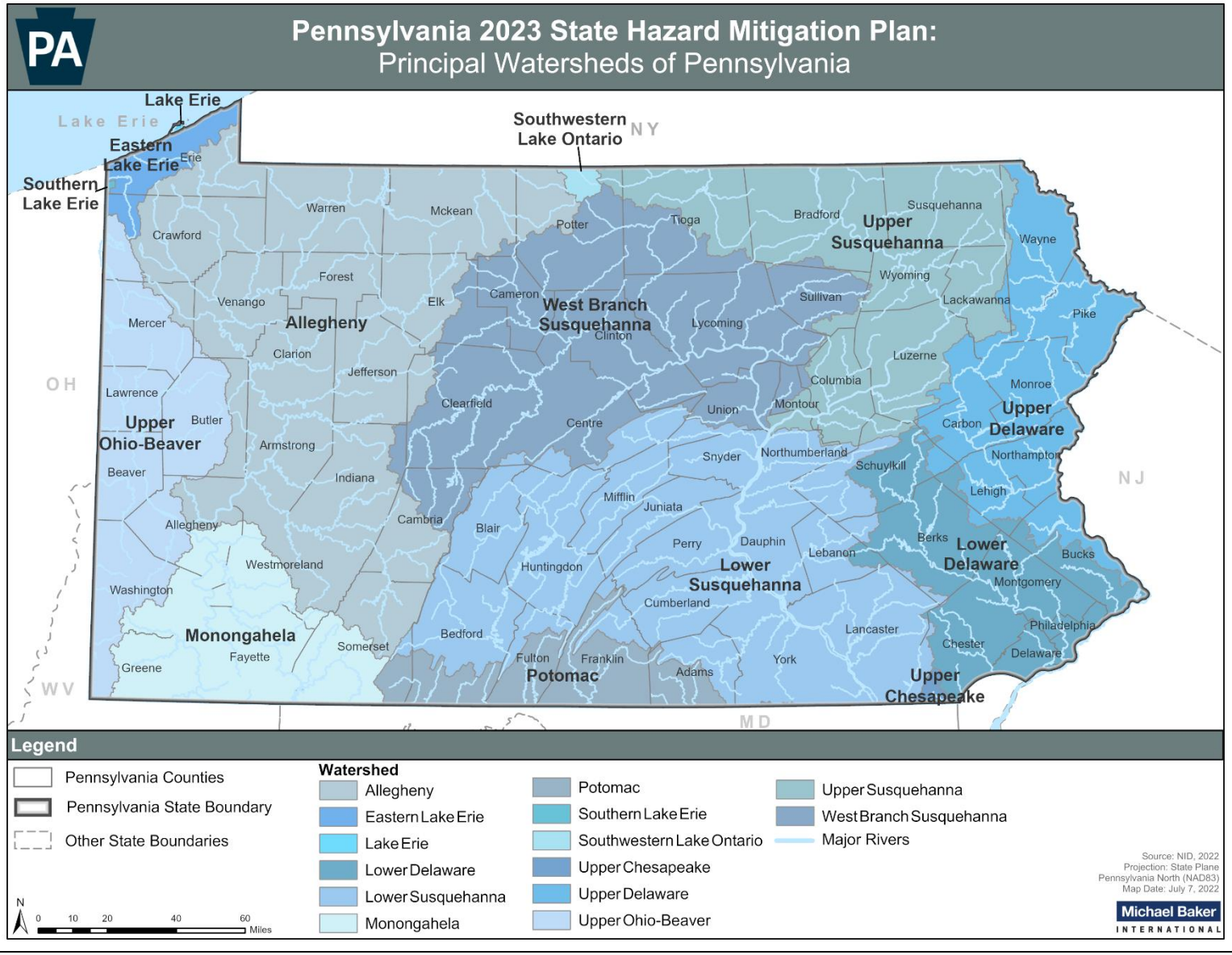
2.1. Geography and Environment

The Commonwealth of Pennsylvania consists of approximately 46,058 square miles, 44,820 square miles of which are land area. It is the 33rd largest of the 50 states. Pennsylvania covers an area defined approximately within 39.7 degrees to 42.3 degrees North Latitude and 74.4 degrees to 80.5 West Longitude.

Pennsylvania is bordered to the north by New York and Lake Erie. In the south, the Commonwealth shares a border with Maryland, New Jersey, Delaware, and West Virginia. It is bordered to the east by New Jersey and part of New York. The western border of the state is shared with West Virginia and Ohio.

The Commonwealth's eastern border is located approximately 60 miles inland from the Atlantic Ocean and the Northwestern corner of the Commonwealth borders Lake Erie. Pennsylvania has two tidal coasts: 112 miles of coastline along the Delaware Estuary and 77 miles of coastline along Lake Erie (PA DEP CRM, 2022). Major rivers in the Commonwealth are the Allegheny River, Susquehanna River, Delaware River, and the Ohio River. Topographically, the Commonwealth is drained by the headwaters and main stems of four principal drainages: the Delaware River, Susquehanna River, the Ohio and Potomac. The Genesee and Erie watersheds drain to the Great Lakes. These principal watersheds are shown in Figure 2.1-1.

Figure 2.1-1 Major Watersheds in Pennsylvania



Pennsylvania topography varies from mountains to valleys to coastal plains as the Commonwealth contains topographic sections of the Coastal Plain, Piedmont, Ridge and Valley and Appalachian Plateau and Central Lowlands Physiographic provinces (Figure 2.1-2). The Allegheny Mountains are the primary mountain range in the state, stretching diagonally from the southwest to the northeast.

The geology of the Commonwealth is determined by these physiographic provinces. The provinces have distinct geology which can include sandstone, siltstone, clay, quartzite, etc. Karst geology is also present in the Commonwealth and can cause land subsidence and sinkholes. Karst geology is discussed in more detail is Section 4.3.13.

The various physiographic provinces of Pennsylvania also exhibit distinctive climatic characteristics based on region and elevation. In addition, Pennsylvania's climate is affected by Lake Erie and the Atlantic Ocean. The effect of the provinces on climate is described below.

Atlantic Coastal Plain and Piedmont Provinces

The Appalachian Mountains to the west and the Atlantic Ocean to the east moderate the climate of the Atlantic Coastal Plain and Piedmont provinces. Warm summers and mild winters are characteristic of this climatic zone. Daily temperatures reach 90°F or above on an average of 20 or more days during the summer season, and the area occasionally experiences uncomfortable warm periods of light winds and high relative humidity.

During the winter months, there are on average 100 or more days that have minimum temperatures at or below the freezing point. Minimum temperatures of 0°F or lower generally occur one or two times per year. The freeze-free season averages 170 to 200 days.

Precipitation is fairly evenly distributed throughout the year; maximum amounts occur during the late summer months. Annual precipitation averages 43 inches, and mean seasonal snowfall is 28 inches, the lowest for the state. Fields are normally snow covered about one third of the time during the winter season.

Ridge and Valley Province

The Ridge and Valley province has many of the characteristics of a mountain-type climate. Mountain and valley influences cause greater temperature extremes and an increase in daily ranges. The freeze-free season is generally between 140 and 180 days.

Maximum temperatures in most years are not excessively high; temperatures equal to or above 90°F occur on an average of only 18 days during the summer season. Temperatures above 100°F are seldom recorded. Minimum temperatures during January, February, and March are commonly below freezing, but are seldom below 0°F.

The average annual precipitation is 44 inches, similar to that of the Atlantic Coastal Plain and Piedmont provinces. A larger percentage of this precipitation falls in the form of snow, which averages 42 inches during the winter season.

Appalachian Plateaus Province

The Appalachian Plateaus province is fairly typical of a continental-type climate having changeable temperatures and more frequent precipitation than other parts of Pennsylvania. Latitude and elevation make the northern part of the province the coldest area of the state. Daily temperature ranges exceed those of other areas, averaging between 20°F and 30°F.

Because of the rugged topography, the freeze-free season is variable, ranging from 130 days in the north to 180 days in the south. Daily high temperatures reach 90°F or above on an average of 10 days during the summer season, but temperatures rarely exceed 100°F. During the winter months, there are normally about 145 days when temperatures dip to or below the freezing point. Low temperatures equal to or below 0°F generally occur eight days per season. In northern sections, subzero temperatures occur twice as often.

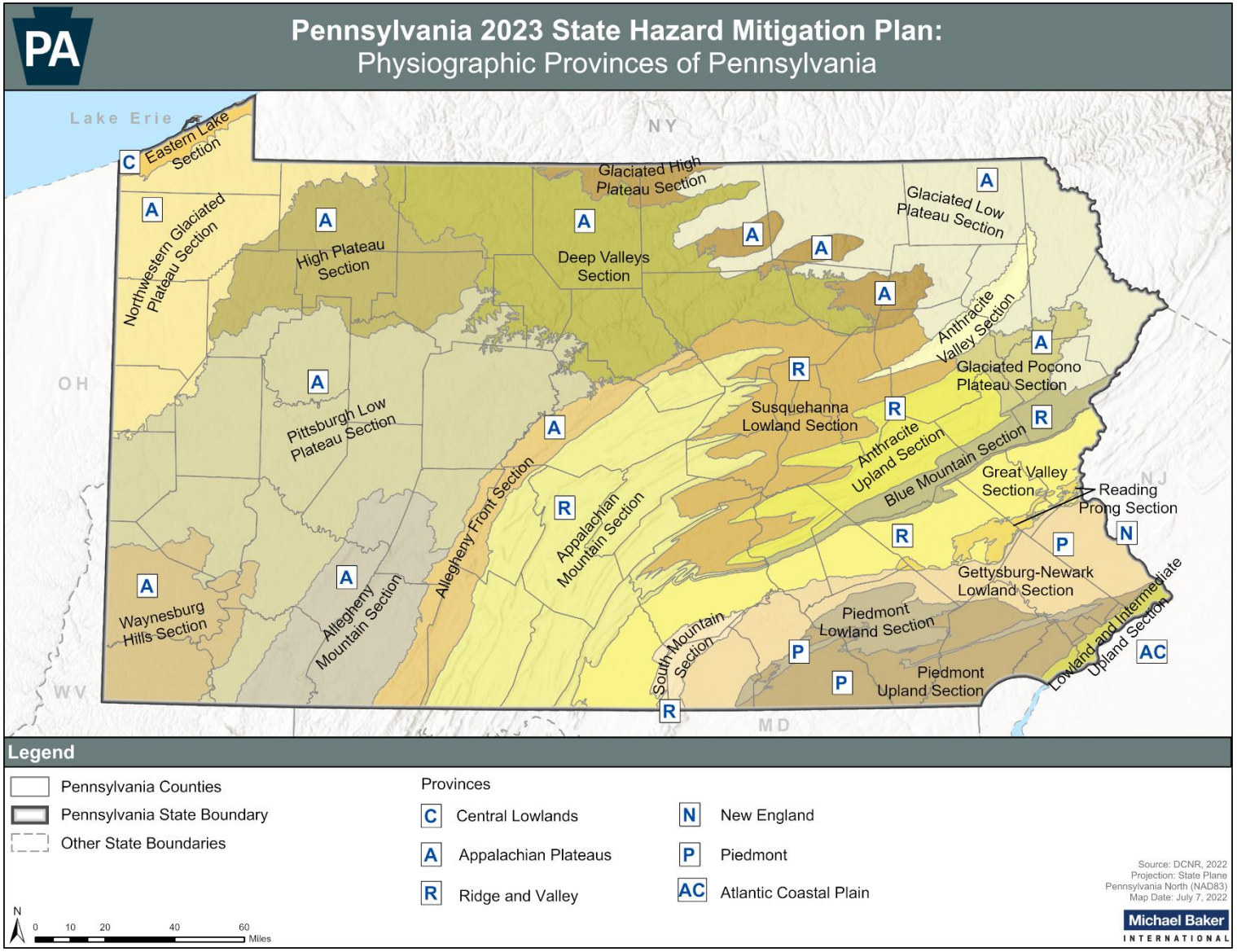
Mean annual precipitation is 40 inches, and seasonal snowfall is normally about 50 inches. The greatest amounts occur in the northern regions, where some areas average more than 80 inches annually. Fields are usually snow covered three fourths of the time during the winter season.

Central Lowland Province

The influence of Lake Erie is profoundly evident in the climate of the Central Lowland province. The lake has a moderating effect on temperatures, and the freeze-free season is normally extended to about 200 days. Temperatures above 90°F or below 0°F are extremely rare. The lake also reduces daily temperature ranges to less than 20°F in most months.

Temperature differences between the air and water produce cloudiness and frequent snowfalls during the winter months. The lake also acts as an important moisture source for the region. In Erie, mean annual snowfall averages about 60 inches, and annual precipitation averages close to 40 inches. Just inland of the lake, snowfall averages about 80 inches per year due to the added effect of Orographic influences.

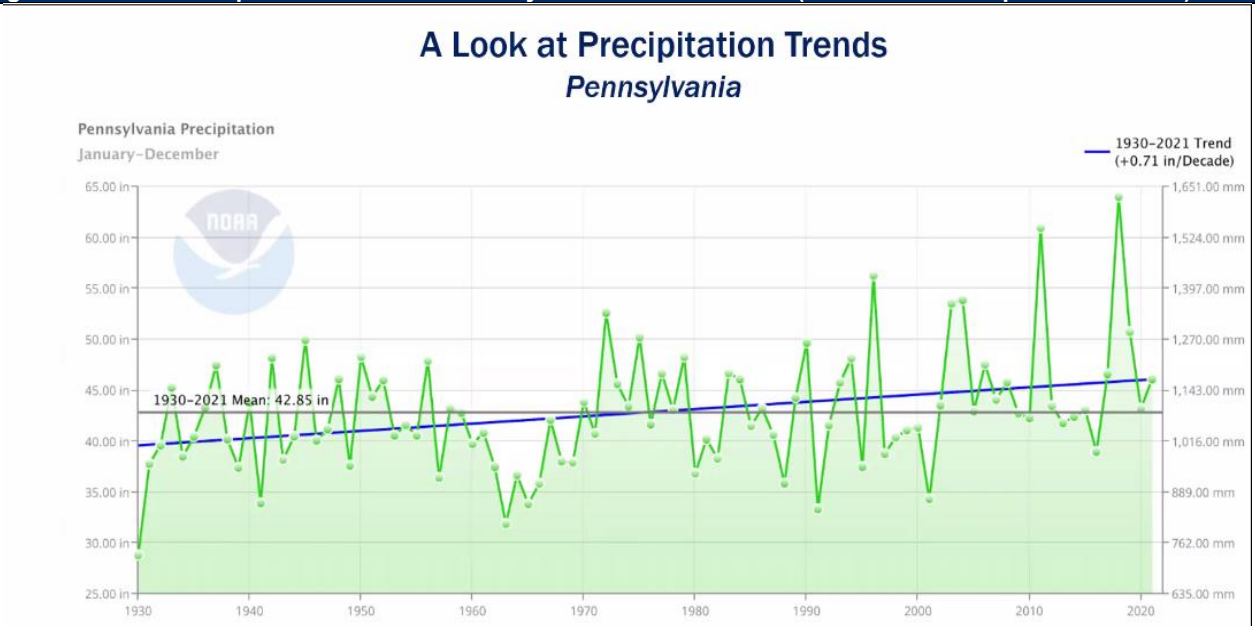
Figure 2.1-2 Physiographic Provinces of Pennsylvania (DCNR, 2022a).



Pennsylvania is also home to a prairie, the Jennings prairie near Slippery Rock. It is a unique ecosystem in the state, with tall grasses, few trees, and brightly colored flowers when they are in bloom towards the end of the summer. There are around 225 native plant species, butterflies, moths, birds, amphibians, small mammals such as weasels and moles that inhabit the 20-acre area. It is also home to the endangered eastern massasauga rattlesnake. There is currently an expansion project underway to nearly double the habitat for the endangered snake and other species such as the golden-winged warbler, American woodcocks, red-headed woodpecker, and Baltimore checkerspot butterfly. The expansion project is part of an effort to recover from the impacts of the emerald ash borer, which killed off trees that border the habitat (Kubis, 2022).

Figure 2.1-3 below represents the trend of precipitation across the Commonwealth between 1930 and 2022. The average yearly precipitation is 42.85 inches, yet averages don't tell the whole story due to how much precipitation can fluctuate year to year. The 1960s experienced years at or below the average, yet almost every year in the 1970s was at or above that same average. In addition, the last three decades have included more drastic year-to-year fluctuations. These large fluctuations point to a need to look at individual storm events and how the precipitation per event rather than yearly averages. The trendline shown displays that precipitation averages per decade have increased by 0.71 inches each decade since 1930.

Figure 2.1-3 Precipitation Trends for Pennsylvania from 1930-2022 (2022 Climate Adaptation Seminar)

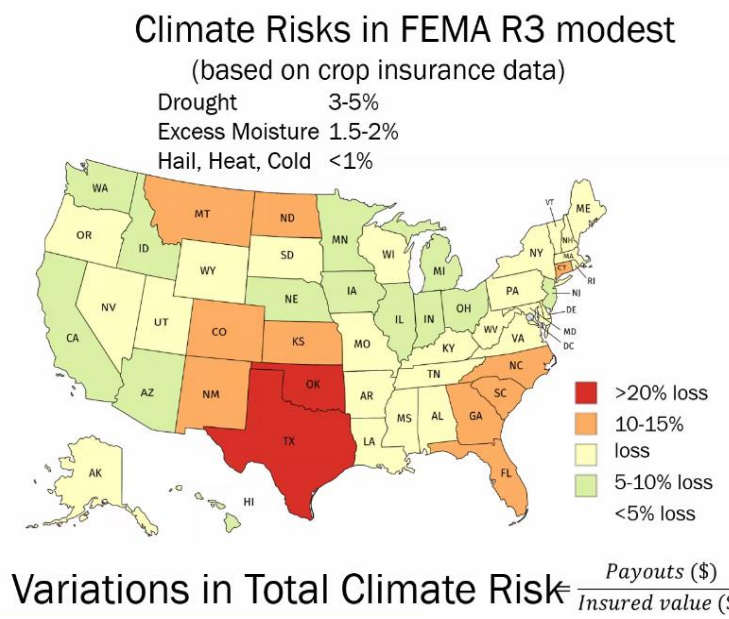


2.2. State Facts

The first known inhabitants of the area now known as Pennsylvania were Native American tribes, such as the Leni-Lenape (Delawares), Susquehannock, Shawnee, and Iroquois Confederacy. By the 1600's, European settlers in the area were the Dutch and the Swedes who held trading posts in the region. In 1664, the English claimed some of the land area of present-day Pennsylvania which led to conflicts with the Dutch who also held claims to some of the land. By 1681, William Penn founded the Commonwealth of Pennsylvania (Pennsylvania General Assembly, 2010). As of April 2023, there were no federally recognized tribes with land use authority in the Commonwealth. State agencies do consult with the Seneca tribe about burial grounds in the Commonwealth.

Throughout history, agriculture has been a leading industry in Pennsylvania. Primary crops are wheat, corn, rye, and soybeans. Although the number of farms and total farm acreage in the Commonwealth has declined since 1900, farm production has increased dramatically to meet consumer needs thanks to improved farming technologies. Today, Pennsylvania ranks 23rd overall in agricultural production (USDA, 2021). There is some speculation that Pennsylvania may increase agricultural production with the projected wetter warmer climate changes, and the predictions of increased natural hazards like drought in other high agricultural production states. Figure 2.2-1 below shows a USDA analysis (presented during the Climate Adaptation Summit, 7/2022) based on crop insurance data for how each state may be impacted by climate risks. The equation for how risks were calculated is based on the total payout per year over the crops insured. For more information on Risk Management Agency Payments by County, by month, year, and product, please go to the AgRisk Viewer here: https://swclimatehub.info/rma/rma-data-viewer.html.

Figure 2.2-1 Climate Risks for Crop Production



It is important to note that both drought and excess moisture present risks to crop production in Pennsylvania. In fact between 1989 and 2021, Drought was the leading cause of loss in terms of USDA Risk Management Agency Payments, with the majority of losses occurring in June and July.

Pennsylvania has a rich history of coal mining. There are two types of coal in Pennsylvania, bituminous in the west and anthracite in the northeast. Industries such as iron and steel production were once prominent in Pennsylvania. The growth of these industries was enabled by the anthracite coal industry. Furthermore, textiles, leathermaking, lumbering, shipbuilding, publishing, and tobacco and paper manufacturing also prospered in the 1800s and early 1900s in Pennsylvania. Coal mining and associated industries experienced a decline in the late 1900s, as economic demand and expanded knowledge about the public and environmental health impacts influenced regulations. In addition, the rise of natural gas extraction as an industry has resulted in heavy impacts to the coal industry. With the decline of many of these industries, new sectors arose which now contribute to the state's employment including wholesale and retail trade, food processing, health care and social administration, and educational, professional, scientific, and technical services. Some communities are still figuring out how to deal with declining employment opportunities, with many distressed coal communities sharing characteristics such as high unemployment, aging populations, insufficient infrastructure, and low educational attainment levels (Simeone, Okiro, and Bennett, 2018).

Tourism is also a growing industry in Pennsylvania. The Commonwealth contains abundant natural resources and scenic landscapes which provide outdoor recreation opportunities such as fishing, camping, boating, bird-watching, hunting, hiking, swimming, and skiing. Pennsylvania is also one of the best places in the region for stargazing as it is home to some of the darkest skies along the Eastern Seaboard. Cherry Springs State Park, located in Potter County, is the first International Dark Sky Park in the Eastern U.S. and the second location in the world to receive the Gold Tier rank (Visit PA, 2021). In addition to Cherry Springs, Pennsylvania contains 123 state parks and several of the best museums in the country including the Philadelphia Museum of Art and the Carnegie Museums in Pittsburgh.

2.3. Population and Demographics

Pennsylvania contains 67 counties and 2,561 municipalities. The state's capital is Harrisburg. Over the last 10 years, the population has increased (13,002,700 estimated for the 2020 census, from 12,702,379 in 2010). Pennsylvania is the 5th highest population state in the country. It is important to note that the 2020 census occurred during a global shutdown due to the COVID-19 pandemic which impacted data collection in different ways. Table 2.3-1 depicts the change in population for each county between the censuses. Pennsylvania gained 300,321 residents, an increase of 2.36%. The following figures showcase the information spatially. Figure 2.3-1 and Figure 2.3-2 show the total population and population density of all counties according to the 2020 Census and 2016-2020 five-year estimates, respectively. Figure 2.3-3 depicts the change for each county. Population trends are described in Section 4.4.2.

Table 2.3-1 Population Change by County 2010-2020 (U.S. Census 2010 and 2020)				
COUNTY	2010 POPULATION	2020 POPULATION	NET CHANGE	PERCENT CHANGE
Adams	101,407	103,852	2,445	2.41%
Allegheny	1,223,348	1,250,578	27,230	2.23%
Armstrong	68,941	65,558	-3,383	-4.91%
Beaver	170,539	168,215	-2,324	-1.36%
Bedford	49,762	47,577	-2,185	-4.39%
Berks	411,442	428,849	17,407	4.23%
Blair	127,089	122,822	-4,267	-3.36%
Bradford	62,622	59,967	-2,655	-4.24%
Bucks	625,249	646,538	21,289	3.40%
Butler	183,862	193,763	9,901	5.39%
Cambria	143,679	133,472	-10,207	-7.10%
Cameron	5,085	4,547	-538	-10.58%
Carbon	65,249	64,749	-500	-0.77%
Centre	153,990	158,172	4,182	2.72%
Chester	498,886	534,413	35,527	7.12%
Clarion	39,988	37,241	-2,747	-6.87%
Clearfield	81,642	80,562	-1,080	-1.32%
Clinton	39,238	37,450	-1,788	-4.56%
Columbia	67,295	64,727	-2,568	-3.82%
Crawford	88,765	83,938	-4,827	-5.44%
Cumberland	235,406	259,469	24,063	10.22%
Dauphin	268,100	286,401	18,301	6.83%
Delaware	558,979	576,830	17,851	3.19%
Elk	31,946	30,990	-956	-2.99%
Erie	280,566	270,876	-9,690	-3.45%
Fayette	136,606	128,804	-7,802	-5.71%
Forest	7,716	6,973	-743	-9.63%
Franklin	149,618	155,932	6,314	4.22%
Fulton	14,845	14,556	-289	-1.95%
Greene	38,686	35,954	-2,732	-7.06%
Huntingdon	45,913	44,092	-1,821	-3.97%
Indiana	88,880	83,246	-5,634	-6.34%
Jefferson	45,200	44,492	-708	-1.57%
Juniata	24,636	23,509	-1,127	-4.57%
Lackawanna	214,437	215,896	1,459	0.68%
Lancaster	519,445	552,984	33,539	6.46%
Lawrence	91,108	86,070	-5,038	-5.53%

Table 2.3-1 Population Change by County 2010-2020 (U.S. Census 2010 and 2020)				
COUNTY	2010 POPULATION	2020 POPULATION	NET CHANGE	PERCENT CHANGE
Lebanon	133,568	143,257	9,689	7.25%
Lehigh	349,497	374,557	25,060	7.17%
Luzerne	320,918	325,594	4,676	1.46%
Lycoming	116,111	114,188	-1,923	-1.66%
McKean	43,450	40,432	-3,018	-6.95%
Mercer	116,638	110,652	-5,986	-5.13%
Mifflin	46,682	46,143	-539	-1.15%
Monroe	169,842	168,327	-1,515	-0.89%
Montgomery	799,874	856,553	56,679	7.09%
Montour	18,267	18,136	-131	-0.72%
Northampton	297,735	312,951	15,216	5.11%
Northumberland	94,528	91,647	-2,881	-3.05%
Perry	45,969	45,842	-127	-0.28%
Philadelphia	1,526,006	1,603,797	77,791	5.10%
Pike	57,369	58,535	1,166	2.03%
Potter	17,457	16,396	-1,061	-6.08%
Schuylkill	148,289	143,049	-5,240	-3.53%
Snyder	39,702	39,736	34	0.09%
Somerset	77,742	74,129	-3,613	-4.65%
Sullivan	6,428	5,840	-588	-9.15%
Susquehanna	43,356	38,434	-4,922	-11.35%
Tioga	41,981	41,045	-936	-2.23%
Union	44,947	42,681	-2,266	-5.04%
Venango	54,984	50,454	-4,530	-8.24%
Warren	41,815	38,587	-3,228	-7.72%
Washington	207,820	209,349	1,529	0.74%
Wayne	52,822	51,155	-1,667	-3.16%
Westmoreland	365,169	354,663	-10,506	-2.88%
Wyoming	28,276	26,069	-2,207	-7.81%
York	434,972	456,438	21,466	4.94%
TOTAL	**12,702,379**	**13,002,700**	**300,321**	**2.36%**

Figure 2.3-1 **Map Displaying Distribution by County of 2020 Census Populations Estimates Throughout Pennsylvania (U.S. Census, 2020).**

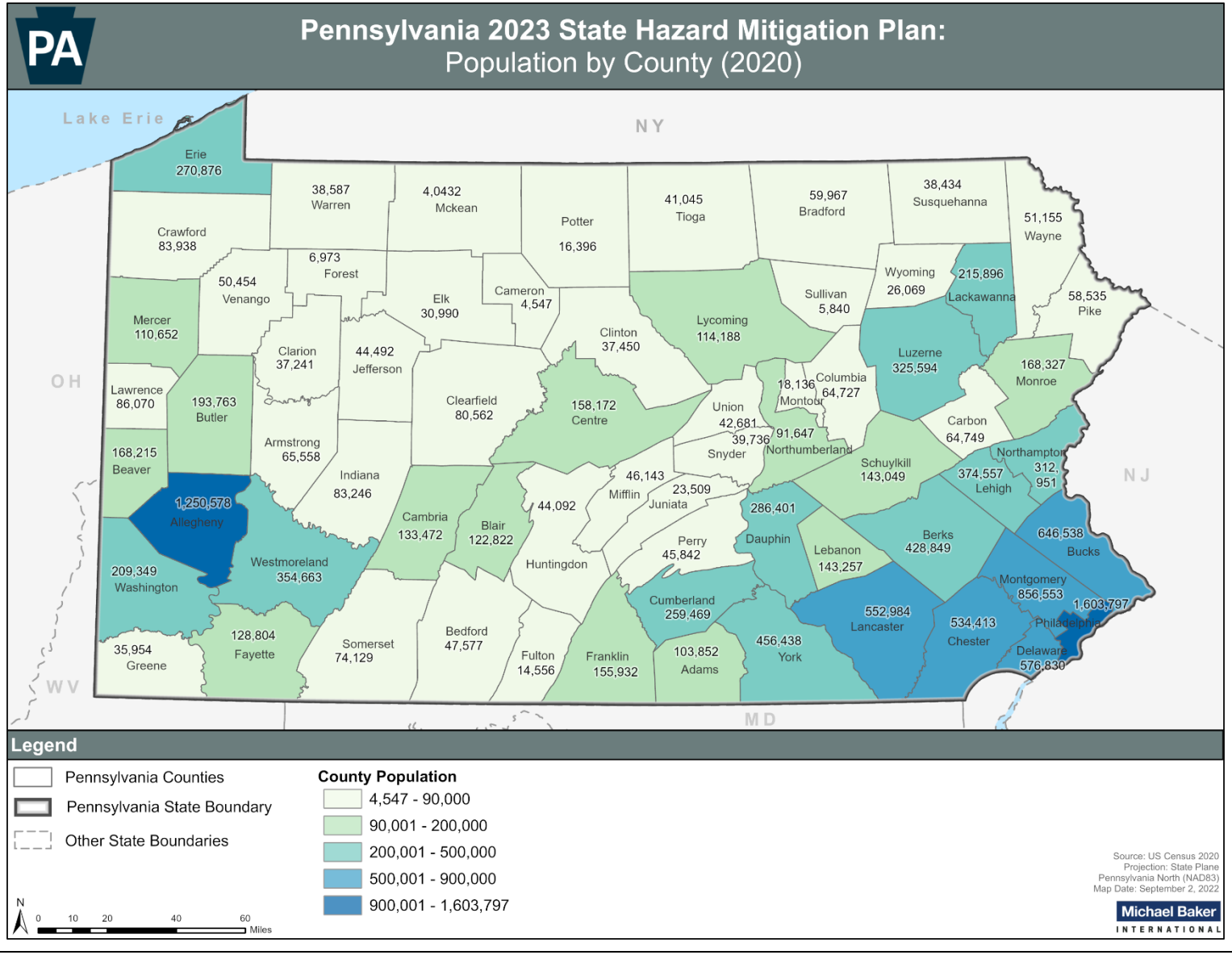


Figure 2.3-2 Pennsylvania 2020 Population Density (U.S. Census, 2016-2020).

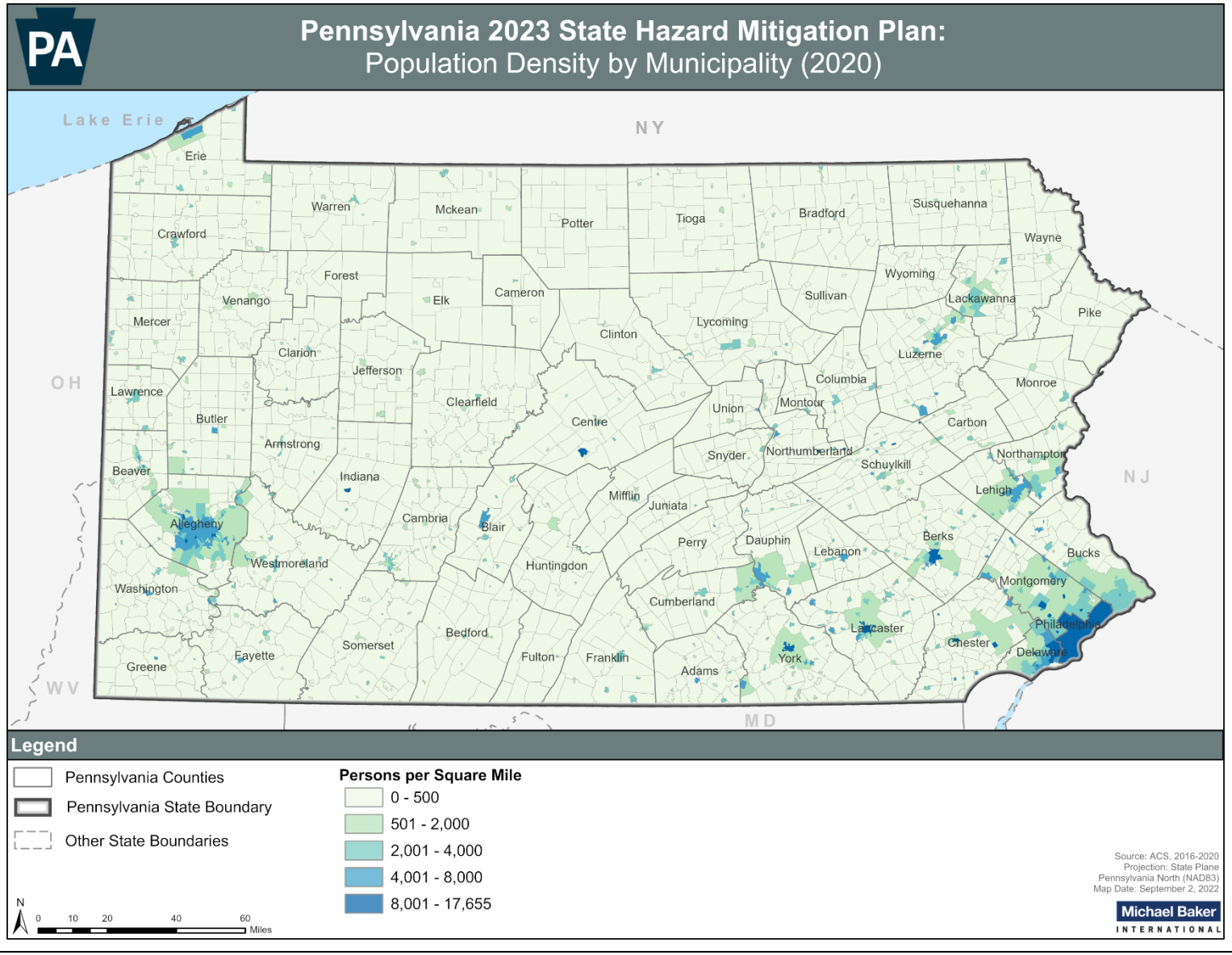
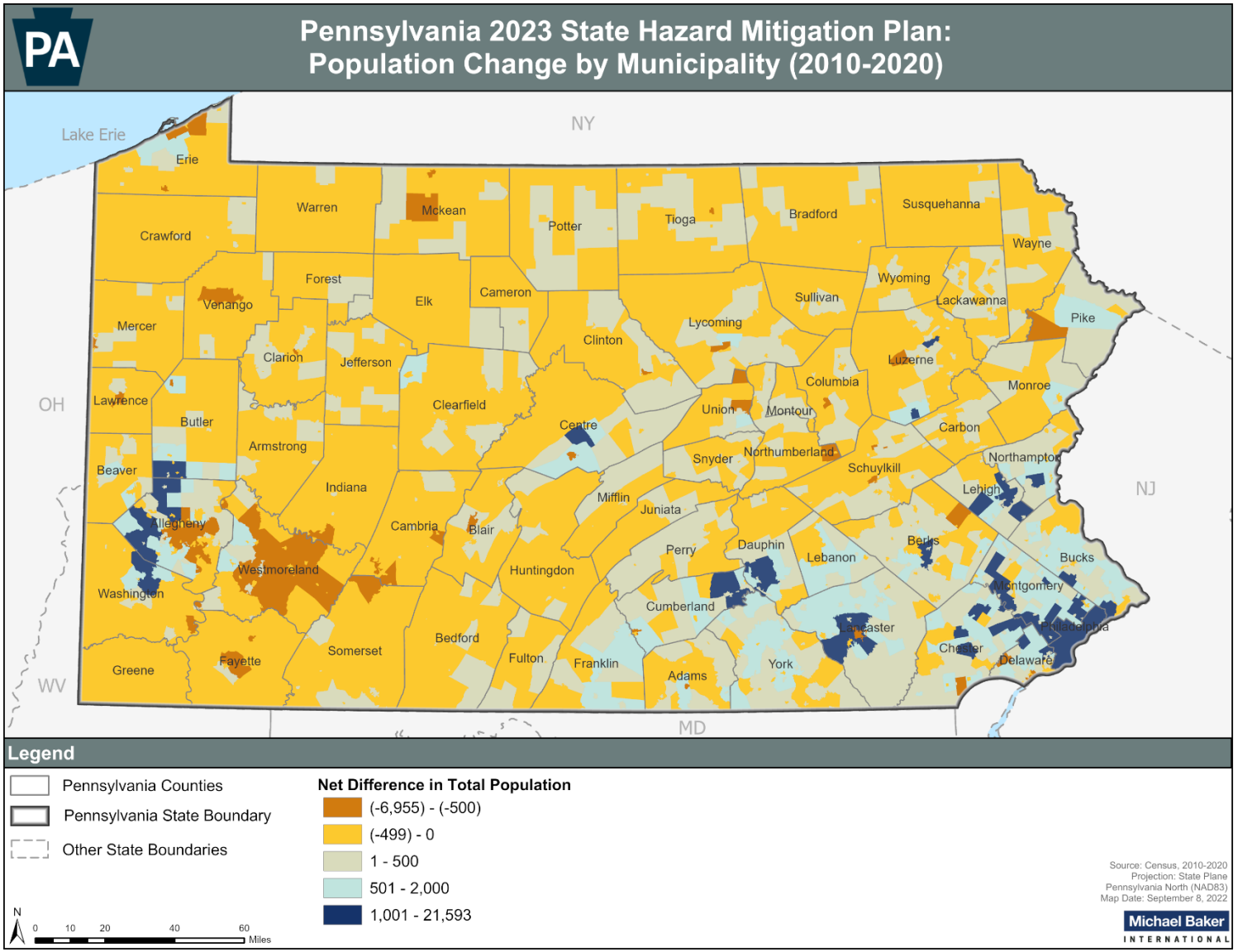


Figure 2.3-3 Pennsylvania Population Change by Municipality (US Census, 2010-2020)



The most populous county in the Commonwealth is Philadelphia County, which is conterminous with the City of Philadelphia, with a 2020 Census population of 1,603,797. Cameron County, with a population of 4,547, is the least populated county according to the 2020 Census population. Populations are most dense in and around cities. Philadelphia, whose county and city jurisdictional boundaries are the same, is the largest city in the Commonwealth. The second most populous city is Pittsburgh, with a 2020 Census population of 302,971. Figure 2.2-3 shows population density throughout the Commonwealth based on the Census 2016-2020 five-year estimates.

Of the 25 and older Pennsylvanians surveyed for the 2021 ACS, 34.5 percent had Bachelor's Degrees or higher, with 58.4 percent employed. In terms of vulnerable populations, 5.5 percent of the population surveyed identified not having any health care coverage.

Population density has a strong correlation with hazard vulnerability and loss. For example, urban areas like Philadelphia and Pittsburgh naturally have larger populations and number of structures; therefore, they have a higher potential for economic loss during hazard events.

Demographics in additional to population density can indicate whether communities may have additional vulnerability to disasters. Different neighborhoods, municipalities, or counties may have fewer resources to prepare for, respond to, or recover from hazards, and may be more susceptible to hazards' impacts. Vulnerable communities exposed to the same hazard may experience disproportionate death, injury, loss, or disruption of livelihood. A variety of population a demographic information identifies areas that may be more vulnerable if impacted by disaster. Congregate care facilities are home to a variety of vulnerable populations, with large variance in how prepared they may be with generators, medical staff, and other needs during and after a disaster event.

Hazard risks may also be different for different cultural communities, and Pennsylvania is a Commonwealth with a diverse cultural history home to communities with a wide variety of lifestyles and ideologies. For example, Elizabethtown College's Young Center for Anabaptist and Pietist Studies surveyed Plain Communities in Pennsylvania (e.g. the Amish and Old Older Mennonite), and estimated approximately 87,000 individuals across 60 settlements in over 580 districts. This research suggests that Pennsylvania may have the highest concentration of Plain Communities in the US (Elizabethtown College, 2022). While most of these settlements do not access electricity from public utility lines and may be less at risk for power grid failures, they also limit use of technology. Electronic alert systems and online information systems will not be the most effective way to communicate pre- and post-disaster.

Across Pennsylvania, 10.9 percent of populations surveyed identified as not having an internet subscription (ACS, 2021).

The age of populations can correlate with vulnerability to hazards. Elderly populations and children may be more susceptible to hazards such as extreme temperature and pandemics. Table 2.3-2 depicts age distribution and median age of the population of each Pennsylvania County. The median age of residents of the Commonwealth of Pennsylvania is 40.8, with 20.9 percent of the population under 18 years of age and 18.2 percent 65 years or older. The

Commonwealth ranks ninth in the nation in percentage of population age 65 and older. According to the Pennsylvania Department of Community and Economic Development (DCED) 2015 State Land Use and Growth Management Report, the age 65 and older population will make up nearly 23% of the state's population by the year 2030.

Table 2.3-1 Age Distribution and Median Age of County Populations, 5-Year Estimates 2017-2021 (Census, 2021).

COUNTY	AGE UNDER 5	AGE 5 – 19	AGE 65+	MEDIAN AGE
Adams	5,059	18,966	21,335	44
Allegheny	64,802	203,369	235,342	40.7
Armstrong	3,117	10,885	14,623	47
Beaver	8,357	27,754	35,943	44.9
Bedford	2,413	7,932	10,785	47.2
Berks	24,119	84,637	73,073	40
Blair	6,249	22,088	25,366	43.4
Bradford	3,469	11,088	12,800	44
Bucks	30,702	114,906	120,674	44
Butler	9,551	34,481	36,381	43.3
Cambria	6,527	23,346	30,111	45.5
Cameron	200	662	1,288	51.8
Carbon	2,974	10,684	13,536	46.2
Centre	6,050	29,415	23,050	33.5
Chester	28,897	107,301	87,163	40.6
Clarion	1,952	6,815	7,354	41.6
Clearfield	3,744	12,464	16,512	45.2
Clinton	2,007	7,184	7,036	39.7
Columbia	2,849	11,844	12,823	41.5
Crawford	4,585	15,507	17,427	43.3
Cumberland	13,674	47,215	47,125	40.5
Dauphin	17,382	53,163	48,181	39.5
Delaware	33,396	111,732	93,913	39
Elk	1,550	5,118	6,849	48.1
Erie	14,885	52,041	49,109	39.9
Fayette	6,591	21,024	27,393	45.1
Forest	170	445	1,663	49.6
Franklin	9,027	29,584	30,118	41.8
Fulton	720	2,472	3,108	45.7
Greene	1,847	6,292	6,941	42.7
Huntingdon	1,967	7,436	9,102	43.4
Indiana	3,860	15,805	16,254	40.1
Jefferson	2,511	8,025	9,296	43.6

Table 2.3-1 Age Distribution and Median Age of County Populations, 5-Year Estimates 2017-2021 (Census, 2021).

COUNTY	AGE UNDER 5	AGE 5 – 19	AGE 65+	MEDIAN AGE
Juniata	1,358	4,479	4,758	42.6
Lackawanna	11,196	39,335	42,545	42.1
Lancaster	35,231	109,649	98,919	38.7
Lawrence	4,431	15,060	18,860	45
Lebanon	8,297	27,961	27,398	40.8
Lehigh	22,130	73,188	61,667	38.8
Luzerne	17,060	56,469	63,664	42.4
Lycoming	6,028	20,858	22,105	41.2
McKean	1,948	7,387	7,818	43.5
Mercer	5,285	19,656	24,114	44.8
Mifflin	2,947	8,390	9,808	43.6
Monroe	7,699	31,031	29,452	43.3
Montgomery	45,839	158,490	150,256	41.2
Montour	1,003	3,153	3,774	43.1
Northampton	14,901	57,643	59,023	42.1
Northumberland	4,658	15,296	19,407	44.4
Perry	2,572	8,202	8,559	43.3
Philadelphia	102,394	290,525	219,185	34.8
Pike	2,106	9,488	12,958	48.6
Potter	833	2,891	3,954	47.7
Schuylkill	6,872	24,486	28,931	44.1
Snyder	2,154	8,009	7,511	40.3
Somerset	3,439	11,427	16,492	46.2
Sullivan	195	582	1,655	54.5
Susquehanna	1,834	6,284	9,123	48.6
Tioga	2,088	7,266	9,048	45
Union	1,928	8,202	7,822	39.6
Venango	2,440	8,360	11,572	47.4
Warren	2,025	6,320	8,920	47.1
Washington	10,452	36,090	42,901	44.2
Wayne	2,075	7,363	12,292	48.4
Westmoreland	15,699	57,651	80,611	47.1
Wyoming	1,223	4,640	5,616	45.2
York	25,249	86,596	79,398	40.8
PA TOTAL	**700,792**	**2,354,107**	**2,361,790**	***40.8***

There are an estimated 5,728,788 housing units in the state, eighty nine percent of which are occupied with the remaining eleven percent being vacant. The median value of an owner-occupied home in the state is $197,300 (U.S. Census Bureau, 2022).

The median income for households in Pennsylvania is $68,957 (ACS, 2021). This is slightly less than the national median household income of $69,717. However, 12.1% of the Commonwealth's residents live in poverty compared to the national average of 11.6% for the United States (U.S. Census, 2021). While higher than the national average, the impact of disasters tends to be worse in low-income populations. Those living in poverty have fewer resources for evacuation during an event and less available funds for mitigation or other protective measures.

The majority of Pennsylvanians identify as White (81 percent), with predominantly English, French, German, Irish, Italian, Norwegian, Polish, and Scottish ancestry. The majority of individuals identifying as Black/ African American (12.2 percent) reference Sub-Saharan African ancestry. Additionally, 8.4 percent identify as Hispanic or Latino, 3.9 percent as Asian, and 0.5 percent is American Indian, Alaska Native, Native Hawaiian, Pacific Islander or some other race (U.S. Census Bureau, 2022).

While many Pennsylvanians only speak English at home (88.2 percent), there are significant populations speaking other languages such as Spanish (5.2 percent), other Indo-European languages (3.7 percent), Asian and Pacific Islander languages (2 percent), and other languages (0.9 percent). The ability for state agencies to share information translated into multiple languages, and in formats that can be translated through apps and readers is critical to ensuring these populations have access to the same information as English speakers about disaster response, recovery, and long term mitigation opportunities.

Approximately 6.2 percent of Pennsylvanians are veterans (with 92.6 percent of that population identifying as male) (ACS, 2021). The majority having served in the Vietnam war (https://www.va.gov/vetdata/Veteran_Population.asp). Pennsylvania has the fourth highest total veteran population in the US (Center for Veterans Analysis and Statistics, 2023). While there are six VA Medical Centers with Hospital service, none are located in counties with the highest Veteran populations. Of the 813,629 veterans surveyed, 137,513 were receiving disability compensation (as of 9/30/2020), approximately 17 percent. By comparison, the 819,185 veterans surveyed as of 9/30/2107, 125,847 were receiving disability compensation, approximately 15 percent.

Table 2.3-2 below shows the minimum wages for changes Pennsylvania and neighboring states. While Pennsylvania aligns with the federal minimum wage, it is the only state amongst its immediate neighbors to not increase minimum wage at all in the last ten years. Pennsylvanians earn $1.50 below the next closest state, West Virginia. It's possible that Pennsylvania becomes less competitive to future employees as all the neighboring states have increased their minimum wage at some point in the last decade.

Table 2.3-2 Minimum Wage Changes for Pennsylvania and Neighboring States 2013-2023 (Labor Law Center, 2023)											
STATE	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Delaware	$7.25	$7.75	$8.25	$8.25	$8.25	$8.25	$8.75	$9.25	$9.25	$10.50	$11.75
Maryland	$7.25	$7.25	$8.00	$8.75	$9.25	$10.10	$10.10	$11.00	$11.75	$12.50	$13.25
New Jersey	$7.25	$8.25	$8.38	$8.38	$8.44	$8.60	$10.00	$11.00	$12.00	$13.00	$14.13
New York	$7.25	$8.00	$8.75	$9.00	$9.70	$10.40	$11.10	$11.80	$12.50	$13.20	$14.20
Ohio	$7.85	$7.95	$8.10	$8.10	$8.15	$8.30	$8.55	$8.70	$8.80	$9.30	$10.10
Pennsylvania	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25
West Virginia	$7.25	$7.25	$8.00	$8.75	$8.75	$8.75	$8.75	$8.75	$8.75	$8.75	$8.75

The Social Vulnerability Index (SoVI) published by the University of South Carolina's Hazards and Vulnerability Research Institute (HVRI) measures the social vulnerability of populations to environmental hazards at different geographies. SoVI is one of the most well-established indices for quantifying social vulnerability, and based on years 2010-2014 in its most recent release. The Centers for Disease Control (CDC) uses the SoVI. This index can help show where there are uneven differences in a community's ability for preparedness, response, and recovery to hazards and disasters. It can be used to help direct resources to reduce pre-existing vulnerabilities. SoVI is based on 29 socioeconomic variables, primarily from the United States Census Bureau. According to the SoVI website, eight significant components explain 78% of variance in the social vulnerability data. The eight principal components of this index are:

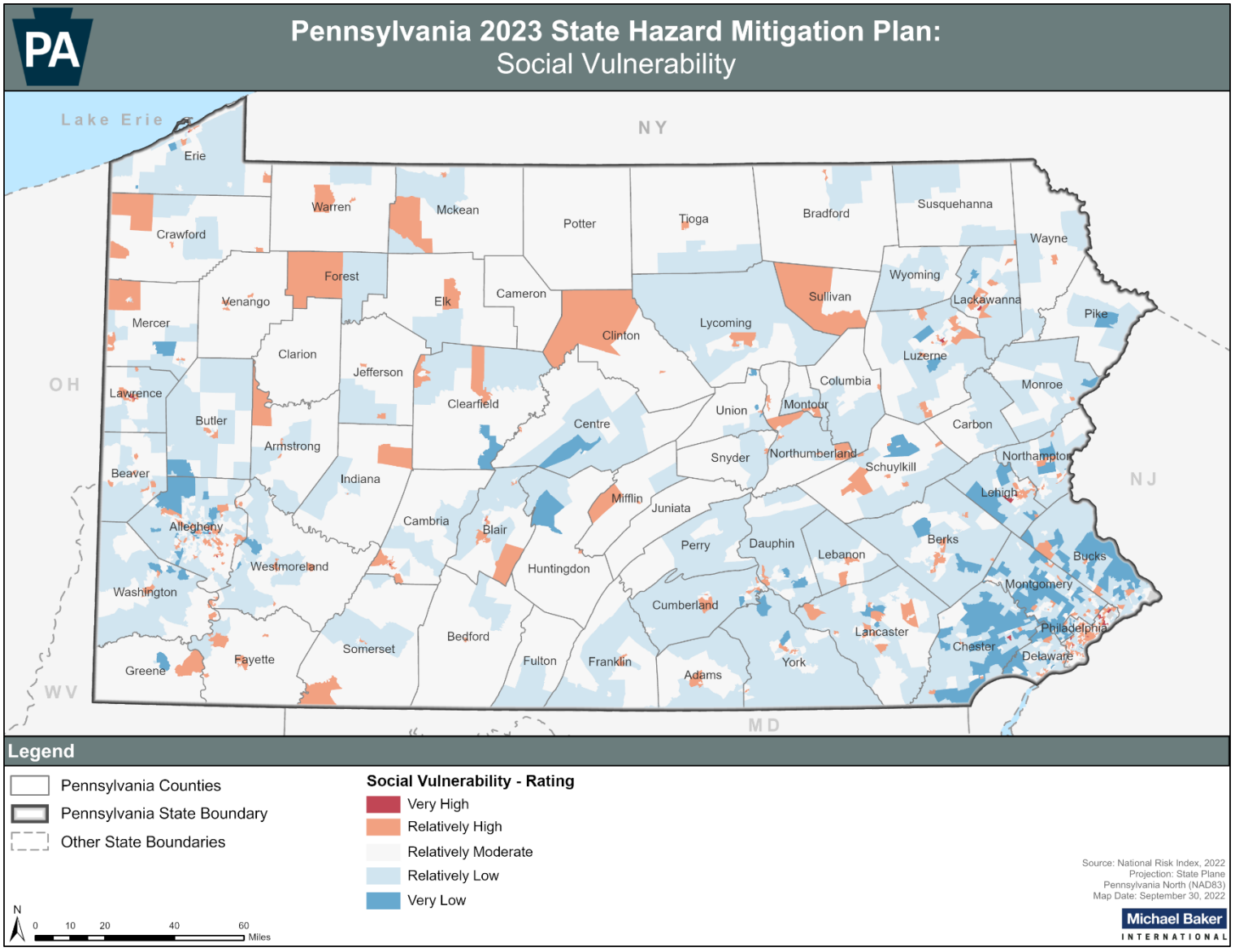
- Wealth
- Race and social status
- Elderly residents
- Hispanic ethnicity and residents without health insurance
- Special needs individuals
- Service industry employment
- Native American populations
- Gender

A description of the SoVI index and county-scale maps are available at http://artsandsciences.sc.edu/geog/hvri/.

FEMA's National Risk Index (NRI) utilizes social vulnerability as a consequence enhancing risk-factor that is geographically based. A risk index score is developed in the NRI and is based on three key factors. These factors include Social Vulnerability, in addition to Community Resilience, and Expected Annual Loss, which is then broken down into three more categories of exposure, frequency, and historic loss ratio. Risk factors are the core to FEMA's NRI. The Social Vulnerability aspect is classified into five categories per county and census tract, from "very low" to "very high".

Figure 2.3-4 shows the NRI data for each census tract across the state. Census tracts with a high index score are more likely to struggle to prepare for, respond to, or recover from hazards. Areas with particularly large concentrations of vulnerable communities include the Wyoming Valley (the historic industrialized region in the Scranton/Wilkes-Barre metropolitan area), the greater Philadelphia area, and the greater Pittsburgh area.

Figure 2.3-4 Pennsylvania Community Social Vulnerability Index (FEMA National Risk Index, 2022).



The Climate and Economic Justice Screening Tool (CEJST) is another way to identify overburdened and underserved census tracts, labeling them as disadvantaged. The tool uses eight categories of burden to identify these communities: Climate change, Energy, Health, Housing, Legacy Pollution, Transportation, Water and Wastewater, and Workforce Development. There are 34 different datasets used in the process. More information on this can be found at https://screeningtool.geoplatform.gov/en/methodology#3/33.47/-97.5.

Communities are identified as disadvantaged if they meet the threshold for one of the eight burden categories and they are at or above the 65th percentile for low income. For example, communities that are identified as disadvantaged with a climate change burden are census tracts that meet that low-income threshold and are at or above the 90th percentile in either expected agriculture loss rate, expected building loss rate, expected population loss rate, projected flood risk, or projected fire risk. Figure 2.3-5 below identifies the specific census tracts across Pennsylvania that have been identified as disadvantaged. The analysis can be taken a step further by analyzing the percentage of census tracts in each county that are identified as disadvantaged, which is shown in Figure 2.3-6. The counties in Southeastern Pennsylvania, especially the Philadelphia suburbs, have relatively low rates of disadvantaged communities, while the counties in the central region tend to have higher rates. The full table of census tract counts and county percentages can be found in Appendix Q.

It is important to connect these identified disadvantages to hazard risk. In Appendix M, there are two tables that showcase how each county rates the risk for each natural and human-made hazard. These maps, those tables, and the SoVI map above represent an opportunity to overlap identified vulnerabilities with identified risks and may help prioritize mitigation strategies moving forward. For example, 23 of the 36 (64%) census tracts in Fayette County were identified as disadvantaged, there are small pockets of relatively high social vulnerability, and a risk assessment at the county level revealed that their highest risk hazards are Extreme Temperatures, Flooding, Wildfire, and Winter Storms. This information can help guide mitigation strategy by identified communities that may need greater assistance than others and what situations they may need it in.

Figure 2.3-5 Pennsylvania Disadvantaged Communities (CEJST, 2023).

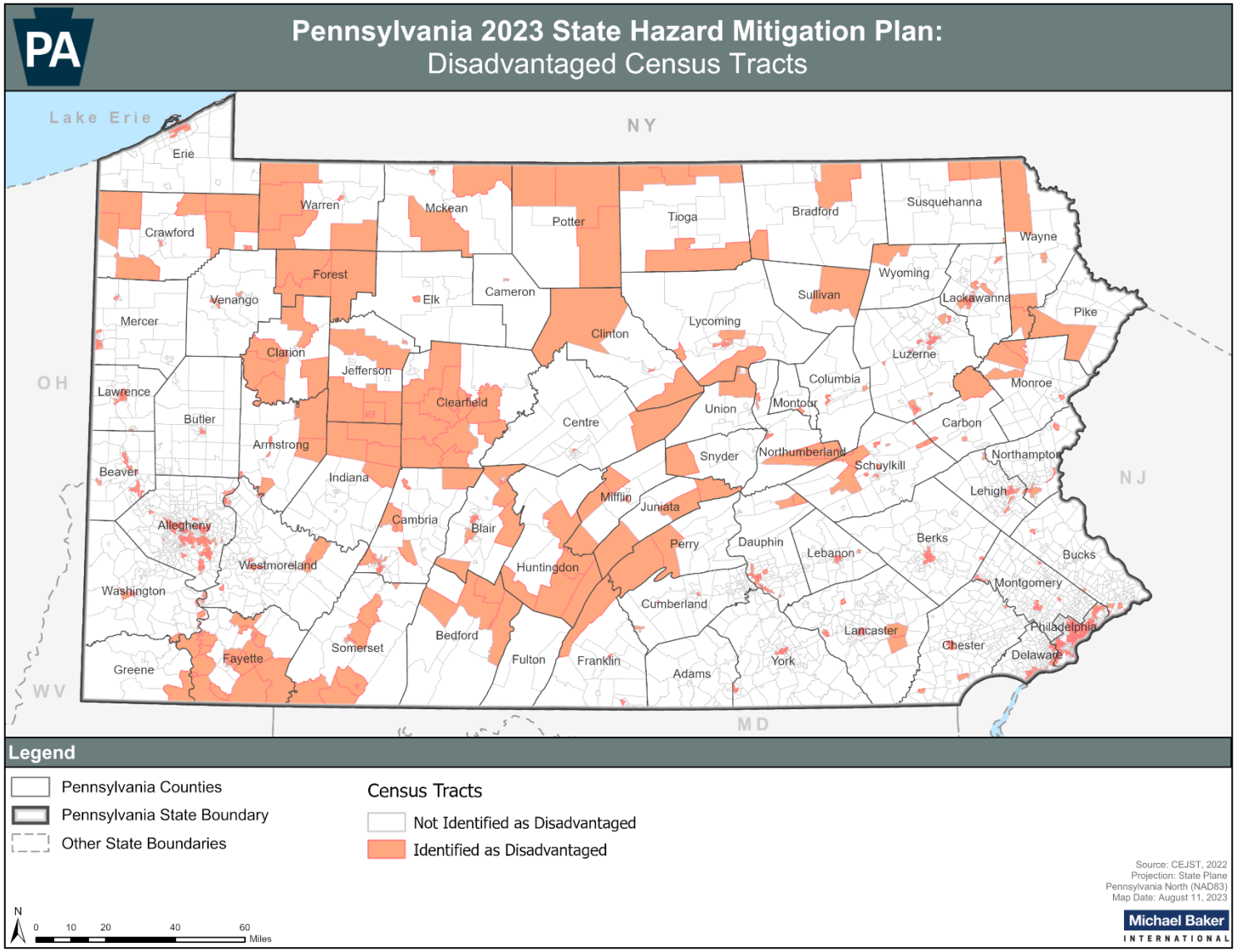
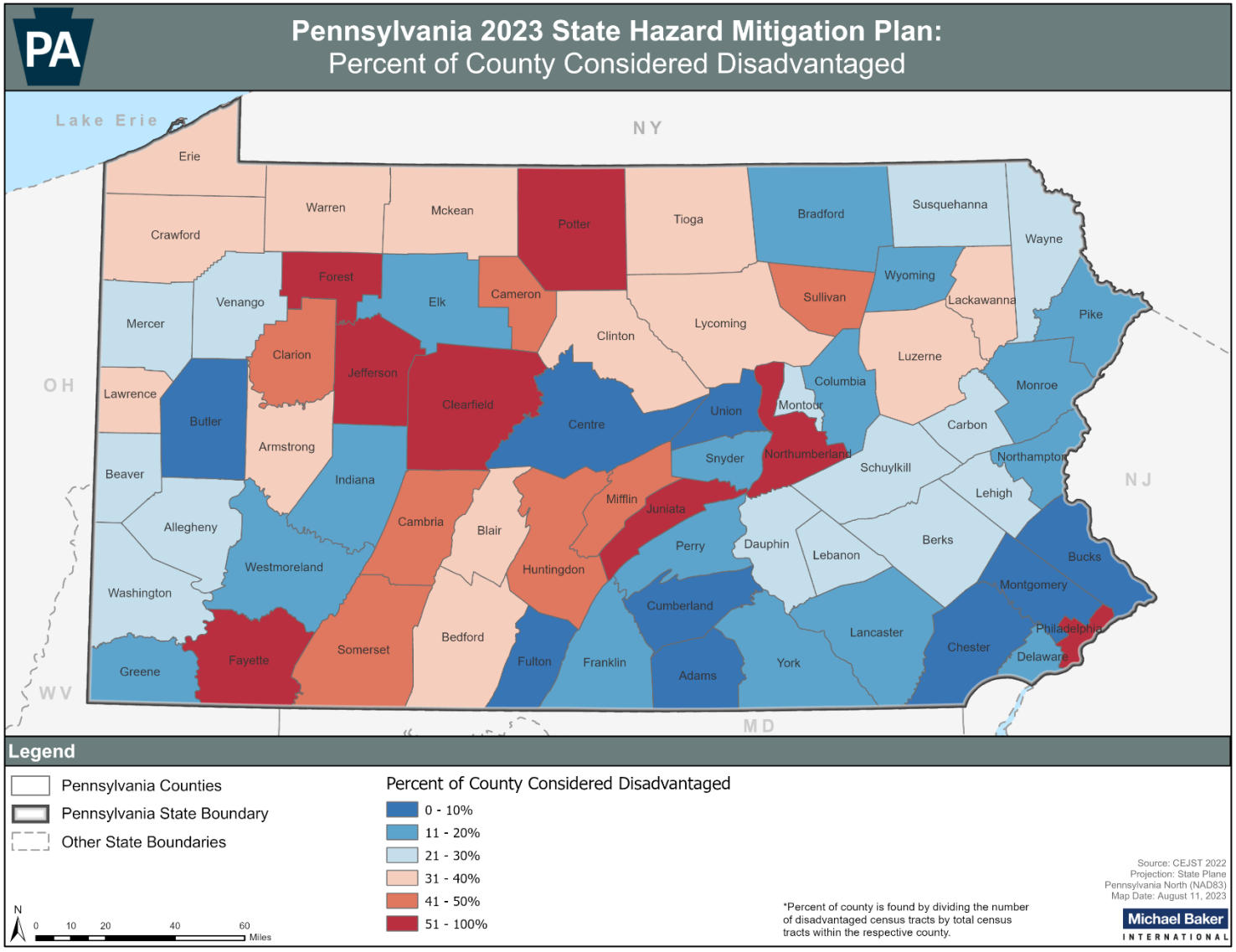
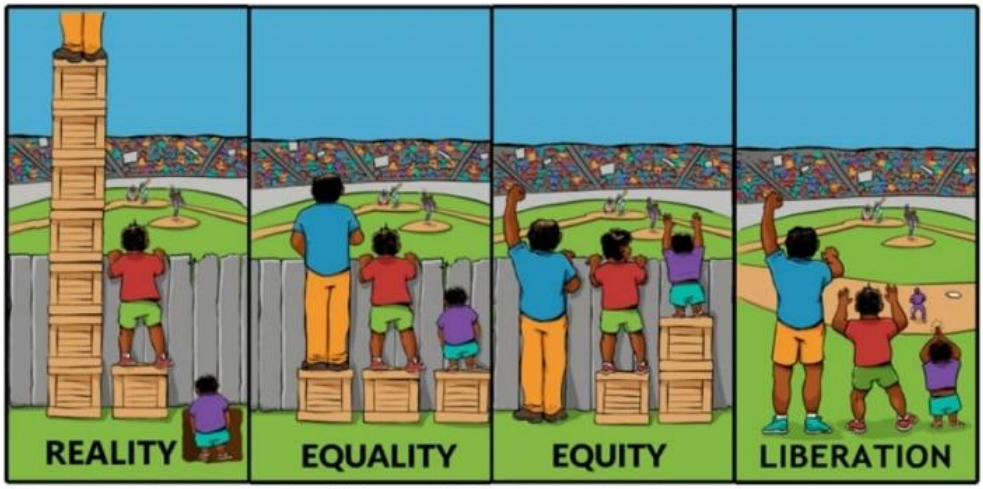


Figure 2.3-6 Share of County Considered Disadvantaged (CEJST, 2023).



It also important to consider the limitations with using only one or two data sources to determine vulnerabilities and communities in need. Within a community, not every resident, business owner, employee, or other individual will experience a hazard the same way. An individual experiencing health challenges, limited mobility, with a limited support network may have more challenges recovering after a disaster. Some communities have robust supports for community members pre-disaster, paratransit to dialysis, language translating services, and more. But post-disaster the continuity of operations plan may not include maintaining services that vulnerable populations need. What communities offer pre-disaster often sets the highest bar they can achieve post disaster.



Vulnerable populations are also not static. Someone who commutes by car daily, becomes transit-dependent when the car is in the shop. Someone who walks and runs regularly, may become limited mobility with an injury.

As part of the planning process, the Planning team discussed what it means to be disadvantaged, underserved, or otherwise considered a vulnerable population. For the purposes of the Commonwealth-wide plan, the Planning team aligned the definitions from FEMA with other potential grant funders for County and community level grants. However, these definitions are not meant to be final and will likely be iterative. The populations considered and the data used to determine disadvantage may change as well.

For example, The PA DEP Environmental Justice Tool pulls data from multiple state sources, census, and EPA EJ tool. In both, community member access to broadband is a factor in vulnerability. However, in the CEJST tool that multiple federal agencies (including EPA) have signed on to, broadband access is not considered a core disadvantage. Additionally, CEJST housing data looks at a variety of factors but excludes mobility limitations and single-story accessibility. Some tools may focus on income and not acknowledge wealth when analyzing poverty. These differences and limitations point to an opportunity for the Commonwealth to further develop its understanding of vulnerability. The Commonwealth intends to do this by progressing mitigation actions related to understanding vulnerability and how to best mitigate vulnerabilities to natural and human-caused hazards.

2.4. Economics

GDP and Trade

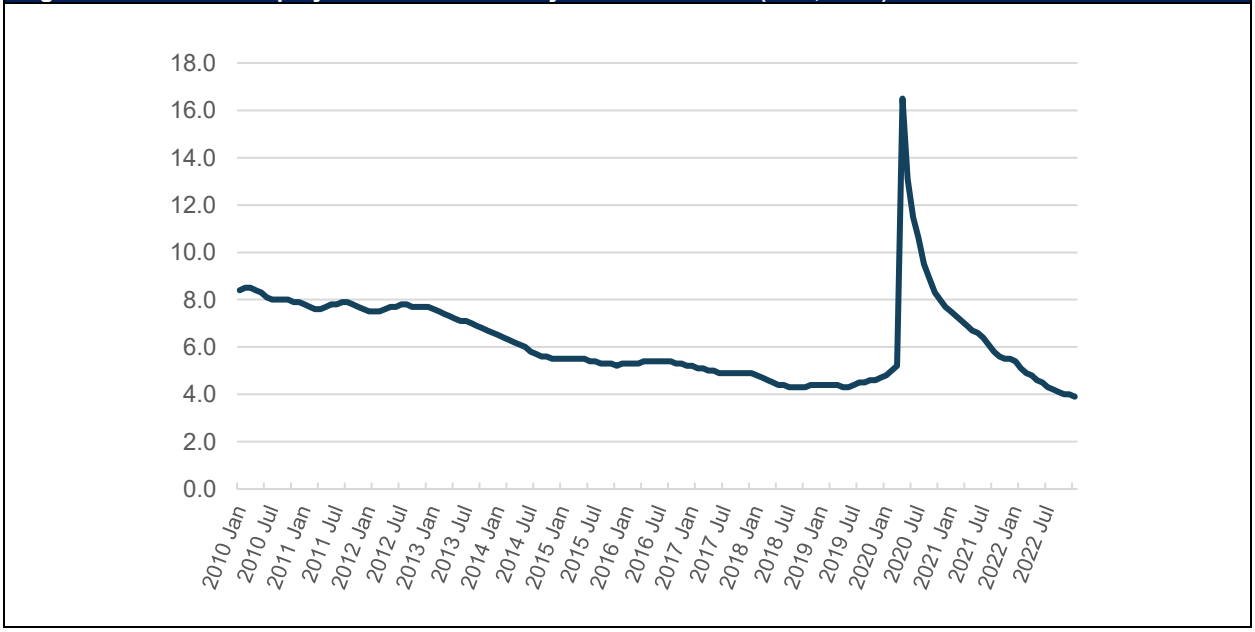
The Bureau of Economic Analysis reports that Pennsylvania's seasonally adjusted GDP in Quarter 3 of 2022 was $727.2 billion and the total personal income was $848.5 billion (BEA, 2022). Both figures ranked sixth in the country. The Commonwealth exported $44.7 billion worth of goods and imported $98.0 billion in 2021 (ITA, 2022).

Overview of Labor and Industry

Unemployment and Labor Force Participation

Figure 2.4-1 below showcases the unemployment rate in Pennsylvania from 2010 to 2022. The general trend reveals a steady decline in unemployment after the 2008 subprime mortgage crisis, with a very large spike to over 16% due to Covid-19 in early 2020. Employment recovery has been fully achieved from an overall standpoint, but it has not been equal across industries or racial groups. As of July 2022, the only industries that have seen employment levels grow compared to February 2020 are Trade, Transportation, and Utilities and Professional Business Services. The Financial, Manufacturing, Construction, Education and Health, Government, and Leisure and Hospitality industries are still below their 2020 employment levels. Not only did Black and Hispanic populations endure higher unemployment than White populations before the pandemic, but their recovery has been slower (Herzenberg, Kovach, and Murtaza, 2022).

Figure 2.4-1 Unemployment Rate in Pennsylvania 2010-2022 (BLS, 2022)



Part of the reason that the unemployment rate is so low yet industries have not fully recovered in total employment numbers is the labor force participation rate, which is defined as the percentage of people in the labor force, typically aged 15-64, that are either working or actively looking for work (BLS, 2023). As Figure 2.4.2 shows, the labor force participation rate has also been declining. Part of this decline has been people leaving the workforce, as both the 25-54 and 55 and older cohorts have lower participation rates than they did pre-pandemic (Herzenberg, Kovach, and Murtaza, 2022). Those who leave the workforce altogether and are

not actively looking for a job are not counted in the unemployment rate. The decrease in labor force participation, most notably driven by the Covid-19 pandemic, has created an overall shortage of workers for many industries in the state. A common theme across meeting with stakeholders from different economic sectors was concerns over how this shortage impacts their ability to operate within normal conditions, let alone plan for and respond to hazards. Strategies to address this issue are presented in Section 6, Mitigation Strategy.

Figure 2.4-2 Labor Force Participation Rate in Pennsylvania 2010-2022 (BLS, 2022)

Labor Market Demographics

Table 2.4-2 below shows the employment levels and unemployment rate for men and women in Pennsylvania based on the 2022 averages. The data shows that a larger portion of men in the state are employed, yet they experience a higher unemployment rate than women. There is a direct relationship between the amount of time women devote to unpaid work, such as childcare, and their labor force participation rates (Ferrant, Pesando, Nowacka, 2014). The COVID-19 pandemic also plays a role. Studies done by the U.S. Chamber of Commerce found that many women who left the labor force during the pandemic, most likely due to the severe decline in available and affordable childcare, have not yet returned. Nearly 60% of parents who left the workforce during this time cited a lack of childcare as their reason for leaving (Ferguson, 2022). As showcased above, this change in labor force participation rate will have an impact on unemployment rates.

Table 2.4-1 Overall Employment by Gender (BLS, 2023)				
POPULATION GROUP	EMPLOYED		UNEMPLOYED	
	TOTAL	PERCENTAGE OF TOTAL POPULATION	TOTAL	RATE (%)
Men	3,242,000	63.7	143,000	4.2
Women	2,937,000	54.8	121,000	4.0
Total	**6,179,000**	**59.1**	**264,000**	**4.1**

Table 2.4-3 provides similar data but for different age cohorts. The 25 to 34 year old cohort is both the largest labor block and largest unemployed block in Pennsylvania. Those aged 35 to 44 have very similar numbers as well, with both cohorts having a 4.1% unemployment rate. The significant drop-off from the 55 to 64 year old cohort to 65+, both in total numbers and as a percentage of their population, showcases how many leave the workforce around that age. These workers will not only need to be replaced in the workforce, but will need to be supported by the younger generations of workers. As discussed in the sections above, Pennsylvania ranks highly in the percentage of population aged 65 or older and that share is only expected to increase in the future. The two youngest cohorts, along with those under 16, will be tasked with replacing those aging out of the workforce. While these cohorts currently exhibit the highest unemployment rates and low total population employed, many people in this age range are still students.

Table 2.4-2 Employment Statistics by Age Cohort (BLS, 2023)				
AGE COHORT	EMPLOYED		UNEMPLOYED	
	TOTAL	PERCENTAGE OF TOTAL POPULATION	TOTAL	RATE (%)
16 to 19	214,000	35.0	19,000	8.2
20 to 24	572,000	67.1	45,000	7.3
25 to 34	1,339,000	81.5	57,000	4.1
35 to 44	1,287,000	81.3	55,000	4.1
45 to 54	1,196,000	78.0	35,000	2.8
55 to 64	1,127,000	63.8	37,000	3.2
65+	444,000	18.1	17,000	3.6

Table 2.4-4 takes a look at employment statistics by racial group. The table compares the same employment statistics as the previous two tables. It is no surprise that white residents make up the large majority (79.4%) of employed persons in the Commonwealth as 81% of all residents are white. The percentage of the white population being employed (59.5%) is similar to those with Hispanic or Latino ethnicity (59.1%), yet Hispanic or Latino residents experience a 6.9% unemployment rate compared to only 3.7% for white residents. Despite being the smallest racial group of the ones represented, Asian residents exhibit the largest share of total population being employed (67.8%) and a 2.7% unemployment rate. This unemployment rate is

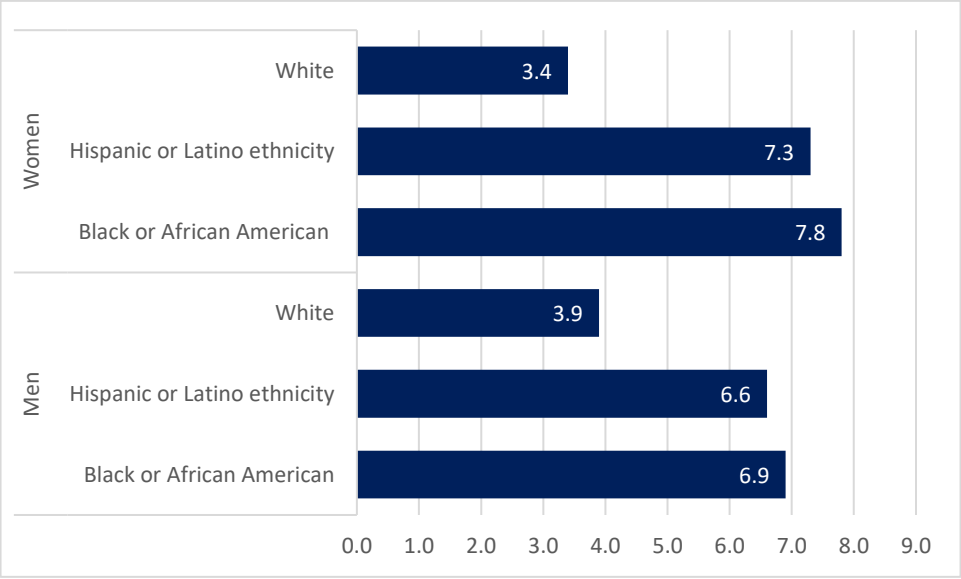
significantly lower than Pennsylvania as a whole. Black or African American residents have both the lowest share of their total population employed and the highest unemployment rate despite being the second largest population group in Pennsylvania.

Table 2.4-3 Employment Statistics by Race (BLS, 2023)

RACE	EMPLOYED		UNEMPLOYED	
	TOTAL	PERCENTAGE OF TOTAL POPULATION	TOTAL	RATE (%)
White	5,118,000	59.5	194,000	3.7
Black or African American	635,000	54.0	51,000	7.4
Asian	277,000	67.8	8,000	2.7
Hispanic or Latino ethnicity	412,000	59.1	30,000	6.9

Figure 2.4-3 below expands the racial lens used above to include gender as well by presenting the different unemployment rates for each group. Note that the Asian community is not represented in the chart as the data from the BLS was not broken down into gender. The figure includes data on each different group, with the unemployment rate representing the percentage of people in that group that are in the labor force and actively looking for work yet are not employed. They are not percentages of the total population, but percentages of their group's population. White women are the only group of women to have lower unemployment rates than the men in their same racial group. Black or African American women have the highest unemployment rate of any group, almost 1 full percentage point more than Black or African American men. Hispanic or Latino women also have a significant unemployment rate, which is 0.7 percentage points higher than their male counterparts.

Figure 2.4-3 Unemployment Rate by Gender and Race (BLS, 2023)



Employment by Industry

Agriculture is an important industry for Pennsylvania. An analysis sponsored by the PA Department of Agriculture reported that the industry supported a total of 301,900 direct jobs, produced $81.5 billion in goods and services, and paid out $14.5 billion in direct income. The analysis went further to look at indirect outcomes that are supported by the industry and found 593,600 jobs, $132.5 billion in total output, and $32.8 billion in labor income (PA Department of Agriculture, 2022a). These indirect jobs included those working in transportation, warehousing, administration, finance, insurance, and trade. The industry as a whole is very susceptible to natural hazards, particularly severe storms, hail, invasive species, wildfires, drought, and extreme temperatures. The possible contamination caused by human made hazards such as hazardous waste and oil & gas spills are another concern.

The Bureau of Labor Statistics' Quarterly Census of Employment and Wages reported that there were 5,901,290 people employed in non-farm jobs in Pennsylvania as of June 2022. These employees are spread across 387,852 different establishments. Table 2.4-4 shows how many people each industry employs in the Commonwealth, along with how many individual establishments there are within that industry. The top employment industry in Pennsylvania is Education and Health Services, with 1,192,907 people employed. Trade, Transportation, and Utilities was close behind with 1,124,254 people employed. Professional and Business Services employed the third most people yet had the most establishments. Private enterprises made up the bulk of employment, with all three levels of government only accounting for 650,960 jobs (11%).

Table 2.4-4 Non-Farm Employment by Industry as of June 2022 (US Bureau of Labor Statistics, 2022)				
INDUSTRY	EMPLOYMENT	ESTABLISHMENTS	EMPLOYMENT QUOTIENT	TOTAL WAGE QUOTIENT
Federal Government	98,382	2,639	0.88	0.83
State Government	126,236	1,468	0.72	0.75
Local Government	431,342	8,892	0.79	0.81
Natural resources and mining	50,171	3,805	0.68	0.73
Construction	268,329	31,071	0.87	0.93
Manufacturing	566,897	14,623	1.13	1.06
Trade, transportation, and utilities	1,124,254	76,245	1.02	0.98
Information	93,555	8,513	0.78	0.62
Financial activities	337,136	32,500	1.00	1.01
Professional and business services	844,605	78,397	0.96	1.00
Education and health services	1,192,907	59,476	1.32	1.42
Leisure and hospitality	567,951	34,583	0.89	0.80
Other services	199,525	35,640	1.15	1.05
Total (All Industries)	**5,901,290**	**387,852**	**1.00**	**1.00**

In addition to aggregate employment numbers, the table also shows both the employment and total wage quotient of each industry relative to the United States. The employment quotient is a ratio that shows how Pennsylvania's level of employment or the compensation it pays workers in that industry compares to the entire country. If it is higher than 1, then Pennsylvania has a relatively high concentration of employment or pays its workers relatively higher in that industry. If lower, Pennsylvania has a relatively small concentration of employment in that industry and pays its workers less.

The Pennsylvania economy includes a specialization in Education and Health Services, with those employed in that industry also making relatively higher wages than their counterparts across the country. Fifteen of the top fifty employers in the state are either schools or hospitals, with other health service companies also making the list (DLI, 2022). This concentration can be beneficial from a hazard mitigation perspective, as the influx of trained education and health sector professionals may increase capabilities to respond to and recover from natural and human-caused disasters.

The Manufacturing industry is another specialization of Pennsylvania. The total output from this industry in 2021 was $101.9 billion. Chemical manufacturing, most notably pharmaceutical and medicine manufacturing, is the most prominent subsector and accounted for $21.6 billion in output (. Manufacturing can play a significant role in hazard mitigation due to the wide variety of companies that fall under its umbrella and is vulnerable to hazards that impact infrastructure

and supply chains. Significant employers in the industry include Merck Sharp & Dohme Corporation, East Penn Manufacturing, PPG Industries, and U.S. Steel Corporation.

The quotients for Trade, Transportation, and Utilities show a small specialization for the Commonwealth. This is technically a super-sector designation and consists of wholesale trade, retail trade, transportation and warehousing, and utilities. Wholesale and retail trade include a wide variety of subsectors, from cars to furniture to machinery and more. December 2021 figures from the PA Department of Labor & Industry reported they employed 204,784 and 596,672 people, respectively. They were hit hard by the Covid-19 pandemic, which impacted both the health of their workers and the structure of operations, but rebounded to produce over $96 billion in output in 2021 (U.S. Bureau of Economic Analysis, 2022). Notable employers include Wal-Mart, Giant Food Stores, Amazon, Lowe's, Home Depot, and Target. December 2021 employment figures for the Transportation and Warehousing industry came in at 325,671 and notable employers include USPS and UPS. This subsector is vulnerable to a wide variety of hazard risk, as transportation infrastructure is rarely protected from natural hazards and can often be a target for acts of terrorism. Transportation Incidents are also a significant hazard themselves.

An important discussion about these three sectors involves the development of the digital economy and online shopping. The growth in this industry can lead to job growth but also has a physical imprint through increased the volume and frequency of freight and warehousing developments leading to strained infrastructure and adverse environmental impacts (Yuan, 2020). The Lehigh Valley has added tens of thousands of jobs through this distribution economy and become one of the logistic hubs of the country, approving nearly 45 million square feet of warehousing space between 2015-2021 and garnering over $1 billion in private investment. However, local officials have begun speaking out about issues surrounding these developments, including the impact on municipal infrastructure and land use (McElwee, 2022).

The Utilities subsector was reported to employ 33,683 people in December 2021 (). Utility Interruption is considered a very significant hazard for Pennsylvania, as it can cascade into negative impacts for a myriad of additional industries and essential resources.

Other Services is also a specialty of the Commonwealth, but it encompasses such a large variety of potential businesses that it is difficult to analyze beyond simply employment and establishment numbers. The BLS definition includes machinery repair, religious activities, advocacy, laundry services, personal care, pet care, parking, and more. These services were undeniably impacted by the Covid-19 pandemic and would be subject to similar hazard risk as many businesses such as flooding, winter storms, terrorism, and more. These services are important for communities but may not be looked upon as essential.

Employer Size

Table 2.4.5 below analyzes private employment by the size of the company. It's important to note that establishments is a count of places of work, not employers. Nearly half of all private establishments in Pennsylvania had between 1 and 4 employees, yet they only employed around 6.6% of all private employees. Places with 20-49 employees had the highest share of total employment at 18.2%. Those with more than 100 employees only made up 2.1% of all establishments yet employed nearly half of all people across Pennsylvania.

Table 2.4-5	Employment Statistics by Business Size (PA Department of Labor & Industry, 2022)				
SIZE CODE	2022 2nd QUARTER				
	ESTABLISHMENTS	SHARE (%)	AVERAGE EMPLOYMENT	TOTAL EMPLOYEES	SHARE (%)
0	37,884	10.1%	0	0	0.0%
1-4	179,124	47.8%	2	347,235	6.6%
5-9	63,805	17.0%	7	422,381	8.1%
10-19	44,274	11.8%	14	600,709	11.5%
20-49	31,600	8.4%	30	953,712	18.2%
50-99	10,444	2.8%	69	719,086	13.7%
100-249	5,631	1.5%	151	848,736	16.2%
250-499	1,400	0.4%	341	477,782	9.1%
500-999	477	0.1%	682	325,170	6.2%
1000 & Over	236	0.1%	2,331	550,055	10.5%
Total	**374,875**	**100%**	**14**	**5,244,866**	**100%**

Note: Data is preliminary

The Digital Economy & Inequality

Each year, aspects of everyday life become increasingly digital and require access to certain technologies. Information, services, resources, and products are more easily disseminated, provided, housed, and developed online, creating increased levels of convenience for many. However, access to technology, even online banking and credit cards, is not equal. This digital inequality corresponds closely with other inequalities such as income, education, race and ethnicity, age, immigration status, and geography and can even exacerbate them (HUD PD&R, 2016). These economically or societally disadvantaged groups are also those that tend to be the most at-risk for hazards and their consequences.

The Covid-19 pandemic highlighted a lot of issues caused by this digital divide. As schools were closed in an effort to stop the coronavirus spread in 2020, classrooms were moved online, and remote learning became the new normal. This change was a challenge for families that did not have reliable internet access, lacked requisite digital devices, relied on school meals, or whose parents' jobs did not allow them to work from home and supervise their children. The shift highlighted the inequalities not only at the household level but between school districts as well (Layne, 2020).

Another transition that has been difficult for those with low access to reliable internet and technology is telemedicine, which was required at time due to the restrictions in place. This digital way of delivering medical services is susceptible to intervention-generated inequalities, which occur when interventions disproportionately benefit more advantaged patients due to their increased access to said intervention (Price and Simpson, 2022). Relying on digital access not only creates initial barriers, but also impacts adherence and effectiveness of treatments. Telemedicine can overcome geographical barriers for accessing high-quality medical services, but the benefits will tend to be concentrated in certain communities.

As things like financial services, educational and job opportunities, healthcare, and more become increasingly digitized, it is important for access to expand as well. Not only can improved access help improve the health and socioeconomic status of vulnerable communities, but it can also help develop their preparedness and build resilience to both natural and human-made hazards.

2.5. Land Use and Development

The Commonwealth of Pennsylvania has a variety of land uses ranging from agriculture to industrial. Residential land uses are concentrated in high densities in urban areas and are generally low-density and more spread out throughout the rest of the Commonwealth. Agriculture is also a prominent land use; there are over 7.3 million acres of farmland and nearly 53,000 farms throughout the Commonwealth (USDA 2022). As of 2021, over 6,000 farms, totaling over 611,000 acres of farmland are permanently preserved, thus protecting it from development and helping to maintain the rural character of the Commonwealth (Pennsylvania Department of Agriculture, 2022b).

Throughout its history, Pennsylvania has been covered in forests. In fact, the name *Pennsylvania* translates to “Penn’s woods.” Although much of the state’s original forest is gone, forest is still a primary land cover in the Commonwealth (Figure 2.4-1). In fact, forests blanket more than 60 percent (16.6 million acres) of the Commonwealth, from the deep forests of the northern tier “big woods”, to the forested ridges of the south, and to the woodlots and urban and community forests scattered in between.

Land cover significantly affects hazard vulnerability. For example, counties with a large percentage of forest cover, such as those that contain the Allegheny National Forest are more susceptible to wildfire hazards and some invasive species. Additionally, human encroachment on wooded areas can leave more people vulnerable to wildfires if they do not appropriately plan for fire defensible space around their homes. Wildfire risks can be mitigated through forest maintenance. The presence of trees can also reduce vulnerabilities, as is the case with flooding and certain public health risks with extreme temperatures. Figure 2.4-1 displays areas the overall land cover in the Commonwealth. As urbanization occurs, areas that were once covered with trees and grass are being replaced by impervious surfaces of roads, roofs, and parking lots. This urbanization reduces infiltration of rainwater thus increasing the amount of stormwater runoff and the potential for flash flooding (USGS, 2005). This increase in stormwater runoff has a particular impact on communities built in karst areas, as more stormwater accelerates the natural percolation process that causes subsidence and sinkholes. Changes in ground cover can also exacerbate natural hazards like landslides since removing natural vegetation can cause unstable slopes. Development trends, including urbanization, are discussed in more detail in Section 4.5.

Pennsylvania land use and development are often defined by the Commonwealth’s transportation system. Roads, rail lines, airports, and ports are important for the transportation of people, goods, and services and development typically occurs around transportation hubs. Pennsylvania has a widespread highway network of over 120,000 miles which includes major

interstate highways such as Interstate 80, the Pennsylvania Turnpike, Interstate 90, Interstate 79 and Interstate 81 (Figure 2.4-1). The Commonwealth has over 25,000 state-owned bridges and approximately 6,600 bridges on locally-owned roads. Pennsylvania contains over 5,600 miles of railway and 121 public-use airports, six of which are international airports (PennDOT 2022). Furthermore, there are three major ports in Pennsylvania that move over 61 million tons of goods: Philadelphia, Pittsburgh, and Erie.

The Department of Community and Economic Development completes growth management and land use reports in order to promote proactive land use planning in the Commonwealth. This report is completed every five years and evaluates contemporary land use issues, historic and projected trends, and development patterns at the state and regional level. According to their 2020 State Land Use and Growth Management Report, the pace of development was low between 2011 and 2016, as the amount of developed land increased by only 0.9%. In the 2015 version of the report, the 1.6% increase between 2006 and 2011 was deemed to be low as well when compared to the 131% increase observed between 1992 and 2005.

The report identified that a lack of affordable housing is a challenge in faster-growing regions in Pennsylvania, such as the southeast. Another housing challenge is the significant portion of housing being 70 or more years old. When discussing transportation policy, it highlighted an increasing demand for distribution warehouses on farmland in rural areas. In terms of agricultural land, the number of farms and the acreage of farms has continued to decrease over the last ten years, while the percentage of farms that are considered harvested croplands has increased by three percent over the same time period.

An important aspect of land use and development are the greenhouse gas (GHG) emissions that result from various land use sectors, including residential homes, commercial areas, industrial sites, transportation infrastructure and its use, electricity production, agriculture, and waste management. According to the 2022 Greenhouse Gas Inventory, Pennsylvania has achieved a nearly 18 percent reduction in GHG emissions compared to 2005. However, emissions actually rose in 2018 and 2019 and there are still reductions needed to meet targets. In 2019, the residential sector accounted for 8 percent of all emissions. This was the fourth largest contribution, behind the industrial sector, electricity production, and transportation (PA DEP, 2022a).

In terms of residential structures it is worth noting that Pennsylvania's housing stock price has increased (please see Figure 2.5-1) and multiple state agencies voiced concern over available affordable housing and encouraging affordable housing construction. As a case study, Yardley- with a median home sale price of $380k, is listed as one of the most competitive cities in PA as indicated by homes sold above asking price. Homes also sell very quickly (e.g. within 4-8 days of listing). It is also worth noting, 80% of Yardley homebuyers searched to stay within Yardley. Potential homebuyers from outside Yardley included buyers from New York City, Washington DC, and San Francisco, CA (some of the most expensive housing markets in the country).

Redfin estimates that 46% of Yardley's housing stock (609 homes) is at risk of flooding and that will likely increase to 48% (637 homes) within the next 30 years. During the Housing Sector presentation, state agencies DCED and DHS both observed generally (not specific to Yardley)

that after Hurricane Ida, the affordable housing stock portfolio in Pennsylvania decreased, and noted concern that the replacement housing in impacted communities may not be affordable.

Figure 2.5-1 Average Housing Sale Price (Redfin.com, 2023)

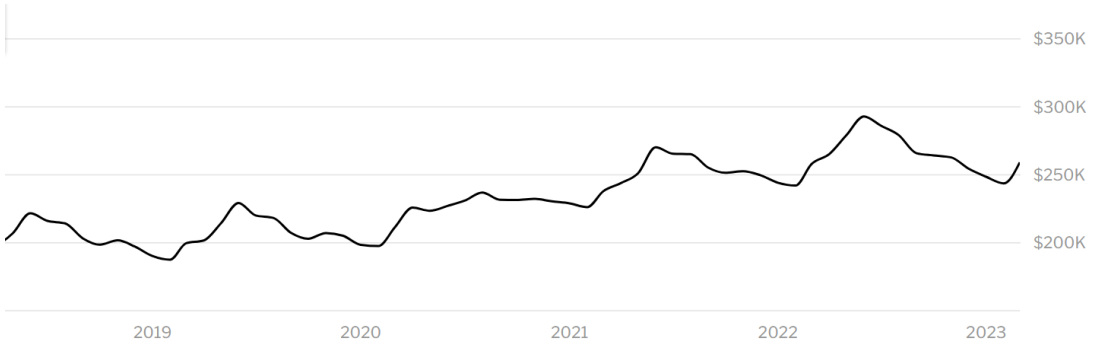


Figure 2.5-2 provides a map with more detail of Pennsylvania's land use in different classification. Data here is provided by the Multi-Resolution Land Characteristics Consortium (MRLC) from their 2019 National Land Cover Database (NLCD). The legend on the map is based off characteristics from the MRLC classifications of land cover. Developed land is classified into 4 categories: Open Space, Low , Medium, and High Intensity. These developed lands are a mix of construction materials and vegetation, with high intensity including row homes and apartment complexes, and open space containing large single lot homes, parks, and golf courses. The impervious surfaces for open space, low, medium, high intensity account for 0-20%, 20-49%, 50-79%, and 80-100% of the total land cover, respectively. Majority of Pennsylvania contains forested land cover. Highly developed land sprawls out from major cities, such as Philadelphia, Pittsburgh, Harrisburg, Scranton-Wilkes Barre, Allentown, and others, into suburban developments such as the suburbs of Bucks and Montgomery County. Large pockets of cultivated land are found in the greater Lancaster region and central Pennsylvania. Cultivated lands contain pasture and hay areas used for grazing, and areas of cultivated crops used for annual crop production, orchards, or vineyards. Smaller areas of woody wetland can be seen in Monroe County in the east, and in northwest counties towards Erie. More information on the MRLC and the NLCD can be found at their website (mrlc.gov)

Pennsylvania has over 85,000 miles of streams and rivers within its borders, as seen in Figure 2.4-3. Every county in the Commonwealth has at least 100 miles of streams, and each county averages 1,283 linear miles of waterways. In general, counties within the Delaware River watershed have fewer miles of streams. It is important to note that fewer stream miles does not always mean reduced risk to flooding and flooding related hazards. In urban areas, streams were often historically filled in or piped into sewer systems. Hindering the natural flow of a stream can interrupt the ability of the natural environment to accommodate flood water and poor fill can lead to building collapses. Regardless of the mileage, Pennsylvania has an overall high volume of streams statewide, contributing to Pennsylvania's long and expensive flooding history.

Figure 2.5-4 provides a map of state-owned or leased facilities that are included in the risk assessment analysis completed for each hazard in Section 4. The map only displays facilities for agencies that have more than 100 facilities. Otherwise, the map may be unreadable due to utilizing data from 30 different agencies in the analysis. Table 2.5-1 shows how many of these facilities each agency has. Figure 2.5-5 does the same for all state-identified critical facilities that location data was available for across the state. The SPT defined critical facilities as assets that are essential to the Commonwealth's security, public health and safety, economic vitality, and way of life. These assets are mostly privately-owned and operated and include facilities such as power grids and water filtration plants; national monuments and government facilities; telecommunications and transportation systems; and chemical facilities. More information on these critical assets and the analysis of their vulnerability is present in Section 4.1.1 and in the State Facility and Jurisdictional Vulnerability Assessments completed for each hazard in their profiles throughout Section 4.3.

While the map of state owned or leased facilities (Figure 2.5-2) shows the distribution across Pennsylvania, it is also important to note agencies with fewer than 100 facilities (Table 2.5-1). For agencies with fewer facilities, there may be more vulnerability when the facility is inaccessible (e.g. from flooding or fire). Continuity of operations for those agencies may include working with other state agency facilities and/or increasing telework expectations temporarily.

Table 2.5-1 State Owned and Leased Facilities

AGENCY NAME	TOTAL FACILITIES
Attorney General	9
Dept. of Agriculture	16
Dept. of Banking and Securities	2
Dept. of Community& Economic Development	4
Dept. of Conservation & Natural Resources	2
Dept. of Corrections	696
Dept. of Education	1
Dept. of Environmental Protection	13
Dept. of General Services	131
Dept. of Health	48
Dept. of Labor & Industry	69
Dept. of Military and Veterans Affairs	1
Dept. of Public Welfare	98
Dept. of Revenue	10
Dept. of Transportation	1691
Drug and Alcohol Programs	1
Emergency Management Agency	8
Executive Offices	2
Fish and Boat Commission	154
Governor's Office	1
Historical & Museum Commission	30
Insurance	2
Liquor Control Board	546
Public School Employees' Retirement System	6
State Civil service Commission	1
State Department	1
State Employees' Retirement System	4
State Police	36
State System of Higher Education	855
Thaddeus Stevens College of Technology	20
Treasury	2
TOTAL	**4,460**

Figure 2.5-2 Map of Land Cover throughout Pennsylvania (NLCD, 2019).

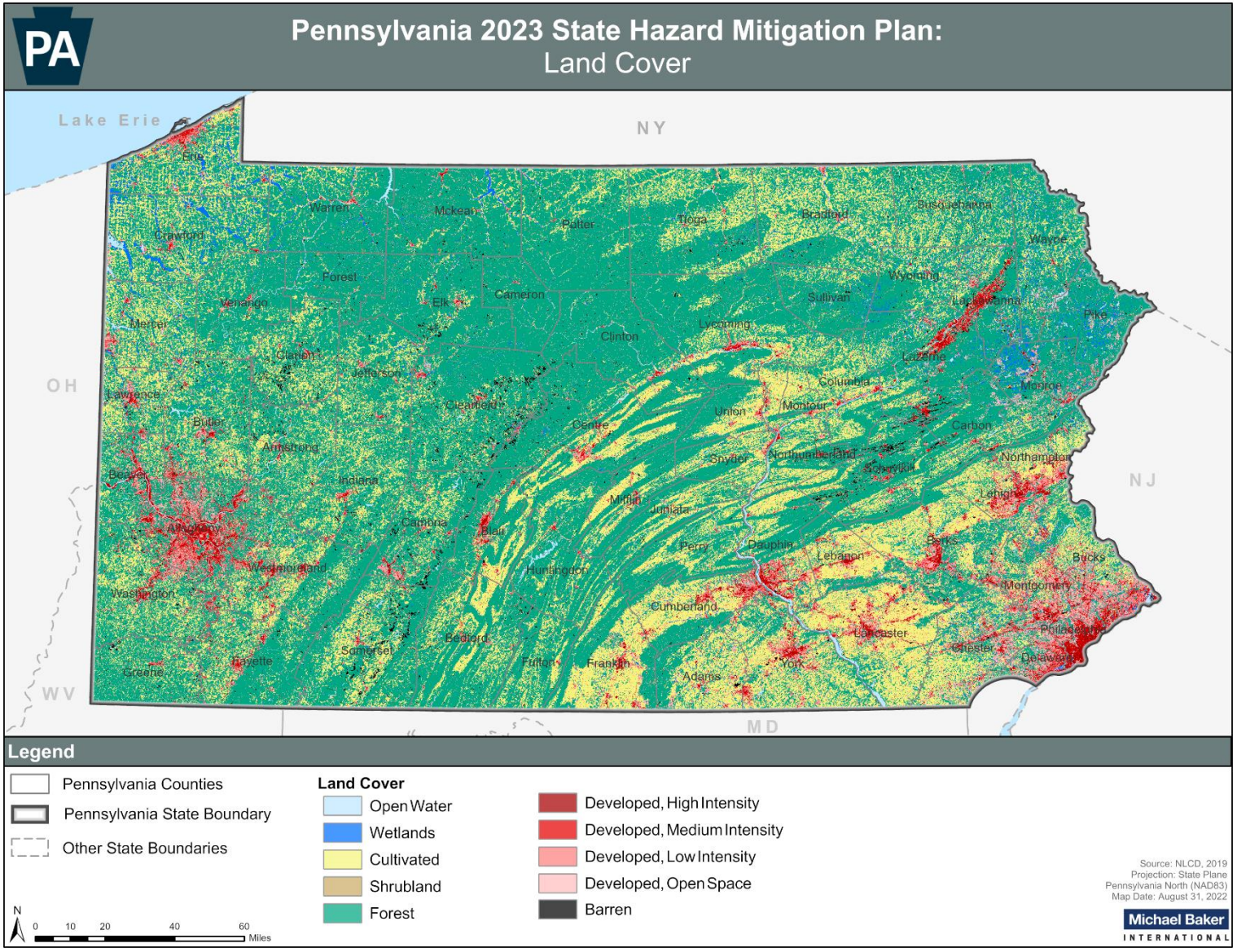


Figure 3.1-1 Major Highways and Rails in Pennsylvania (PennDOT, 2022a).

Figure 3.1-2 Stream Miles per County (National Hydrography Dataset, 2022).

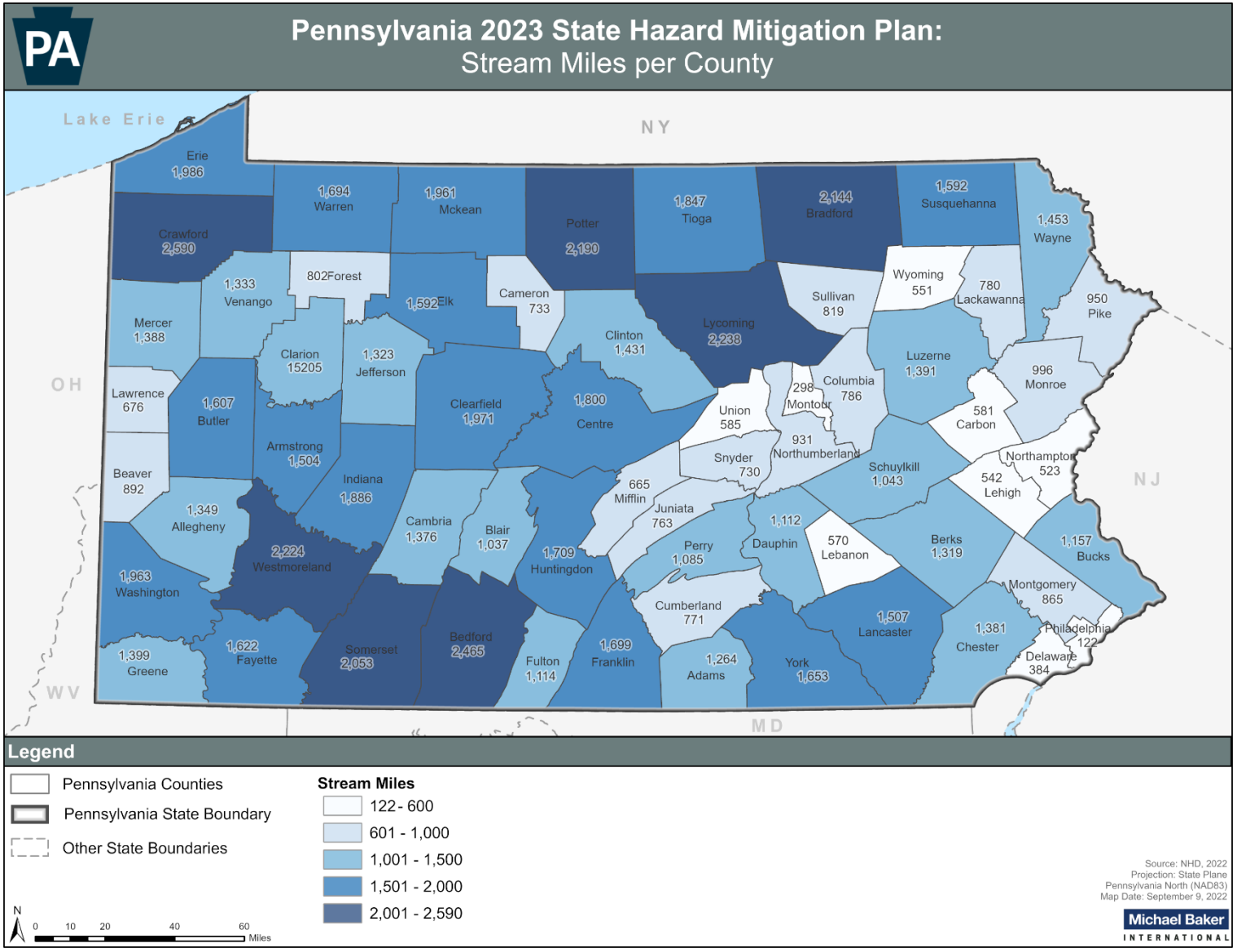


Figure 3.1-3 Map of State-Owned or Leased Facilities Included in the State Vulnerability Assessment (DGS, 2018 and PEMA, 2018).

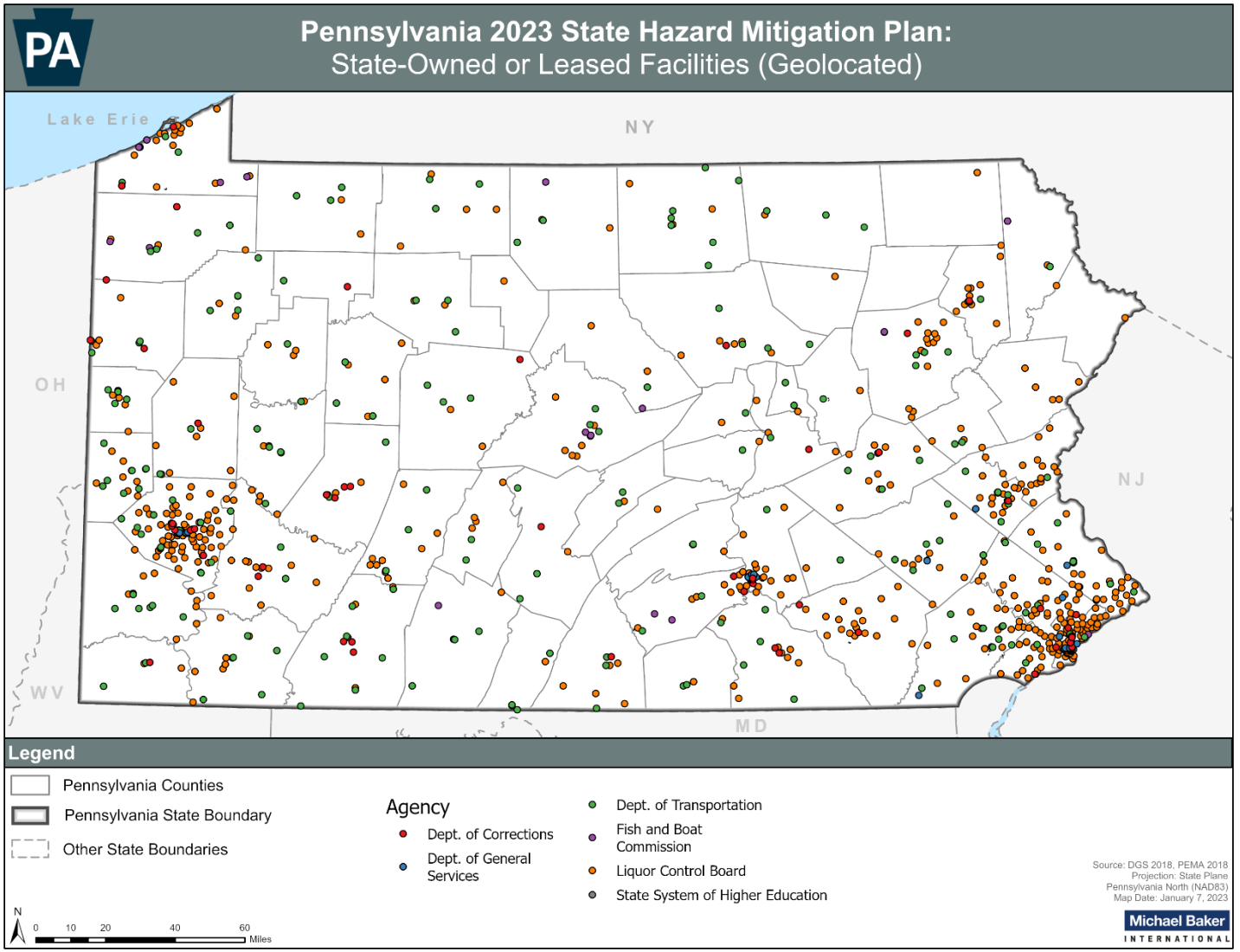
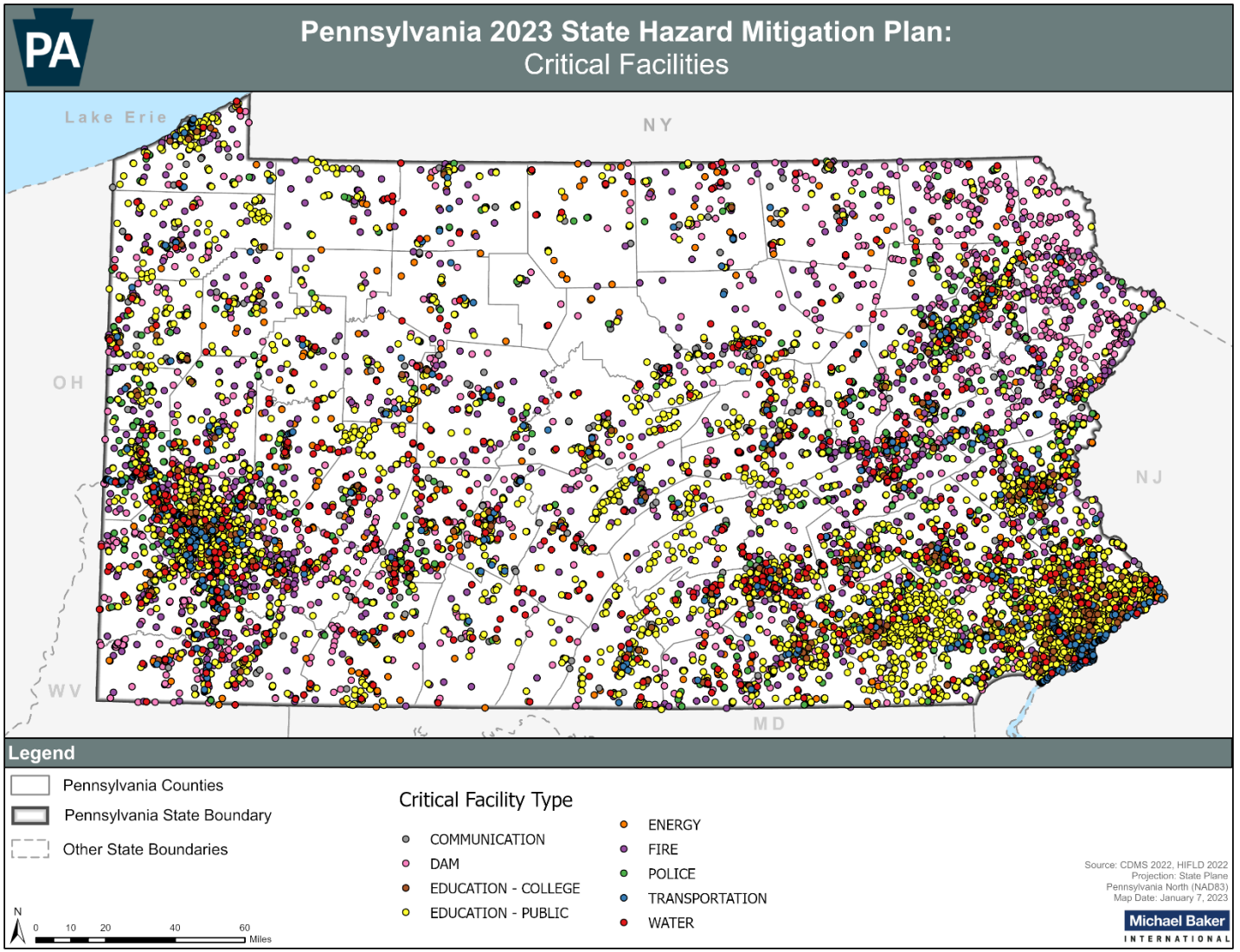


Figure 3.1-4 Map of Critical Facilities Included in the State Vulnerability Assessment (HIFLD 2022, CDMS 2022).



2.6. Data Sources

To complete the Commonwealth's risk assessment, data was collected from a variety of sources. Overall, analysis was based on collecting the best data currently available. Information from previous SHMPs was reviewed and incorporated as appropriate. Statewide data sets were used to perform spatial analyses that could more robustly address probabilistic risk.

The assessment began with a review of all the local hazard mitigation plans available in the Commonwealth. Hazards covered in county hazard mitigation plans are summarized in Section 4.1. The risk analyses in these local plans informed each of the hazard profiles throughout Section 4.3. Since the local plans use different data sources with various levels of detail, the SPT was consulted and research was conducted to identify consistent, statewide data sources. The data sources assembled through this research include national and Commonwealth databases as well as published reports. To estimate potential losses at the county and state levels, the best available data were identified for each hazard. For the vast majority of profiled hazards, more current and/or more robust datasets were available to estimate potential losses. For a few hazards, however, the measure of vulnerability did not change from the 2018 SHMP.

Data sources used for this update are covered in the Standard Operating Guide. This will allow local plans to use the same data sources as the state plan and will help standardize risk assessments throughout the Commonwealth (see Appendix D for full list). Distinct datasets and methodologies were used for natural hazards and human-made hazards. For both hazard types, however, probabilistic data on the past occurrences of hazard events was gathered, and a consistent methodology was applied to the extent possible.

The risk assessment for natural hazards was based largely on FEMA's National Risk Index, (NRI). FEMA collaborated with dozens of partners in academia, government, and private industry to develop the NRI. By combining natural hazard likelihood with social and physical factors, the NRI aims to provide state and local decision makers with a holistic understanding of place-based risk. For this SHMP, the National Risk Geodatabase was downloaded and the datasets characterizing natural hazard likelihood were extracted. These natural hazard datasets were developed from data collected from authoritative government agencies and research institutes specializing in each hazard. FEMA used nationwide, probabilistic, and continuous data where possible, and processed the data to calculate hazard values at the census tract scale.

FEMA's NRI hazard values, in turn, are based largely on the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) Storm Events Database. The NCEI Storm Events Database provides a comprehensive record of significant meteorological events that caused loss of life, injuries, or property damage, or that were otherwise rare or unusual. The database is based on reports from National Weather Service field offices across the US. Since 1950, these field offices have submitted reports on significant storm events to National Weather Service (NWS) headquarters, and headquarters staff have then checked the reported location and impacts before entering them into the Storm Events Database.

Note that the NRI documentation tends to refer to the calculated hazard values as "the maximum number of [hazard events] recorded in a given census tract" over the period of record. While this NRI wording was retained in the plan update, it is somewhat misleading. The geoprocessing steps applied to the source data generally involved a step to transform point data to grid data, and this step tended to result in overcounting. The hazard values therefore *correspond* to the number of occurrences of a hazard event, but should not be interpreted to *equal* the number of occurrences.

For this plan update FEMA's NRI was used to inform nine hazard profiles: Drought; Extreme Temperature; Hailstorm; Hurricane, Tropical Storm, Nor'easter; Landslide; Lightning Strike; Tornado, Windstorm; Wildfire; and Winter Storm.

While the risk assessment for natural hazards was based largely on data from FEMA's National Risk Index, the risk assessment for human-made hazards was based largely on data from PEMA's incident management systems. An incident management system provides a centralized communication platform for state and local agencies engaged in incident response, allowing for more effective cross-agency and cross-jurisdictional collaboration. Since 2001, PEMA has used three different software systems to support its emergency management operations: the Pennsylvania Emergency Incident Reporting System or PEIRS (January 2001 – June 2009), WebEOC (June 2009 – Fall 2012), and PEMA-KC (Fall 2012 – present). The current incident management system, PEMA-KC, is an internet-based system that allows registered users to collaborate on emergency management by sharing incident information, planning documents, standard operating guidelines, contact information, and geospatial information. The PEMA-KC database was used to inform five hazard profiles: Civil Disturbance, Environmental Hazard – Gas and Liquid Pipelines, Terrorism, Urban Fire and Explosion, and Utility Interruption.

As previously stated, an attempt was made to provide consistency in reporting information. Population data used throughout this plan was drawn from the 2010 and 2020 US Censuses and the 2016 and 2021 American Community Surveys. These different Census products were used concurrently because the 2010 and 2020 Census data no longer includes the "long form" – the detailed report of economics, housing, travel, and work patterns. This data is now only released in the American Community Survey. Additionally, the American Community Survey data is only released to the Census block group level rather than the block; this has implications in the Level 2 Hazus analysis completed for this plan update (See Section 4.1). Where specified in this SHMP, projected population estimates for the years 2010 - 2040 were obtained from the Pennsylvania Department of Environmental Protection (DEP).

Additionally, with so many hazards having an impact on agricultural yields, this SHMP uses the USDA Census of Agriculture to estimate losses and identify vulnerable counties. The USDA conducts this Census every 5 years. While the USDA is done collecting the data for its 2022 reporting year, this data is not yet available for use. As a result, this SHMP uses the 2017 Census.

As expected with the number and diversity of hazards being profiled, the sources of data used within this SHMP vary from hazard to hazard. Natural hazards tended to have more available information than human-made hazards. However, when available, GIS data was used for the

hazards to identify hazard vulnerability and estimate potential losses. This information is presented in map and table format. GIS data was obtained from all levels of government; from the local government by obtaining building points along the Lake Erie shoreline for coastal erosion analysis; from the Commonwealth by obtaining critical facility locations and dams; and from the federal government by obtaining the most current flood and levee data, just to name a few. A complete list of data sources used primarily for mapping and analysis is listed in *Appendix D – Data Sources Lis*t. All other sources referenced in the body of the plan are listed in *Appendix A – Bibliography*. It should be noted that several GIS datasets were obtained from the Pennsylvania Spatial Data Access (PASDA) website (http://www.pasda.psu.edu/). PASDA is the official public access geospatial information clearinghouse for the Commonwealth of Pennsylvania. PASDA was developed by the Pennsylvania State University as a service to the citizens, governments, and businesses of the Commonwealth. PASDA is a cooperative project of the Governor's Office of Administration, Office for Information Technology, Geospatial Technologies Office and the Penn State Institutes of Energy and the Environment of the Pennsylvania State University. Data from the National Inventory of Dams was used to update Section 4.3.20 in Appendix H.

Despite rapid strides in the quality and availability of GIS data in recent years, data limitations remain. Perhaps most conspicuously, dam inundation areas have yet to be compiled in GIS format, precluding the identification of critical facilities within those areas. Similarly, up-to-date Levee Protection Areas are net yet available in a centralized geodatabase, requiring the development of alternative methodologies to estimate vulnerability. Every effort was made to use the best available, most up-to-date information to conduct the risk assessment and vulnerability analysis for this plan update. As more accurate hazard data becomes available, the risk assessments presented in this SHMP will be further refined.

The data sources for completing the state and jurisdictional vulnerability assessments and loss estimations are presented in Section 4.1, followed by a summary of the methodologies applied.

It is important to note that there can be a fine line between security and transparency during hazard mitigation planning. At times, they can be in conflict with one another as some information that is relevant to assessing, understanding, and mitigating risk is highly confidential due to its sensitive nature. It is important that state-level planning is as transparent as possible to ensure decision-makers at all levels are operating with the same information, especially with a project such as this that impacts the health, safety, and security of every Pennsylvanian, but there also are situations where this information being readily available can actually place residents in greater danger. Examples of this include information about dams and pipelines. The consistent participation from all stakeholders and their communication with the planning team allowed this balance to be achieved to the best of our collective abilities.

3 Planning Process

3. Planning Process

3.1. Update Process and Participation Summary

The Planning Process was the leading force in building the SHMP. The input required to guide the update process was collected through meetings and communication with stakeholders from all levels of government, numerous agencies and organizations within the Commonwealth, the public, and PEMA staff. Three key groups that led the plan update include the SPT, County staff, and PEMA staff. These groups provided input on how to complete the update and reviewed outlines and draft text for sections of the plan as they were developed. Additionally, stakeholder outreach sessions were conducted to both educate and gather input for the plan update.

The 2023 update to the SHMP focused on value added improvements. Outreach was expanded and increased to new stakeholders. Climate change, plan integration, and historic preservation were topics that were expanded upon in the 2018 update, and that focus continues for this update. Another primary focus on the 2023 update is underserved communities and socially vulnerable populations, particularly engaging with them throughout the entire planning process. The mitigation strategy was updated in greater detail, adding more objectives and focusing on risk-informed mitigation actions. It was addressed in two large SPT meetings and then through additional follow-up via agency-specific meetings, conference calls, and targeted emails. The format of the plan remained consistent with the fully implemented Standard Operating Guide (SOG) for Pennsylvania allowing the focus on the update to be on clearly informing readers on risks and mitigation action in Pennsylvania.

The update process is described in the first sub-section of Sections 3 through 7. Table 3.1-1 summarizes plan updates from the 2010, 2013, 2018, and 2023 SHMP updates.

Table 3.1-1 Summary of Updates of the SHMP

PLAN SECTION	SUMMARY OF UPDATE
SUMMARY OF THE 2010 UPDATE OF THE 2007 SHMP	
1. Introduction	Information that was contained in the Preface of the 2007 SHMP was re-summarized and expanded to address Background, Purpose, Scope, Authority and References, and Statue Compliance Assurances.
2. State Profile	Information that was spread throughout the 2007 SHMP was consolidated into one section and re-summarized to address Geography and Environment, State Facts, Population and Demographics, Land Use and Development, and Data Sources. Not all information related to these topics from 2007 was used in the 2010 SHMP in order to re-focus the plan on mitigation and follow FEMA hazard mitigation planning guidance more closely. In the 2010 SHMP, this base information serves as a summary of the Commonwealth prior to describing how hazards impact the Commonwealth.

Table 3.1-1 Summary of Updates of the SHMP	
PLAN SECTION	SUMMARY OF UPDATE
3. Planning Process	Previous hazard mitigation planning efforts described in the 2007 SHMP were summarized. Information was added to describe the 2010 planning process in the sections Update Process and Participation Summary, State Planning Team, Meeting and Documentation, Public and Stakeholder Participation, and existing Planning Mechanisms.
4. Risk Assessment	All hazards identified in the 2007 SHMP were profiled in the 2010 SHMP. Two new natural hazards and one human-made hazard were profiled. Each hazard profile was re-arranged, re-summarized and new research was conducted to address the following sub-sections: 4.3.X.1 Location and Extent 4.3.X.2 Range of Magnitude 4.3.X.3 Past Occurrence 4.3.X.4 Future Occurrence 4.3.X.5 Environmental Impacts 4.3.X.6 Jurisdictional Vulnerability Assessment 4.3.X.7 State Facility Vulnerability Assessment 4.3.X.8 Jurisdictional Loss Estimation 4.3.X.9 State Facility Loss Estimation Please note that to complete spatial analysis to address all the above topics state-wide data sets were sought. Using the best data available for the 2010 plan, allowed for more robust risk analysis than just researching disasters in the 3-year period between plans.
5. Capability Assessment	Information that was in section 1.4.1 and 1.4.1.a of the 2007 SHMP was re-summarized and expanded to address Update Process Summary, State Capability Assessment, and Local Capability Assessment. Sub-sections within the 2010 SHMP more closely follow FEMA guidance for hazard mitigation planning.
6. Mitigation Strategy	Information that was in section 1.4 and 1.5 of the 2007 SHMP was re-summarized and expanded to address Update Process Summary, State Mitigation Strategy, and Local Mitigation Strategy. Sub-sections within the 2010 SHMP more closely follow FEMA guidance for hazard mitigation planning.
7. Plan Maintenance	Information that was in section 1.6 and 1.7 of the 2007 SHMP was re-summarized and expanded to address Update Process Summary; Monitoring, Evaluation and Updating the Plan; Incorporation into Other Planning Mechanisms; Continued Public Involvement; and Monitoring Progress of Mitigation Actions.
8. Plan Adoption	Information in 1.1.1 of the 2007 SHMP was re-summarized and addressed in Section 8 of the 2010 SHMP.
SUMMARY OF THE 2013 UPDATE OF THE 2010 SHMP	
1. Introduction	Information that was contained in the Preface of the 2010 SHMP was reviewed for correctness and for updates to the legislative and policy framework of hazard mitigation planning in the US and specific to Pennsylvania.

Table 3.1-1 Summary of Updates of the SHMP	
PLAN SECTION	SUMMARY OF UPDATE
2. State Profile	Information from the 2010 plan was updated and to address Geography and Environment, State Facts, Population and Demographics, Land Use and Development, and Data Sources. Major inclusions include new, 2010 Census data and an update of the major data sources and limitations faced during the planning process. In the 2013 SHMP, this base information serves as summary of the Commonwealth and provides overall context for the risk assessment and mitigation strategy portions of the plan.
3. Planning Process	Previous hazard mitigation planning efforts described in the 2007 and 2010 SHMP were summarized. Information was added to describe the 2013 planning process in the sections Update Process and Participation Summary, State Planning Team, Meeting and Documentation, Public and Stakeholder Participation, and existing Planning Mechanisms.
4. Risk Assessment	All hazards identified in the 2010 SHMP were profiled in the 2013 SHMP. The SPT decided to incorporate climate change into all profiles of hazards that may be exacerbated by climate change. One new human-made hazard profile was added to the plan for Mass Food/Animal Food Contamination. Additionally, lock failure was added to the existing Dam Failure profile, Cyber Attack was added to the existing Terrorism profile, and internet interruption was added to the existing Utility Interruption profile. The SPT also decided to expand the existing Invasive Species profile. Each hazard profile was reviewed, and new research and data was added within the existing profile framework of: 4.3.X.1 Location and Extent 4.3.X.2 Range of Magnitude 4.3.X.3 Past Occurrence 4.3.X.4 Future Occurrence 4.3.X.5 Environmental Impacts 4.3.X.6 Jurisdictional Vulnerability Assessment 4.3.X.7 State Facility Vulnerability Assessment 4.3.X.8 Jurisdictional Loss Estimation 4.3.X.9 State Facility Loss Estimation Using the best data available for the 2013 plan allowed for more robust risk analysis than just researching disasters in the 3-year period between plans.

Table 3.1-1 Summary of Updates of the SHMP	
PLAN SECTION	SUMMARY OF UPDATE
5. Capability Assessment	The 2013 SHMP expands upon the 2010 Capability Assessment with a summary of the tools available to the Commonwealth for pre- and post-disaster hazard mitigation efforts as well as development management. Federal, state, local and private funding sources are provided in this section. Additionally, major updates and additions include: addition of "Legal Context" section; addition of "Federal Programs Supporting Hazard Mitigation in Pennsylvania" section; updates to the BORM staff text such as job descriptions, trainings, conferences, exercises, etc.; updates to the organizational charts for PEMA and BORM; addition of "Other State and Multi-Agency Programs in Pennsylvania" section; addition of "Hazard Mitigation Land Use Measures in Pennsylvania" section; additions to the PA Emergency Operations Center section; updates to the Status of Local Hazard Mitigation Plans section text and mapping; updates to the Summary & Evaluation of Local Mitigation Capability section text and mapping; addition of a CRS participation map, Firewise and StormReady information. The 2013 Capability Assessment provides a more robust discussion of plan integration.
6. Mitigation Strategy	An evaluation of the existing strategy was conducted including a comparison of high-ranking hazards and number of associated mitigation actions. The results of this evaluation are illustrated and described in Section 6. All goals, objectives and actions were evaluated, and the Mitigation Action Plan was updated accordingly. Mitigation project information from 2010 to 2013 was incorporated in the plan. Portions of Section 6.5 that pertained to funding and assistance were moved to Sections 5.3, Capability Assessment. Commonwealth. A new "Mitigation Successes" section was added.
7. Plan Maintenance	Information that was in the 2010 SHMP was reviewed and updated as needed to reflect new plan maintenance procedures and schedules. Special emphasis was given to the integration of the SHMP into future planning efforts in the Commonwealth.
8. Plan Adoption	Information in Section 8 of the 2010 SHMP was reviewed and revised as necessary in the 2013 SHMP.
SUMMARY OF THE 2018 UPDATE OF THE 2013 SHMP	
1. Introduction	Information was reviewed and updated to reflect current authorities and references for State hazard mitigation planning. The new *State Mitigation Plan Review Guide* for March 2015 is noted along with broad level improvements to address climate change and historic preservation.
2. State Profile	Information from the 2013 plan was updated to address Geography and Environment, State Facts, Population and Demographics, Land Use and Development, and Data Sources.

Table 3.1-1 Summary of Updates of the SHMP	
PLAN SECTION	SUMMARY OF UPDATE
3. Planning Process	Previous hazard mitigation planning efforts from 2007, 2010, and 2013 were summarized. Information was added to describe the 2018 planning process in the sections Update Process and Participation Summary, State Planning Team, Meeting and Documentation, Public and Stakeholder Participation, and existing Planning Mechanisms.
4. Risk Assessment	All hazards identified in the 2013 SHMP were profiled in the 2018 SHMP. Climate change was more robustly incorporated into all profiles of hazards that may be exacerbated by climate change based on new 2015 FEMA guidance and the input of the SPT. Four new human-made hazard profiles were added to the plan for Building and Structure Collapse, Cyber-terrorism, Environmental Hazard - Gas and Liquid Pipeline, and Opioid Addiction. Environmental Hazards was divided into multiple profiles for 2018. This was an update to the state plan and SOG.; the new profiles are: • Environmental Hazard - Coal Mining • Environmental Hazard - Conventional Oil and Gas Wells • Environmental Hazard - Gas and Liquid Pipeline • Environmental Hazard - Hazardous Materials Releases • Environmental Hazard - Unconventional Wells Each hazard profile was reviewed, and new research and data was added. The framework changed slightly to combine Vulnerability Assessment and Loss Estimation for Jurisdictions in 4.3.X.6 and State Facilities in 4.3.X.7. This change was made because each sub-section was short, and it made sense to slightly streamline the plan for these topics. The profile framework is now: 4.3.X.1 Location and Extent 4.3.X.2 Range of Magnitude 4.3.X.3 Past Occurrence 4.3.X.4 Future Occurrence 4.3.X.5 Environmental Impacts 4.3.X.6 Jurisdictional Vulnerability Assessment and Loss Estimation 4.3.X.7 State Facility Vulnerability Assessment and Loss Estimation ~~4.3.X.8 Jurisdictional Loss Estimation~~ ~~4.3.X.9 State Facility Loss Estimation~~
5. Capability Assessment	The 2018 update focused on updating existing information, improvement graphics and explanations in plan integration, adding information on the Commonwealth developing historic preservation mitigation capabilities, and recognizing that some of the Repetitive Loss and Severe Repetitive Loss actions from 2010 and 2013 were truly capabilities and moving from Section 6 to 5.
6. Mitigation Strategy	All goals, objectives and actions were evaluated in group meetings and by individual follow-up, then the Mitigation Action Plan was updated accordingly. Mitigation project information from 2013 to 2018 was incorporated in the plan to document success and progress.

Table 3.1-1 Summary of Updates of the SHMP	
PLAN SECTION	SUMMARY OF UPDATE
7. Plan Maintenance	Information that was in the 2013 SHMP was reviewed and updated as needed to reflect new plan maintenance procedures and schedules. The documentation of annual meetings was noted to show that Pennsylvania had met in 2014, 2015, 2016, 2017 to update the SHMP.
8. Plan Adoption	Information in Section 8 of the 2013 SHMP was reviewed and revised as necessary in the 2018 SHMP.
SUMMARY OF THE 2023 UPDATE OF THE 2018 SHMP	
1. Introduction	Information was reviewed and updated to reflect current authorities and references for State hazard mitigation planning. The new *State Mitigation Plan Review Guide* for April 2022 is noted along with broad level improvements to address climate change and equity considerations.
2. State Profile	Information from the 2018 plan was updated to address Geography and Environment, State Facts, Population and Demographics, Land Use and Development, and Data Sources.
3. Planning Process	Previous hazard mitigation planning efforts from 2007, 2010, 2013, and 2018 were summarized. Information was added to describe the 2023 planning process in the sections Update Process and Participation Summary, State Planning Team, Meeting and Documentation, Public and Stakeholder Participation, and existing Planning Mechanisms.
4. Risk Assessment	All hazards identified in the 2018 SHMP were profiled in the 2023 SHMP. Climate change was more robustly incorporated into all profiles of hazards that may be exacerbated by climate change based on new 2015 FEMA guidance and the input of the SPT. The following changes were made to hazard names at the recommendation of stakeholders: • Opioid Addiction -> Substance Use Disorder • Transportation Accidents -> Transportation Incidents Each hazard profile was reviewed, and new research and data was added. The framework changed slightly to include Environmental Impacts in the Range of Magnitude section instead the individual section from the past. This change was made as environmental impacts should be included within the overall discussion on what impacts each hazard can have and should be mentioned before discussing Past and Future Occurrences. The profile framework is now: 4.3.X.1 Location and Extent 4.3.X.2 Range of Magnitude 4.3.X.3 Past Occurrence 4.3.X.4 Future Occurrence ~~4.3.X.5 Environmental Impacts~~ 4.3.X.5 Jurisdictional Vulnerability Assessment and Loss Estimation 4.3.X.6 State Facility Vulnerability Assessment and Loss Estimation

Table 3.1-1 Summary of Updates of the SHMP	
PLAN SECTION	SUMMARY OF UPDATE
5. Capability Assessment	The 2023 update focused on updating existing information. Language surrounding the transfer of NFIP responsibility from DCED to PEMA was updated to reflect the change officially being made. New organizations and programs were added to bolster pre-disaster capabilities and showcase new funding and technical assistance opportunities. Plan Integration Worksheets were updated to highlight successes achieved in the years since the 2018 plan.
6. Mitigation Strategy	All goals, objectives and actions were evaluated in group meetings and by individual follow-up, then the Mitigation Action Plan was updated accordingly. Mitigation project information from 2018 to 2023 was incorporated in the plan to document success and progress.
7. Plan Maintenance	Information that was in the 2018 SHMP was reviewed and updated as needed to reflect new plan maintenance procedures and schedules. The documentation of annual meetings was noted to show that Pennsylvania had met in 2019, 2021, 2022 to update the SHMP.
8. Plan Adoption	Information in Section 8 of the 2018 SHMP was reviewed and revised as necessary in the 2023 SHMP.

Documentation of the Planning Process Prior to 2007

PEMA was designated as the lead agency for the Commonwealth of Pennsylvania's Hazard Mitigation Plan preparation effort. It began the process of hazard mitigation planning as an outgrowth of the State's obligation under requirements of the federal Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1998. The latest version of that regulatory compliant plan (2001) was used as the starting point for the construction of the Emergency Management Accreditation Program (EMAP) compliant and FEMA-approved Stafford Act compliant SHMP.

Each plan deemed regulatory compliant by FEMA for the period 1993 to 2007 enabled the Commonwealth to receive post-disaster assistance. Evaluation under the EMAP standards that include the National Fire Protection Association 1600: Standard on Disaster/Emergency Management and Business Continuity Programs determined that the June 2001 version of the SHMP was non-compliant. As a result, a comprehensive revision was undertaken to meet the EMAP Standards of an All-Hazard Mitigation Plan. The events of September 11, 2001 and the subsequent leadership of the Department of Homeland Security re-affirmed that all-hazards planning and mitigation activities in Pennsylvania needed to embrace EMAP standards. The first final draft version of the Commonwealth SHMP, designed to specifically meet both EMAP and Section 322 standards, was developed in 2003 and adopted by Pennsylvania in early 2004. Throughout 2004, the document continued to evolve and be modified to meet the standards of Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Pub. Law 93-288). The SHMP was formally promulgated September 30, 2004, garnering FEMA approval as a "Standard" State Plan on October 13, 2004.

Upon receiving approval in 2004 for a Standard State Plan, PEMA worked to modify the SHMP from 2004 to 2006 (known as the "Triennial Update") in order to obtain "Enhanced Status." Enhanced Plan Status was officially granted by FEMA on August 23, 2006.

Updates between 2004 and 2006 included:

- Integrating the Commonwealth's SEOP with the SHMP.
- Compiling, analyzing, and implementing approved local hazard mitigation plans, published research documents, and other agency initiatives into the Risk Assessment and Capability Assessment portions of the Plan.
- PEMA began a review that evaluated the performances of the intended system of integration of local plans into the State Plan and coordination of post disaster mitigation funding.
- PEMA, prior to and following disasters that occurred in 2004, 2005, and 2006, began looking at information management systems to track and record Hazard Mitigation Project Opportunities (HMPOs). They looked at National Emergency Management Information System (NEMIS) and the National Tool.
- PEMA realized it would be best to integrate local plans through the alignment of new NIMS compliant Local Emergency Operations Plans that incorporate HMPs and local projects. This was believed to allow all-hazard mitigation to be more thoroughly addressed and integrated into other planning efforts.

- PEMA reviewed mitigation actions identified in the SEOP to see if other state agencies and departments had funding vehicles for the action/project or knew of a potential external source of funding.
- Reorganization of the text of the Hazard Mitigation Plan took place in 2006. This was undertaken by the State Hazard Mitigation Officer (SHMO).
- PEMA performed review and coordination of local plans from 2004-2007 by:
- Meeting with Hazard Mitigation officers from each county as a requisite activity of the Emergency Management Planning Grant.
- Presenting hazard mitigation topics at PEMA quarterly training.
- Meeting with planners and team members individually and collectively to foster collaboration with the communities during preparation of the Hazard Mitigation Plans.
- Meeting with citizen groups to explain the nature of hazard mitigation and the process being undertaken in communities to develop Hazard Mitigation Plans.
- Meeting with Hazard Mitigation Teams to provide compliance reviews and suggestions and strategies to be considered for inclusion into the plan to assure regulatory compliance. During the Triennial Period, PEMA met with 41 County Hazard Mitigation Planning Teams.
- Providing preliminary informal reviews of Hazard Mitigation documents.
- Providing coordination with FEMA personnel to assist in the development of a local plan compliance strategy. PEMA utilized post-disaster assistance from FEMA to secure planners that visited with each county, with the exception of Philadelphia during the Triennial Period.
- Providing review and coordination of plans prior to adoption.
- Providing draft plan reviews and coordination assistance to 66 of 67 counties.

Documentation of the Triennial Planning Process in 2007

The 2007 triennial plan update was conducted as follows:

- The Federal Requirements present in Section 322 were reviewed and analyzed.
- The Requirements of the 2007 NFPA 1600 Standards were reviewed and analyzed.
- FEMA regulatory guidance was collected and analyzed for implications for plan revision.
- On May 15, 2007, meetings with FEMA Region 3 were held to determine Federal priorities of actions identified in the Draft Guidance and obtained clarification of certain perceived broad and ambiguous guidance requirements presented in the Draft Update Guidance. The Commonwealth proposed and received concurrence on submitting a revised Hazard Mitigation Plan based on the August 2006 format that included before each section a change sheet that identified the process used to review, evaluate and update each section and that included an evaluation rationale for each changed and unchanged section. In addition, a compendium of changes was submitted to FEMA.
- Tasks the Commonwealth indicated would be elements of the SHMP update were extracted from the 2006 Plan.
- A scope of tasks based on regulatory requirements, the indicated plan obligated tasks and update requirements from the FEMA guidance and tasks to maintain compliance

with EMAP standards were developed. Critical path elements were identified, and decision point elements were prioritized and presented to PEMA management on June 1, 2007. This meeting was coordinated through email and telephone conversations. During this meeting PEMA was again delegated as the Lead for updating the Plan. It was decided that existing organizational structures would be utilized to update the Plan.

- Tasks were internally assigned to PEMA employees. PEMA Bureau of Plans was tasked to coordinate the update of the Hazard Vulnerability Analysis (HVA) components and the discussion of the Recovery Plan implementation. The PEMA Bureau of Recovery and Mitigation (BORM) coordinated the update of the non-HVA tasks. PEMA BORM was identified as the final document compiler for the submission to FEMA.
- The strategy of plan development, review, and update was presented to the Flood Budget Task Force. This task force included the Office of the Governor, PEMA, DEP, Department of Conservation and Natural Resources (DCNR) and Office of Administration (OA). This task force created a comment and suggested revision form that was circulated with copies of the 2006 plan to Commonwealth agencies and the public through the Homeland Security and Emergency Preparedness Executive Cabinet Advisory Council. Members of this Council included:
    - Greater Philadelphia Chamber of Commerce (non-profit)
    - Pennsylvania Chiefs of Police Association (non-profit)
    - Pennsylvania Association of Colleges and Universities (non-profit)
    - PECO Exelon Corporation (private sector)
    - Sanofi Pasteur, Inc. (private sector)
    - Philadelphia Eagles (private sector)
    - H.J. Heinz, North America (private sector)
    - Norfolk Southern Corporation (private sector)
    - American Red Cross-Southeastern PA (non-profit)
    - Kravco Simon (private sector)
    - County Commissioners Association of PA (non-profit)
    - Sysco Food Services of Central PA, LLC (private sector)
    - Philadelphia International Airport
    - Southeast Pennsylvania Transportation Authority
    - Pennsylvania Emergency Health Services Council (non-profit)
    - PJM Interconnector (private sector)
    - ASIS International / The Hershey Company (private sector)
    - WITF, Inc. (private sector)
    - AMTRAK Police Department
    - Philadelphia Regional Port Authority
    - ARAMARK food services (private sector)
    - Hospital & Health System Association of Pennsylvania (non-profit)
    - Pennsylvania Motor Truck Association (non-profit)
    - American Water Works Association, Pennsylvania Section (non-profit)
    - Pennsylvania Chemical Industry Council (non-profit)
    - Delaware River Port Authority
    - Alternates:

- Chester County Department of Emergency Services
- Bucks County Emergency Management Agency
- Allegheny County Emergency Management Department
- Pennsylvania Association of Colleges and Universities (non-profit)
- Membership of the Executive Cabinet consists of:
- Pennsylvania Emergency Management Agency
- Office of Homeland Security
- Pennsylvania State Police
- Governor's Office
- Office of General Council
- Department of Corrections
- Department of General Services
- Pennsylvania Department of Transportation
- Department of Environmental Protection
- Department of Health
- Department of Military and Veteran Affairs
- Office of Administration

Annual progress update forms were developed from FEMA guidance documents and suggested templates. These forms were sent to department agency directors. Responses are summarized in Table 3.1-2.

Table 3.1-2 Commonwealth Agency SHMP Progress Update as of August 8, 2007.

AGENCY	NO RESPONSE	PROGRESS INDICATED	PROGRESS NOT INDICATED
Office of Administration		X	
Department of Aging		X	
Department of Agriculture		X	
Auditor General			X
Department of Banking		X	
Department of Community and Economic Development		X	
Department of Conservation and Natural Resources		X	
Department of Corrections		X	
Department of Education		X	
Department of Environmental Protection		X	
Department of General Services		X	
Fish and Boat Commission		X	
General Counsel		X	
Department of Health		X	
Higher Education Facilities Authority		X	
Human Relations Commission		X	
Pennsylvania Historical and Museum Commission	X		
Department of Insurance		X	
Department of Labor and Industry		X	
Liquor Control Board		X	

Table 3.1-2 Commonwealth Agency SHMP Progress Update as of August 8, 2007.			
AGENCY	NO RESPONSE	PROGRESS INDICATED	PROGRESS NOT INDICATED
Department of Military and Veterans Affairs		X	
Pennsylvania Infrastructure Investment Authority (PENNVEST)	X		
Probation and Parole			X
Public School Building Authority		X	
Public Television Network Commission		X	
Public Utilities Commission		X	
Department of Public Works		X	
Department of State		X	
Pennsylvania State Police		X	
PennDOT	X		
Office of Victims Advocate			X
Department of Revenue			X

Upon receiving the progress forms, a causative factor analysis was performed to determine the broad classes of successful vs. unsuccessful tasks. Upon review, discussion elements were prepared for inclusion into the SHMP update change document. An update change summary document entitled “Element of Change” was prepared and the document was disseminated for comment. Comments received were incorporated where appropriate, and PEMA revised the document upon FEMA review. The final document underwent EMAP review.

The following organizations, departments and agencies directly and indirectly participated in development of the 2007 SHMP:

- Office of the State Fire Commissioner
- Office of Administration
- Governor’s Policy Office
- Office of Lieutenant Governor
- Governor’s Office of General Counsel
- Pennsylvania Game Commission
- Pennsylvania Department of Education
- Pennsylvania Historical and Museum Commission
- Pennsylvania Rural Development Council
- Pennsylvania Department of Environmental Protection
- Pennsylvania Department of Transportation
- Pennsylvania Department of Health
- Pennsylvania Department of Revenue
- Pennsylvania Public Utility Commission
- Governor’s Green Government Council

- Pennsylvania Department of Conservation and Natural Resources
- Pennsylvania Department of Community and Economic Development
- Pennsylvania Department of Agriculture
- Governor's Office of Budget
- Pennsylvania Department of General Services
- Pennsylvania Legislature Local Government Commission
- Pennsylvania Housing Finance Agency
- PA Infrastructure Investment Authority
- Governor's Action Team
- Pennsylvania Fish and Boat Commission
- Federal Emergency Management Agency
- United States Army Corps of Engineers
- United States Department of Commerce
- Institute of Business and Safety (non-profit)
- National Weather Service of the National Oceanic and Atmospheric Administration
- Delaware River Basin Commission (non-profit)
- Susquehanna River Basin Commission (non-profit)
- United States Department of Agriculture
- United States Geologic Survey
- Hamel Geotechnical Consultants (private sector)
- Harry F. Ferguson and Associates, Ltd. (private sector)
- State University of New York
- Pennsylvania State University
- The multitude of citizens and their representative organizations

Documentation of the Triennial Planning Process in 2010

The 2010 SHMP represented a significant revision to the 2007 plan. PEMA, with the approval of the SPT and County staff, decided that the outline of the Commonwealth Plan should closely match the Standard Operating Guide (SOG) developed for county plan updates in Pennsylvania. The benefit of having the Commonwealth and local hazard mitigation plans have information in similar sections is that it will become easier for counties and the Commonwealth to share information and cross reference each other's plans. The 2007 plan cross referenced the Commonwealth's State Emergency Operation Plan (SEOP) and Governor's Executive Budget fairly extensively, especially in the Mitigation Strategy Section. For the 2010 update, PEMA, with the approval of the SPT and County staff, decided to re-focus the plan on mitigation and follow guidance provided from FEMA for hazard mitigation planning more closely. The *Pennsylvania 2010 SHMP* had extraneous information from the 2007 plan removed so the plan could focus on its purpose and not duplicate efforts addressed in other plans and planning processes. The 2010 SHMP had broad participation from a diverse State Planning Team

representing 45 agencies, organizations, counties, and institutions statewide, including 26 new agencies. The following organizations, departments and agencies directly and indirectly participated in development of the 2010 SHMP:

- Clearfield County
- Community Research Associates, Inc.
- Delaware County Planning Department
- Delaware River Basin Commission
- Delaware Valley Regional Planning Commission
- Pennsylvania Department of Aging
- Pennsylvania Department of Agriculture
- Pennsylvania Department of Community and Economic Development
- Pennsylvania Department of Conservation and Natural Resources
- Pennsylvania Department of Corrections
- Pennsylvania Department of Education
- Pennsylvania Department of Environmental Protection
- Pennsylvania Department of General Services
- Pennsylvania Department of Health
- Pennsylvania Department of Labor and Industry
- Pennsylvania Department of Public Welfare
- Pennsylvania Department of Public Works
- Pennsylvania Department of State
- FEMA Region 3
- Interstate Commission on the Potomac River Basin
- Lycoming County
- Millersville University
- Office of Administration
- Office of Budget
- Office of the Attorney General
- Office of the State Fire Commissioner
- Penn State Agricultural Extension
- Pennsylvania Chapter of American Planning Association
- Pennsylvania Climatology Office
- Pennsylvania Emergency Management Agency
- Pennsylvania Fish and Boat Commission
- Pennsylvania Game Commission
- Pennsylvania Human Relations Committee

- Pennsylvania State Police
- Pennsylvania State System of Higher Education
- Pennsylvania Treasury
- Pennsylvania Turnpike Commission
- PENNVEST
- Philadelphia Office of Emergency Management
- Public Utility Commission-Fixed Utility & Gas Safety
- Susquehanna River Basin Commission
- United States Army Corps of Engineers
- United States Department of Homeland Security
- United States General Service Administration
- United States Geological Survey
- Michael Baker Jr., Inc. and Dewberry.

The 2007 and 2010 SHMP update efforts solicited public input during the initial planning process at in-person public forums and via the PEMA Hazard Mitigation Planning website to provide input.

Documentation of the Triennial Planning Process in 2013

The 2013 update of the plan represents a significant revision to the 2010 plan. PEMA, with the approval of the SPT and County staff, decided that the outline of the Commonwealth Plan should closely match the Standard Operating Guide (SOG) developed for county plan updates in Pennsylvania. The SOG and related tools are discussed in further detail in Section 6.3.1.1. The benefit of having the Commonwealth and local hazard mitigation plans have information in similar sections is that it will become easier for counties and the Commonwealth to share information and cross reference each other's plans. The 2007 plan cross referenced the Commonwealth's State Emergency Operation Plan (SEOP) and Governor's Executive Budget fairly extensively, especially in the Mitigation Strategy Section. For the 2010 plan update, PEMA, with the approval of the SPT and County staff, decided to re-focus the plan on mitigation and follow guidance provided from FEMA for hazard mitigation planning more closely. Now, for the 2013 update, PEMA, with direction from FEMA, improved the plan to highlight mitigation success stories and capture the capabilities of the Commonwealth departments. PEMA also requested that THIRA be integrated as appropriate into the Risk Assessment section of the plan. The Pennsylvania 2010 SHMP had extraneous information from the 2007 plan removed, so the plan could focus on its purpose and not duplicate efforts addressed in other plans and planning processes.

The Planning Process was a top priority for the 2013 update. The SPT garnered participation from:

- Clearfield County
- County Commissioners Association of Pennsylvania

- Department of Agriculture
- Department of Community and Economic Development
- Department of Conservation and Natural Resources
- Department of Corrections
- Department of Environmental Protection (Including the Bureau of Radiation Protection)
- Department of General Services
- Department of Health
- Department of Insurance
- Department of Labor and Industry
- Department of Military and Veterans Affairs
- Department of Public Welfare
- Department of State
- Division of Facilities and Property Management
- Federal Emergency Management Agency, Region 3
- Governor's Office of Homeland Security
- Keystone Emergency Management Association
- Millersville University
- Northampton County
- Office of Administration
- Penn State Capital College (Police Department)
- Pennsylvania Department of Transportation
- Pennsylvania State System of Higher Education
- Pennsylvania Emergency Management Agency
- Pennsylvania Housing Finance Agency
- Pennsylvania Treasury
- Pennsylvania Turnpike Commission
- PENNVEST
- Philadelphia Office of Emergency Management
- Salvation Army
- United States Army Corps of Engineers
- United States Department of Homeland Security (including Office of Infrastructure Protection)
- United States General Services Administration
- United States Geological Survey – Pennsylvania Water Science Center
- Michael Baker Jr., Inc. and Delta Development Group

In addition to SPT meetings and County focused presentations, public outreach was conducted in 2013. The outreach was interesting and fun. It included travel to the Carnegie Science Center

in Pittsburgh to conduct experiments on flooding with children and tabling at Academy of Science climate-related events. Though interesting, the public outreach process did not capture substantive input to the SHMP. The in-person public outreach process was not repeated in 2018 nor 2023 to focus on stakeholder engagement. Despite this change in outreach strategy, participation increased in the 2018 plan. The SPT garnered participation from:

- Community Affairs and Development
- County Commissioners Association of Pennsylvania
- Cumberland County Planning Department
- Delaware Valley Regional Planning Commission
- Department of Agriculture
- Department of Banking and Securities
- Department of Community and Economic Development
- Department of Conservation and Natural Resources
- Department of Drug and Alcohol Programs
- Department of Environmental Protection
- Department of General Services
- Department of Health
- Department of Homeland Security
- Department of Human Services
- Department of Labor & Industry
- Department of Meteorology and Atmospheric Science, The Pennsylvania State University
- Fayette County Emergency Management
- Federal Emergency Management Agency, Region 3
- Franklin County Department of Emergency Services
- Governor's Office of Homeland Security
- Housing Alliance of Pennsylvania
- Lehigh County Emergency Management Agency
- Lower Merion Township Police Department
- Millersville University Disaster Research Center
- Northern Tier Regional Planning and Development Commission
- Penn State Capital College
- Penn State University Extension - Agriculture
- Pennsylvania Department of Transportation (PennDOT)
- Pennsylvania Association of Floodplain Managers
- Pennsylvania Emergency Management Agency
- Pennsylvania Historical and Museum Commission
- Pennsylvania Housing Finance Agency
- Pennsylvania Municipal League
- Pennsylvania Office of Attorney General
- Pennsylvania State Association of Township Supervisors

- Pennsylvania State Police
- Pennsylvania's State System of Higher Education
- PENNVEST
- Perry County
- Public Health Management Corporation
- Public Utility Commission
- SEDA-Council of Governments
- Tri County Regional Planning Commission
- U.S. Department of Homeland Security
- U.S. Geological Survey - Pennsylvania Water Science Center
- United States Army Corps of Engineers
- Michael Baker International, Inc., Vernon Land Use, LLC, and Nurture Nature Center

Information on how the 2023 plan expanded on this previous participation is listed below.

3.2. State Planning Team

The SPT brought together by PEMA for the 2023 plan built on the 2018, 2010, and 2013 SPTs, strong Pennsylvania Silver Jackets participation, and annual participation in SHMP updates. The 2023 SHMP update formally started with two kick-off meetings in June of 2022, one in Harrisburg and a virtual one via Microsoft Teams.

FEMA's *State Mitigation Plan Review Guide* of 2022 outlines that the plan update must engage, at minimum, stakeholders from the following sectors: Emergency Management, Economic Development, Land Use and Development, Housing, Health and Social Services, Infrastructure, and Natural and Cultural Resources. These sectors represent the variety of areas that are involved with aspects of hazard mitigation, either through their connection to one of FEMA's eight Community Lifelines (shown in 5 below), engagement in response and recovery activities, or vulnerability to hazards. Each sector brings knowledge about how different hazards impact different areas, communities, and assets across Pennsylvania. In addition, it is often important for stakeholders from these sectors to work together when engaging in hazard mitigation work. For example, impacts to our energy infrastructure can cascade into other sectors if they impact hospitals, residential homes, businesses, and government facilities.

Figure 3.2-1 FEMA's Community Lifelines (FEMA, 2021b)

The SHMP had invited and gained attendees from these sectors in previous plan updates, though the SPT decided to work towards gaining additional SPT members in 2023. The effort was successful in increasing participation in each sector, building on the success in 2018. Table 3.2-1 shows SPT participation by sector. Note that additional stakeholders participated in the planning process, but not the SPT and are addressed later in Section 3.

Table 3.2-1 SPT Participation by Sector.

SECTORS FOR ENGAGEMENT	COUNT OF AGENCIES IN SECTOR			PERCENT CHANGE 2013-2023	PERCENT CHANGE 2018-2023
	2013	2018	2023		
A. Emergency Management	10	9	17	70%	88%
B. Economic Development	3	4	8	166%	100%
C. Land Use and Development	6	9	14	133%	55%
D. Housing	1	3	5	400%	66%
E. Health and Social Services	4	5	12	200%	149%
F. Infrastructure	4	7	10	150%	42%
G. Natural and Cultural Resources	4	8	26	550%	225%
H. Administration/Other	4	2	34	750%	1600%
I. County and Local	2	6	79	3,850%	1216%
Grand Total	38	53	206	442%	288%

Please note that many of the SPT agencies bridge sectors. For instance, the Department of Community and Economic Development is both B. Economic Development, C. Land use and Development, and touches on the other sectors as well. When this happened the sector that best fit the regular participant was selected. Some agencies did not fit a sector and were included in 'H. Administration/Other', such as the Department of State, Office of Administration, Pennsylvania State System of Higher Education, and State Library of Pennsylvania. In addition to these agencies, there was significant participation from counties, their conservation districts, and local municipalities. Overall, 60 counties participated at some point in the process and were most likely to do so in Emergency Management and Land Use and Development conversations.

Bringing together individuals from multiple agencies and organizations throughout the Commonwealth to address mitigation has multiple benefits including leveraging each other's knowledge, resources, and funding. The role of the SPT was identified in the kick-off meetings on June 17, 2022 and June 22, 2022 as the following:

- Provide new information. Information requested included GIS data, hazard information especially related to past occurrences and probability, new studies, and information on vulnerable populations and assets as well as provide progress on mitigation occurring statewide.
- Guide and provide input on overarching plan improvements including addressing climate change, historic preservation, and new hazards.
- Identify mitigation and funding opportunities.
- Review and evaluate the SHMP.

Attendees at the SPT meetings included representatives from 127 different agencies and organizations, along with those from county and city government. Additionally, the SPT meetings were attended and supported by the Michael Baker International, Vernon Land Use, and Hagerty consultant team. In addition, Connect the Dots helped develop the outreach strategy. Several agencies and organizations sent multiple representatives to one meeting. The table below shows the agencies and organization that were represented at each meeting. The majority of the SPT members are representatives from state agencies or counties. The state agencies were complimented by federal agencies and organizations that work within the Commonwealth. County and city representatives were involved in the SPT to bring local input to the SPT and to compliment the outreach to all counties' various public and stakeholder events and meetings. A summary of each of these outreach sessions is provided in Section 3.4

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
COUNTY						
Adams County			x			
Adams Metropolitan Planning Organization		x				
Allegheny County			x	x	x	x
Allegheny County Conservation District					x	
Armstrong County			x	x		
Beaver County	x		x	x		
Bedford County			x	x	x	
Berks County	x		x	x	x	x
Blair County			x	x		x
Bradford County			x	x		
Bucks County			x	x	x	x
Butler County			x	x		
Cambria County			x	x		x
Cameron County			x	x		x
Carbon County			x		x	
Centre County			x	x	x	
Chemung County (NY)		x				
Chester County	x		x	x	x	x
Clarion County			x	x	x	
Clinton County			x			x
Crawford County			x			
Cumberland County			x		x	x
Dauphin County			x		x	

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Delaware County				x	x	x
Develop Tioga		x		x		x
Elk County			x			
Erie County			x			
Forest County			x			
Franklin County				x		
Fulton County			x	x	x	
Huntingdon County			x		x	
Jefferson County			x		x	
Juniata County			x		x	
Lackawanna County			x	x	x	
Lancaster County				x	x	x
Lancaster Metropolitan Planning Organization			x			x
Lebanon County	x		x	x	x	x
Lebanon Metropolitan Planning Organization			x	x		
Lehigh County	x		x	x	x	x
Luzerne County	x		x		x	
Lycoming County			x	x	x	
McKean County			x			
Mercer County			x			
Mifflin County			x			
Monroe County			x	x	x	x
Monroe County Conservation District				x		
Montgomery County			x		x	

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Northampton County	x		x	x	x	x
Northumberland County				x		
Philadelphia County			x		x	
Pike County			x	x	x	x
Pike County Conservation District				x		
Schuylkill County			x			
SEDA Council of Governments					x	
Snyder County			x	x		
Somerset County			x	x	x	x
Sullivan County			x	x	x	
Susquehanna County			x		x	
Tioga County			x	x	x	x
Tioga County Conservation District		x				
Union County			x			
Venango County Conservation District					x	
Venango County			x			
Warren County			x			
Washington County		x		x	x	x
Wayne County			x		x	
Westmoreland County			x	x	x	x
Wyoming County					x	x
York County		x	x	x	x	x
FEDERAL						
Delaware River Basin Commission	x		x	x	x	

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Federal Emergency Management Agency	x		x	x	x	x
Pennsylvania National Guard						x
U.S. Geological Survey	x					
United States Army Corps of Engineers	x		x		x	x
United States Department of Agriculture	x		x		x	
LOCAL						
East Pennsboro Township	x	x				x
Auburn Township					x	
Borough of Camp Hill					x	
City of Bradford					x	
City of DuBois					x	
City of Philadelphia			x	x	x	x
City of Pittsburgh		x			x	
East Pennsboro Township					x	
Farmington Township		x			x	
Sharpsburg Borough					x	
Thornbury Township					x	x
Town of McCandless					x	
Forest City Borough			x			
Lower Merion Township			x			
Turtle Creek Valley COG			x			
East Goshen Township				x		
Farmington Township				x		
Spring Garden Township				x		

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Limerick Township				x		x
NON-PROFIT						
Susquehanna River Basin Commission	x		x		x	x
Coalition for the Delaware River Watershed	x		x		x	
Disability Rights Pennsylvania	x		x	x	x	x
PennFuture	x	x				
American Red Cross			x	x	x	x
Protect PT				x		
Pennsylvania Environmental Council				x		
American Rivers		x			x	x
Public Health Management Corporation		x				
PRIVATE						
Evolve EA				x		
EQT Corp		x				
REGIONAL						
Mifflin County Council of Governments	x					
SEDA - Council of Governments	x	x	x	x		x
Southern Alleghenies Planning and Development Commission	x					
Tri County Regional Planning Commission			x		x	
Northern Tier Rural Planning Organization			x			x
Indiana-Westmoreland Council of Governments			x		x	
MARISA			x	x		
North Central Regional Planning and Development Commission		x	x	x	x	

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members						
ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Northwest Pennsylvania Regional Planning and Development Commission			x			
Oil Region Council of Governments			x			
Southwestern Pennsylvania Commission			x			
NE Pennsylvania Metropolitan Planning Organization	x		x	x		
AIA Middle Pennsylvania Chapter	x		x			
TRIBAL						
Eastern Shawnee Tribe of Oklahoma			x			
STATE GOVERNMENT						
Cybersecurity and Infrastructure Security Agency		x			x	x
DC Homeland Security and Emergency Management Agency		x		x		
Maryland Emergency Management Agency					x	
PaWARN		x				
Pennsylvania Department of Aging				x	x	
Pennsylvania Department of Community and Economic Development	x	x		x		x
Pennsylvania Department of Conservation and Natural Resources	x	x		x	x	x
Pennsylvania Department of Corrections	x			x	x	x
Pennsylvania Department of Drug and Alcohol Programs	x			x	x	
Pennsylvania Department of Education	x					
Pennsylvania Department of Environmental Protection	x	x	x	x	x	x

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Pennsylvania Department of General Services	x		x	x	x	x
Pennsylvania Department of Health	x	x	x	x	x	x
Pennsylvania Department of Human Services	x	x	x	x	x	x
Pennsylvania Department of Labor and Industry	x	x	x	x	x	x
Pennsylvania Department of Military and Veterans Affairs					x	x
Pennsylvania Department of Revenue	x		x	x	x	
Pennsylvania Department of State	x		x	x	x	x
Pennsylvania Department of Transportation	x		x	x	x	x
Pennsylvania Emergency Management Agency	x	x	x	x	x	x
Pennsylvania Fish and Boat Commission				x		x
Pennsylvania Game Commission	x		x	x	x	
Pennsylvania Geological Survey		x	x	x	x	x
Pennsylvania Governor's Office			x			
Pennsylvania Historical and Museum Commission		x	x	x	x	x
Pennsylvania Human Relations Commission				x		x
Pennsylvania Infrastructure Investment Authority	x	x	x	x	x	
Pennsylvania Milk Marketing Board		x				
Pennsylvania Office of Administration	x					
Pennsylvania Office of the Budget						x
Pennsylvania Office of the State Fire Commissioner	x					
Pennsylvania Public Utility Commission	x			x	x	x
Pennsylvania State Civil Service Commission	x				x	x

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Pennsylvania State Geospatial Coordinating Board	x		x		x	x
Pennsylvania State Historic Preservation Office	x	x	x	x	x	x
Pennsylvania State Library					x	
Pennsylvania State Police	x	x	x	x	x	x
Pennsylvania Public Utility Commission		x	x			
Pennsylvania State Historic Preservation Office		x	x			
Virginia Department of Emergency Management			x			
West Virginia Emergency Management			x			
STATE ORGANIZATION						
Pennsylvania 8-1-1						x
Pennsylvania State Association of Township Supervisors	x		x			
Pennsylvania's State System of Higher Education	x		x	x	x	
The Hospital and Health system Association of Pennsylvania	x		x			x
Pennsylvania Association of Realtors				x		
County Commissioners Association of Pennsylvania			x	x		x
Pennsylvania Association of Floodplain Managers			x			
Health Care Coalition				x	x	x
Pennsylvania Association of County Conservation Districts				x		
Pennsylvania Commission for Community Colleges						x

Table 3.2-2 Summary of Meeting Attendance for State Planning Team Members

ATTENDEES REPRESENTED	KICK-OFF MEETINGS	SECTOR MEETINGS (ANY)	RISK ASSESSMENT MEETINGS	CAPABILITY ASSESSMENT MEETINGS	MITIGATION STRATEGY MEETINGS	DRAFT REVIEW MEETINGS
Pennsylvania Housing Finance Agency					x	
Keystone State Rail Association						x
League of Women Voters of Pennsylvania						x
UNIVERSITY						
Mansfield University of Pennsylvania	x	x	x	x		
Pennsylvania State University	x	x	x	x	x	x
Cheyney University Police Department						x
Bloomsburg University of Pennsylvania	x		x			
Pennsylvania Western University	x	x	x	x		
Slippery Rock University of Pennsylvania	x		x			
Indiana University of Pennsylvania			x			
Millersville University			x		x	x
Temple University Emergency Management			x	x	x	x

PEMA invited a broad spectrum of agencies and organizations to attend SPT meetings. A wide net was cast for invitations so that everyone interested in attending had the opportunity to become involved. The majority of the agencies and organizations that are closely linked to mitigation activities and risk assessment did attend. Action 2-5b in the 2018 Mitigation Strategy addresses the goal to continue to improve involvement in the mitigation planning process throughout the Commonwealth with the following action: *Reach out to agencies that were invited but did not participate in 2018 planning process.* The 2018 'Measure of Success' was achieved by the 2023 SHMP update building on 2018 success and having 497 representatives from 206 agencies, organizations, and counties participate throughout the process.

The United States Army Corp of Engineers (USACE) Silver Jackets Initiative is a key part of mitigation implementation in the Commonwealth. Many of the Silver Jackets members also participate in the SPT and vice versa. Silver Jackets is an initiative to reduce flood risk by building relationships and leveraging funding between agencies and organizations. This entity built on the 2010 SPT's initiatives to continue and evolve into a group that monitors and updates the SHMP and works to implement mitigation projects in the Commonwealth. The Baltimore District is designated the lead USACE Silver Jackets District for Pennsylvania. It is also supported by the Pittsburgh, Buffalo, and Philadelphia Districts since portions of Pennsylvania are within each of these District watersheds. The Silver Jackets initiative aims to provide education and mitigation strategies to combat flood risk and involves interagency participation amongst Federal, State, Regional, and Professional partners. Mitigation Action 2-2b in this year's plan update is to support Silver Jackets work to identify current policies, plans, regulations, and laws that should include mitigation.

3.3. Meetings and Documentation

The 2023 SHMP stakeholder planning process lasted from June 2022 through June 2023. SPT members were engaged through in-person meetings at PEMA headquarters and webinars. This section summarizes the meetings that were held to engage stakeholders and provide input into developing a strong SHMP submission for 2023.

During the period between the 2018 and 2023 SHMP updates, PEMA continued to:

- Hold SHMP plan review meetings.
- Compile, analyze, review and assist in implementing approved local hazard mitigation plans.
- Review and evaluate the performances of the intended system of integration of local plans into the SHMP.
- Coordinate mitigation funding.
- Work with FEMA on plan implementation.
- Work through the Silver Jackets to enhance flood mitigation across agencies and levels of government.
- Host the three PEMA regional Hazard Mitigation Officers meeting once a quarter with each section of their counties to discuss hazard mitigation related topics and concerns. At times these quarterly meetings coincided with the PEMA quarterly training.

- Have the Hazard Mitigation Planner meet with County officers, citizens groups, and regional planning agencies and present at conferences.
- Address plan maintenance by MIRC, formerly BORM, staff on an as-needed basis.

Appendix C provides thorough documentation of the planning process. This appendix includes invitations, sign-in sheets, presentations, and hand-outs, completed questionnaires and evaluation tools, meeting minutes and other items used to gather comprehensive input into the Commonwealth's SHMP.

In March 2022, PEMA selected a consultant team led by Michael Baker International, Inc. (Michael Baker) to update the SHMP, supported by Connect the Dots, Hagerty, Stell, WSP, and Vernon Land Use, LLC. The update process formally began April 29, 2022, with a kick-off meeting with PEMA and consultants to begin planning and project management for completing the update.

Meetings throughout the process were introduced and moderated by the State Hazard Mitigation Officer (SHMO), Deputy SHMO, and State Hazard Mitigation Planner. The consultant team supported the SHMO, Deputy SHMO, and Planner by providing presentations. At all meetings, there were multiple opportunities for input from attendees. The following list represents opportunities for engagement of stakeholders in the 2023 SHMP update:

- **State HMP Kickoff and Priorities Meetings with PEMA, FEMA, and DCED, April 29, 2022**: Reviewed PEMA priorities, established the stakeholder engagement approach, how to handle data collection and sharing, and the next steps for the project.
- **In-Person Kick-off Meeting, June 17, 2022**: Welcomed the attendees to the start of the 2023 update process and reviewed keys priorities for update including addressing new FEMA guidance. The roles of PEMA and the SPT were defined, with an emphasis on

Meeting Key Accomplishments

SPT KICK-OFF

- FEMA's additions to their planning guidance were presented: inreased climate change mitigation and adaptation focus, an inclusive planning process, and program integration.
- The goal os each state agency, board, or commission committing to at least one mitigation action was delivered.
- The issue of the lack of volunteer emergency service personnel was first mentioned.

SPT RISK ASSESSMENT

- Gathered context on how the hazards impact PA and the agencies present.
- Initial discussions on altering Urban Fire & Explosion profile, either combining with Wildifre or new "Structural Fire" hazard to include rural areas.
- Gathered information and data from Disability Rights PA, DEP, MARISA, Penn State Extension, PA PUC, and American Red Cross for plan.

SPT CAPABILITY ASSESSMENT

- Gathered information used to update capability in Section 5 and consequence analysis in Appendix L of plan.

STAKEHOLDER GROUP CALLS

- Engaged stakeholders that were welcome, but did not have time to invest in joining SPT.
- Held 8 seperate webinars, gaining information from each sector to develop understanding of hazard risks, state and local capabilities, and enhance mitigation strategy.

SPT MITIGATION STRATEGY

- The 2023 SHMP Update focused on developing more actions that can be lead by entities other than PEMA, and meetings had significant feedback from these stakeholders.
- Evaluation of 2018 actions and development of new ones was facilitated mostly by group conversations and individual follow-up by Vernon Land Use.
- Major themes of 2023 actions were presented: Workforce Shortages, Broadband Access, Climate Change, and Equity Considerations.

stakeholder participation driving the plan. The SPT was informed about the addition of individual sector meetings and the planning team's hope of getting each state agency, board, and commission to commit to a mitigation action. The lack of volunteer emergency service personnel was briefly discussed as a crisis facing Pennsylvania. Broke out into 3 smaller groups to discuss forms handed out at the meeting and the presented topics:

  - One group discussed the pandemic hazard and the potential for economic downturn to become its own hazard
  - One group discussed data collection, availability, format, and quality
  - One group discussed outreach strategies, cascading impacts, and coordination between planning and funding needs

Hand-outs were not the focus of this meeting instead a facilitator and note taker joined each of the break-out sessions to collect ideas on mitigation strategy updates. Then the group discussions were also documented to guide the update process.

- **Virtual Kick-off Meeting, June 22, 2022:** Welcomed the attendees to the start of the 2023 update process and reviewed keys priorities for update including addressing new FEMA guidance. The roles of PEMA and the SPT were defined, with an emphasis on stakeholder participation driving the plan. The SPT was informed about the addition of individual sector meetings and the planning team's hope of getting each state agency, board, and commission to commit to a mitigation action. Participants were encouraged to review their capabilities listed in the 2018 plan and return comments on any changes. They were also encouraged to fill out the survey form to provide additional information.
- **Health and Social Services Sector Outreach Meeting, September 8, 2022**: The meeting began with an overview of the state hazard mitigation planning process and purpose of the plan itself. Specific hazards with a connection to health and social services were briefly profiled, with a focus on underserved populations and community lifelines. The suggestion to rename with Opioid Addiction and Pandemic hazard profiles to Substance Use Disorder and Pandemic and Infectious Diseases was made. Other discussion topics included extreme temperature programs, carbon monoxide issues, and staffing shortages. Participants were encouraged to fill out and share survey forms discussed at the meeting.
- **In-Person Risk Assessment Meeting, September 28, 2022**: This meeting began with a general overview of the plan and which hazards are planned for the risk assessment, including sources of data and a review of climate change analysis as it relates to Pennsylvania. As the risk assessment was already underway, a few key findings and planning considerations from a handful of hazards were also presented. An open discussion resulted in the following topics from participants:
  - Combining the Wildfire and Urban Explosion profiles
  - Title 35 requirements for every municipality to have an emergency manager
  - Leveraging VOAD and other organizations to coordinate with communities that may be skeptical of sharing data
  - Looking into flooding impacts, specifically how losses are calculated and providing support for vulnerable communities during recovery
- **Virtual Risk Assessment Meeting, September 28, 2022:** This meeting began with a general overview of the plan and which hazards are planned for the risk assessment, including sources of data and a review of climate change analysis as it relates to

Pennsylvania. As the risk assessment was already underway, a few key findings and planning considerations from a handful of hazards were also presented. An open discussion resulted in the following topics from participants:

  - 911 addressing for trailheads, boat launches, and convenient staging areas to support outdoor recreation safety
  - Maintaining road infrastructure and the variety of hazards that impact it
  - Utility reliability, specifically electric and broadband access
  - Various mapping sources for flooding, environmental justice, and infrastructure failures

- **Land Use and Development Sector Outreach Meeting, October 11, 2022:** The meeting began with an overview of the state hazard mitigation planning process and purpose of the plan itself. Specific hazards with direct impacts on land use and development were discussed, with a particular focus on underserved populations and lifeline impacts. The relationship between land use and development and climate change was also explored. Discussion from participants centered around floodplain ordinances and barriers to developing regulations on future conditions. Participants were encouraged to fill out and share survey forms discussed at the meeting.
- **Infrastructure Sector Outreach Meeting, October 18, 2022:** The meeting began with an overview of the state hazard mitigation planning process and the purpose of the plan itself. Hazards with large potential impacts on infrastructure were discussed, with a particular focus on underserved populations and lifeline impacts. Emerging technologies were also presented as ways for infrastructure to become increasingly resilient. The importance of the Infrastructure Investment and Jobs Act was discussed, along with the workforce and maintenance impacts of the COVID-19 pandemic, pipelines, and the importance of identifying what information is sensitive when providing it to the planning team. Participants were encouraged to fill out and share survey forms discussed at the meeting.
- **Goals and Objectives Discussion with PEMA, October 19, 2022:** This meeting focused on additions and changes to the Mitigation and Objectives. The discussion resulted in the wording for one goal being changed and several objectives either being added, combined with others, or reworded as well.
- **Emergency Management Sector Outreach Meeting, November 8, 2022:** The meeting began with an overview of the state hazard mitigation planning process and the purpose of the plan itself. Hazards heavily related to the emergency management sector were discussed, with a particular focus on underserved populations and lifeline impacts. Most of the discussion centered on COVID-19, including congregate care facilities, lack of training, cross-state planning capabilities, PPE needs, emergency shelter for those without permanent housing, after action reports, and other key takeaways from the ongoing response. Two other discussion points were pre-disaster planning and data reporting during disasters.
- **In-Person Capability Assessment Meeting, November 17, 2022**: The meeting focused on opportunities to leverage existing capabilities, build new capability and find solutions to capability gaps in mitigation action. An additional focus was put on plan integration and capturing all of the new programs, plans, and initiatives going on across Pennsylvania. The capability assessment was already underway, so an overview of successes and achievements that the planning team has already captured was presented. The ongoing coordination between state agencies in response to the COVID-19 pandemic and ongoing work with High Hazard Potential Dams were used as

examples. Participants were encouraged to reach out to the planning team with examples for their agencies or organizations.

- **Virtual Capability Assessment Meeting, November 30, 2022:** The meeting focused on opportunities to leverage existing capabilities, build new capability and find solutions to capability gaps in mitigation action. An additional focus was put on plan integration and capturing all of the new programs, plans, and initiatives going on across Pennsylvania. The capability assessment was already underway, so an overview of successes and achievements that the planning team has already captured was presented. The ongoing coordination between state agencies in response to the COVID-19 pandemic and ongoing work with High Hazard Potential Dams were used as examples. A handful of participants provided information on plans and programs they have engaged in. The planning team encouraged others to reach out with examples for their agencies or organizations.
- **Economic Development Sector Outreach Meeting, December 6, 2022:** The meeting began with an overview of the state hazard mitigation planning process and the purpose of the plan itself. Hazards of concern for the sector were profiled, with a focus on how supply chains may be disrupted. Information on the relationship between climate change and the economy was also discussed. Potential mitigation opportunities were presented and discussed by participants, including those aimed at dealing with workforce shortages and ways to fund pre- and post-disaster activities.
- **Housing Sector Outreach Meeting, December 13, 2022:** The meeting began with an overview of the state hazard mitigation planning process and the purpose of the plan itself. Risks for three general components of housing (stock, market, and access) were discussed, focused on vulnerable communities and their resilience level to hazards due to the varying issues that arise from those components. Housing affordability and homelessness data for Pennsylvania was presented to show how providing affordable access to housing is a form of hazard mitigation. Key discussion points included how to provide affordable access in areas that are not hazard-prone and providing easily accessible information on housing assistance of all forms.
- **Natural and Cultural Resources Sector Outreach Meeting, December 20, 2022:** The meeting began with an overview of the state hazard mitigation planning process and the purpose of the plan itself. Hazards with specific impacts on natural and cultural resources were profiled, including a discussion on how the COVID-19 pandemic impacted operations at state parks, schools, museums, and more. Discussion points centered by participants included historic preservation outcomes, capacity issues for municipalities to implement mitigation measures, hazardous dam removal, stormwater management, and the importance of collecting quality data that is publicly available. Several potential mitigation actions and ongoing plans and initiatives were presented by participants.
- **Housing and Economic Development Sector Outreach Meeting, January 10, 2023:** The meeting began with an overview of the state hazard mitigation planning process and the purpose of the plan itself. A similar presentation from the Housing Sector Meeting was presented, but the focus of the meeting was to bring in more economic perspectives as the housing discussion focused on funding opportunities for affordable housing programs. The meeting discussion was centered on providing funding infrastructure so that communities can address resilience before and after a disaster occurs, how supply chain issues can complicate response, and ways to incentivize the development of affordable housing.

- **Virtual Mitigation Strategy Meeting, January 26, 2023:** This meeting focused on presented and review of the mitigation strategy that had been developed through sector meetings, email collaboration, and 1:1 meetings with stakeholders. Mitigation goals and objectives and the changes made were reviewed. Then the update thus far to mitigation actions was reviewed. The 4 different mitigation action techniques were shown, along with some statistics from the 2018 plan. Two examples of how actions were focused were presented, hazard-driven and sector-driven, and examples were given using flooding actions and those aimed at the Natural & Cultural Resources sector. Major themes that were identified throughout the planning and strategy development were presented as workforce shortages, broadband access, climate change impacts, and equity considerations. Discussions centered around both comments on mitigation strategy and providing information for capabilities and potential integration opportunities. Topics included supply chain disruptions, electric vehicle infrastructure, emergency information sharing, sector collaboration, and the importance of the agricultural industry.
- **In-Person Mitigation Strategy Meeting, January 27, 2023**: This meeting focused on presented and review of the mitigation strategy that had been developed through sector meetings, email collaboration, and 1:1 meetings with stakeholders. Mitigation goals and objectives and the changes made were reviewed. Then the update thus far to mitigation actions was reviewed. The 4 different mitigation action techniques were shown, along with some statistics from the 2018 plan. Two examples of how actions were focused were presented, hazard-driven and sector-driven, and examples were given using flooding actions and those aimed at the Natural & Cultural Resources sector. Major themes that were identified throughout the planning and strategy development were presented as workforce shortages, broadband access, climate change impacts, and equity considerations. Outstanding questions were reviewed with the group to gain information for follow-up. Additional actions or revisions to actions were discussed, with the planning team taking note of things to look deeper into. These included collaboration between healthcare sector and emergency management, multi-modal transportation, PPE supply, funding, and environmental hazards.
- **In-Person Draft Plan Review Meeting, March 30, 2023:** The SPT convened to hear a summary of the Draft Plan contents. Highlights of the update were presented by section and attendees were encouraged to comment in person and to take time after the meeting to review in detail. Comments were requested by April 28, 2023 so that they could be incorporated into the FEMA plan submission.

In-Person Draft Meeting at PEMA Headquarters on March 30, 2023.

- **Virtual Draft Plan Review Meeting, March 31, 2023:** The SPT convened to hear a summary of the Draft Plan contents. Highlights of the update were presented by section and attendees were encouraged to comment in person and to take time after the meeting to review in detail. Comments were requested by April 28, 2023 so that they could be incorporated into the FEMA plan submission.

- **PEMA Director and Deputy Director Draft Plan Review, May 22, 2023:** Once the plan is near final it is reviewed with PEMA's leadership to garner any additional comments or improvements. This also is an opportunity to brief leadership on next steps and prepare for FEMA review and Commonwealth adoption of SHMP.

Additional, smaller meetings were also held throughout the process, including presentations on the plan update at external meetings:

- Department of Health
- Department of Human Services
- Office of Administration
- FEMA Enhanced Check-Ins
- Department of Conservation and Natural Resources
- Department of Environmental Protection
- Pennsylvania Health Care Association
- Department of Community and Economic Development
- Plain Community Outreach Meeting with Elizabethtown College
- Risk Reduction Consultations
- Grant Equity Interagency Workgroup Meeting
- Continuity of Operations Plan Meeting
- Department of Environmental Protection Grid Resilience Meeting

Stakeholders were invited to join the Planning Process Meetings, Sector Meetings, Small Group discussions. The SPT also conducted extensive email and one-on-one calls with agencies pertaining to their mitigation actions (including over 37 discussions)- reviewing any changes in risk, actions completed, and challenges they may have faced. Agencies that participated are listed in alphabetical order below.

- American Red Cross
- CCAP
- Cumberland County Conservation District
- Disability Rights PA
- Hospital and Health System Association of Pennsylvania
- PA Association of Boroughs
- PA Association of Conservation Districts
- PA Association of Floodplain Managers
- PA Association of Independent Colleges & Universities of PA (AICUP)
- PA Broadband Development Authority
- PA Commission for Community Colleges (PACCC)
- PA Commission on Crime and Delinquency
- PA DCED
- PA DCNR
- PA DEP
- PA Department of Aging
- PA Department of Agriculture
- PA Department of Banking & Securities
- PA Department of Corrections
- PA Department of Drug and Alcohol Programs
- PA Department of Education
- PA Department of General Services
- PA Department of Health
- PA Department of Human Services

- PA Department of Labor & Industry
- PA Department of Military & Veterans Affairs
- PA Department of Revenue
- PA Department of State
- PA Department of Transportation
- PA Fish & Boat Commission
- PA Game Commission
- PA Governor's Office of Homeland Security
- PA Health Care Association
- PA Human Relations Commission
- PA Juvenile Court Judges' Commission
- PA Liquor Control Board
- PA Medical Society
- PA Milk Marketing Board
- PA Municipal League
- PA Office of Administration
- PA Office of State Fire Commissioner
- PA Office of State Inspector General
- PA Office of the Budget
- PA Office of the State Treasurer
- PA Office of Victim Advocate
- PA One Call
- PA Parole Board
- PA Public School Employees Retirement System
- PA Public Utility Commission
- PA Silver Jackets
- PA State Employees Retirement System
- PA State Geospatial Coordinating Board
- PA State Historic Preservation Office
- PA State Police
- PA State Treasurer
- PA Turnpike Commission
- PASSHE
- PaWARN
- PA Civil Air Patrol
- PEMA
- Penn State University Extension
- PENNVEST
- PHFA
- PHMC
- PSATS

See Appendix C for documentation of meetings, comments, and recommendations.

4 Risk Assessment

4. Risk Assessment

4.1. Update Process Summary

At the SPT Kick-off meeting, the SPT reviewed the list of hazards profiled in the 2018 SHMP, evaluating and identifying potential new hazards, changes in risk, potential enhancements, and new/changed data. Following the Kick-off meeting, the project team conducted research and analysis on these identified changing risks and presented the information at the Risk Assessment Meeting. Following discussion at that meeting, the SPT developed an approach for analyzing these risks. Climate change has been incorporated as a potential factor in future probability for all hazards it is expected to impact, including drought, hurricane, and temperature extremes. A key issue for adapting to climate change is that existing risk models are no longer as accurate as they used to be. Most weather and other hazard models historical data to extrapolate future conditions. With the advent of increasing ahistorical weather events, the ability of existing models to predict future impacts become less effective. Communities are assuming more risk, but do not yet have effective tools to analyze how much more risk. Our recommendation is to leave greater reserves to deal with unexpected hazard levels. For example, rather than recommend 1.5 feet of freeboard to mitigate flooding, recommend 3.0 feet to account for an unexpected level of flooding. Similarly, Hazard Planners should allow for greater reserves of funding, time, supplies and personnel.

A summary of the 33 hazards identified and profiled for the 2023 SHMP is provided in Table 4.1-1 along with historical information regarding whether the hazard was profiled in the 2004, 2007, 2010, 2013, 2018, and 2023 SHMPs. There was discussion about merging hazards (e.g. conventional and unconventional wells) but given the differences in emergency response and information available, stakeholders agreed to leave these separate for now. Stakeholders also discussed merging the wildfire and urban fire profiles, without consensus the SPT left these hazards separate. There was a suggestion to list wildfires and human-caused since the majority are, and the SPT recommended a more extensive discussion around the fire hazards and how they are covered will be warranted for the next plan updated. Some stakeholders voiced an interest in creating a climate change hazard, though ultimately determined climate change needed to be integrated into every applicable hazard rather than being seen as a unique situation. Given workforce shortages and decreasing volunteers to emergency response positions, stakeholders discussed listing this as a hazard to give the concern increased weight. Given that paid and unpaid positions are part of Pennsylvania's overall capabilities, the decision was made to increase the narrative in the capabilities section instead. The final proposed new hazard was focused on economic and supply chain disruptions, looking at how a global recession might impact Pennsylvania and other factors that stakeholders saw or grew concerned about during the COVID-19 pandemic. State agencies agreed this was a concern but that more information needed to be gathered to determine if it was a hazard or not. The SPT added the economic discussion to the State Profile (section 2) to support this path forward. Accordingly, while the table below shows an increase in the number of hazards identified and profiled in Pennsylvania since 2004, no new hazards were added in this update. As part of the 2023 update, the SPT did add lifeline discussions to each hazard profile and additional equity considerations.

Table 4.1-1 List of Hazards Identified and Profiled in the 2004, 2007, 2010, 2013, 2018, and 2023 Pennsylvania SHMPs.

HAZARD	YEAR PROFILED					
	2004	2007	2010	2013	2018	2023
Building and Structure Collapse	No	No	No	No	Yes	Yes
Coastal Erosion	Yes	Yes	Yes	Yes	Yes	Yes
Drought	Yes	Yes	Yes	Yes	Yes	Yes
Earthquake	Yes	Yes	Yes	Yes	Yes	Yes
Extreme Temperature	Yes	Yes	Yes	Yes	Yes	Yes
Flood, Flash Flood, Ice Jam	Yes	Yes	Yes	Yes	Yes	Yes
Hailstorm	Yes	Yes	Yes	Yes	Yes	Yes
Hurricane, Tropical Storm,	No	No	Yes	Yes	Yes	Yes
Invasive Species	No	No	Yes	Yes	Yes	Yes
Landslide	Yes	Yes	Yes	Yes	Yes	Yes
Lightning Strike	Yes	Yes	Yes	Yes	Yes	Yes
Pandemic	No	Yes	Yes	Yes	Yes	Yes
Radon Exposure	Yes	Yes	Yes	Yes	Yes	Yes
Subsidence, Sinkhole	Yes	Yes	Yes	Yes	Yes	Yes
Tornado, Wind Storm	Yes	Yes	Yes	Yes	Yes	Yes
Wildfire	Yes	Yes	Yes	Yes	Yes	Yes
Winter Storm	Yes	Yes	Yes	Yes	Yes	Yes
Civil Disturbance	Yes	Yes	Yes	Yes	Yes	Yes
Cyber Terrorism	No	No	No	No	Yes	Yes
Dam Failure	Yes	Yes	Yes	Yes	Yes	Yes
Environmental Hazard – Coal	Yes	Yes	Yes	Yes	Yes	Yes
Environmental Hazard – Conventional Oil and Gas Wells*	Yes	Yes	Yes	Yes	Yes	Yes
Environmental Hazard – Gas and Liquid Pipelines*	No	No	No	No	Yes	Yes
Environmental Hazard – Hazardous Materials Releases*	Yes	Yes	Yes	Yes	Yes	Yes
Environmental Hazard – Unconventional Oil and Gas Wells*	No	No	No	Yes	Yes	Yes
Levee Failure	No	No	Yes	Yes	Yes	Yes
Mass Food and Animal Feed Contamination	No	No	No	Yes	Yes	Yes
Nuclear Incident	Yes	Yes	Yes	Yes	Yes	Yes
Opioid Addiction Response	No	No	No	No	Yes	Yes
Terrorism	Yes	Yes	Yes	Yes	Yes	Yes
Transportation Accident	Yes	Yes	Yes	Yes	Yes	Yes
Urban Fire and Explosion	Yes	Yes	Yes	Yes	Yes	Yes
Utility Interruption	Yes	Yes	Yes	Yes	Yes	Yes
*Note that not all Environmental Hazards are profiled with equal detail in each plan.						

Each hazard identified is profiled in Section 4.3 in order to:

- Estimate the location and extent of the area potentially impacted
- Describe the range of magnitude or severity of impacts that could potentially occur
- Summarize environmental impacts most commonly experienced
- Identify and summarize the impacts of previous occurrences
- Estimate the probability of future occurrences, with a focus on climate change impacts

The quality of a hazard profile is strongly dependent on the information available for use in characterizing the presence and impact of the hazard on Pennsylvania. Of the hazard profile categories described above, estimating the probability of future occurrences is often the most challenging. The probability of a hazard event of a given magnitude is usually expressed in terms of annual probability. Certain hazards (e.g., floods) have received detailed study and have well-understood probability distributions. For many hazards, however, probability information is lacking. In these cases, historical occurrences and input from members of the SPT are used to characterize the frequency of a given hazard as:

- *Unlikely*: Less than 1% annual probability
- *Possible*: Between 1 & 49.9% annual probability
- *Likely*: Between 50% and 90% annual probability
- *Highly Likely*: Greater than 90% annual probability

Throughout the planning process, stakeholders noted the varying relationships between hazards. So as to further integrate the Pre-Disaster Recovery Plan, the SPT created tables for each profile listing the most likely lifeline to be affected by the hazard and if the impact was primarily direct (causal), or indirect (compounding or cascading).

Table 4.1-2 Affected Lifelines

Hazard Impact	Icon
Causal	
Compounding	
Cascading	

4.1.1. State Assets

A key component of the risk assessment process is the evaluation of potential losses to state assets. Please note there are multiple definitions for critical facilities, varying from the FEMA Policy Guide, “Critical facilities are structures that the state determines must continue to operate before, during and after an emergency and/or hazard event and/or are vital to health and safety.” To the general glossary list of examples, “Typical critical facilities include hospitals, fire stations, police stations, storage of critical records, and similar facilities.” The SPT defines critical facilities for this plan update as assets that are essential to the Commonwealth’s security, public health and safety, economic vitality, and way of life. The SPT decided to assess the vulnerability of two types of state assets: state-owned or leased facilities and state-identified critical facilities. These assets are mostly privately-owned and operated and include facilities such as power grids and water filtration plants; national monuments and government facilities; telecommunications and transportation systems; and chemical facilities.

To perform the vulnerability assessment and loss estimation for state assets, an inventory of state-owned or leased facilities obtained from the Department of General Services (DGS) was combined with a PEMA inventory of Pennsylvania State System of Higher Education (PASSHE) facilities. The DGS inventory was delivered to the SPT on March 16, 2018 and includes more than 17,000 structures that are potentially owned or leased by the Commonwealth. An updated dataset for 2023 could not be provided to the SPT, as DGS is currently migrating between two different data management systems. The inventory is designed to provide information on more than 40 attributes for each facility, including information on structure type, name, location, and replacement value. The Pennsylvania Office of Administration is in the process of populating all this information. The PEMA inventory of PASSHE facilities includes 855 structures owned by PASSHE. As many facilities as possible were geolocated based on the provided latitude and longitude or the provided street address. Of the approximately 18,000 records in the combined inventories, only 4,460 included sufficient information to be geolocated. Table 4.1.1-1 shows the number of such facilities for each state agency. shows the number and replacement value of geolocated state facilities, categorized by agency or department. Replacement values were not available for all facilities. The available values, however, were assumed to provide a representative sample. For the 2023 update, the SPT decided to include two additional attributes from the provided DGS inventory dataset; the number of facilities that are owned and the reported square footage. Similar to insufficient address information, there are facilities within the DGS inventory that did not possess complete records; for example, a facility may record the square footage of the building, but not the building replacement value. Including these additional attributes could provide better understanding of replacement costs or damage, as processes between damaged owned buildings vs leased buildings could differ. As for building square footage, there could be a certain cost per square foot of replacing damaged buildings. These additions are assumed to provide a better understanding of potential damage costs. Figure 3.1-3 provides a map of all geolocated state facilities. Only those agencies with more than 100 geolocated facilities are denoted in the legend. Counties may have more detailed information on facilities within their area of jurisdiction that the state can consider for future updates. During the plan review process, additional information was provided that may be included in future updates. Figure 3.1-4 shows the map of all critical facilities that were included in the vulnerability analysis, including those that are not state-owned.

Table 4.1.1-1 Summary of State-Owned or Leased Facilities Included in the State Vulnerability Assessment (DGS, 2018 and PEMA, 2018).

DEPARTMENT	NUMBER OF FACILITIES	NUMBER OF GEOLOCATED FACILITIES	PERCENT GEOLOCATED	REPLACEMENT VALUE	OWNED GEOLOCATED FACILITIES	GEOLOCATED REPORTED SQUARE FOOTAGE
Attorney General	13	9	69%	-	0	189,068
Department of Agriculture	30	16	53%	$33,546,430	11	1,168,804
Department of Banking and Securities	5	2	40%	-	0	49,820
Department of Community and Economic Development	4	4	100%	-	0	9,750
Department of Conservation and Natural Resources	4,843	2	0%	$1,300,000	1	37,703
Department of Corrections	1,340	696	52%	$880,660,437	666	12,420,030
Department of Education	5	1	20%	-	1	0
Department of Environmental Protection	93	13	14%	-	1	369,619
Department of General Services	275	131	48%	$2,182,487,819	118	12,025,555
Department of Health	65	48	74%	-	0	203,430
Department of Labor and Industry	90	69	77%	$126,178,237	10	1,415,840
Department of Military and Veterans Affairs	1,498	1	0%	-	0	2,500
Department of Public Welfare	820	98	12%	$17,385,000	0	1,560,963
Department of Revenue	18	10	56%	-	0	153,216
Department of Transportation	4,822	1,691	35%	$597,802,708	1,510	3,984,236
Drug and Alcohol Programs	1	1	100%	-	0	17,503
Emergency Management Agency	20	8	40%	$11,972,884	8	109,430
Executive Offices	2	2	100%	-	0	39,265
Fish and Boat Commission	648	154	24%	$13,134,279	153	340,327

Table 4.1.1-1 Summary of State-Owned or Leased Facilities Included in the State Vulnerability Assessment (DGS, 2018 and PEMA, 2018).

DEPARTMENT	NUMBER OF FACILITIES	NUMBER OF GEOLOCATED FACILITIES	PERCENT GEOLOCATED	REPLACEMENT VALUE	OWNED GEOLOCATED FACILITIES	GEOLOCATED REPORTED SQUARE FOOTAGE
Governor's Office	1	1	100%	-	0	535
Historical and Museum Commission	525	30	6%	$5,018,300	3	8,942
Insurance Department	2	2	100%	-	0	42,511
Liquor Control Board	632	546	86%	$23,000,000	1	3,056,188
Public School Employees' Retirement System	8	6	75%	-	0	83,977
State Civil Service Commission	2	1	50%	-	0	620
State Department	1	1	100%	-	0	84,349
State Employees' Retirement System	7	4	57%	-	0	59,932
State Police	107	36	34%	-	0	372,551
State System of Higher Education	855	855	100%	-	-	-
Thaddeus Stevens College of Technology	23	20	87%	$26,346,722	20	2,200
Treasury Department	3	2	67%	-	0	7,483
Total	**17,916**	**4,460**	**25%**	**$3,918,832,815**	**2,503**	**37,816,347**

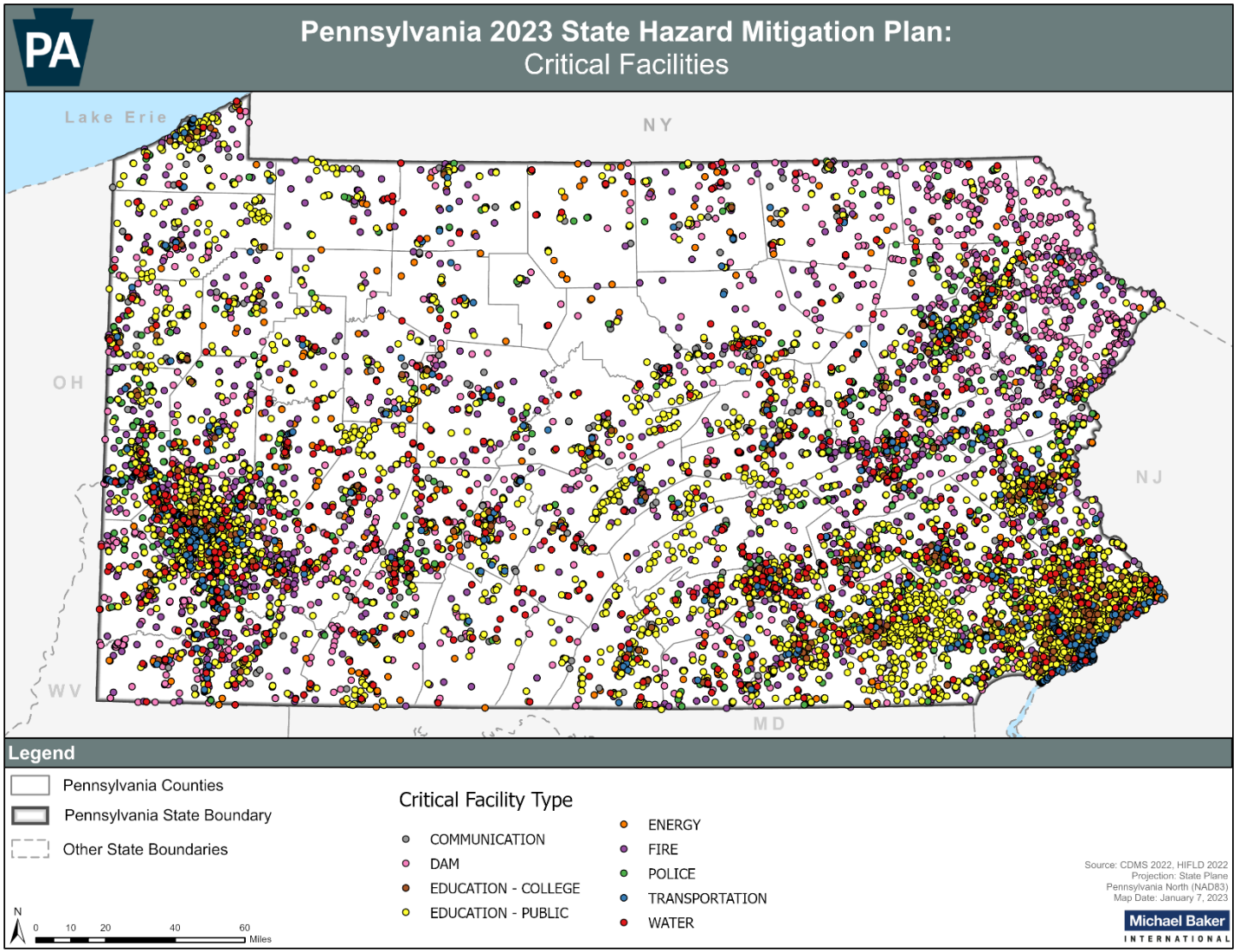
To perform the vulnerability assessment and loss estimation for critical facilities, an inventory of facilities deemed essential to the state by the SPT was compiled primarily from two publicly accessible databases: DHS's Homeland Infrastructure Foundation-Level Data (HIFLD) Open data portal, and FEMA's Comprehensive Data Management System (CDMS).

FEMA's CDMS was used to gather geospatial data for the few types of critical facilities not available through HIFLD Open. A component of FEMA's Hazus software, the CDMS allows users to export the default geospatial data that Hazus uses to estimate potential losses. This default geospatial data includes national data for essential facilities, high potential loss facilities, selected transportation and lifeline systems, agriculture, vehicles, and demographics. More information on the sources for the Hazus default data can be found at https://www.fema.gov/summary-databases-hazus-multi-hazard. During the 2023 update, FEMA released HAZUS 6.0, which included a large baseline data update to the CDMS inventory. This inventory includes new general building stock (GBS) data sources with more site-specific building characteristics and more accurate commercial building data. Demographics, high potential loss facilities, transportation and utility systems were all updated. The HIFLD Open data portal is the result of more than 15 years of work by the U.S. Department of Homeland Security (DHS), the National Geospatial-Intelligence Agency (NGA), and other federal agencies. Following the attacks of September 11, 2001, federal agencies began aggregating data from hundreds of regional and local data providers to compile national datasets of essential assets and infrastructure. At first, these national data layers were disseminated through computer discs and access was restricted to FOUO – For Official Use Only. With time, however, DHS recognized the value of these data layers to support community preparedness, resiliency, research, and more, and decided to provide public access to a subset of the data. In 2016, the HIFLD Subcommittee released the HIFLD Open data portal, providing online access to 270+ dynamic, public domain datasets. As of 2022, this data portal provides access to over 500 national geospatial data layers within the open public domain (DHS HIFLD, 2022).

The critical facility inventory also includes a dam layer that is available to the public through the USACE dam inventory, and a national monument layer obtained from the NPS Integrated Resource Management Applications (IRMA) Portal. As the Hazus 6.0 CDMS inventory update was released in late 2022, majority of the baseline data was deemed to be accurate, efficient, and up to date. The baseline data was cross checked with HIFLD data and changes were made where necessary. The final critical facility inventory includes 13,448 critical facilities and 17 facility types. Table 4.1.1-2 shows the number and replacement value of geolocated critical facilities, as well as the data source for each facility type. Figure 4.1.1-1 provides a map of all geolocated critical facilities. Only those facility types with more than 300 geolocated facilities are denoted in the legend.

Table 4.1.1-2 Geolocated Critical Facilities (HIFLD, 2022 and CDMS, 2022).			
CRITICAL FACILITY TYPE	NUMBER OF FACILITIES	REPLACEMENT VALUE (1000s)	DATA SOURCE
AGRICULTURE	275	0	HIFLD
BANKING	4	0	HIFLD
COMMERCIAL	21	0	HIFLD
COMMUNICATION	558	$60,822.00	CDMS
DAM	1,492	0	National Dam Inventory
EDUCATION-COLLEGE	399	$54,312,890.17	CDMS
EDUCATION-PUBLIC	4,689	$51,907,044.39	CDMS
ENERGY	364	$154,181,567.46	CDMS
EOC	71	$324,101.71	CDMS
FIRE	2,613	$3,262,824.30	CDMS
GOVERNMENT	25	0	HIFLD
MEDICAL	311	$40,534,216.16	CDMS
NATIONAL MONUMENT	6	0	NPS
NUCLEAR	5	0	HIFLD
POLICE	1,302	$8,144,470.67	CDMS
TRANSPORTATION	678	$6,578,233.65	CDMS
WATER	635	$74,060,721.00	CDMS
TOTAL	**13,448**	**$393,366,892.52**	**N/A**

Figure 4.1.1-1 Map of Critical Facilities Included in the State Vulnerability Assessment (HIFLD 2022, CDMS 2022).



4.1.2. Jurisdictional Assets

Another key component of the risk assessment process is the evaluation of potential losses to jurisdictions within the Commonwealth. To perform the vulnerability assessment and loss estimation for Pennsylvania counties, the 2023 SHMP leverages Census data on population and Hazus data on generalized building stock. FEMA's Hazus v6.0 includes a default inventory of generalized building stock at both the census tract and census block scales. The information provided includes the number of residential, commercial, industrial, agricultural, and other buildings, as well as the estimated building value and estimated indirect building values, such as contents, wages, and income. To assess the relative vulnerability of jurisdictions to hazards, databases of population, building counts, and building value were assembled at two scales: the census tract scale, and the smaller census block scale. While it is not feasible to reproduce the tables at either of these scales, a table aggregated to the county scale is provided below (Table 4.1.2-1).

Table 4.1.2-1 Jurisdictional Population and Building Stock.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $
Adams	103,852	44,413	$20,451,791
Allegheny	1,250,578	517,299	$262,225,147
Armstrong	65,558	34,121	$12,446,068
Beaver	168,215	74,647	$34,155,970
Bedford	47,577	28,835	$12,126,640
Berks	428,849	158,856	$85,486,684
Blair	122,822	55,591	$27,514,417
Bradford	59,967	32,476	$14,402,891
Bucks	646,538	238,122	$158,740,404
Butler	193,763	78,114	$45,408,133
Cambria	133,472	67,698	$33,263,669
Cameron	4,547	3,534	$1,261,793
Carbon	64,749	34,462	$11,350,313
Centre	158,172	52,781	$30,632,329
Chester	534,413	189,944	$145,853,432
Clarion	37,241	20,673	$8,205,840
Clearfield	80,562	34,941	$16,568,610
Clinton	37,450	16,523	$6,302,292
Columbia	64,727	28,691	$12,725,536
Crawford	83,938	49,842	$24,415,962
Cumberland	259,469	96,435	$54,712,323
Dauphin	286,401	110,224	$62,272,979
Delaware	576,830	190,755	$118,806,474
Elk	30,990	20,195	$8,360,975
Erie	270,876	98,239	$48,855,610

Table 4.1.2-1 Jurisdictional Population and Building Stock.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $
Fayette	128,804	68,178	$24,776,001
Forest	6,973	6,759	$2,044,813
Franklin	155,932	68,010	$31,455,169
Fulton	14,556	9,994	$4,575,785
Greene	35,954	17,643	$9,453,141
Huntingdon	44,092	20,959	$7,959,176
Indiana	83,246	38,631	$16,650,945
Jefferson	44,492	28,330	$8,093,150
Juniata	23,509	11,888	$4,341,292
Lackawanna	215,896	83,107	$45,276,657
Lancaster	552,984	204,825	$105,000,879
Lawrence	86,070	39,355	$14,655,316
Lebanon	143,257	57,158	$29,282,373
Lehigh	374,557	127,848	$75,564,595
Luzerne	325,594	130,663	$56,666,268
Lycoming	114,188	50,586	$21,850,982
McKean	40,432	21,849	$8,638,561
Mercer	110,652	53,873	$27,796,853
Mifflin	46,143	22,882	$9,250,718
Monroe	168,327	77,585	$37,316,515
Montgomery	856,553	295,243	$206,915,131
Montour	18,136	6,882	$3,323,480
Northampton	312,951	110,958	$58,649,984
Northumberland	91,647	39,319	$20,713,853
Perry	45,842	22,217	$8,263,642
Philadelphia	1,603,797	527,787	$259,829,378
Pike	58,535	40,691	$16,795,933
Potter	16,396	10,525	$2,819,003
Schuylkill	143,049	69,030	$29,524,156
Snyder	39,736	15,403	$8,691,215
Somerset	74,129	44,260	$23,129,158
Sullivan	5,840	6,562	$2,049,204
Susquehanna	38,434	27,754	$13,780,704
Tioga	41,045	23,735	$8,657,355
Union	42,681	13,363	$6,873,096
Venango	50,454	28,038	$9,730,517
Warren	38,587	24,810	$7,440,243
Washington	209,349	99,395	$45,713,731

Table 4.1.2-1 Jurisdictional Population and Building Stock.			
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $
Wayne	51,155	34,378	$11,839,759
Westmoreland	354,663	170,039	$80,296,372
Wyoming	26,069	12,856	$5,774,581
York	456,438	165,970	$84,093,677
Total	**13,002,700**	**5,206,749**	**$2,712,099,644**

To demonstrate one approach to assessing the vulnerability of historic resources, and to identify some of the jurisdictions whose historic resources are most at risk, the 2018 SHMP added an evaluation of historic resource vulnerability to the jurisdictional vulnerability assessment for three natural hazards: flood, hurricane, and wildfire. Of the five natural hazards ranked highest by the SPT, these three pose the most significant challenge to the preservation of historic places. The other two natural hazards ranked among the top five – extreme temperature and winter storm – are more likely to affect people than places.

In developing the 2023 SHMP, the SPT recognized the importance of protecting not just lives and property, but sense of place as well. Historic and cultural resources can be fundamental to a community's sense of place, "ground[ing] us to the past, the present, and the future" (PHMC, 2018). Understanding the vulnerability of these resources to the hazards that affect a community is therefore an important part of understanding the vulnerability of the community as a whole. The 2023 SHMP continues to recognize the importance of preserving this sense of place by continuing this vulnerability analysis. The planning team met with PHMC to discuss both those resources that have been identified and the risk for those that have not. Environmental and historic preservation assets that are not identified may need to be identified post-disaster in order to be eligible for FEMA post-disaster grants.

To evaluate historic resource vulnerability to the selected natural hazards, such as flooding and landslides, the 2023 SHMP used Pennsylvania's Historical and Archaeological Resource Exchange (PA-SHARE). PA-SHARE is a map-based inventory of the historic and archaeological sites and surveys maintained by the Pennsylvania Historical and Museum Commission (PHMC), Pennsylvania State Historic Preservation Office (PA SHPO). The inventory reflects nearly a century of information collection, and includes 150,278 historic resources. For the 2023 plan update, PHMC provided the SPT with a statewide geospatial dataset including all the historic properties that could be shared with the public. Table 4.1.1-2 shows the distribution of these historic assets by resource type and National Register eligibility. In addition to buildings (such as houses, barns, or churches), historic properties in the PA-SHARE database include "structures" that are not intended primarily to provide shelter (such as tunnels or bridges), "objects" that are primarily artistic or are relatively small in scale (such as monuments or mileposts), "sites" that were the location of a significant event or building (such as battlefields or ruins), and "districts" that have a significant concentration of historically united features (such as canal systems or business districts). The PA-SHARE inventory classifies all of these historic properties in terms of

their eligibility for the National Register of Historic Places. The National Register of Historic Places is the federal government's official list of the nation's historic places worthy of preservation. To be eligible for listing in the National Register, a property must meet several criteria for evaluation. For an eligible property to be listed in the National Register, the property must be nominated by the owner, and the nomination must be reviewed by the State Review Board and approved by the National Park Service. Properties that are designated by the Secretary of the Interior as National Historic Landmarks are also listed in the National Register of Historic Places. It is important to note equity issues involved with registering and protecting historical and cultural resources. Typically, requests for historic demarcation come from communities that have the funding to survey their assets and catalog them. Those without the means to do this may be more at-risk for their resources being damaged or lost in a disaster.

Table 4.1.2-2 Properties in the Pennsylvania CRGIS (PHMC, as of December 6, 2022)

TYPE	ELIGIBLE	LISTED	NATIONAL HISTORIC LANDMARK	NOT ELIGIBLE	UNDETERMINED	DEMOLISHED	OTHER	TOTAL BY RESOURCE TYPE
Building	5,204	7,677	205	14,088	100,712	1,450	340	129,676
District	834	683	50	1,141	1,109	20	214	4,051
Object	42	13	0	38	165	3	1	262
Site	77	80	11	294	1,510	9	11	1,992
Structure	828	454	22	9,851	1,877	1,231	19	14,282
Landscape	2	0	0	0	13	0	0	15
Total Status	6,987	8,907	288	25,412	105,386	2,713	585	150,278

For the purposes of this plan, all historical assets in the PA-SHARE dataset were evaluated for vulnerability to the selected natural hazards. In 2018, the resources considered of greatest importance for preservation were those classified as Eligible, Listed, and National Historic Landmark (NHL). In addition, the resource types considered of greatest relevance to the jurisdictional vulnerability assessment were historic buildings. However, conversations with PHMC revealed importance for all other assets and statuses. Therefore, the SPT decided to include all known historical assets in the 2023 HMP update. Table 4.1.2-3 shows the distribution of all historical assets in the Commonwealth by county. The counties with the largest numbers of historic buildings include those in the greater Philadelphia and greater Pittsburgh regions. The Mayor of Philadelphia has created a task force with the National Trust for Historic Preservation to explore preservation tools that encourage growth without compromising each neighborhood's authentic character. The city's goal is to remove barriers to encourage rehab and reuse, demonstrating that historic buildings can improve the way we live in the 21st century (National Trust for Historic Preservation, n.d.).

Table 4.1.2-3 Historic Buildings in Pennsylvania by County (PHMC, as of December 6, 2022)		
COUNTY	HISTORICAL ASSETS	% OF STATE TOTAL
Adams	3,843	2.5%
Allegheny	12,728	8.4%
Armstrong	562	0.4%
Beaver	734	0.5%
Bedford	4,785	3.2%
Berks	4,567	3.0%
Blair	1,139	0.8%
Bradford	868	0.6%
Bucks	4,073	2.7%
Butler	883	0.6%
Cambria	2,835	1.9%
Cameron	278	0.2%
Carbon	226	0.1%
Centre	8,047	5.3%
Chester	10,012	6.6%
Clarion	1,331	0.9%
Clearfield	1,245	0.8%
Clinton	842	0.6%
Columbia	2,163	1.4%
Crawford	1,795	1.2%
Cumberland	1,815	1.2%
Dauphin	2,105	1.4%
Delaware	2,271	1.5%
Elk	629	0.4%
Erie	2,847	1.9%
Fayette	2,222	1.5%
Forest	352	0.2%
Franklin	1,240	0.8%
Fulton	885	0.6%
Greene	1,090	0.7%
Huntingdon	2,759	1.8%
Indiana	1,520	1.0%
Jefferson	731	0.5%
Juniata	652	0.4%
Lackawanna	2,157	1.4%
Lancaster	5,625	3.7%
Lawrence	370	0.2%
Lebanon	3,024	2.0%
Lehigh	1,781	1.2%

Table 4.1.2-3 Historic Buildings in Pennsylvania by County (PHMC, as of December 6, 2022)		
COUNTY	HISTORICAL ASSETS	% OF STATE TOTAL
Luzerne	2,811	1.9%
Lycoming	7,028	4.6%
McKean	328	0.2%
Mercer	853	0.6%
Mifflin	546	0.4%
Monroe	1,718	1.1%
Montgomery	5,530	3.7%
Montour	223	0.1%
Northampton	1,866	1.2%
Northumberland	1,164	0.8%
Perry	969	0.6%
Philadelphia	6,314	4.2%
Pike	329	0.2%
Potter	1,157	0.8%
Schuylkill	684	0.5%
Snyder	950	0.6%
Somerset	1,430	0.9%
Sullivan	369	0.2%
Susquehanna	1,474	1.0%
Tioga	666	0.4%
Union	545	0.4%
Venango	414	0.3%
Warren	224	0.1%
Washington	2,869	1.9%
Wayne	556	0.4%
Westmoreland	5,919	3.9%
Wyoming	876	0.6%
York	6,517	4.3%
Total	151,360	**100%**

4.1.3. Vulnerability Assessment and Loss Estimation Methodology

For the purposes of this SHMP, *vulnerability* refers to the exposure of people and property to a hazard. The 2023 SHMP update included a comprehensive vulnerability assessment for the state and jurisdictional assets discussed in Sections 4.1 and 4.2. In general, two types of methodologies were applied: a Hazus-based methodology, and an exposure-based methodology.

The Hazus-based methodology was applied to flood, earthquake, and hurricane hazards. This methodology used FEMA's Hazus v6.0 to estimate social and economic losses across the Commonwealth. Hazus divides the loss estimation process into three phases:

1. **Hazard Analysis Phase**. In this phase, the model analyses the physical processes that determine loss. In the case of flood hazards, for example, the model would determine the depth and velocity of flooding associated with different flood frequencies.

2. **Damage Estimation Phase**. In this phase, the model overlays the hazard layer with a set of inventory layers to identify the buildings and infrastructure exposed to the hazard, then uses vulnerability curves to estimate the extent of structural damage. The default Hazus inventory consists of four components: 1) the general building stock (the number and characteristics of residential, commercial, industrial, agricultural, and other buildings), 2) essential facilities (e.g., police stations), 3) high potential loss facilities (e.g., dams), and 4) selected transportation and utility systems (e.g., highway bridges and water treatment plants). Hazus uses a variety of data sources for site specific building data, with the Nationwide Structure Inventory (NSI) as the primary source. The NSI is maintained by the USACE. Hazus v6.0 uses baseline data from the 2020 Census.

3. **Loss Estimation Phase**. In this phase, the model quantifies the social and economic losses caused by the estimated structural damage. Hazus measures social impact in terms of displaced households, shelter requirements, and other parameters, and economic impact in terms of direct building losses and business interruption losses. Direct building losses consist of the damage to structures and their contents (including inventory), while business interruption losses consist of the various losses that accrue while a business remains inoperable – including relocation expenses, employee wage loss, business income loss, and rental income loss. For more detailed information on the Hazus methodology, see the Hazus technical manuals for flood, earthquake, and hurricane hazards at https://www.fema.gov/hazus-mh-user-technical-manuals.

FEMA designed Hazus to be a flexible software tool that allows for varying levels of customization depending on user resources and needs. A Level 1 analysis relies mostly on Hazus default data, a Level 2 analysis augments the Hazus default data with more recent or detailed data for the study region, and a Level 3 analysis involves adjusting the built-in loss estimation models for the earthquake, flood, and hurricane loss analysis.

The 2023 SHMP used a Level 2 analysis to assess jurisdictional vulnerability to flood, earthquake, and hurricane wind hazards. The Hazus analyses conducted for the 2023 SHMP utilized the Hazus 6.0 inventory update, with additional inventory replacements described in Section 4.1.1. In addition, the Level 2 flood analysis used detailed local flood depths derived from the latest available FEMA flood maps and the best available ground elevation data.

An exposure-based methodology was applied to assess jurisdictional vulnerability for the remaining natural and human-made hazards, and state asset vulnerability for all hazards. The exposure-based methodology was comparable to the first and second phases of the Hazus methodology. First, high hazard areas were identified for the hazard of interest. Second, high hazard areas were intersected with the distribution of population, buildings, and building value to estimate the number of exposed people and assets. Note that the exposure-based methodology

is in some ways more conservative than the Hazus-based methodology, but in other ways less conservative. The exposure-based methodology does not distinguish between different levels of structural damage – reporting the cost to replace all affected structures, rather than the cost to repair the probable level of damage. On the other hand, the exposure-based methodology does not account for many of the economic and social impacts of hazard events. Unlike in the Hazus-based methodology, the exposure-based methodology does not account for losses to contents or inventory, does not account for business interruption losses, and does not account for social impacts such as displaced households and shelter requirements.

A more detailed summary of the loss estimation methodology for each profiled hazard is provided in Section 4.2.2.

4.1.4. Local and University Hazard Rankings

The HAZUS and GIS analysis described above will be available for future local risk assessments. It is based on state-wide data sources that had local input but did not come from local HMPs. In addition to vulnerability assessment results obtained through HAZUS and GIS analysis, HMPs for counties and universities throughout the Commonwealth were reviewed to determine the presence of each hazard on a jurisdictional basis and ensure that the 2023 SHMP incorporates information from local risk assessments, including which counties profile which hazards, and any hazard ranking provided at the local level. 4 summarizes the results of this review of county HMPs. A complete summary of the hazards profiled in each county HMP is provided as an appendix.

Figure 4.1.4-1 Summary of Hazards Profiled in County HMPs throughout Pennsylvania.

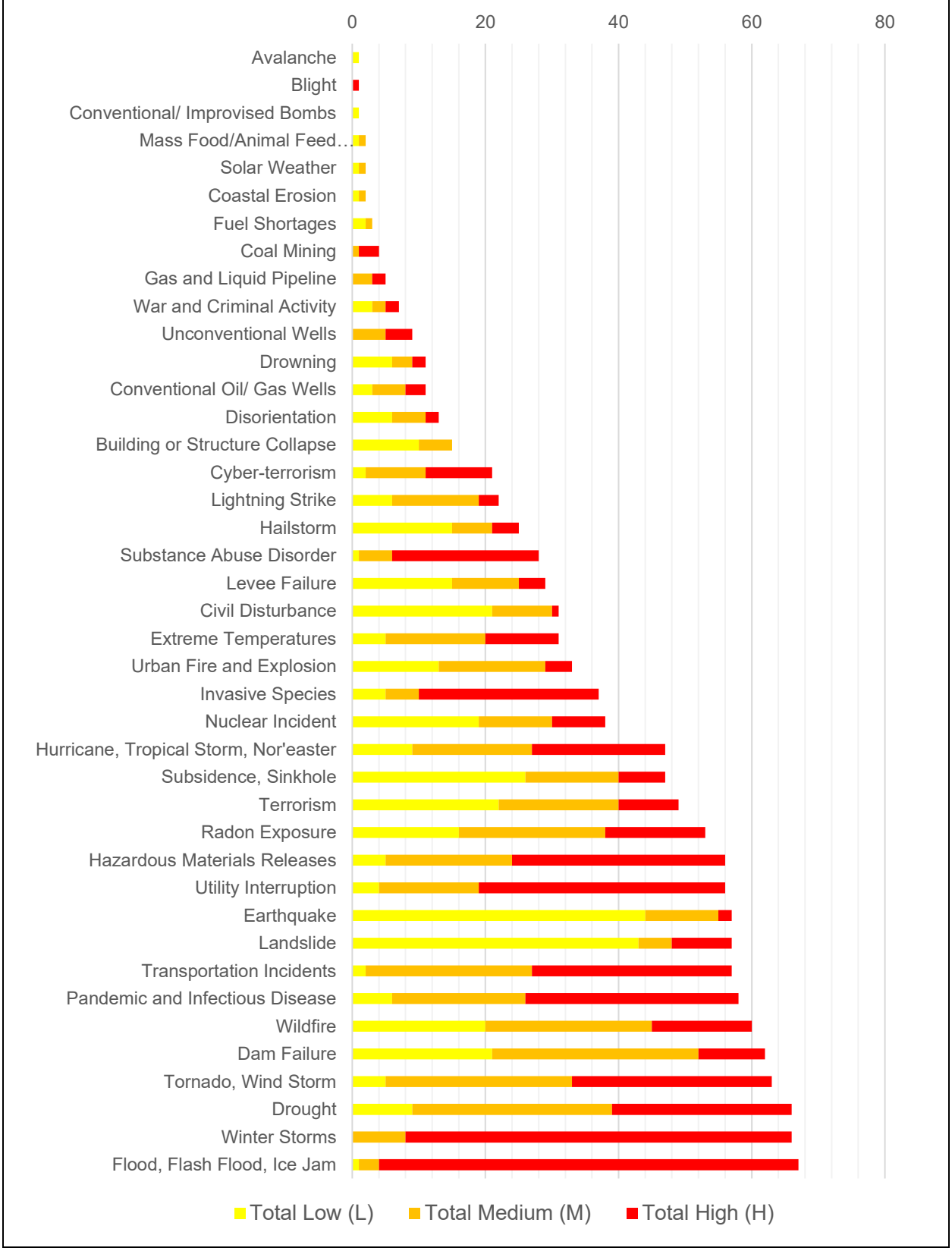


Table 4.1.4-1 below showcases the differences between how the 2018 SHMP reported hazard rankings by counties and the current 2023 SHMP. A positive number in a column indicates that more counties assigned that hazard that risk level than was reported in the last plan, a negative indicates the opposite. The Total column reflects the difference in how many counties ranked each hazard at all, regardless of the risk level assigned. A positive number shows an increase in the amount of county plans that included the hazard in their risk rating analysis, a negative number shows the opposite. It is important to note that the processes for capturing how each county's HMP ranked hazards has changed for this plan update. In 2018, the planning team recorded hazards that were covered but not actually scored by the counties. This time, if there was no score and rank assigned using the methodology mentioned in Section 4.1.5 below, then it was not counted. This means that the Low, Medium and High columns may not add up to the Total column, as total numbers from 2018 were counting hazards that weren't given a risk level at all.

The biggest change is how counties addressed Hazard Materials Releases, with 4 more counties ranking it as a Low-Risk hazard, 14 ranking it as Medium Risk, and 26 ranking it as High Risk. A risk rating analysis of the hazard was included in 39 more plans compared to 2018. Additional hazards that saw large increases in the number of plans that calculated their risk level are Invasive Species, Pandemic and Infectious Disease, Cyber-terrorism, and Substance Use Disorder. The majority of the changes for Invasive Species, Pandemic and Infectious Disease, Hazardous Material Releases, and Substance Use Disorder hazards were counties adding them to their list of high-risk hazards. Natural Hazards generally saw an increase in the risk ratings given to them as a majority saw increases in Medium and/or High ratings. More specifically, it appears that counties gave higher risk ratings to hazards associated with climate change like Drought, Extreme Temperatures, Flooding, and Severe Storms than they did in the previous analysis. Utility Interruption and Terrorism saw similar changes. Hazards that had less counties calculate risk ratings for them were Coastal Erosion, Conventional/Improvised Bombs, Dam Failure, Nuclear Incident, and Solar Weather. Avalanche and Blight saw no changes.

Table 4.1.4-1 Total Risk Ranking Differences by Hazard from 2018 SHMP to 2023 SHMP

HAZARD	LOW	MEDIUM	HIGH	TOTAL
NATURAL HAZARDS				
Coastal Erosion	1	-1	-1	-1
Drought	6	-11	10	0
Earthquake	3	1	0	0
Extreme Temperatures	-1	0	7	2
Flood, Flash Flood, Ice Jam	0	-1	6	0
Hailstorm	3	-2	4	4
Hurricane, Tropical Storm, Nor'easter	1	-1	10	7
Invasive Species	-1	-3	20	14
Landslide	0	-4	7	2
Lightning Strike	-3	3	2	1
Pandemic and Infectious Disease	-3	2	21	19

Table 4.1.4-1 Total Risk Ranking Differences by Hazard from 2018 SHMP to 2023 SHMP				
HAZARD	LOW	MEDIUM	HIGH	TOTAL
Radon Exposure	0	10	-1	7
Subsidence, Sinkhole	-3	9	-1	4
Tornado, Wind Storm	-2	-2	9	0
Wildfire	6	-3	2	1
Winter Storms	0	2	3	1
HUMAN CAUSED HAZARDS				
Avalanche	0	0	0	0
Blight	0	0	0	0
Building or Structure Collapse	-1	3	0	1
Civil Disturbance	8	-1	1	5
Conventional/ Improvised Bombs	1	0	0	-1
Cyber-terrorism	2	9	7	17
Dam Failure	2	-2	3	-1
Disorientation	3	2	-1	4
Drowning	1	0	1	2
Coal Mining	0	-2	2	0
Conventional Oil/ Gas Wells	2	3	-1	4
Unconventional Wells	0	3	0	3
Hazardous Materials Releases	4	14	26	39
Gas and Liquid Pipeline	0	0	2	2
Fuel Shortages	1	1	0	2
Levee Failure	2	1	0	1
Mass Food/Animal Feed Contamination	-1	1	0	2
Nuclear Incident	2	-1	-1	-4
Substance Use Disorder	0	4	22	26
Solar Weather	0	0	0	-1
Terrorism	1	4	6	8
Transportation Incidents	1	-2	7	2
Urban Fire and Explosion	3	3	2	6
Utility Interruption	2	-5	13	7
War and Criminal Activity	0	1	2	1

In the past, universities in the Pennsylvania State System of Higher Education (PASSHE) have also completed hazard mitigation plans with assistance from a Pre-Disaster Mitigation (PDM) grant. A summary of the hazards included in risk assessments for the fourteen available university HMPs is provided in Table 4.1.4-2. There are seventeen total hazards evaluated in the university HMPs; fourteen of which are considered by every institution to have potential impact. There have been no tracked updates to these plans since the 2018 SHMP. Note that all hazards identified in county and university HMPs throughout Pennsylvania are included in the risk assessment for the SHMP.

Table 4.1.4-2 Summary of Hazards Profiled in University HMPs Throughout Pennsylvania.

HAZARD	UNIVERSITY														RANK *
	BLOOMSBURG UNIVERSITY	CALIFORNIA UNIVERSITY OF	CHEYNEY UNIVERSITY	CLARION UNIVERSITY	EAST STROUDSBURG UNIVERSITY	EDINBORO UNIVERSITY	INDIANA UNIVERSITY OF	KUTZTOWN UNIVERSITY	LOCK HAVEN UNIVERSITY	MANSFIELD UNIVERSITY	MILLERSVILLE UNIVERSITY	SHIPPENSBURG UNIVERSITY	SLIPPERY ROCK UNIVERSITY	WEST CHESTER UNIVERSITY	
Earthquake	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Environmental Hazards	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Extreme Temperature	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Flood, Flash Flood, Ice Jam	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Hailstorm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Landslides	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Lightning Strike	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Nuclear Incident	✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	✓	15
Pandemic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Subsidence, Sinkhole	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Terrorism	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Tornado, Wind Storm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Transportation Accident	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Urban Fire and Explosion											✓				17
Utility Interruption	✓			✓	✓	✓		✓			✓	✓		✓	16
Wildfire	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1
Winter Storm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	1

* Each hazard is ranked by the total number of university HMPs which identify the individual hazard. There are fourteen hazards which every university HMP identifies. This results in fourteen counties being ranked as "1," causing the numbering scheme for *Rank* to skip from "1" to "15."

4.1.5. Risk Ranking Methodology and Risk Factor Analysis

At the conclusion of the risk assessment, all 33 hazards were ranked in terms of their overall impact on Pennsylvania. Ranking hazards helps the Commonwealth set goals and mitigation priorities. 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 be used to assist officials in ranking and prioritizing hazards that pose the most significant threat to Pennsylvania based on a variety of factors deemed important by the SPT and other stakeholders involved in the hazard mitigation planning process.

The RF system relies mainly on historical data, local knowledge, general consensus opinions from the SPT, surveys of state agencies and other planning process participants, and information collected through development of the hazard profiles and vulnerability assessments included in Section 4.3. The most important factors considered when updating the matrix were the knowledge generated from hazard profiles and the survey responses of state agencies, commissions, organizations, etc. Ratings that were given a particular focus were ones where survey results were noticeably different than the ratings from the 2018 plan. This showed the planning team that either the perception of the hazard has changed or that previous ratings needed improvement. 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.

The risk assessment categories and corresponding matrix shown in Table 4.1-10 are based on FEMA's Comprehensive Preparedness Guide (CPG) 101 (see pg. 3-11 of CPG-101). Similar matrices have been used in other states for hazard mitigation and emergency management planning. For example, the Arizona Emergency Management advocates using this approach, found online at: http://www.maricopa.gov/Emerg_Mgt/pdf/cpri%20guidance.pdf. Additionally, Pointe Coupee Parish, Louisiana, Lyon County, Kansas, Yucaipa County, California, Phelps County, Missouri, and the Commonwealth of Massachusetts use similar priority risk indices, which include the same *Probability* and *Impact* descriptions used since the Pennsylvania 2010 SHMP.

This approach compliments more quantitative analysis by capturing participants' qualitative analysis and providing a value to summarize and compare hazards. Pennsylvania recognizes limitations to this approach. There are numerous examples where risk levels may not be entirely compatible with all-hazard scenarios or events and particular indices may not reflect certain unique hazard classifications. There may also be differences in how hazards are scored in dense urban areas versus rural areas. Nonetheless, the method serves as a useful tool for providing systematic and consistent prioritization of qualitative hazard information. It is particularly helpful when evaluating hazards for which there have not been conclusive scientific studies of risk and probability.

RF values were obtained by assigning varying degrees of risk to five categories for each of the 33 hazards profiled in the 2023 SHMP. Those categories include: *probability*, *impact*, *spatial extent*, *warning time*, and *duration*. Probability ranges from unlikely to highly likely, which gives an indication of how frequently a given hazard event will occur. They may not be catastrophic in scope; for example, floods of some magnitude occur each year in the Commonwealth. Similarly,

winter storms, utility interruptions, wildfires, and transportation accidents are expected each year. Impact looks at the systemic loss of life, property, and economic well-being induced in a significant hazard event. The planning team created an assumed scenario that is a step down from the absolute worst-case scenario when deciding upon an Impact rating. It is important to note that this is one category that looks at a significant hazard event and not necessarily an average or typical event. An effort was made to consider a range of perspectives when considering impact, such as the difference Extreme Temperature events make to vulnerable populations such as the elderly or unhoused. Spatial extent indicates the geographic area a given hazard event will cover and whether a hazard event is expected to be statewide, regional, or extremely localized. Warning time evaluates how far in advance a community will know of an impending hazard event, taking into account hazard-specific warning systems. Finally, duration indicates the length of time the hazard event will last, be it a multi-day winter storm event or a two-hour tornado.

Each degree of risk was assigned a value ranging from 1 to 4. The weighting factor derived from a review of best practice plans and agreed upon by the SPT is shown in the blue box below. During the Draft Plan Meeting, stakeholders discussed revising the weighting to more heavily value human life (currently accounted for in the Impact category). Currently there are a variety of estimates available, and calculations may change as new data is available. For example, the EPA's Mortality Risk Evaluation places a value of $11 million on a "statistical life", (EPA, n.d.). 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 example equation:

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

Table 4.1.7-2 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. In addition to the five categories that contributed to RF, climate change is a category that was added in this iteration of the plan. Since numerical values were not assigned, it does not contribute to RF. Nonetheless, it is important to consider how anticipated climate changes may impact these hazards in the future. The three ratings range from an increase of probability or impact for the hazard, either insufficient evidence or indirect impacts, and no expected impact. For example, we are anticipating changes to atmospheric conditions that will result in increases in precipitation and severe precipitation events, so flooding is expected to increase. This anticipated change has a direct impact on flooding but has an indirect impact on levee and dam failure, lightning strikes, landslides, and more. If the planning team was not confident in finding a direct link between climate change and the hazard, it was given the "Potential Negative" rating. Analysis on climate change impacts are present in each hazard profile. The Climate Change column pertains to an overall increase in risk- be it from event frequency, impact, or otherwise. So for example, while the number of tropical storms is not projected to increase, the destructiveness from inland flooding and wind damage is anticipated to go up (NOAA, 2023), so the overall risk is shown as an increase.

Table 4.1.5-1 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 & 49.9% ANNUAL PROBABILITY	**2**	
	LIKELY	BETWEEN 50 & 90% ANNUAL PROBABILITY	**3**	
	HIGHLY LIKELY	GREATER THAN 90% ANNUAL PROBABILTY	**4**	
IMPACT *In terms of injuries, damage, death, and economic impact, 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**	

Table 4.1.5-1 Summary of Risk Factor Approach Used to Rank Hazard Risk.

RISK ASSESSMENT CATEGORY	DEGREE OF RISK			WEIGHT VALUE
	LEVEL	CRITERIA	INDEX	
CLIMATE CHANGE *How will climate change impact the other 5 ratings for the hazard?*	**NEGATIVE IMPACT**	EXPECTED TO INCREASE RISKS	↑	**N/A**
	POTENTIAL NEGATIVE	POTENTIAL TO INCREASE RISKS THROUGH INDIRECT MEANS	↔	
	LITTLE TO NO IMPACT	NO IMPACT OR SMALL RISK INCREASE THROUGH INDIRECT MEANS	↔	
	POSITIVE IMPACT	RISK EXPECTED TO DECREASE	↓	

The following figures showcase our understanding of how climate change and its impacts will affect risk for Pennsylvania moving forward. 4 summarizes the level of uncertainty that exists for different hazards. Figure 4.1.5-2 showcases an example of how DEP is considering the current risk rating for different climate change hazards and compares that rating to what is expected in 2050. Figure 4.1.5-3 presents information for the same hazards, but presents a separate risk rating for different aspects of life in Pennsylvania. Figure 4.1.5-2 and Figure 4.1.5-3 were presented as part of the multi-agency Grid Resiliency public meeting (8/31/22).

Figure 4.1.5-1 Understanding of Climate Risks for Certain Hazards (Wuebbles, et al., 2014).

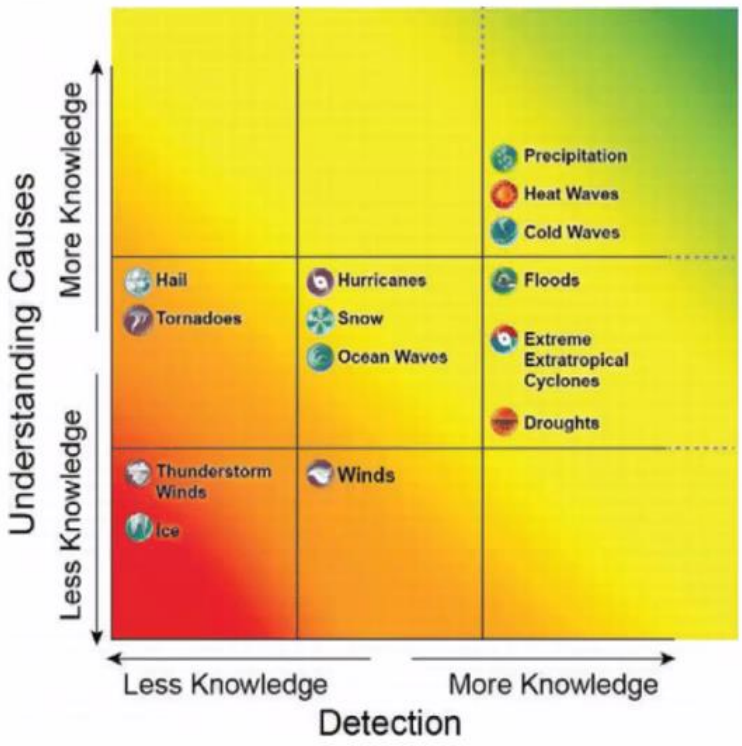


Figure 4.1.5-2 Risk Ratings for Climate Change Related Hazards in Pennsylvania

Climate Hazard	Current Risk Rating	2050 Risk Rating
Increasing average temperatures	Medium (5.3)	High (10.7)
Heavy precipitation and inland flooding	High (9.9)	High (9.9)
Heat waves	Medium (4.7)	High (9.3)
Landslides	Medium (5.6)	Medium (5.6)
Sea level rise	Low (1.9)	Medium (5.6)
Severe tropical and extra-tropical cyclones	Medium (5.3)	Medium (5.3)

Figure 4.1.5-3 Climate Change Related Hazards and Their Impacts on Aspects of Life in Pennsylvania

Consequence Category → / Hazard ↓	Human health	Environmental justice and equity	Agriculture	Recreation and tourism	Energy and other economic activity	Forests, ecosystems, and wildlife	Built infrastructure	Overall Risk Rating
Increasing average temperatures	12	12	8	12	8	16	4	10.7
Heavy precipitation and inland flooding	12	8	12	8	8	8	12	9.9
Heat waves	16	12	8	4	8	4	8	9.3
Landslides	3	6	3	3	6	3	12	5.6
Sea level rise	3	3	3	3	6	6	12	5.6
Severe tropical and extra-tropical cyclones	6	4	6	4	4	4	8	5.3

The economic impacts of climate change may go beyond just property damage, as shown in Figure 4.1.5-4 below. Local governments that face a higher risk of hazard events, especially extreme events that may become more extreme and frequent due to climate change, will face more scrutiny by credit rating agencies.

Figure 4.1.5-4 Climate Change Credit Risks

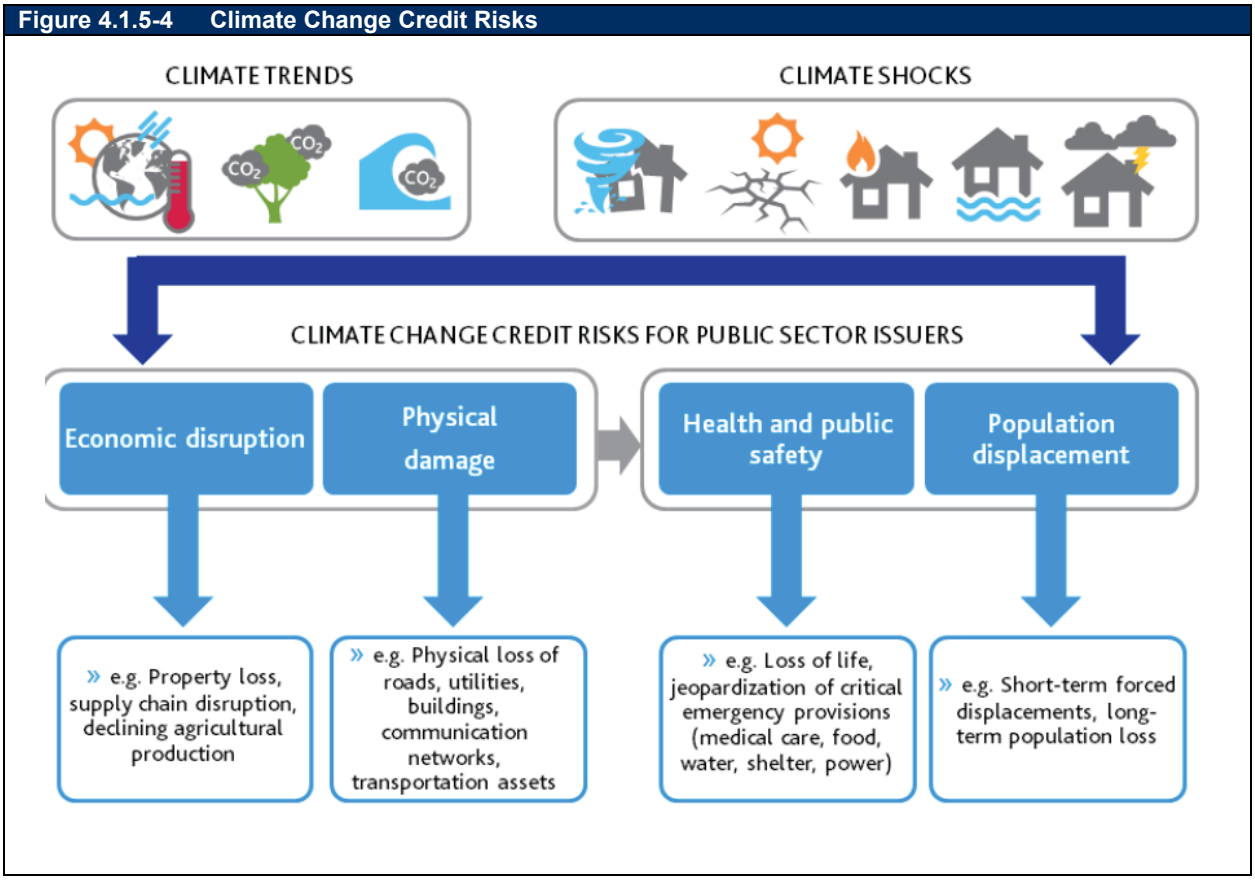


Table 4.1.5-2 lists the Risk Factor calculated for each of the 33 potential hazards from high to low identified in the 2023 SHMP.

Table 4.1.5-2 Ranking Results by Hazard for Pennsylvania Using the Risk Factor Methodology

	RISK ASSESSMENT CATEGORY						
HAZARD NATURAL(N) OR MAN-MADE(M)	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RISK FACTOR (RF)	CLIMATE CHANGE
Flood, Flash Flood, Ice Jam (N)	4	3	4	4	3	3.6	↑
Substance Use Disorder (M)	4	3	3	4	1	3.2	↑

Table 4.1.5-2 Ranking Results by Hazard for Pennsylvania Using the Risk Factor Methodology

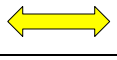
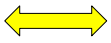
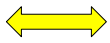
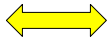
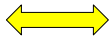
RISK ASSESSMENT CATEGORY							
HAZARD NATURAL(N) OR MAN-MADE(M)	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RISK FACTOR (RF)	CLIMATE CHANGE
Cyber-terrorism (M)	3	3	3	4	2	3	
Winter Storm (N)	4	2	4	1	3	3	
Transportation Incident (M)	4	3	2	4	1	3	
EH - Hazardous Materials Release (M)	4	2	2	4	2	2.8	
Extreme Temperature (N)	4	2	3	1	3	2.8	
Hurricane, Tropical Storm, Nor'easter (N)	3	3	3	1	3	2.8	
Pandemic (N)	2	3	4	1	4	2.8	
Urban Fire and Explosion (M)*	4	3	1	4	1	2.8	
Utility Interruption (M)	4	2	2	4	2	2.8	
Tornado, Wind Storm (N)	3	3	1	4	3	2.7	
Wildfire (N)	4	2	2	3	2	2.7	
Building and Structure Collapse (M)	3	3	1	3	4	2.7	
Invasive Species (N)	3	2	3	1	4	2.6	
Landslide (N)	4	2	1	4	2	2.6	
Mass Food/Animal Feed Contamination (M)	2	3	2	3	2	2.4	
Dam Failure (M)	1	3	2	4	4	2.4	
Nuclear Incident (M)	1	3	2	4	4	2.4	
Civil Disturbance (M)	3	2	1	4	2	2.3	
Drought (N)	2	2	3	1	4	2.3	

Table 4.1.5-2 Ranking Results by Hazard for Pennsylvania Using the Risk Factor Methodology

RISK ASSESSMENT CATEGORY							
HAZARD NATURAL(N) OR MAN-MADE(M)	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RISK FACTOR (RF)	CLIMATE CHANGE
Terrorism (M)	2	3	1	4	2	2.3	⟷
EH - Coal Mining (M)	2	2	2	4	3	2.3	⟷
EH - Gas and Liquid Pipelines (M)	2	2	2	4	3	2.3	⟷
EH - Unconventional Oil and Gas Wells (M)	2	2	2	4	3	2.3	⟷
EH -Conventional Oil and Gas Wells (M)	2	2	2	4	3	2.3	⟷
Coastal Erosion (N)	4	1	1	1	4	2.2	↑
Lightning Strike (N)	4	1	1	4	1	2.2	⟷
Radon Exposure (N)	3	1	2	1	4	2.1	⟷
Subsidence, Sinkhole (N)	3	2	1	2	2	2.1	⟷
Levee Failure (M)	1	3	1	3	3	2	⟷
Earthquake (N)	2	2	1	4	1	1.9	⟷
Hailstorm (N)	3	1	1	4	1	1.9	⟷

Red numbers mean that rating has increased from 2018 plan, Green shows a decrease
*with over 188 fire fatalities reported by Red Cross last year, impact was increased to a 3

The top eleven hazards were highlighted red. The next twenty, which included all the ones with ratings 2.0 or above, were highlighted orange. Lastly, the two hazards with the lowest RFs were highlighted yellow. The three hazards that saw the largest increase were Substance Use Disorder, Urban Fire and Explosion, Pandemic, and Building and Structure Collapse. Their RFs increased by 1.0, 0.9, 0.8, and 0.8 respectively. These increases, like many of the other increases, were driven by changes to their Probability and Impact ratings as these ratings have the largest weights in the formula. Other hazards that saw noticeable increases were Transportation Incidents, Extreme Temperature, Landslide, Mass Food/Animal Feed Contamination, Subsidence/Sinkhole, and Levee Failure. The main reason for many Impact increases was adding the assumed scenarios to the process, which gave the planning team a specific event to evaluate. As previously stated, surveys from participants allowed the planning

team to identify old ratings that did not match with current perceptions and created a foundation for investigating any needed changes.

4.1.6. THIRA and SHMP Relationship

For the purposes of this SHMP, risk is defined as the potential for damage, injury, or death as a result of natural or human-made hazard events. The risk assessment included in this section seeks to determine which hazards are most significant in Pennsylvania, identify regions or jurisdictions most at risk, and provide guidance for development of mitigation actions. The structure of the information presented in the risk assessment is similar to that of the 2010, 2013, and 2018 SHMPs. This structure helps to: 1) clearly and effectively communicate how and to what extent the Commonwealth is exposed to each hazard; 2) improve consistency of the plan with the Disaster Mitigation Act of 2000 (DMA) and requirements of 44 CFR Part 201; and 3) follow the PA Standard Operating Guide and ease the risk roll-up from local plans to the SHMP. Data sources have been updated to include the best available information (see Section 2.5).

The SHMP Risk Assessment complements Pennsylvania's Threat and Hazard Identification and Risk Assessment (THIRA) completed by PEMA to meet the requirements of CPG 201. The THIRA, along with the Stakeholder Preparedness Review (SPR), is a complementary planning process that focuses on identifying key gaps and accomplishments in core capabilities. Table 4.1.6-1 compares the focus, assessment, and funding aspects of the THIRA and the SHMP.

Table 4.1.6-1 Comparison Between SHMP and THIRA

SHMP AND HIRA	THIRA AND SPR
Focus on mitigation	Focus on identifying capability and resource gaps
Detailed hazard profiles including geographic extent, range of magnitude, past occurrence, probability and future occurrence, environmental impacts, and loss estimation	Adds in a threat component and chooses natural, technological, and adversarial hazards that will stress the "overall system" the most.
The grant program primarily focuses on natural hazards and actions that can be taken to reduce/eliminate the impact of the hazard	The grant program focuses on identifying gaps and taking action to reduce the gaps in order to build, maintain, and sustain a capability

As discussed in Section 5.5, State-Level Program and Plan Integration, the THIRA is an important planning mechanism for SHMP integration. The THIRA process was used to develop and/or revise worst-case scenarios for some hazards profiled in the SHMP. The SHMP and THIRA planning processes include the same agencies and stakeholders, enabling goals, objectives, strengths, gaps, and general awareness to be shared between the two allowing for a more streamlined and integrated approach for the Commonwealth.

Additionally, all hazards profiled in the SHMP are covered in the THIRA, see Figure 5.5-1. Cyber-Terrorism for example was introduced and incorporated into the SHMP because it had been previously evaluated as part of the THIRA and was ranked as being particularly difficult to respond to. The decision to include this hazard in the SHMP has allowed for more focus on prevention and mitigation.

The first step in the THIRA process is identifying threats and hazards of concern for the Commonwealth by considering which are reasonably likely to have an impact and if that impact

will challenge at least one of the 32 core capabilities The next step is giving the threats and hazards context through details such as location, magnitude, and time of an incident. The use of standardized impact language that is used commonly in emergency management metrics relevant to each hazard or threat situation, a new addition in the latest guidance from the 3rd Edition of the National Preparedness Goal and Comprehensive Preparedness Guide 201: Threat and Hazard Identification and Risk Assessment Guide (CPG 201). The engagement of relevant stakeholders and subject matter experts is crucial at this step, similar to how survey responses from SHMP stakeholders were used to inform updates to the Risk Factor Ratings given to each hazard in Section 4.1.5 above. The final step is developing capability targets that are focused on addressing the most challenging impacts of hazards, which were identified in the previous step and are meant to address the largest capability gaps.

The overall goal of the THIRA process is to evaluate the Commonwealth's capabilities for addressing all-hazards events across the 5 Mission Areas: Prevention, Protection, Mitigation, Response, and Recovery. Mitigation relevant capabilities and gaps identified through this process were incorporated into the SHMP as needed. The SPR process is an annual one that involves a similar three-step self-assessment of capabilities based on the targets identified in the THIRA.

The THIRA process previously included a hazard risk ranking similar to what has been done in Section 4.1.5 above, but new guidance has removed this requirement from the THIRA process. The THIRA emphasized extent, probability, likelihood, and impact which informed the development of the Pennsylvania RF methodology used in the SHMP as described in more detail in Section 4.1.5. The vulnerability of the Commonwealth to each threat and hazard in the THIRA was ranked using the following scale:

1) A potential incident would have a very small geographic footprint. People are easily protected by evacuation, sheltering in place or through other simple protective measures.
2) People are not so easily protected by evacuation or sheltering in place, but protective measures generally remain simple.
3) A potential incident would have a moderate geographical footprint. Buildings may be vulnerable to some damage and therefore may not offer protection to people in more prone areas of the building. Critical infrastructure, resources, industry, and systems may be vulnerable to some damage, interruption, and/or failure. Protective measures may be extensive.
4) Buildings may be vulnerable to moderate damage or more and therefore will only provide protection to people in designated safe areas. Advanced preparation for effective protective measures will be required. Critical infrastructure, resources, industry, and systems may be vulnerable to moderate damage, interruption, and/or failure.
5) A potential incident would have a large geographical footprint. During this incident, people, structures, critical infrastructure, resources, industry, and systems in the affected area are completely vulnerable and will likely be destroyed or severely damaged.

While this process is no longer a THIRA requirement, it still impacts the SHMP through its influence on the Risk Factor approach outlined in Section 4.1.5.

4.2. Hazard Identification

4.2.1. Table of Presidential and Other Disaster Declarations

Pennsylvania's disaster history helps provide direction on the identification of hazards and their significance. For purposes of providing government disaster assistance, a disaster can be declared at the federal level by a Presidential Disaster or Emergency Declaration or by the Small Business Administration, or at the state level through a Gubernatorial Disaster Declaration or Proclamation. Records of all disaster declarations in the Commonwealth since 1955 are available from FEMA, PEMA, and the Small Business Administration (SBA). Historically, flood events significantly outnumber other hazards in terms of disaster declarations. Hurricanes, tropical storms, winter storms, and urban fires and explosions have also generated a significant number of disaster declarations.

FEMA's declaration regulations outline the factors that the agency considers when evaluating a Governor's request for a Presidential Disaster or Emergency Declaration. The President can issue a Presidential Disaster Declaration for any natural event that "has caused damage of such severity that it is beyond the combined capabilities of state and local governments to respond" (FEMA, 2023a). The President can issue an Emergency Declaration for any occasion when the President determines that federal assistance is needed. The scope and amount of assistance for Emergency Declarations is generally smaller, since Emergency Declarations are intended to supplement State and local government efforts.

In evaluating whether to recommend the provision of Public Assistance under a Presidential Disaster Declaration, FEMA compares the estimated per capita cost of public assistance (both Federal and non-Federal) to an indicator amount that is adjusted each year for inflation. In 2023, the county-level per capita impact indicator was $4.44, and the state-level indicator was $1.77.

Table 4.2.1-1 displays the Presidential Disaster and Emergency Declarations that have affected Pennsylvania since 1955, with the most recent events listed first. DR-4618 was declared for damage due to Hurricane Ida.

Table 4.2.1-1 Presidential Disaster and Emergency Declarations Affecting Pennsylvania.

DATE	EVENT	AFFECTED AREAS
September, 2021	Hurricane	Bedford, Bucks, Chester, Dauphin, Delaware, Fulton, Huntingdon, Luzerne, Montgomery, Northampton, Philadelphia, Schuylkill, York
March, 2020	COVID-19 (DR)	Statewide
March, 2020	COVID-19 (EM)	Statewide
November, 2018	Flood	Bradford, Columbia, Lackawanna, Lycoming, Montour, Northampton, Schuylkill, Sullivan, Susquehanna, Tioga, Wyoming
December, 2016	Flood	Bradford, Centre, Lycoming, Sullivan
March, 2016	Snow	Adams, Bedford, Berks, Blair, Bucks, Chester, Cumberland, Dauphin, Fayette, Franklin, Fulton, Juniata, Lancaster, Lebanon, Lehigh, Montgomery, Northampton, Perry, Philadelphia, Schuylkill, Somerset, Westmoreland, York
February, 2014	Severe Ice Storm	Bucks, Chester, Delaware, Lancaster, Montgomery, Philadelphia, York

Table 4.2.1-1 Presidential Disaster and Emergency Declarations Affecting Pennsylvania.		
DATE	EVENT	AFFECTED AREAS
October, 2013	Severe Storm(s)	Allegheny, Centre, Clearfield, Clinton, Crawford, Fayette, Huntingdon, Jefferson, Lawrence, Venango, Wayne
January, 2013	Hurricane	Bedford, Bucks, Cameron, Dauphin, Forest, Franklin, Fulton, Huntingdon, Juniata, Monroe, Montgomery, Northampton, Philadelphia, Pike, Potter, Somerset, Sullivan, Wyoming
October, 2012	Hurricane	Statewide
September, 2011	Flood	Adams, Bedford, Berks, Bradford, Bucks, Chester, Columbia, Cumberland, Dauphin, Delaware, Huntingdon, Juniata, Lackawanna, Lancaster, Lebanon, Luzerne, Lycoming, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne, Wyoming, York
September, 2011	Flood	Blair, Cambria, Carbon, Centre, Clinton, Franklin, Fulton, Lehigh, Somerset, Wayne
September, 2011	Hurricane	Bucks, Chester, Delaware, Lehigh, Luzerne, Monroe, Montgomery, Northampton, Philadelphia, Pike, Sullivan, Susquehanna, Wayne, Wyoming
August, 2011	Hurricane	Bucks, Chester, Delaware, Lehigh, Luzerne, Monroe, Montgomery, Northampton, Philadelphia, Pike, Sullivan, Wayne, Wyoming
July, 2011	Severe Storm(s)	Bradford, Lycoming, Sullivan, Tioga, Wyoming
April, 2010	Snow	Adams, Allegheny, Armstrong, Beaver, Bedford, Blair, Butler, Cambria, Chester, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Lancaster, Lebanon, Montgomery, Perry, Philadelphia, Somerset, Westmoreland, York
February, 2007	Severe Storm(s)	Bradford, Lackawanna, Luzerne, Schuylkill, Sullivan, Susquehanna, Wayne, Wyoming
June, 2006	Severe Storm(s)	Adams, Armstrong, Berks, Bradford, Bucks, Carbon, Chester, Columbia, Dauphin, Franklin, Indiana, Lackawanna, Lancaster, Lebanon, Luzerne, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Pike, Schuylkill, Sullivan, Susquehanna, Tioga, Wayne, Wyoming
September, 2005	Hurricane	Statewide
April, 2005	Severe Storm(s)	Bradford, Bucks, Columbia, Lackawanna, Luzerne, Monroe, Northampton, Pike, Susquehanna, Wayne, Wyoming
September, 2004	Severe Storm(s)	Statewide
September, 2004	Hurricane	Statewide
August, 2004	Severe Storm(s)	Berks, Bradford, Delaware, Montgomery, Philadelphia, Sullivan, Susquehanna
September, 2003	Severe Storm(s)	Chester
August, 2003	Severe Storm(s)	Blair, Clarion, Crawford, Forest, Lackawanna, Lawrence, McKean, Mercer, Potter, Statewide, Tioga, Venango, Warren, Wayne, Wyoming
March, 2003	Severe Storm(s)	Adams, Bedford, Berks, Blair, Cambria, Carbon, Chester, Clinton, Columbia, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene,

Table 4.2.1-1 Presidential Disaster and Emergency Declarations Affecting Pennsylvania.		
DATE	EVENT	AFFECTED AREAS
		Huntingdon, Juniata, Lancaster, Lebanon, Lehigh, Lycoming, Mifflin, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Schuylkill, Snyder, Somerset, Union, Washington, Westmoreland, York
June, 2001	Severe Storm(s)	Berks, Bucks, Montgomery
September, 1999	Flood	Dauphin, Lycoming, Northumberland, Snyder, Union
September, 1999	Hurricane	Berks, Bucks, Chester, Delaware, Lancaster, Montgomery, Philadelphia, York
September, 1999	Severe Storm(s)	Juniata, McKean
June, 1998	Severe Storm(s)	Allegheny, Beaver, Berks, Pike, Somerset, Susquehanna, Wyoming
December, 1996	Flood	Tioga
September, 1996	Flood	Cumberland, Huntingdon, Juniata, Mifflin, Montgomery, Perry
July, 1996	Flood	Armstrong, Blair, Cambria, Clarion, Clearfield, Crawford, Greene, Indiana, Jefferson, Venango
June, 1996	Flood	Adams, Beaver, Bedford, Bucks, Franklin
January, 1996	Flood	Statewide
January, 1996	Snow	Adams, Allegheny, Armstrong, Bedford, Berks, Blair, Bradford, Bucks, Cambria, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Lycoming, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Pike, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Union, Washington, Wayne, Westmoreland, Wyoming, York
March, 1994	Severe Storm(s)	Adams, Allegheny, Armstrong, Beaver, Bedford, Berks, Bucks, Cambria, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Delaware, Fayette, Franklin, Greene, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Lycoming, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Union, Washington, Westmoreland, Wyoming, York
March, 1993	Snow	Statewide
June, 1986	Flood	Allegheny
November, 1985	Flood	Allegheny, Fayette, Greene, Somerset, Washington, Westmoreland
October, 1985	Hurricane	Carbon, Lackawanna, Luzerne, Susquehanna, Wayne, Wyoming
June, 1985	Tornado	Beaver, Clearfield, Crawford, Erie, Forest, Lycoming, McKean, Mercer, Northumberland, Union, Venango
August, 1984	Flood	Allegheny, Armstrong, Bedford, Blair, McKean, Somerset, Westmoreland
June, 1981	Flood	Clarion, Crawford, Jefferson, Mercer, Venango
August, 1980	Flood	Armstrong, Butler, Clarion
June, 1980	Tornado	Allegheny, Armstrong, Indiana, Westmoreland
July, 1977	Flood	Bedford, Blair, Cambria, Clearfield, Indiana, Jefferson, Somerset, Westmoreland

Table 4.2.1-1 Presidential Disaster and Emergency Declarations Affecting Pennsylvania.		
DATE	EVENT	AFFECTED AREAS
January, 1977	Snow	Beaver, Cambria, Carbon, Clarion, Clearfield, Crawford, Erie, Fayette, Indiana, Jefferson, Lawrence, Luzerne, Mercer, Potter, Schuylkill, Somerset, Tioga, Venango, Washington, Wayne, Westmoreland
October, 1976	Flood	Adams, Bradford, Columbia, Cumberland, Dauphin, Franklin, Juniata, Lackawanna, Lancaster, Lebanon, Luzerne, Mifflin, Northumberland, Perry, Schuylkill, Snyder, Sullivan, Susquehanna, Wayne, Wyoming, York
July, 1976	Flood	Lackawanna, Tioga
September, 1975	Flood	Adams, Berks, Bradford, Centre, Clinton, Columbia, Cumberland, Dauphin, Franklin, Fulton, Juniata, Lackawanna, Lancaster, Lebanon, Luzerne, Lycoming, Mifflin, Montour, Northumberland, Perry, Potter, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne, Wyoming, York
July, 1973	Flood	Berks, Bucks, Chester, Columbia, Delaware, Lancaster, Monroe, Montgomery, Northampton, Wayne
September, 1972	Flood	Indiana
June, 1972	Flood	Statewide
September, 1971	Flood	Bucks, Chester, Delaware, Fayette, Montgomery, Philadelphia, Westmoreland
August, 1969	Flood	Carbon, Monroe, Pike, Schuylkill
August, 1965	Drought	Berks, Bucks, Carbon, Chester, Delaware, Lehigh, Monroe, Montgomery, Northampton, Philadelphia, Pike, Schuylkill, Wayne
January, 1959	Flood	Statewide
August, 1956	Severe Storm(s)	Statewide
May, 1956	Severe Storm(s)	Statewide
March, 1956	Flood	Statewide
August, 1955	Flood	Statewide

In addition to these Presidentially-declared disasters, 67 disaster events warranted Gubernatorial Disaster Declarations (Table 4.2.1-2).

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations		
DATE	EVENT	AFFECTED AREAS
January, 2022	Proclamation of Disaster Emergency—Forbes Avenue Bridge Collapse	Allegheny County – transfer of $1,000,000 in appropriated funds to PEMA and an additional $2,000,000
August, 2021	Proclamation of Disaster Emergency—Hurricane Ida	All 67 counties – transfer of $2,000,000 in appropriated funds to PEMA and an additional $5,000,000
April, 2021	Proclamation of Disaster Emergency—Civil Disturbance	All 67 counties – transfer of $5,000,000 in appropriated funds to PEMA and an additional $15,000,000
February, 2021	Proclamation of Disaster Emergency—Pandemic	All 67 counties – extension of March 2020 proclamation, also extended in May 2021
February, 2021	Proclamation of Disaster Emergency--Opioid Crisis	All 67 counties – 90-day renewal of declaration, done again in May and August 2021

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations		
DATE	EVENT	AFFECTED AREAS
February, 2021	Proclamation of Disaster Emergency—Winter Weather	All 67 counties – transfer of $2,000,000 in appropriated funds to PEMA and an additional $5,000,000
December, 2020	Proclamation of Disaster Emergency—Winter Weather	Adams, Allegheny, Armstrong, Bedford, Berks, Blair, Bradford, Bucks, Butler, Cambria, Cameron, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Delaware, Elk, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Lycoming, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Washington, Wayne, Westmoreland, Wyoming, York – transfer of $2,000,000 in appropriated funds to PEMA and an additional $5,000,000
October, 2020	Proclamation of Disaster Emergency—Civil Disturbance	Philadelphia County – transfer of $2,000,000 in appropriated funds to PEMA and an additional $5,000,000
May, 2020	Proclamation of Disaster Emergency—Civil Disturbance	Allegheny, Dauphin, and Philadelphia Counties – transfer of $2,000,000 in appropriated funds to PEMA and additional $4,000,000
March, 2020	Proclamation of Disaster Emergency—Pandemic	All 67 counties, extended in June, August, and November 2020
February, 2020	Proclamation of Disaster Emergency--Opioid Crisis	All 67 counties – 90-day renewal of declaration, done again in May, August, and November 2020
September, 2019	Proclamation of Disaster Emergency--Opioid Crisis	All 67 counties – 90-day renewal of declaration
August, 2018	Proclamation of Disaster Emergency—Rapid, Heavy Rainfall Resulting in Flash Floods	All 67 counties
March, 2018	Proclamation of Emergency-- Opioid Crisis, Severe Winter Storms	Berks, Bradford, Bucks, Carbon, Chester, Columbia, Dauphin, Delaware, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Monroe Montgomery, Montour, Northampton, Northumberland, Philadelphia, Pike, Schuylkill, Sullivan, Susquehanna, Wayne, Wyoming, and York because of the continuing severe winter weather pattern. Transfer of $5,000,000 in unused appropriated funds to PEMA and additional $1,000,000
January, 2018	Proclamation of Disaster Emergency--Opioid Crisis	All 67 counties – 4th 90-day renewal of declaration December 21, 2018
March, 2017	Proclamation of Emergency-- Severe Winter Storm	All 67 counties--resources determined by Department of Transportation
March, 2017	Proclamation of Emergency-- Severe Winter Storm	All 67 counties
November, 2016	Proclamation of Disaster--Flash Flooding	Bradford, Centre, Lycoming, and Sullivan Counties--transfer of $500,000 in funds to PEMA

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations		
DATE	EVENT	AFFECTED AREAS
January, 2016	Proclamation of Emergency--Severe Winter Storm	All 67 counties--$500,000 in funds transferred to PEMA
August, 2015	Proclamation of Emergency-- Severe Storms	All 67 counties
January, 2015	Proclamation of Emergency-- Severe Winter Storms	All 67 counties--$250,00 in funds transferred to PEMA
September, 2014	Proclamation of Emergency -- Terrorism, Civil Disturbance	Pike County-$500,000 provided to PEMA, amount may be increased or decreased as conditions require
February, 2014	Proclamation of Disaster--Severe Winter Storm	All 67 counties
February, 2014	Proclamation of Disaster--Severe Winter Storm	All 67 counties--transfer of $500,000 in funds to PEMA
February, 2014	Proclamation of Disaster Emergency--Severe Winter Storm	All 67 counties--transfer of $500,000 in funds to PEMA
January, 2014	Proclamation of Disaster Emergency--Extreme Weather, Utility Interruption	All 67 counties
June, 2013	Proclamation of Emergency – High Winds, Thunderstorms, Heavy Rain, Tornado, Flooding	All 67 counties - to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation; to provide $200,000 in funds to PEMA for disaster-related expenses
May, 2013	Proclamation of Emergency – Dauphin Bridge Fire	Dauphin, Cumberland, Perry, York, and Lebanon Counties - to utilize all available resources and personnel as is deemed necessary to cope with the situation; to provide $2,000,000 in funds to PEMA and other state agencies for disaster-related expenses
October, 2012	Proclamation of Emergency – Hurricane Sandy	All 67 counties - to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation; to provide $5 million in funds to PEMA for disaster-related expenses
April, 2012	Proclamation of Emergency – Spring Winter Storms	All 67 counties - to utilize all available resources and personnel as is deemed necessary to cope with the magnitude of this emergency situation
August, 2011 (amended September 2011)	Proclamation of Emergency - Severe Storms and Flooding (Lee/Irene)	All 67 counties - to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation; to provide $15 million in funds to PEMA for disaster-related expenses
January, 2011	Proclamation of Emergency - Severe Winter Storm	All 67 counties - to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations		
DATE	EVENT	AFFECTED AREAS
February, 2010	Proclamation of Emergency - Severe Winter Storm	All 67 counties - to utilize all available resources and personnel as is deemed necessary to supplement county and municipal efforts
April, 2007	Severe Storm	All 67 counties - to utilize all available resources and personnel as is deemed necessary to supplement county and municipal efforts
February, 2007	Proclamation of Emergency - Severe Winter Storm	All 67 counties - to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
February, 2007	Proclamation of Emergency - Regulations	All 67 counties - waive the regulations regarding hours of service limitations for drivers of commercial vehicles
April, 2007	Proclamation of Emergency - Severe Winter Storm	All 67 counties - to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
April, 2006	Proclamation of Emergency - Regulations	Southeast Region of the Commonwealth - for greater flexibility in truck driver regulations to accommodate truck drivers in the finding and transporting of fuel
September, 2006	Proclamation of Emergency - Tropical Depression Ernesto	All 67 counties - utilize all available resources and personnel as deemed necessary to cope with the magnitude and severity of the emergency situation
March, 2005	Heavy Rainfall/ Snowstorm/Embankment Failures	Beaver, Greene, Washington and Westmoreland Counties
September, 2005	Proclamation of Emergency - Hurricane Katrina	All 67 counties - regarding waiving enforcement of applicable state laws & regulations that govern transport of oversized loads
January, 2004	Sinkhole	Northampton County
December, 2003*	High Winds and Heavy Rains	Greene County
February, 2002	Drought & Water Shortage	Adams, Bedford, Berks, Bucks, Carbon, Chester, Cumberland, Dauphin, Delaware, Franklin, Fulton, Huntingdon, Lancaster, Lebanon, Lehigh, Montgomery, Monroe, Northampton, Perry, Philadelphia, Pike, Schuylkill, Wayne and York Counties
September, 2001	Terrorism	Somerset County
February, 2000*	Flooding	Allegheny, Fayette, Washington and Westmoreland Counties
August, 2000	Flooding	Bucks County
July, 1999	Drought	Adams, Allegheny, Beaver, Bedford, Berks, Blair, Bradford, Bucks, Cambria, Cameron, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Lackawanna, Lancaster, Lawrence, Lebanon, Lehigh, Luzerne, Lycoming, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Washington, Wayne, Westmoreland, Wyoming and York Counties
May, 1998	I-95 Highway Disaster	Delaware County

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations		
DATE	EVENT	AFFECTED AREAS
December, 1998	Drought	Bedford, Blair, Cambria, Cameron, Clarion, Clearfield, Clinton, Crawford, Elk, Erie, Jefferson, Lycoming, Snyder and Somerset Counties
March, 1997	Tire Fire	Washington County
April, 1997	Snowstorm	Carbon, Chester, Lackawanna, Luzerne, Monroe, Pike, Schuylkill and Wayne Counties
March, 1996	Highway Bridge (I-95) Destruction	Philadelphia County
September, 1995	Drought	Adams, Berks, Bradford, Bucks, Cameron, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Delaware, Lackawanna, Lehigh, Luzerne, Lycoming, Monroe, Montgomery, Montour, Northampton, Northumberland, Philadelphia, Pike, Potter, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne, and Wyoming Counties
August, 1994*	Flooding	Bradford, Lycoming and Tioga Counties
September, 1994	Airplane Crash	Allegheny and Beaver Counties
January, 1988	Oil Spill	Allegheny, Beaver and Washington Counties
November, 1980	Drought Emergency	Berks, Bucks, Carbon, Chester, Delaware, Lackawanna, Lebanon, Lehigh, Luzerne, Monroe, Montgomery, Northampton, Philadelphia, Pike, Schuylkill and Wayne Counties, plus 34 Central/ Eastern Counties
January, 1978	Heavy Snow	All 67 counties
February, 1978	Blizzard	All 67 counties
March, 1976	Heavy Rain/Ice	Erie County
May, 1976	Fire	Allegheny County (McKeesport)
July, 1976	Flood	Armstrong, Tioga and Wayne Counties
July, 1976	High Winds/ Flooding	Jefferson and Westmoreland Counties
February, 1974	Truckers Strike	Statewide
July, 1974	Flood	Western and Northern Central Counties
August, 1974	Flood	Jefferson and Westmoreland Counties
December, 1974	Heavy Snow/ Power Outage	Southwestern Counties
February, 1972	Heavy Snow	Statewide
December, 1972	Steam Heat Problem	Philadelphia County (Lower Merion)
March, 1971	Drought	Allegheny County
March, 1971	Land Subsidence	Beaver County
January, 1966	Heavy Snow	Statewide
March, 1964	Flood	Allegheny River, W. Branch Susquehanna River
March, 1963	Ice Jam	Susquehanna-Juniata Rivers
August, 1963	Violent Wind	Allegheny County
August, 1962	Refuse Bank Fire	Luzerne County (Plymouth)
February, 1958	Heavy Snow	Berks, Bucks, Chester, Dauphin, Delaware, Lancaster, Lebanon, Lehigh, Montgomery, Northampton and York Counties and the City of Philadelphia

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations		
DATE	EVENT	AFFECTED AREAS
September, 1955	Drought	Adams, Berks, Bradford, Bucks, Cameron, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Delaware, Lackawanna, Lehigh, Luzerne, Lycoming, Monroe, Montgomery, Montour, Northampton, Northumberland, Philadelphia, Pike, Potter, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne and Wyoming Counties
*Event also received Small Business Administration Loan Assistance		

Pennsylvania has also received Small Business Administration (SBA) Assistance for a number of disaster events. A Small Business Administration Disaster Declaration qualifies communities for access to affordable, timely, and accessible financial assistance. The 89 Pennsylvania events receiving Small Business Administration disaster-related loan assistance are listed in Table 4.2.1-3. It is important to note that SBA loans are also made available after Presidential Disasters, so SBA assistance has also been available for the events shown in Table 4.2.1-1.

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance		
DATE	EVENT	AFFECTED AREAS
August, 2022	Heavy Rain and Flash Flooding	Allegheny, Armstrong, Buter, Cambria, Fayette, Indiana, Somerset, Washington, Westmoreland
January, 2022	Apartment Fire	Allegheny, Armstrong, Beaver, Butler, Washington, Westmoreland
August, 2021	Severe Storm	Potter and Tioga Counties
August, 2021	Flash Flooding	Bradford, Lycoming, Potter, Tioga
July, 2021	Flash Flooding	Greene and Fayette Counties
July, 2021	Flash Flooding	Bucks, Bradford, Delaware, Lehigh, Lycoming, Montgomery, Northampton, Philadelphia, Potter, Tioga
August, 2020	Severe Storm	Berks, Bucks, Chester, Delaware, Lancaster, Lebanon, Lehigh, Montgomery, Schuylkill
July, 2020	Apartment Fire	Berks, Chester, Delaware, Lancaster, Montgomery
May, 2020	Apartment Fire	Bedford, Blair, Centre, Fulton, Franklin, Huntingdon, Juniata, Mifflin
October, 2019	Severe Storms and High Winds	Erie County
July, 2019	Flash Flooding	Allegheny, Armstrong, Beaver, Butler, Washington, Westmoreland
July, 2019	Flash Flooding	Armstrong, Butler, Clarion, Forest, Jefferson, Venango
July, 2019	Flash Flooding	Berks, Chester, Lancaster, Lebanon, Lehigh, Montgomery, Schuylkill
June, 2019	Severe Weather and Flooding	Bucks, Delaware, Philadelphia
June, 2019	Flash Flooding	Berks, Chester, Lancaster, Lebanon, Lehigh, Montgomery, Schuylkill
May, 2019	Tornadoes	Lawrence and Mercer Counties
December, 2018	Fire	Philadelphia County
November, 2018	Tornadoes	Adams and York Counties
September, 2018	Flooding	Westmorland County

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance		
DATE	EVENT	AFFECTED AREAS
September, 2018	Flooding	Lancaster and York Counties
August, 2018	Severe Storms and Flooding	Susquehanna and Wayne Counties
August, 2018	Flooding	Berks, Carbon, Chester, Dauphin, Juniata, Lackawanna, Lebanon, Lehigh, Luzerne, Lycoming, Montgomery, Montour, Perry, Philadelphia, Snyder, Sullivan, Tioga, Union, Wayne and Wyoming Counties
July, 2018	Flooding	Berks, Carbon, Columbia, Dauphin, Lebanon, Lehigh, Luzerne and Northumberland Counties
July, 2018	Flooding	Bedford, Cambria, Centre, Clearfield and Huntingdon Counties
June, 2018	Flooding	Armstrong, Beaver, Butler, Cambria, Fayette, Indiana, Somerset and Washington Counties
May, 2018	Flooding	Adams and Franklin Counties
June, 2017	Fire	Allegheny County
November, 2016	Flash Flooding	Centre and Lycoming Counties
September, 2016	Flash Flooding	Fayette, Greene, Somerset, Washington and Westmoreland Counties
July, 2016	Flash Flooding	Adams, Bedford, Berks, Blair, Bucks, Chester, Cumberland, Dauphin, Fayette, Franklin, Fulton, Juniata, Lancaster, Lebanon, Lehigh, Montgomery, Northampton, Perry, Philadelphia, Schuylkill, Somerset, Westmoreland and York Counties
June, 2014	Severe Storms and Flooding	Elk County
April, 2014	Severe Winter Storms	Berks, Bucks, Chester, Delaware, Lancaster, Lehigh Philadelphia and Montgomery Counties
September, 2013	Storms and Severe Weather	Armstrong County
August, 2013	Severe Storms and Flooding	Lawrence County
July, 2013	Severe Storms and Flooding	Allegheny County
July, 2013	Severe Storms and Flooding	Clearfield, Fayette and Jefferson Counties
October, 2012	Fire	Montgomery County (Cheltenham Township)
September, 2012	Fire	Centre County (Bellefonte Borough)
October, 2009	Fire	Columbia, Luzerne, Lycoming, Montour, Northumberland, Schuylkill and Sullivan Counties
August, 2009	Storms and Flooding	Berks, Bucks, Chester, Delaware, Lehigh, Montgomery and Philadelphia Counties
July, 2009	Fire	Adams, Cumberland, Dauphin, Lancaster and York Counties
June, 2009	Severe Storms and Flooding	Allegheny, Armstrong, Beaver, Butler, Cambria, Crawford, Erie, Fayette, Indiana, Somerset, Warren, Washington and Westmoreland Counties
March, 2009	Fire	Crawford, Erie and Warren Counties
January, 2009	Fire	Berks, Chester, Delaware, Lancaster and Montgomery Counties

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance		
DATE	EVENT	AFFECTED AREAS
September, 2008	Fire	Berks, Bucks, Chester, Delaware, Lehigh, Montgomery and Philadelphia Counties
August, 2008	Fire	Berks, Bucks, Chester, Delaware, Lehigh, Montgomery and Philadelphia Counties
July, 2008	Fire	Allegheny, Armstrong, Beaver, Butler, Washington and Westmoreland Counties
November, 2007	Fire	Berks, Bucks, Chester, Delaware, Lehigh, Montgomery and Philadelphia Counties
August, 2007	Severe Storms and Flooding	Allegheny, Armstrong, Beaver, Butler, Cambria, Fayette, Indiana, Somerset and Westmoreland Counties
August, 2007	Hail and High Winds	Bucks County
August, 2007	Hail	Carbon, Lehigh, Luzerne, Monroe, Northampton and Schuylkill Counties
July, 2007	Severe Storms and Flooding	Allegheny, Beaver, Butler, Lawrence and Washington Counties
July, 2007	Severe Storms and Flash Flooding	Wayne County
July, 2007	Drought	McKean, Potter and Warren Counties
May, 2007	Drought	Erie and Warren Counties
April, 2007	Drought and Extreme Heat	Beaver, Crawford, Erie, Lawrence and Mercer Counties
April, 2007	Severe Storms and Flooding	Pike County
April, 2007	Severe Storms and Flooding	Bucks and Philadelphia Counties
April, 2007	Severe Storms and Flooding	Delaware County
January, 2007	Fire	Bedford, Blair, Cambria, Fulton, Huntingdon, and Somerset Counties
December, 2006	Severe Storms and Tornadoes	Carbon, Columbia, Lackawanna, Luzerne, Monroe, Schuylkill, Sullivan and Wyoming Counties
November, 2006	Severe Storms and Flooding	Carbon, Columbia, Lackawanna, Luzerne, Monroe, Schuylkill, Sullivan and Wyoming Counties
August, 2006	Excessive Rain, Flooding and Flash Flooding	Erie, McKean, Potter and Warren Counties
June, 2004	Heavy Rain, High Winds and Flooding	Allegheny, Beaver, Butler, Lawrence, Mercer and Washington Counties
May, 2004	Heavy Rain, High Winds and Flooding	Adams, Cumberland, Dauphin, Lancaster and York Counties
April, 2003	Fire	Forest, Clarion, Elk, Jefferson, McKean, Venango and Warren Counties
March, 2003	Fire, Borough of Emporium	Cameron, Clearfield, Clinton, Elk, McKean and Potter Counties
August, 2002	Severe Storms - May 31	Armstrong, Beaver, Butler, Washington and Westmoreland Counties
July, 2002	Flash Flood	Washington County
October, 2001	Fire	Philadelphia County

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance		
DATE	EVENT	AFFECTED AREAS
August, 2001	Flooding	Lehigh, Berks, Bucks, Carbon, Montgomery, Northampton and Schuylkill Counties
May, 2001	Fire	Montgomery, Bucks, Berks, Chester, Delaware, Lehigh and Philadelphia Counties
March, 2001	Fire	Montgomery, Bucks, Berks, Chester, Delaware, Lehigh and Philadelphia Counties
August, 2000	Flooding	Allegheny, Armstrong, Beaver, Butler, Cambria, Fayette, Indiana, Somerset, Washington and Westmoreland Counties
December, 1999	Fire	Cumberland County
February, 1999	West Shore Farmer's Market Fire	Adams, Cumberland, Dauphin, Franklin, Perry and York Counties
January, 1998	Fire	Philadelphia County
July, 1997	Flooding	Allegheny County
January, 1997	Fire	Allegheny County
September, 1996	Flooding	Erie County
January, 1996	Fire	Bucks County
October, 1995	Fire	Monroe County
March, 1995	Fire	Montgomery County
December, 1994	Fire	Blair County
July, 1994	Flood	Philadelphia County
December, 1993	Fire	Cumberland County
August, 1993	Flash Flood	Bucks County
April, 1993	Flash Flood	Wyoming County
March, 1993	Fire	Philadelphia County
February, 1993	Fire	Bucks County
January, 1993	Fire	Allegheny County
August, 1992	Fire	Chester County
July, 1992	Fire	Philadelphia County
July, 1992	Flood	Warren County
June, 1992	Fire	Bucks County
March, 1992	Fire	Clearfield County
August, 1991	Flash Flood	Delaware County
July, 1991	Drought	Adams, Bedford, Blair, Bradford, Cambria, Cameron, Carbon, Centre, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lackawanna, Lancaster, Lebanon, Luzerne, Lycoming, Mifflin, Monroe, Montour, Northumberland, Perry, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Wayne, Wyoming and York Counties
June, 1991	Fire	Dauphin County
May, 1990	Fire	Bucks County
April, 1990	Petroleum Spill	Allegheny, Armstrong, Beaver and Butler Counties
January, 1990	Fire	Dauphin County
September, 1989	Flood	Berks, Carbon, Lancaster, Lehigh and Northampton Counties
July, 1989	Flood	Chester and Delaware Counties

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance		
DATE	EVENT	AFFECTED AREAS
March, 1989	Fire	Montgomery County
February, 1989	Fire	Chester County
December, 1988	Fire	Bucks County
January, 1988	Fire	Luzerne County
December, 1987	Fire	Lycoming County
September, 1987	Flood	Berks, Lehigh and Northampton Counties
June, 1987	Fire	Bucks County
November, 1985	Flash Flood	Fayette, Greene and Westmoreland Counties
September, 1985	Flood	Carbon, Lackawanna, Luzerne, Monroe, Wayne, Wyoming and Susquehanna Counties
February, 1981	Flash Flood	Pike County (Matamoras)
February, 1981	Flash Flood/ Ice Jam	Venango County (Oil City)
January, 1981	Fire	Washington County (Charleroi)

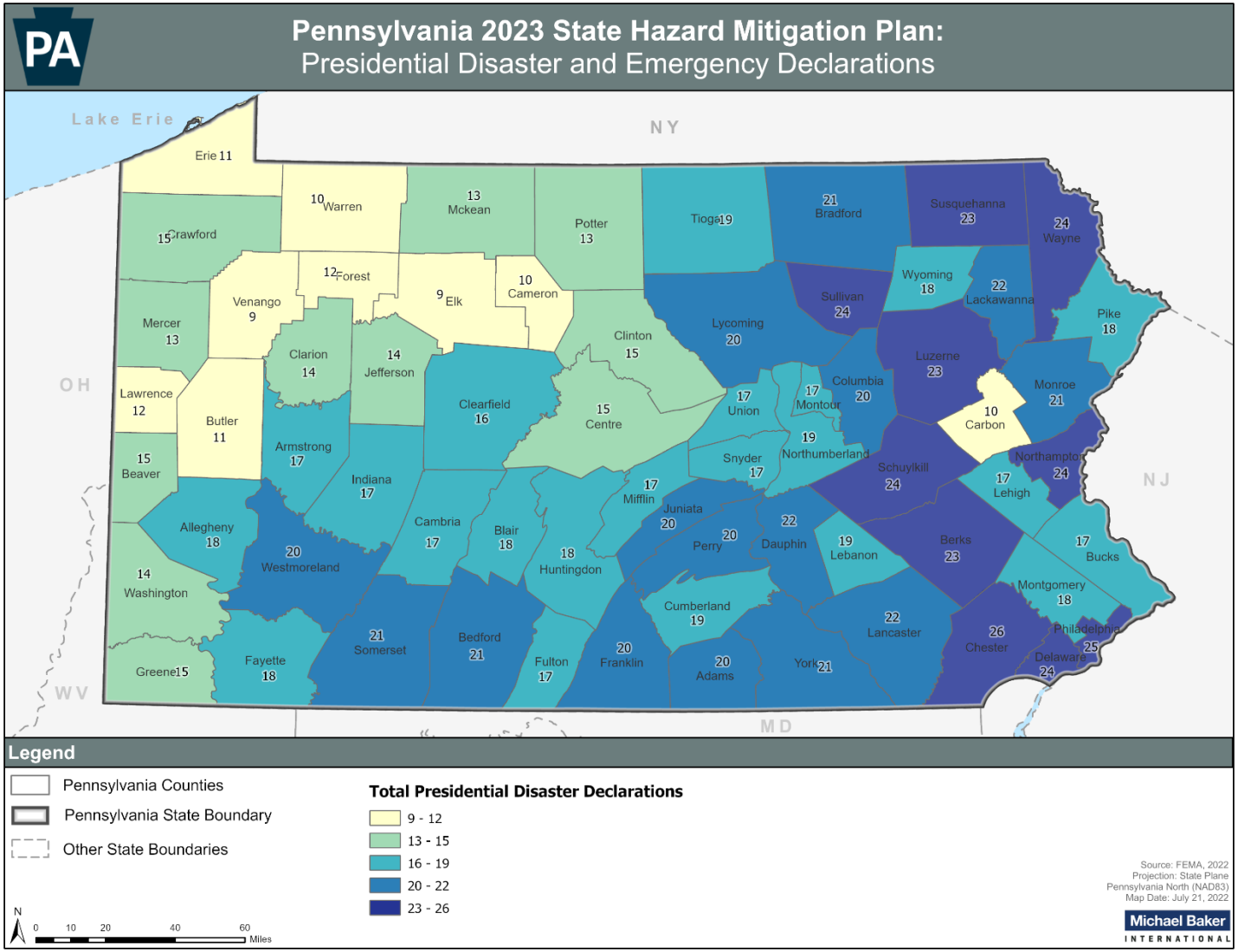
Finally, a number of disaster events in Pennsylvania's history were reported as having no action taken, displayed in Table 4.2.1-4. These "No Action" events are disaster events that occurred but did not result in any type of disaster declaration – Presidential, Gubernatorial, or Small Business Administration. These events were recorded from 1967 to 1980, but have not been recorded after 1980. These events are included in the state's disaster history because in the past, disasters were recorded regardless of their declaration status. Currently, only events that result in a declaration are recorded in the Commonwealth's disaster history.

Table 4.2.1-4 Disaster Events Where No Declaration Occurred.

DATE	TYPE	AFFECTED AREAS
June, 1980	Fire	Indiana County (Indiana Borough)
June, 1980	High Winds/Hail	York County
August, 1980	Flash Flood	Allegheny
January, 1979	Flood	Lackawanna, Lebanon, Lehigh, Luzerne, Mifflin and Montgomery Counties
February, 1979	Fire	Warren County (Tidioute)
March, 1979	Fire	Lycoming County (Williamsport)
March, 1979	Nuclear Facility Incident (TMI)	Dauphin, Lancaster, York, Cumberland, Perry and Lebanon Counties
July, 1979	Flood	Bucks County
January, 1978	Flood	Bradford, Lancaster and Northumberland Counties
July, 1978	High Winds	Armstrong, Clarion and Jefferson Counties
December, 1978	Fire	Delaware County (Morton)
April, 1977	Tornado	Dauphin County
June, 1977	Tornado	Armstrong County
July, 1977	Flash Flood	Allegheny, Snyder and Warren Counties
September, 1977	Tornado	Erie County (Lake City)
September, 1977	Tornado	Erie County (Washington Township)
March, 1976	Tornado	York County
July, 1976	Tornado	Lycoming County
March, 1975	Tornado	Beaver County
April, 1975	High Winds	Statewide
January, 1974	Flood	Allegheny, Fayette and Lawrence Counties
April, 1974	Flood	Erie and Lawrence Counties
May, 1974	Flood	Crawford and Erie Counties
July, 1974	Flash Flood	Fulton County (Ft. Littleton Scout Camp)
July, 1974	Windstorm	Mifflin County
September, 1974	Flood	Indiana, Jefferson and Sullivan Counties
September, 1973	Flood	Washington County
December, 1973	Flood	Montgomery County
November, 1972	Flood	Erie County
November, 1972	Flood	Bucks County
December, 1972	Flood	Westmoreland County
August, 1967	Flash Flood	Northampton County

Geographically, the highest concentration of Presidential Disaster and Emergency Declarations is located in the Commonwealth's most densely populated areas in the eastern half of the state. Montgomery County had the most Presidential Disaster or Emergency Declarations, with a total of 26. Bucks, Chester, Wyoming, Philadelphia, Wayne, Berks, Delaware, and Sullivan have also experienced over 20 Presidential Disaster or Emergency Declarations, as shown in 4. It is unclear if the increase in declarations is fully because of increased risk/ County vulnerability to flooding, or increased capability to track and account for damages. Please note that each county in Pennsylvania has experienced at least 7 Presidential Disaster or Emergency Declarations since 1954. These totals do not include the three statewide declarations that have occurred, one for the COVID-19 pandemic in 2020, Hurricane Sandy in October 2012, and one for severe storms, tornadoes and flooding in August 2003.

Figure 4.2.1-1 Total Presidential Disaster Declarations in Pennsylvania by County between 1954 and 2022.



4.2.2. Summary of Hazards

Using previous disaster declaration history, the 2004, 2007, 2010, 2013, and 2018 SHMPs, County HMPs, and input from the SPT (as described in Section 2.1), the 33 hazards selected for profiling in the 2023 SHMP are provided in the following table, along with hazard descriptions. To navigate to maps showing the distribution of hazard and vulnerability, please see the Table of Figures at the start of this plan. All hazards that were profiled in the 2010 plan were also profiled in 2013, and 2018. Three new hazards were added to the Commonwealth's risk assessment for the 2018 plan: Building and Structure Collapse, Cyber-Terrorism, and Opioid Addiction Response. In addition, the Environmental Hazards profile was divided into five separate profiles, and a more thorough assessment was developed for the environmental hazards posed by gas and liquid pipelines. There were no new hazards added for this plan update, but the names of two have changed. The Opioid Addiction hazard was updated to Substance Use Disorder and the Transportation Accidents hazard is now Transportation Incidents.

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.

PROFILED HAZARDS	DESCRIPTION
NATURAL	
Coastal Erosion 	Coastal erosion is a natural coastal process in which rocks, soils, and/or sands are either worn down or carried away. This movement of sediment can be caused by large storms, flooding, strong wave action, seal level rise, or human activities. Apart from portions of Erie County and potentially along the Delaware River in Southeast Pennsylvania, coastal erosion is not a hazard for communities in Pennsylvania.
Drought 	Drought is defined as a deficiency of precipitation experienced over an extended period of time, usually a season or more. Drought events are defined by rainfall amounts, vegetation conditions, soil-moisture conditions, water levels in reservoirs, stream flow, agricultural productivity, or economic impacts. This hazard is of particular concern in Pennsylvania due to the prevalence of farms and other water-dependent industries, water-dependent recreation uses, and residents who depend on wells for drinking water. (NWS NOAA, n.d.).
Earthquake 	An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area. (Ready.gov, 2018).

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
Extreme Temperature 	Extreme temperature hazards are not tied to a specific temperature threshold; instead, these hazards occur when the temperature is extremely high or extremely low (PSC, n.d.). Extremely high temperatures cause heat stress along with heat rash, sunburn, heat cramps, heat exhaustion, heat stroke, and death (CDC, 2017a). Cold temperatures can be extremely dangerous to humans and animals exposed to the elements as well. Without heat and shelter, cold temperatures can cause hypothermia, frost bite, and death (NOAA NWS, n.d.a).
Flood, Flash Flood, Ice Jam 	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 (PEMA, 2018). A large amount of rainfall over a short time span, like a cloudburst, can result in flash flood conditions. Small amounts of rain can result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas (MRCC, 2022). Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly.
Hailstorm 	Hail precipitation is often produced at the front of a severe thunderstorm system or in conjunction with a tornado event when ice crystals form within a low-pressure front as warm air rises into the upper atmosphere and is cooled (NOAA NSSL, 2022a). Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation in the form of balls or irregularly shaped masses of ice. Hailstorms can cause significant damage to crops, livestock and property, depending on the size, duration, and intensity of hail precipitation.
Hurricane, Tropical Storm, Nor'easter 	Tropical storm systems (i.e., hurricanes, tropical storms, tropical depressions) impacting Pennsylvania develop in tropical or sub-tropical waters of the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea (NOAA NOS, 2021). Nor'easters are extra-tropical storms which typically develop from low-pressure centers off the Atlantic Coast between Georgia and New Jersey during the winter months (NOAA NWS, n.d.b). Potential threats from these storms include powerful winds, heavy rainfall, storm surges, coastal and inland flooding, rip currents, tornadoes, and landslides.

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
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: amphibian, plant, fish, invertebrate, mammal, bird, disease, or pathogen. 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 or after a wildfire, as the already weakened state of the native ecosystem causes it to succumb to an infestation more easily (Flory, et. al, 2022).
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. (PA DCNR, 2018 and USGS, 2018).
Lightning Strike 	Lightning is a giant spark of electricity resulting from the build-up of positive and negative charges within a thunderstorm. The flash or "bolt" of light can occur within the thunderstorm cloud or between the cloud and the ground. Lightning is a leading cause of injury and death from weather-related hazards. Although most lightning victims survive, people struck by lightning often report a variety of long-term, debilitating symptoms. (NOAA NWS, 2018a and Ready.gov. 2018).
Pandemic and Infectious Disease 	Pandemic is defined as a disease outbreak affecting or attacking a large number of people across an extensive region, including several countries, and/or continent(s). It is further described as extensively epidemic. Generally, pandemic diseases cause sudden, pervasive illness in all age groups on a global scale (USDHS, 2022). Infectious diseases are also highly virulent, and can be spread from person-to-person.
Radon Exposure 	Radon is a radioactive gas produced by the breakdown of uranium in soil and rock that can lead to lung cancer in people exposed over a long period of time. Approximately 40% of homes in Pennsylvania have radon levels above this guideline level (PA DEP, 2022b). Three sources of radon in houses are now recognized (PA DEP, 2021a): • Radon in soil air that flows into the house; • Radon dissolved in water from private wells and exsolved during water usage; this is rarely a problem in Pennsylvania; and • Radon emanating from uranium-rich building materials (e.g., concrete blocks or gypsum wallboard); this is not known to be a problem in Pennsylvania.

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
Subsidence, Sinkhole 	Land subsidence is a gradual settling or sudden sinking of the Earth's surface due to removal or displacement of subsurface earth materials (USGS, 2019). Sinkholes are subsidence features resulting from the downward movement of surficial material into a pre-existing subsurface void. There are two common causes of subsidence in Pennsylvania: 1) dissolution of carbonate rock such as limestone or dolomite and 2) mining activity. Collapse sometimes occurs only after a large amount of activity, or when a heavy burden is placed on the overlying material (DCNR, 2022b).
Tornado, Wind Storm 	A tornado is a narrow, violently rotating column of air that extends from a thunderstorm to the ground (NOAA NSSL, 2022b). The impact of tornado or wind storm hazards is ultimately dependent on the population or amount of property (i.e., buildings, infrastructure, agricultural land, etc.) present in the area in which the they occur. Tornado events are often so severe that property loss or human fatality is typically inevitable if evacuation or proper construction standards are not implemented.
Wildfire 	Wildfires occur throughout wooded and open vegetation areas of Pennsylvania. Open fields, grass, dense brush, and forest-covered areas are typical sites for wildfire events. Under dry conditions or droughts, wildfires have the potential to burn forests as well as croplands. Most wildfires are caused by human carelessness or negligence. However, some are precipitated by lightning strikes (DCNR, 2022c). Large events may require evacuation from one or more communities and necessitate regional or national firefighting support.
Winter Storm 	Winter storms are regional events and most often impact a large portion or all of Pennsylvania. Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. They begin as low-pressure systems that move through Pennsylvania usually following the jet stream (NOAA NSSL, 2022c). A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of oil heating supplies (FEMA, 2022d).

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
HUMAN-MADE	
Building and Structure Collapse 	Buildings and other engineered structures, including bridges, may collapse if their structural integrity is compromised, especially due to effects from other natural or human-made hazards. Older buildings or structures, structures that are not built to standard codes, or structures that have been weakened are more susceptible to be affected by these hazards.
Civil Disturbance 	Civil disturbance is a broad term that is typically used by law enforcement to describe one or more forms of disturbance caused by a group of people. FEMA defines civil disturbance as civil unrest activity, such as demonstration, riot, or strike, that disrupts a community and requires intervention to maintain public safety (FEMA, 2022j).
Cyber Terrorism 	Cyber terrorism 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: "Cyberterrorism…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, an attack should result in violence against persons or property, or at least cause enough harm to generate fear." (Denning, 2000).
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. (ASDSO, 2018).

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
Environmental Hazards – Coal Mining 	Major impacts from coal mining include subsidence, landscape changes, and the chemical degradation of surface and subsurface waters. In addition, active and abandoned mines can result in injury and loss of human life. In active mines, workers can be injured or killed by mine collapse, entrapment, poisonous gases, inundation, explosions, fires, equipment malfunction, or improper ventilation. In abandoned mines, causes of injury or death include falling and drowning.
Environmental Hazards – Conventional Oil and Gas Wells 	Many of the hazards associated with conventional oil and gas extraction relate to the contamination of surface and subsurface waters. Abandoned oil and gas wells that are not properly plugged can contaminate groundwater and consequently domestic drinking water wells (Raimi et al., 2021). In addition, surface waters and soil can be contaminated by brine, a salty wastewater product of oil and gas well drilling, or by oil spills.
Environmental Hazards – Gas and Liquid Pipelines 	According to the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA), in 2021 Pennsylvania had 90,135 miles of natural gas pipelines and 4,254 miles of liquid petroleum pipelines. Failures along these pipelines are considered low-probability events but potential consequences are high due to the hazardous and inflammable materials that may be released. In addition, explosions associated with pipeline failures can cause severe injury to nearby residents and destroy homes and other property.
Environmental Hazards – Hazardous Materials Releases 	Hazardous material releases can contaminate air, water, and soils and have the potential to cause injury or death. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events. The severity of the incident is dependent on the weather, geographical conditions, the type of material released, and the distance and related response time for emergency response teams (FEMA, 2019).

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
Environmental Hazards – Unconventional Oil and Gas Wells 	The Pennsylvania Department of Environmental Protection (PA DEP) defines unconventional wells as wells drilled deep into shale rock formations found thousands of feet underground. Potential impacts from Marcellus Shale gas well drilling include surface water depletion, contaminated surface and groundwater from hydraulic fracturing and the recovery of contaminated hydraulic fracturing fluid, soil contamination via toxic material surface spills, and methane and other hydrocarbon emissions from drilling, production, and intentional venting. (Srebotnkaj, 2018).
Levee Failure 	A levee is a human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water to provide protection from temporary flooding (FEMA, 2016a). A levee failure or breach occurs when a levee fails to prevent flooding on the landside of the levee. The consequences of a sudden levee failure can be catastrophic, with the resulting flooding causing loss of life, emergency evacuations, and significant property damage. (USACE, 2018).
Mass Food/Animal Feed Contamination 	Mass food or animal feed contamination hazards occur when food or food sources are contaminated with pathogenic bacteria, viruses, or parasites, or with chemical or natural toxins. Mass food contamination can occur during the production, processing, or distribution of foods. Incidences of mass contamination may lead to foodborne illnesses and/or interruptions in the food supply. (Foodsafety.gov, 2018).
Nuclear Incident 	Nuclear explosions can cause significant damage and casualties from blast, heat, and radiation. The primary concern following a nuclear accident or nuclear attack is the extent of radiation, inhalation, and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns, severe impairment), chronic health effects (e.g. cancer), and psychological effects. (EPA, 2018; Ready.gov, 2018).

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
Substance Use Disorder 	Substance use disorder occurs when an individual becomes physically dependent on a drug, either legal or illegal. The most likely cause are opioids, a class of drugs that reduces pain. “Opioid” is used as a broad term and includes opiates, which are drugs naturally extracted from certain types of poppy plants, and narcotics. Substance abuse can lead to overdose, which can be fatal. Additional substances that individuals may become physically dependent on include
Terrorism 	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 (FEMA, 2009). Cyber-attacks have become an increasingly pressing concern.
Transportation Incident 	Transportation incidents are defined as incidents involving highway, air, and rail travel. These incidents are collectively the costliest of all hazards in the Commonwealth in terms of lives lost, injuries, and economic losses. Pennsylvania has the fifth largest state highway system in the United States – larger than New York, New Jersey, and New England combined. Significant passenger vehicle, air, and rail transportation incidents can result in a wide range of outcomes from damage solely to property to serious injury or death.
Urban Fire and Explosion 	Urban fire and explosion hazards include vehicle and building/structure fires as well as overpressure rupture, overheat, or other explosions that do not ignite. This hazard occurs in denser, more urbanized areas statewide and most often occurs in residential structures. In 2020 alone, there were an estimated 475,000 fires in both residential and nonresidential buildings, resulting in 2,710 deaths and over $11.75 billion in damage (U.S. Fire Administration, 2022).

Table 4.2.2-1 List of Hazards Profiled in the 2023 Pennsylvania SHMP with Associated Descriptions.	
PROFILED HAZARDS	DESCRIPTION
Utility Interruption 	Utility interruption hazards are hazards that impair the functioning of important utilities in the energy, telecommunications, public works, and information network sectors. The focus of utility interruptions as a hazard lies in fuel, energy, or utility failure; this hazard is often secondary to other natural hazard events, particularly transportation accidents, lightning strikes, extreme heat or cold events, and coastal and winter storms. Utility interruptions occur throughout the Commonwealth but are usually small-scale, localized incidents.

Several hazards including avalanche; disorientation; drowning; dust and sand storm; expansive soils; tsunami; volcano; and war and criminal activity were not profiled in 2004, 2007, 2010, 2013 or 2018. Each of these hazards either overlapped significantly with hazards profiled (e.g. war and criminal activity) or were not considered by the SPT to have notable effects on the Commonwealth. The SPT also determined that a more robust assessment of climate change impacts should be included in the Future Occurrence section of each hazard profile.

These hazards do not exist in a vacuum and typically are very inter-related. Figure 4.2.2-2 illustrates these relationships. For example, utility interruption, a highly ranked hazard, typically occurs in conjunction with or because of a winter storm, tornado, hurricane, flood, or hailstorm. Flood events and their impacts can be related to dam failures and levee failures.

Figure 4.2.2-1 Inter-Relationships between Hazard Events in Pennsylvania.

A summary of the potential losses associated with the hazards identified in the 2023 SHMP is presented in Table 4.2.2-2. For each hazard, the potential losses shown include the number of state assets at risk, the total population at risk, and the estimated building value at risk. It is important to note that the exposed building value for hazards that did not use Hazus modeling represents the total replacement value for all buildings determined to be at risk, while the exposed building value for hazards that did use Hazus modeling (flood, earthquake, and hurricane wind) represents the estimated cost to repair or replace the damage caused to buildings and their contents. In other words, the values derived with Hazus account for the level of exposure to the hazard and the vulnerability of structures, while the values derived without Hazus reflect the replacement cost if all structures were entirely destroyed. For those values derived without Hazus, the exposed building value therefore errs on the side of safety. It is also important to note that some hazards do not cause direct damage to buildings (e.g., pandemics). The metric of Exposed Building Value is not relevant to these hazards, and no value is listed.

The final column of Table 4.2.2-2 summarizes the methodology for estimating potential losses associated with each hazard. The loss estimation methodology is further explained in Sections 4.1 and 4.3. See Section 4.1 for a general summary of the data sources and methodology, and the hazard profiles in Section 4.3 for a more detailed description of the data used and assumptions made.

Table 4.2.2-2 Overview of Vulnerable State Assets and Loss Estimates per Hazard.					
HAZARDS	VULNERABLE STATE FACILITIES	VULNERABLE CRITICAL FACILITIES	VULERABLE POPULATION	EXPOSED BUILDING VALUE (THOUSANDS $)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Building or Structure Collapse	NA	NA	2,320,492	$375,850,056	Vulnerable facilities, population, and building value were estimated based on location within high-risk census tracts. Census tracts were defined as high risk when more than 75 percent of housing units were built before 1960.
Civil Disturbance	NA	24	NA	NA	Vulnerable facilities were identified based on use rather than location. Government buildings and national monuments/icons were assumed to be at greatest risk.
Coastal Erosion	0	0	NA	$1.142,519	Vulnerable building value was estimated based on location within high-risk areas. Areas were defined as high risk where census blocks intersect the Erie County Bluff Recession Hazard Area.
Cyber-Terrorism	NA	NA	NA	NA	Distribution of hazard and vulnerability is highly uncertain.
Dam Failure	Protected	Protected	Protected	Protected	This data is protected by PA DEP.
Drought	30	275	2,256,986	NA	Vulnerable facilities were identified based on types and use rather than location. State facilities with uses listed as animal facility, greenhouse, agricultural-storage, or land and critical facilities with type listed as agricultural were assumed to be at greatest risk. Vulnerable population was identified based on location in high-risk areas. Census tracts were defined as high risk if more than 110 drought events were recorded based on FEMA's National Risk Index (NRI 2021)

Table 4.2.2-2 Overview of Vulnerable State Assets and Loss Estimates per Hazard.					
HAZARDS	VULNERABLE STATE FACILITIES	VULNERABLE CRITICAL FACILITIES	VULERABLE POPULATION	EXPOSED BUILDING VALUE (THOUSANDS $)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Earthquake	740	3,318	NA	$99,301,503	Vulnerable state facilities were identified based on location within areas of relatively high risk. High risk areas were defined as those in which the Peak Ground Acceleration for ground shaking event with a 2 percent probability of exceedance in 50 years is estimated to be greater than or equal to 10 %g. Vulnerable populations and building value were estimated using Hazus v6.0. A Level II analysis was conducted to estimate average annualized losses in each census tract.
Environmental Hazards (Coal Mine Incidents)	781	1,983	1,278,502	$265,829,702	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when within 1.5 miles of an active or abandoned coal mine.
Environmental Hazards (Conventional Oil & Gas Well Incidents)	908	2,515	1,879,386	$399,780,475	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when within 1,000 yards of an active or abandoned well.
Environmental Hazards (Gas and Liquid Pipelines)	495	1,406	1,333,814	$307,937,435	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located within 0.25 miles of major gas or liquid pipelines.
Environmental Hazards (HazMat Releases)	3,782	9,644	8,399,817	$1,760,182,329	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located within 0.25 miles of major Interstates, US highways, state highways, and rail lines, and areas within 1.5 miles of hazardous materials sites.

Table 4.2.2-2 Overview of Vulnerable State Assets and Loss Estimates per Hazard.

HAZARDS	VULNERABLE STATE FACILITIES	VULNERABLE CRITICAL FACILITIES	VULERABLE POPULATION	EXPOSED BUILDING VALUE (THOUSANDS $)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Environmental Hazards (Unconventional Oil & Gas Well Incidents)	68	229	138,854	$33,699,119	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when within 1,000 yards of an active, inactive, or unplugged well.
Extreme Temperature (Cold)	253	704	332,916	$76,212,123	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located in census tracts with greater than 10 excessive cold and wind chill events between 2005 and 2017.
Extreme Temperature (Heat)	528	2,259	3,648,713	$752,205,778	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located in census tracts with greater than 80 heatwave events between 2005 and 2017.
Flood, Flash Flood, Ice Jam	148	1,338	(Households Displaced)	$22,329,000,000	Vulnerable state facilities were identified based on location within areas of relatively high risk. High risk areas were defined as those in the FEMA 1%-annual-chance floodplain. Vulnerable populations and building value were estimated using Hazus v6.0. A Level II analysis was conducted to estimate the 1%-annual-chance losses in each census block.
Hailstorm	566	1,819	1,717,704	$365,583,755	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located in census tracts with greater than 100 hail events between 1986 and 2017.

Table 4.2.2-2 Overview of Vulnerable State Assets and Loss Estimates per Hazard.					
HAZARDS	VULNERABLE STATE FACILITIES	VULNERABLE CRITICAL FACILITIES	VULERABLE POPULATION	EXPOSED BUILDING VALUE (THOUSANDS $)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Hurricane, Tropical Storm, Nor'easter	399	1,565	NA	$1,137,459,413	Vulnerable state facilities were identified based on location within areas of relatively high risk. Areas were identified as high risk when located in census tracts that overlapped with at least one hurricane path between 1851 and 2022. Vulnerable populations and building value were estimated using Hazus v4.0. A Level II analysis was conducted to estimate average annualized losses in each census tract.
Invasive Species	NA	NA	NA	NA	Distribution of hazard and vulnerability is highly uncertain.
Landslide	2,183	6,021	4,487,715	$946,515,948	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located in areas classified as high-incidence or high-susceptibility by USGS.
Levee Failure	197	383	252,192	$52,377,224	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located within 2,000 feet of a levee identified in the USACE National Levee Database.
Lightning Strike	488	2,115	1,974,252	$423,337,414	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located in census tracts with greater than 1,200 cloud-to-ground lightning strikes between 1986 and 2012.
Mass Food and Animal Feed Contamination	NA	NA	NA	NA	Distribution of hazard and vulnerability is highly uncertain.

Table 4.2.2-2 Overview of Vulnerable State Assets and Loss Estimates per Hazard.					
HAZARDS	VULNERABLE STATE FACILITIES	VULNERABLE CRITICAL FACILITIES	VULERABLE POPULATION	EXPOSED BUILDING VALUE (THOUSANDS $)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Nuclear Incident	60	683	434,688	$95,948,714	Vulnerable state facilities were identified based on a combination of location and use. All facilities within the 10-mile Plume Exposure EPZ and all agricultural facilities within the 50-mile Ingestion Exposure EPZ were identified as vulnerable. Vulnerable populations and building value were estimated based on location only. Areas were defined as high-risk when located within the 10-mile Plume Exposure EPZ.
Opioid Addition Response	NA	NA	NA	NA	Insufficient data available.
Pandemic and Infectious Disease	NA	NA	NA	NA	Distribution of hazard and vulnerability is highly uncertain.
Radon Exposure	NA	NA	NA	$800,636,640	Vulnerable building value was estimated based on location within high-risk areas. Areas were defined as high risk when located within zip codes with average radon readings of greater than 4pCi/L. To estimate building-related loss, the average radon mitigation system cost of $1,200 was applied to 20 percent of high risk buildings.
Subsidence, Sinkhole	1,418	3,336	3,210,732	$661,105,251	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when underlain by carbonate rocks at or near the land surface or carbonate rocks buried less than 50 feet deep.
Terrorism	NA	NA	NA	NA	Distribution of hazard and vulnerability is highly uncertain.

Table 4.2.2-2 Overview of Vulnerable State Assets and Loss Estimates per Hazard.					
HAZARDS	VULNERABLE STATE FACILITIES	VULNERABLE CRITICAL FACILITIES	VULERABLE POPULATION	EXPOSED BUILDING VALUE (THOUSANDS $)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Tornado & Wind Storm	876	3,776	4,765,872	$1,032,809,118	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located in census tracts that contained 3 or more tornado events, or more than 200 strong wind events between 1986 and 2019.
Transportation Accident (highway)	2,988	6,687	4,793,415	$1,047,535,264	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located within 0.25 miles of major Interstates, US highways, or state highways.
Transportation Accident (air)	137	517	595,583	$122,163,494	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located within 5 miles of public or private airports or heliports with more than 1,000 enplanements per year.
Transportation Accident (rail)	1,098	3,573	2,784,671	$628,496,372	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Areas were defined as high risk when located within 0.25 miles of active rail lines.
Urban Fire and Explosion	1,476	5,313	5,866,360	$1,053,738,224	Vulnerable facilities, population, and building value were estimated based on location within high-risk census tracts. Census tracts were defined as high risk when more than 60 percent of housing units were built before 1970.
Utility Interruption	NA	NA	NA	NA	Distribution of hazard and vulnerability is highly uncertain.

Table 4.2.2-2 Overview of Vulnerable State Assets and Loss Estimates per Hazard.

HAZARDS	VULNERABLE STATE FACILITIES	VULNERABLE CRITICAL FACILITIES	VULERABLE POPULATION	EXPOSED BUILDING VALUE (THOUSANDS $)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Wildfire	104	229	124,904	$27,624,703	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Census tracts were defined as high risk when the area of moderate to high wildfire hazard potential exceeds an NRI index score of 4 or more.
Winter Storm	345	641	501,948	$109,396,882	Vulnerable facilities, population, and building value were estimated based on location within high-risk areas. Census tracts were defined as high risk when the number of winter weather events s between 2005 and 2017 exceeded 100.

4.3. Hazard Profiles and Vulnerability Analysis

NATURAL HAZARDS

4.3.1 Coastal Erosion

4.1.1.1. Location and Extent

A coastal zone is the area where the land meets the sea and includes both coastal waters and adjacent shore lands. These areas face increasing pressure from development, shoreline erosion, biodiversity losses, and nonpoint source pollution (PA DEP CRM, 2018). Pennsylvania has two coastal zones that are subject to potential coastal erosion hazards; the coastlines along Lake Erie and the Delaware River.

The Lake Erie coastline in Pennsylvania stretches approximately 77 miles across the northern border of Erie County. The Lake Erie coastal zone in Erie County includes shorelines of major tributaries and the highest bluffs anywhere on the Lake Erie shore.

Lake Erie also contains Presque Isle State Park, which is the only significant coastal depositional feature on the south shore of the lake. It is a compound re-curved spit made up of beach, dune, and inter-dune-pond features which protects Erie Harbor. Most of the Pennsylvania lake shore consists of narrow beaches lakeward of bluffs, five to 180 feet high (PA DEP, 2002). The glaciers that carved out the Great Lakes basin resulted in the deposition of sediments that make up the bluffs. These unconsolidated glacial sediments include sand, gravel, and clay, all of which are very vulnerable to erosion when exposed to the forces of direct wave contact, groundwater flows, surface water runoff, ice, wind and rain. In some areas along the Lake Erie coast, the bluffs have a bottom layer of exposed bedrock or shale, which is often weathered and undercut over the long-term by wave action.

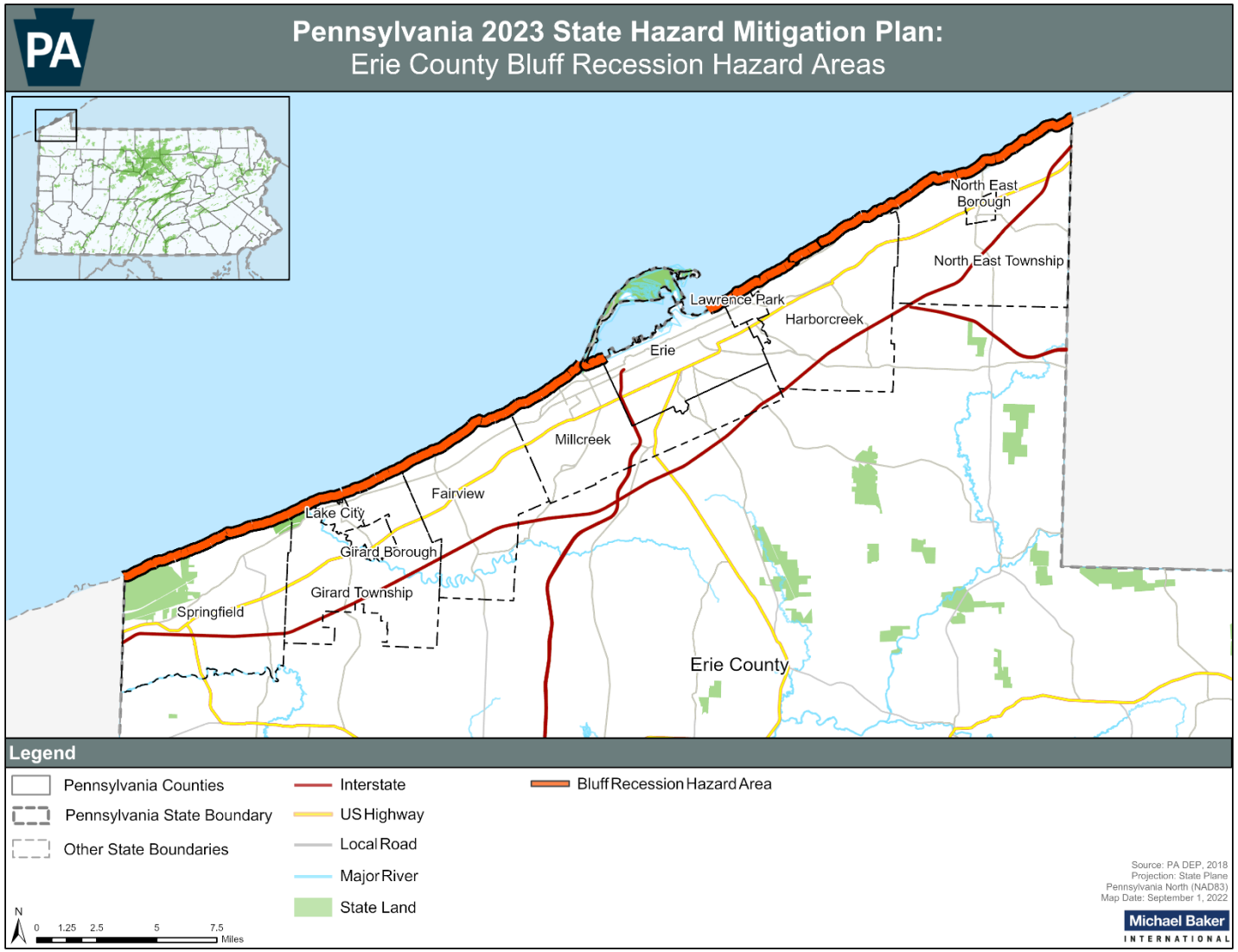
There are 112 miles of coastline along the Delaware Estuary. The Delaware Estuary coastal zone lies within Bucks, Philadelphia, and Delaware Counties and contains islands, marshes and shore lands of tributary streams that are tidally influenced (PA DEP CRM, 2018). While it is subject to coastal or wetland erosion, the high degree of urbanization along the southeastern Pennsylvania Delaware River shoreline has resulted in a significant amount of shoreline hardening with structures such as bulkheads, piers, and marginal wharves. Although detailed structure inventories have not been performed, these structures greatly reduce erosion hazards along most of the Delaware River shoreline. Therefore, Lake Erie is the area of primary concern for coastal erosion hazards and is the focus of the risk assessment.

Figure 4.3.1-1 depicts the Bluff Recession Hazard Areas (BRHAs) identified by the Pennsylvania Department of Environmental Protection (PA DEP) Coastal Resources Management Program (CRMP). BRHAs are defined in Section 3 of the Bluff Recession and Setback Act as “an area or zone where the rate of progressive bluff recession creates a substantial threat to the safety or stability of nearby or future structures or utility facilities.” These bluffs are present along the majority of Erie County’s border with Lake Erie and present a

hazard. Original designations of BRHAs, codified at 25 Pa. Code § 85.26, are based on a 1975 study titled *Shoreline Erosion and Flooding – Erie County* (PA DEP, 2004). Current designations were established in 2009 based on a 2004 study titled, *Study to Tentatively Designate Bluff Recession Hazard Areas*. All BHRAs were first established in 1980 except for the BRHA within the City of Erie, which was established during the 2009 update (Pennsylvania Bulletin, 2009).

The BRHAs determine where along the shoreline development will be subject to Minimum Bluff Setback Distances. Sections of shoreline that are not identified as a BRHA (e.g. beach and dune areas, headlands, armored shorelines, etc.) may not be subject to bluff recession, but remain vulnerable to shoreline erosion.

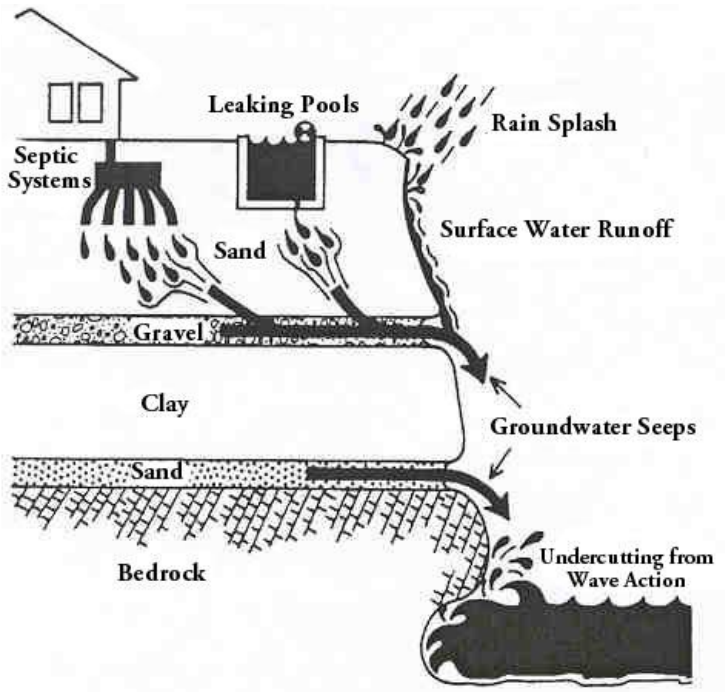
Figure 4.3.1-1 Bluff Recession Hazard Areas along the Lake Erie Shoreline (PA DEP, 2018a).



4.3.1.2. Range of Magnitude

Bluff recession and shoreline erosion events can take place gradually over decades or abruptly during a single storm event. The magnitude of bluff recession and shoreline erosion events depends greatly on fluctuating lake levels and the amount of beach material along the shoreline However, other factors that affect rate of erosion include surrounding land use, precipitation, storm impacts, vegetative cover, soil type, depth of unconsolidated soils, hydrology, bedrock geology, slope gradient, offshore bathymetry, and human activity (Foyle, 2018). Figure 4.3.1-2 illustrates both the natural and human-induced processes that influence bluff recession rates of change. Bluff instability often occurs from erosion of foreshore beach materials and the undercutting of bluffs by wave attack. However, slumping and mass-wasting of the bluff face can also occur without the presence of direct wave attack.

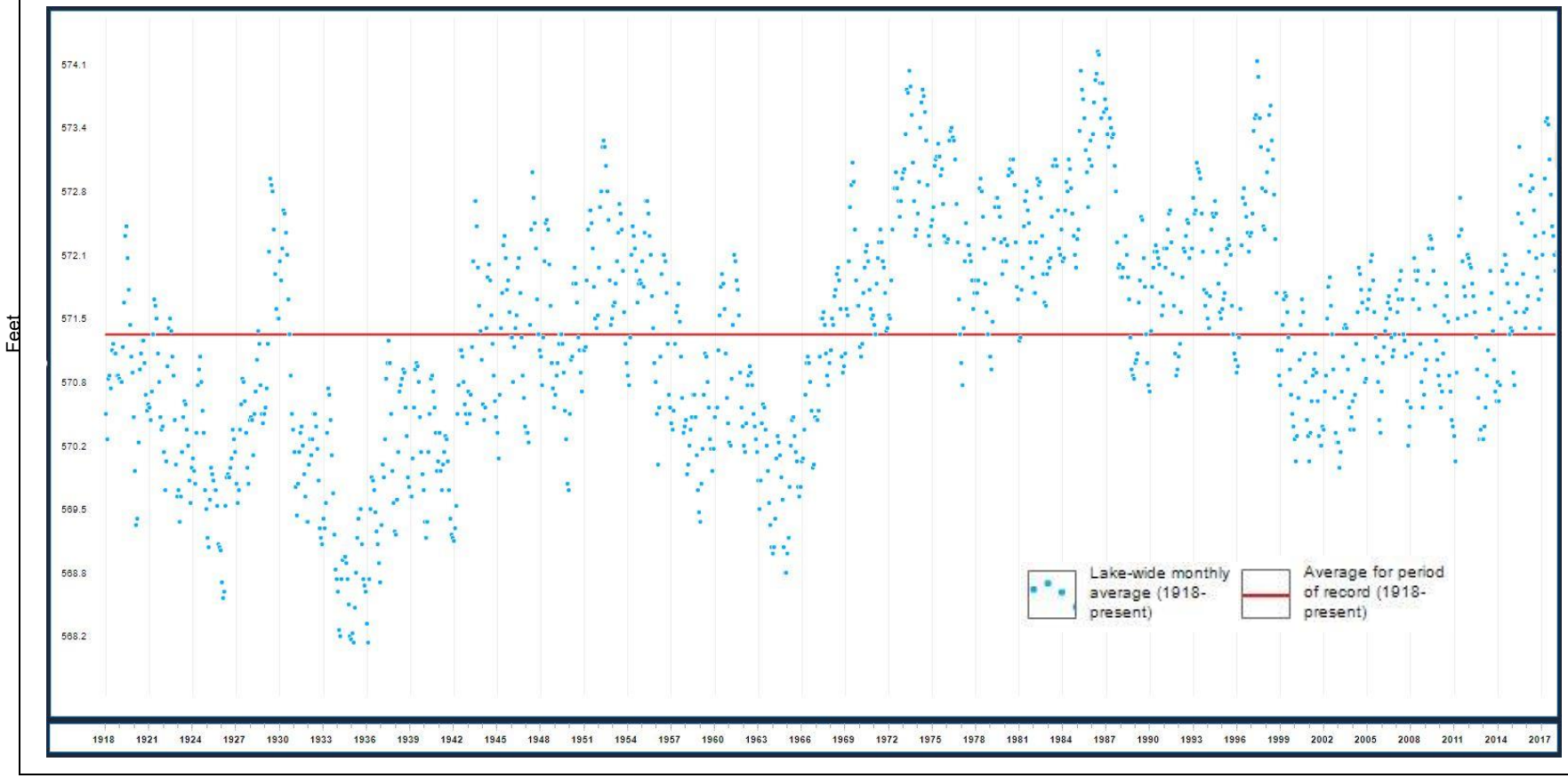
Figure 4.3.1-2 Diagram of the Natural and Human-Induced Processes that Influence Coastal Erosion



Much of Lake Erie and its beaches and bluffs are frozen during winter, inhibiting the formation of storm waves and reducing erosion. Spring rains, snowmelt, and low evaporation rates cause Lake Erie's average water level in June to be more than 11.8 inches above the typical January level. Several years of above-normal precipitation, as in the mid-1980s, can cause Lake Erie's water level to rise significantly above its long-term average, increasing the likelihood of erosion.

Long-term changes are caused by variations in precipitation and evapotranspiration rates. Figure 4.3.1-3 shows average annual lake levels of Lake Erie for the period between 1918 and 2017. Lake levels have varied on the order of approximately six feet over this period. The droughts of the 1930's and 1960's are clearly reflected in the low lake levels. An annual cycle and short-term changes related to weather also affect the lake level. The most severe erosion events occur when lake levels are at their highest. This is reflected in the fact that 1987 and 1998 erosion events referenced in Section 0 correspond with lake-level peaks shown in Figure 4.3.1-3.

Figure 4.3.1-3 Lake Erie Water Levels Between 1918 and 2017 (NOAA GLERL, 2018)



An important reason why severe erosion occurs during high lake levels is because it allows waves to impact more vulnerable areas. In beach and dune areas such as Presque Isle, wind-driven waves can inundate natural protective beaches and allow water and damaging waves to reach the back-beach areas (Rafferty and Foyle, 2021). Large quantities of beach material can be moved offshore during prolonged periods of inundation, and these periods are when the greatest threat of property damage and site instability occurs as beaches can no longer absorb part of the wave energy (Rafferty and Foyle, 2021). For the bluffs, higher lake levels mean that waves are more likely to impact the less-stable middle and upper layers of the rock instead of the resistant bedrock at the base of the bluff. Figure 4.3.1-1 depicts this scenario. Lake Erie is the shallowest of the Great Lakes and because of this, the effects of storm-driven waves are amplified. Significant erosional waves typically occur during spring and fall storms.

While waves attack the lower levels of the bluff, groundwater, surface water, and freeze/thaw cycles will deteriorate both the upper and internal stability of the bluffs. Groundwater can be beneficial if its supporting vegetation that stabilizes the bluff but can also lead to internal instability when it cuts through the sandy upper layer of the bluff; it can even end up flowing out the face of the bluff (Hapke, et al. 2009 and Rafferty and Foyle, 2021). The groundwater freezes during the winter months, expanding and increasing the internal pressure of the bluff; once it thaws it can then flow through any additional cracks. Surface water contributes in a similar way; it can nourish stabilizing vegetation, or it can wash sediment off the face as it flows downward. When the ground can no longer infiltrate it, it may pond and the increased weight can act as a catalyst for erosion events (Rafferty and Foyle, 2021).

The impacts of bluff recession and shoreline erosion may be minimal in areas where buildings and infrastructure have been constructed at an adequate setback distance or erosion mitigation measures have been employed. However, development within designated hazard areas can result in damage or complete destruction of property, public infrastructure, and loss of recreational opportunity, as well as threaten public health and safety (Foyle, 2018). A worst-case scenario for coastal erosion would be if coastal erosion from a strong storm occurred, causing a slumping or mass-wasting of a bluff and numerous homes on the bluff to collapse. This could result in not only property damage, but loss of life or injuries if the homes are occupied at the time of the slope collapse. Figure 4.3.1-4 shows an example of a building imminently threatened by significant bluff recession.

Figure 4.3.1-4 Photograph of Large Erosion Event along the Lake Erie, PA Shoreline (PA DEP, 2022c).

Table 4.3.1-1 Most Likely Lifelines Impacted by Coastal Erosion

Lifelines	Impact Type	Notes
Safety and Security	⚠	Anticipating a causal relationship where the Safety and Security lifelines will require significant personnel in response, some in recovery, and mitigation as well.
Food, Water, Shelter	⚠	Anticipating a causal relationship for the Food, Water, and Shelter lifeline, depending on where and how rapidly the erosion occurs.
Energy	⚠	Anticipating causal relationship with Energy as power and utility lines will likely be impacted.

4.3.1.3. Past Occurrence

PA DEP's CRMP monitors coastal erosion along the Lake Erie shoreline with approximately 130 established control points, but recent data collection has used aerial imaging and remote sensing technology to create more precise measurement by analyzing around 2,000 locations at

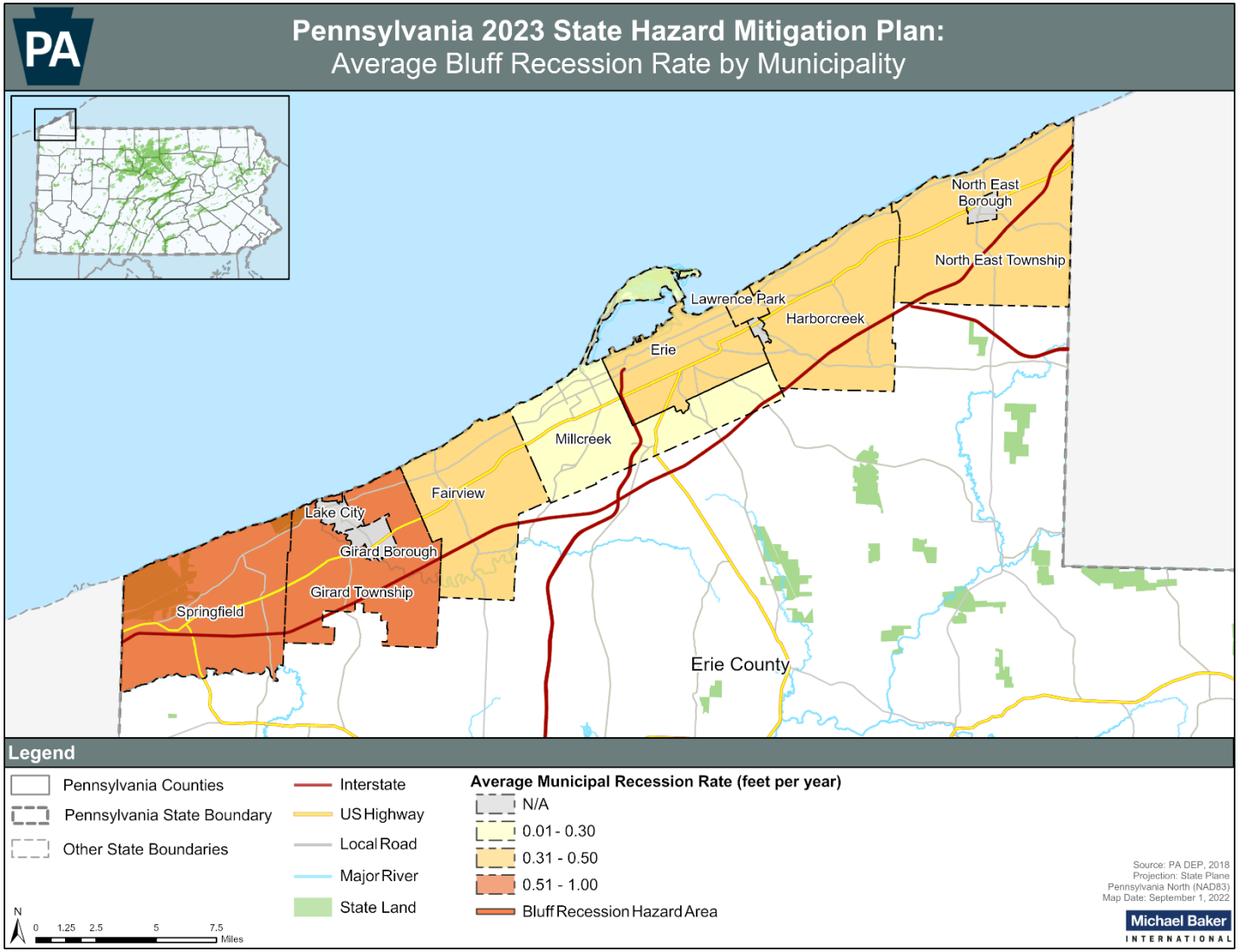
more frequent intervals (Rafferty and Naber, 2021). The CRMP method resulted in average recession rates ranging from 0.2 feet per year in Millcreek Township to .89 feet per year in the easternmost municipality of Springfield from 1975 to 2019. The mean rate of change across all control points is .51 feet per year as measured by CRMP, with a long-term (25-year) average recession for the Pennsylvania Lake Erie Coastal Zone of 0.75 feet per year. However, losses of up to twenty feet in a single year have been observed (Hapke et al., 2009 and Pennsylvania Sea Grant, 2002). This method has been criticized due to the low number of measurements, resulting in around 1,640 feet between locations (Rafferty and Naber, 2021).

Erosion and recession rates vary by location and happen at different rates over time, which is why increasing the number of locations you measure from is important. A 2009 study performed by the U.S. Geological Survey (USGS) in cooperation with the CRMP divided the Pennsylvania Lake Erie shoreline into eastern and western areas and calculated recession rates using satellite imagery and spatial analysis (Hapke et al., 2009). Using data from 1938 to 2006, the study area extending southwest of Presque Isle had an average rate of recession of 0.98 +/- 0.33 feet per year. Using data from 1938 to 1998, the study area extending northeast of Presque Isle had an average rate of recession of 0.66 +/- 0.33 feet per year. Once potential explanation for the difference is the presence of stronger bedrock in the eastern coastline (Rafferty and Foyle, 2021). A maximum rate of 3.28 +/- 0.33 feet per year was measured in each study area, both occurring in predominantly agricultural areas where groundwater seepage from irrigation is higher.

A 2021 study looked at erosion rates in two time periods, 2007-15 and 2012-15, using similar methods to the USGS study in 2009. It found that the mean rate of change along the entire coast was .71 feet per year from 2007-15 and 1 foot per year from 2012-15. For the 2007-15 analysis, 2,232 locations were used. The average recession rates ranged from .50 feet per year in Lake City Borough to .87 feet per year in North East Township (Rafferty and Naber, 2021). The 2012-15 analysis, using 1,753 locations, had average recession rates ranging from .50 feet per year in Lake City Borough to 1.48 feet per year in North East Township. In this study, higher rates of recession were found in the eastern portion of the coastline, which runs counter to the 2009 study and CRMP data. A reason for this could be the timeframe of the data used, as this study used much more recent data over a shorter timeframe while the others focused on long-term historical trends (Rafferty and Naber, 2021). Additionally, the western coastline is more susceptible to a uniform and consistent style of erosion known as translational sliding while the eastern coastline endures the more erratic rotational sliding which tends to happen in larger, infrequent events (Foyle, 2021).

Figure 4.3.1-6 displays average bluff recession rates along the Pennsylvania Lake Erie shoreline as calculated in 2018 using CRMP data; more recent data on recession rates were not available. While average recession rate data is valuable for long-term planning purposes, as discussed, these rates vary spatially and can be episodic. Therefore, the limitations of these rates must be recognized, and data must be used appropriately for purposes of evaluating risk.

Figure 4.3.1-5 Average Bluff Recession Rates along the Pennsylvania Lake Erie Shoreline (PA DEP, 2018a).



Record high lake-levels caused significant erosion events on the Lake Erie shoreline in 1987 and 1998 (Malone, 2010). Table 4.3.1-1 shows the results of a damage assessment that was completed for the 1987 event by PA DEP's CRMP (PA DEP, 1987). This data is from 1987 and a more recent study is not available. No significant long-term trends or short-term erosion events have been identified for the Delaware River shoreline.

Table 4.3.1-2 Summary Damages Caused by High Water Levels in the Pennsylvania Coastal Zone in Erie County, 1985-1987 (PA DEP 1987)

ITEM	NUMBER AFFECTED (TOTAL)	# AFFECTED BY FLOODING	# AFFECTED BY SHORELINE EROSION	# OF PEOPLE AFFECTED
PUBLIC FACILITIES				
Water Plants	1	1	0	0
Sewage Plants	0	0	0	0
Marinas, Decks	12	12	0	300
Parks/Beaches	12	12	11	0
Roadways	6	6	0	0
Hospitals	0	0	0	0
Schools	0	0	0	0
Sewer Facilities Systems	3	3	0	0
Airports	0	0	0	0
Sanitary Landfills	0	0	0	0
PRIVATE FACILITIES				
Commercial	7	3	5	15
Industrial	0	0	0	0
Residential	180	136	144	474
Power Plants	0	0	0	0
OTHER				
Seasonal Residences	31	14	20	65
Boathouses	5	0	5	37
Bathhouse/Comfort Stations	3	3	0	0 (other facilities available)

Various studies, notably those developed by the U.S. Army Corps of Engineers (Buffalo District) and the Coastal Resources Management Program, have assessed shoreline damage statistics and the costs of protection. Shore structure inventories have also been prepared. These documents provide useful information for measuring losses and recording efforts made to mitigate damage. However, studies more recent than the 1987 damage assessment are not currently available.

More recently, due to excessive precipitation in the Spring of 2011, several lakefront properties experienced significant bluff recession. One of the properties affected by this event receded approximately 100 feet (ECDPS, 2011). Presque Isle has also experienced significant erosion and an estimated 38,000 cubic yards of sand is used to offset this erosion annually (ECDPS, 2018).

4.3.1.4.Future Occurrence

Future shoreline erosion and bluff recession can be considered highly likely, as defined by the Risk Factor Methodology probability criteria. While the geological processes along the Lake Erie shoreline are continuous, rates of change vary as a result of the natural and human-caused influences previously described. Rates of change will vary over time, primarily as a function of changing lake levels. Historical rates described in Section 4.3.1.3 can help to serve as estimates of future changes.

Coastal erosion will also be influenced by future climate-related changes projected for Pennsylvania such as warmer temperatures, increases in the frequency and severity of storm events, and increases in precipitation. According to the United States Environmental Protection Agency (EPA), increasing temperatures and changing precipitation patterns will likely intensify flood and drought events in the Commonwealth (EPA, 2016a). Extreme changes between these events can cause increased variability in lake levels and increase the risk of coastal erosion. Additionally, precipitation is likely to increase during the winter and rising temperatures will melt snow earlier in spring (EPA, 2016a). The changes could influence the level of ice build-up during the winter, which typically protects the coastline against severe winter storms. This means that more precipitation, an increase in how much winter precipitation falls as rain, stronger storms, and a decline in frozen ground days all point to more erosion as more runoff is generated and soil gains weight and moisture, weakening the stability of the bluff (Foyle, 2018). On other hand, climate projections show that lake levels are expected to either remain the same or decline as much as 1.7 feet by 2080; this could allow the shoreline to move away from developed land over time (Foyle, 2018).

4.3.1.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to coastal erosion, all state facilities in Erie County located in areas characterized as high risk were identified. High-risk areas were defined as areas within 75 feet of the Lake Erie shoreline. This criterion was determined based on the average recession rate of 0.75 feet per year and the 100-year maximum planning horizon used to calculate MBSDs. The resulting high-risk area is a rough estimate and does not account for observed spatial variability in erosion rates along the shoreline.

No state-owned or leased facilities were identified in areas at high risk of coastal erosion. Therefore, there is no estimated loss or value of structures at risk for such facilities. However, it should be noted that degradation of Presque Isle State Park due to coastal erosion could lead to losses related to tourism dollars and incalculable damage to the unique natural environment. Additionally, no critical facilities were identified in areas at high risk of coastal erosion.

4.3.1.6. Jurisdictional Vulnerability Assessment and Loss Estimation

As previously mentioned, Erie County is the only jurisdiction in the Commonwealth that is significantly threatened by coastal erosion. Since passage of the Bluff Recession and Setback Act in 1980, structures are required to be set back from areas determined to be hazardous due to bluff recession and coastline erosion. PA DEP's CRMP has calculated bluff recession rates to

determine setback distances and periodically recommends setback modifications to municipalities along Lake Erie.

Within Erie County, Springfield Township has the highest average bluff recession rate (0.99 feet per year) among all jurisdictions monitored (PA DEP CRM, 2018b). However, it is important to note that vulnerability is ultimately dependent on development density near receding shorelines. For more information on vulnerability for specific municipalities, see *Bluff Recession Hazard Area Designations* at: http://www.dep.state.pa.us/river/reference/brha.htm.

The Bluff Recession and Setback Act was passed in 1980 and requires that new residential, commercial, and industrial structures will be constructed landward of Minimum Bluff Setback Distances (MBSD). Such setbacks protect the health and safety of residents, as well as property investments. The statutory authority of the Act only applies to Lake Erie. There are nine municipalities along Pennsylvania's Lake Erie coast that have designated BRHAs and enacted ordinances. Table 4.3.1-2 provides a summary of the life span used to calculate MBSDs based on structure type, where:

Bluff Recession Rate (ft/yr) x Appropriate Life Span of Structure (yrs) = MBSD (ft)

Table 4.3.1-3 Summary of Life Spans Used to Calculate Minimum Bluff Setback Distances for Development in Lake Erie Bluff Recession Hazard Areas.

TYPE OF STRUCTURE	APPROPRIATE LIFE SPAN (YEARS)
Residential	50
Commercial	75
Industrial	100

Note: MBSDs are determined by and currently set in 25 Pa. Code § 85.26(c). Some municipalities have enacted setback requirements which are greater than the MBSDs published in Chapter 85.

For purposes of the risk assessment, an investigation of properties located within a 100-year bluff recession hazard area was performed. Based on historical recession rates, properties located within BRHAs that are considered at risk from bluff recession over the next 100 years were identified and analyzed. A planning horizon of 100 years was used since it is the longest of the three life spans used to calculate Minimum Bluff Setback Distances under the Bluff Recession and Setback Act. While this assessment was initially conducted in 2013, more recent data on bluff recession rates have not been made available. Additionally, the assessment was based on a 100-year hazard area. Therefore, the 2013 assessment remains relevant today. The assessment was conducted as follows.

Using building footprints provided by the Erie County Planning Department, the distance of each structure was measured from the approximate bluff edge. The current approximate setback distance was then divided by a representative historical erosion rate (see Figure 4.3.1-7) to determine which buildings are located along areas of the Lake Erie shoreline expected to erode over the 100 years. A summary of these buildings is provided in Table 4.3.1-3 by municipality,

along with total building value information. Building location and building value information is based on 2011 tax assessment data provided by Erie County.

The following assumptions should be considered when interpreting assessment results:

- Long-term bluff recession rates were used to determine setback life. Natural (e.g., changing lake levels) or human influences (e.g. construction of shore protection structures) that will alter future recession rates are not considered.
- Control point monuments are typically located every 1,650 feet along the Lake Erie shoreline. The recession rate from the nearest control point monument was applied to each structure; however, this monument may not always be most representative of erosion risk for a given structure.
- Only buildings located adjacent to the BRHAs were included in this assessment. Additional buildings that may be at risk (e.g., buildings located between breaks in BRHA or in non-bluff areas) were not included. While the number of excluded buildings potentially at risk is considered to be relatively small compared to overall assessment results, it is worth noting as results likely serve as conservative estimates of properties at risk over the next 100 years.
- Setback measurements used in the assessment are determined based on the distance of a given building footprint to the approximate bluff edge. The property on which a building is located, as well as surrounding infrastructure, are likely at risk prior to damage to the building itself.
- By regulation, MBSDs are measured from the bluff crest, which due to its dynamic nature, is determined on a case-by-case basis through field surveys. For purposes of this assessment, a delineation of the bluff edge was created based on the most recent aerial imagery available from the Esri World Imagery dataset. While this delineation is reasonably accurate, it was not verified with topographic data or field survey data and should therefore be considered approximate.
- New or future development is not accounted for; this assessment is based on development as of 2011 only.

Table 4.3.1-4 Buildings Identified in 100-yr Erosion Hazard Area by Community with Associated Building and Land Value Data.				
MUNICIPALITY	NO. OF BUILDINGS IN 100-YR EROSION HAZARD AREA (PERCENT OF TOTAL BUILDINGS THROUGHOUT COUNTY IN 100-YR EROSION HAZARD AREA)	TOTAL BUILDING VALUE	TOTAL LAND VALUE	TOTAL LAND & BUILDING VALUE
Erie City	25 (9.4%)	$316,540	$3,340,650	$3,657,190
Fairview Township	11 (4.2%)	$4,039,100	$2,647,700	$6,686,800
Girard Township	14 (5.3%)	$1,165,600	$6,349,200	$7,514,800
Harborcreek Township	51 (19.2%)	$4,249,070	$8,166,500	$12,415,570
Lake City Borough	0 (0.0%)	$0	$0	$0
Lawrence Park Township	3 (1.1%)	$281,000	$333,200	$614,200
Millcreek Township	111 (41.9%)	$8,842,640	$10,030,000	$18,872,640
North East Township	33 (12.5%)	$2,446,500	$3,240,300	$5,686,800
Springfield Township	17 (6.4%)	$5,619,500	$4,635,300	$10,254,800
TOTAL	**265**	**$26,959,950**	**$38,742,850**	**$65,702,800**

Based on results from this assessment, 265 structures along the Lake Erie shoreline are considered at risk of significant damage or complete destruction from coastal erosion over the next 100 years. These buildings are spread across eight municipalities with over 40% of them located in Millcreek Township. Based on 2011 tax assessment data provided by Erie County, these 265 buildings have a total value of $26,959,950. In addition, the total value of land associated with these properties and potentially at risk from coastal erosion losses equals $38,742,850.

It is imperative that residents living near the shoreline are well-educated on shoreline erosion and bluff recession hazards. Appropriate mitigation measures also need to be established to help lessen the impact of shoreline erosion, bluff recession, and flooding on coastal structures, residents, land, and wildlife.

In addition, because Lake Erie bluffs are reshaped daily by the natural forces of gravity, water, and wind, through proper land-use management practices, bluff recession can be slowed, but not prevented. Since the majority of bluff recession-related problems start at the base of the bluff as a result of wave damage, the following measures can be used to stabilize the shoreline. Note that recent events have shown these measures to be relatively ineffective in protecting bluff areas from groundwater-induced recession:

- Revetments: concrete blocks placed on banks to absorb the energy of incoming waves. These structures protect only the land immediately behind them, not adjacent areas.

- Groins: concrete structures that extend perpendicular from the shore. Groins interrupt the natural wave movement of beach sediment by trapping and retaining sand on the up-drift side of the groin.

Once the shoreline is secured, the following bluff face re-contouring and stabilization practices can be undertaken:

- Biotechnical slope protection combines the use of biodegradable wood cribbing and appropriate vegetation. The structure provides support for the bluff at a groundwater seepage area, while the vegetation absorbs the groundwater, eventually stabilizing the bluff face.
- Dewatering: intercepts groundwater before it reaches the bluff face. Wells and groundwater trenches collect groundwater and re-channel it through pipes over the bluff face to the base of the bluff.
- Vegetation: naturally and inexpensively protects the bluffs. Root systems absorb groundwater and hold the soil together. Leaves intercept the impact of raindrops and transfer water absorbed by the root systems into the atmosphere through evapotranspiration.

The PA DEP CRMP provides funding as well as technical assistance for projects located within the 77 miles of coastline and landward to the Lake Erie watershed boundary. Grant funds can be used for many types of projects including education, construction, research, planning, acquisition, and design. The program's main goal is to balance coastal land use with conservation and protection of water-related resources.

4.3.2. Drought

4.3.2.1. Location and Extent

The current climate in Pennsylvania, when compared to many other states across the U.S., is generally water-rich. However, like all other states, Pennsylvania is subject to periodic droughts that impact the Commonwealth's ability to meet all of its water needs. Droughts are regional climatic events which can impact large areas ranging from several counties in Pennsylvania to the entire mid-Atlantic region. While large geographic areas can be impacted by a given drought, areas with extensive agricultural land use can experience particularly significant impacts.

4.3.2.2. Range of Magnitude

Droughts can have varying effects, depending upon what month they occur, severity, duration and location. Some droughts may have their greatest impact on agriculture and even short-term droughts, when coupled with extreme temperatures can be devastating. Others may impact water supply or other water use activities such as recreation. Most droughts cause direct impacts to aquatic resources. Drought events are defined by rainfall amounts, vegetation conditions, soil-moisture conditions, water levels in reservoirs, stream flow, agricultural productivity, or economic impacts.

Hydrologic drought events result in a reduction of stream flows, reduction of lake/reservoir storage, and reduced groundwater levels. These events have a significant adverse impact 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. Severe drought events may require prioritization of water uses, with essential uses taking precedent and access to water for other uses restricted or denied altogether. Conversations should take place to prepare for a scenario like this.

PEMA has primary responsibility for managing droughts with direct support from PA DEP. According to *Drought Management in Pennsylvania* (2018), PEMA and PA DEP use the following three stages to describe and manage droughts. They are listed in order of increasing severity:

- **Drought Watch:** A period to alert government agencies, public water suppliers, water users and the public regarding the potential for future drought-related problems. When three or more drought indicators are present for a county or group of counties, PEMA convenes a meeting of the Commonwealth Drought Task Force. The Commonwealth Drought Task Force includes representatives from federal, interstate, and state agency who would be potentially impacted by droughts or drought management operations. Informed by Task Force recommendations and direction from the Governor, the Secretary of the DEP may issue a drought watch on behalf of the Governor The focus of a drought watch is on increased monitoring, awareness and preparation for response if conditions worsen. A

request for voluntary water conservation is made. The objective of voluntary water conservation measures during a drought watch is to reduce water uses by 5-10 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.

- **Drought Warning:** This phase involves a coordinated response to imminent drought conditions and potential water supply shortages through concerted voluntary conservation measures to avoid or reduce shortages, relieve stressed sources, develop new sources, and if possible, forestall the need to impose mandatory water use restrictions. The objective of voluntary water conservation measures during a drought warning is to reduce overall water uses by 10-15 percent in the affected areas. Due to varying conditions, individual water suppliers or municipalities may be asking for more stringent conservation actions.

- **Drought Emergency:** This stage is a phase of concerted management operations to marshal all available resources to respond to actual emergency conditions, to avoid depletion of water sources, to assure at least minimum water supplies to protect public health and safety, to support essential and high priority water uses and to avoid unnecessary economic dislocations. It is possible during this phase to impose mandatory restrictions on non-essential water uses that are provided in the Pennsylvania Code (Chapter 119), if deemed necessary and if ordered by the Governor of Pennsylvania. The objective of water use restrictions (mandatory or voluntary) and other conservation measures during this phase is to reduce consumptive water use in the affected area by up to 25 percent, and to reduce total use to the extent necessary to preserve public water system supplies, to avoid or mitigate local or area shortages and to assure equitable sharing of limited supplies.

Although not a drought phase, a public water supplier or local municipality may, with the approval of the Commonwealth Drought Coordinator, 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 the Pennsylvania 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.

The PA DEP is responsible for drought monitoring and reviews drought indicators on a routine basis to identify developing drought conditions. The PA DEP uses five indicators to assess drought conditions: 1) Precipitation Deficits (the percentage difference between current rainfall conditions and the average), 2) Stream Flow (the percentile difference between current and historic stream flow gage measurements), 3) Groundwater Level (percentile indicating how much time the groundwater levels have been below the historical average levels), 4) Soil Moisture (as measured by the Palmer Drought Severity Index), and 5) Reservoir Storage (percentages of storage draw down).

Precipitation Deficits

Because rainfall provides the basis for ground and surface water resources, measuring the difference in precipitation from the normal (30-year average) tends to be the earliest indicator that a drought is possible in an area. The PA DEP will compare the cumulative precipitation by county for varying time periods (minimum of 3 months, maximum of 12 months) each month against the normal, 30-year average value for each same time-period. Any duration that has less than the normal is considered to have had a deficit, represented by a percentage of the normal precipitation (PA DEP, 2018b). Table 4.3.2-1 shows what the deficit values need to be for each time period in order to qualify for each drought stage.

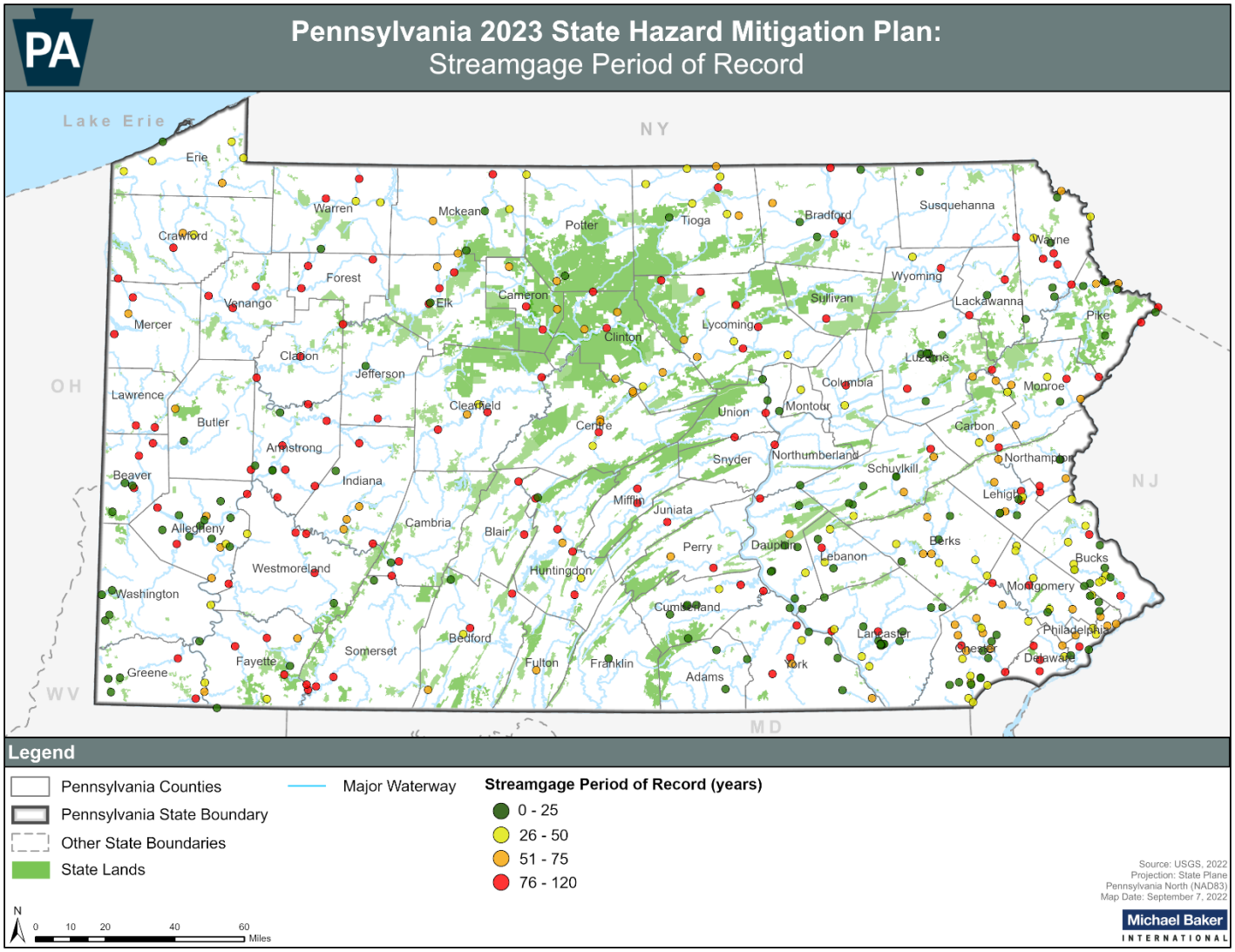
Table 4.3.2-1 Precipitation Deficit Drought Indicators for Pennsylvania (PA DEP, 2018b)

DURATION OF DEFICIT ACCUMULATION (MONTHS)	DROUGHT WATCH (DEFICIT AS PERCENT OF NORMAL PRECIPITATION)	DROUGHT WARNING (DEFICIT AS PERCENT OF NORMAL PRECIPITATION)	DROUGHT EMERGENCY (DEFICIT AS PERCENT OF NORMAL PRECIPITATION)
3	25	35	45
4	20	30	40
5	20	30	40
6	20	30	40
7	18.5	28.5	38.5
8	17.5	27.5	37.5
9	16.5	26.5	36.5
10	15	25	35
11	15	25	35
12	15	25	35

Stream Flows

The next earliest indicator that a drought is developing is stream flow measurements. Figure 4.3.2-1 shows the 61 USGS stream gages that the DEP currently uses to monitor droughts across the state. The DEP calculates and maintains 30-day average values for stream flow by gage and compares it to the entire recording period for each gage. Compared to precipitation, stream flow measurements lag by about a month or two when signaling a drought. For example, the Susquehanna River gage at Harrisburg has more than 110 years of record from which the long-term 30-day average, or normal, flows are now determined.

Figure 4.3.2-1 Stream Gage Locations and Period of Record (USGS, 2022a).



Drought status is determined from stream flows based on percentiles, or exceedances, rather than percentages. Exceedances are complimentary to percentiles; a 75-percent exceedance flow value means that the current 30-day average flow is exceeded in the stream 75-percent of the time; in other words, the 30-day average flow in the stream is less than that value only 25-percent of the time. Similarly, with a 90-percent exceedance flow value, the 30-day average flows in the stream would be less than that value only 10-percent of the time, and only 5-percent of the time for a 95-percent exceedance. A drought watch is indicated by a 30-day average flow having a percentile range of 10 to 25. A drought warning is indicated by a 5 to 10 percentile range, and a drought emergency is a 0 to 5 percentile range (PA DEP, 2018b).

Groundwater Levels

There is about 80 trillion gallons of groundwater stored in the soil beneath Pennsylvania. As a result, it may take several months for precipitation deficits to be reflected in groundwater levels; this is known at the storage effect. Groundwater levels for each day are used to calculate the average level of the preceding 30 days. This 30-day value is compared to the values derived from historical records yielding a percentile indicating how much time the groundwater levels have been below the historical average levels. The USGS also maintains a network of groundwater monitoring wells. Because USGS observation wells with adequate historical records do not exist in every county in the Commonwealth, surrogate wells are used when needed. Groundwater is used to indicate drought status in a manner similar to stream flows. Groundwater percentile ranges of 10 to 25, 5 to 10, and 0 to 5 are used to indicate watch, warning and emergency status, respectively. In this case, it is the 30-day average depth to groundwater that is measured and monitored, again in relation to long-term 30-day averages based on the period of record for each county well. An example of the monitoring performed by other agencies and utilized by the Commonwealth is shown for Bucks County at: BK 929 Bucks County Observation Well - USGS Water Data for the Nation (USGS, 2022b).

Soil Moisture

Soil moisture is measured using the Palmer Drought Severity Index (PDSI). PDSI is compiled by the Climate Prediction Center of the National Weather Service on a weekly basis based a number of meteorological and hydrological factors. A PDSI of -4.00 or less indicates a drought emergency; a value between -3.00 and -3.99 indicates a drought warning, and a value between -2.00 and -2.99 indicates a drought watch (PA DEP, 2018b).

Reservoir Storage Levels

Water level storage in several large public water supply reservoirs (especially three New York City reservoirs in the Upper Delaware River Basin) is the fifth indicator that the PA DEP uses for drought monitoring. Depending on the total quantity of storage and the length of the refill period for the various reservoirs, PA DEP uses varying percentages of storage draw down to indicate the three drought stages for each of the reservoirs.

According to the Fourth National Climate Assessment (2018), drought impacts to the Northeastern United States, which includes Pennsylvania, includes adverse effects to ecosystem function, farm economic viability, and land use. According to the National Drought

Mitigation Center at the University of Nebraska-Lincoln (2022), environmental impacts of drought include:

- Reduced water and food availability, potentially increase disease in wild animals
- Fish and wildlife habitat loss or destruction
- Wildlife migration
- Endangered species stress and potential extinction
- Lower water levels in reservoirs, lakes, and ponds
- Wetlands loss
- Increased number and severity of wildfires
- Reduced soil quality and erosion issues

Table 4.3.2-2 Most Likely Lifelines Impacted by Drought

Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and compounding relationship where the Safety and Security lifelines will require significant personnel in response, some in recovery, and mitigation as well.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, and Shelter lifeline, as crops may be lost and there is some concern over how water will be regulated in future droughts.
Health and Medical		Anticipating a cascading relationship with Health and Medical as food and water shortages could exacerbate health challenges, especially for food vulnerable populations.

Drought events are expected to impact the Safety and Security and Food, Water, and Shelter Community Lifelines. The low availability of water can place residents' safety in danger and impact the operations of the government, particularly firefighting. The dry conditions not only decrease the availability of water for use, but also creates an environment that is more conducive to fires starting and growing. Access to food and agricultural productivity are directly impacted by the lack of water.

The impacts of drought can also lead to greater risks from other hazards. One hazard that would be a cascading impact of a drought event is a water utility interruption. As stated above, the risks associated with wildfire and urban fire hazards may also be increased through drought events. In addition to creating an environment for fires to begin and thrive, drought conditions may also be beneficial to invasive species who are better equipped to survive in the new low-moisture environment or may benefit from wildfires removing native competitors. Disruptions to

agricultural operations could also lead to food or feed contaminations that would impact the food supply chain.

4.3.2.3. Past Occurrence

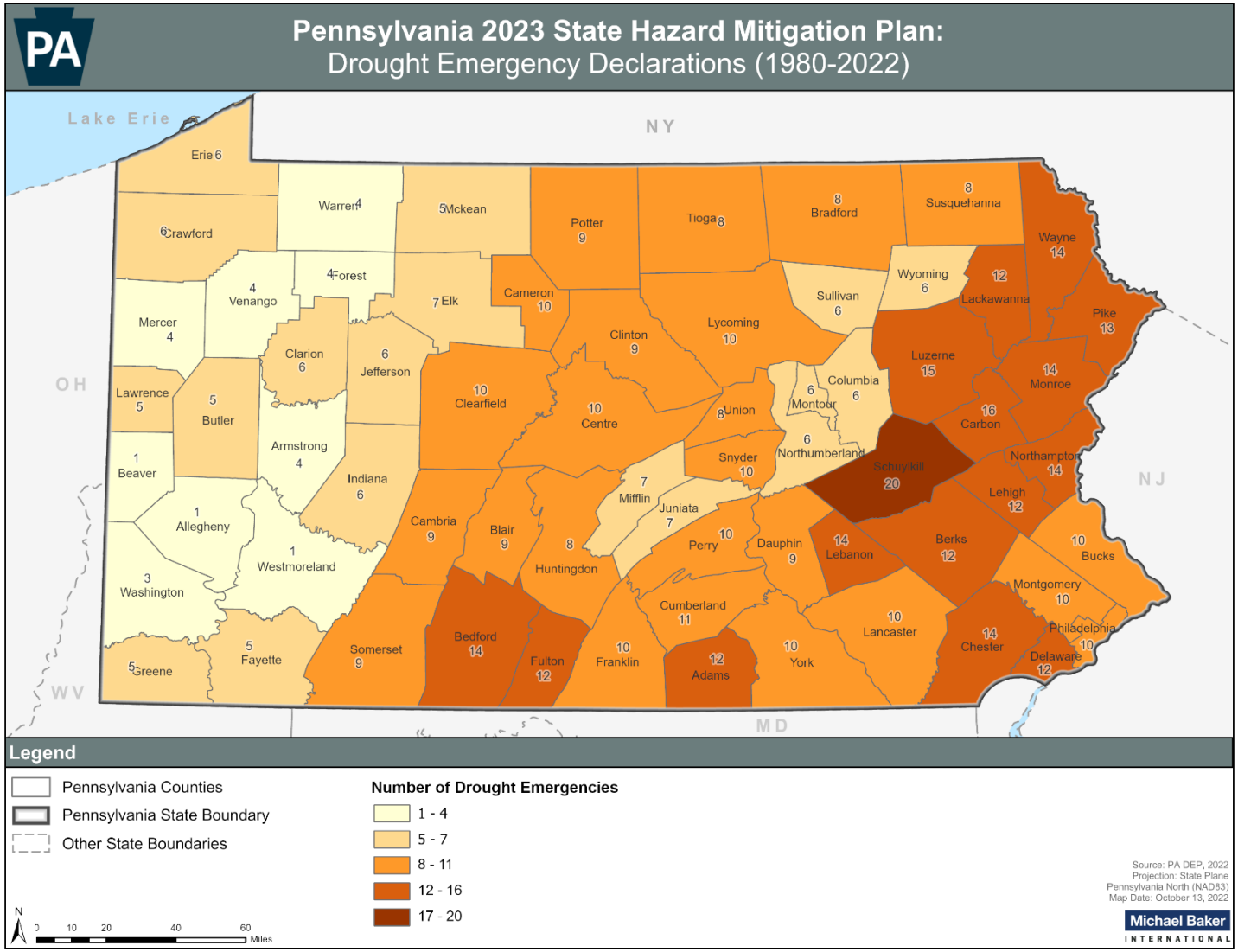
A summary of declared drought status for each county in Pennsylvania between November 1980 and February 2021 is provided in Table 4.3.2-3. Figure 4.3.2-2 shows the number of drought *emergency* declarations for each county in Pennsylvania from 1980 to February 2021.

Table 4.3.2-3 Summary of Declared Drought Status from 1980 to 2021 by County (PA DEP, 2022d).

COUNTY	TOTAL DROUGHT WATCHES	TOTAL DROUGHT WARNINGS	TOTAL DROUGHT EMERGENCIES
Adams	24	14	12
Allegheny	20	13	1
Armstrong	27	11	4
Beaver	25	11	1
Bedford	24	13	14
Berks	22	20	12
Blair	33	10	9
Bradford	35	10	8
Bucks	16	22	10
Butler	28	10	5
Cambria	31	12	9
Cameron	31	13	10
Carbon	21	17	16
Centre	32	14	10
Chester	19	18	14
Clarion	24	12	6
Clearfield	29	13	10
Clinton	29	18	9
Columbia	27	15	6
Crawford	26	8	6
Cumberland	29	14	11
Dauphin	28	12	9
Delaware	17	19	12
Elk	35	8	7
Erie	30	9	6
Fayette	24	9	5
Forest	32	8	4
Franklin	26	13	10
Fulton	28	11	12
Greene	26	9	5
Huntingdon	29	14	8

Table 4.3.2-3 Summary of Declared Drought Status from 1980 to 2021 by County (PA DEP, 2022d).			
COUNTY	TOTAL DROUGHT WATCHES	TOTAL DROUGHT WARNINGS	TOTAL DROUGHT EMERGENCIES
Indiana	32	11	6
Jefferson	24	11	6
Juniata	34	16	7
Lackawanna	19	15	12
Lancaster	24	16	10
Lawrence	26	10	5
Lebanon	20	19	14
Lehigh	18	21	12
Luzerne	22	16	15
Lycoming	35	10	10
McKean	32	13	4
Mercer	30	10	4
Mifflin	32	14	7
Monroe	21	16	14
Montgomery	14	23	10
Montour	30	16	6
Northampton	17	21	14
Northumberland	29	17	6
Perry	31	15	9
Philadelphia	14	23	10
Pike	20	16	13
Potter	29	18	9
Schuylkill	21	17	20
Snyder	30	15	10
Somerset	21	9	9
Sullivan	34	11	6
Susquehanna	25	10	8
Tioga	33	10	8
Union	33	15	8
Venango	28	7	4
Warren	28	9	4
Washington	26	10	3
Wayne	20	14	14
Westmoreland	22	10	1
Wyoming	31	11	6
York	26	14	10

Figure 4.3.2-2 Number of Emergency Drought Declarations in Pennsylvania by County between 1980 and 2022 (PA DEP, 2022d).



Instrumental records of drought for the United States extend back to 1895 (NOAA NIDIS, n.d.a). These records can only provide a limited picture of the size and severity of historical droughts or the factors that affect drought variability (NOAA NCEI, n.d.a). As droughts continue to have increasingly costly and devastating impacts on our society, economy and environment, it is becoming even more important to put the severe droughts of the 20th-century into a long-term perspective. This perspective can be gained through the use of paleoclimatic records of drought. Paleoclimatology data are derived from natural sources such as tree rings, ice cores, corals, and ocean and lake sediments and help scientists understand natural climate variability and future climate change (NOAA NIDIS, n.d.a).

NOAA NCEI uses tree-ring data to create a more complete picture of drought variability by extending beyond the instrumental record and contextualizing instrumental period droughts within a longer time frame (NOAA NCEI, n.d.b). For example, the Living Blended Drought Atlas (LBDA) - Version 2 provides insight into drought variability in North America including past megadroughts of unprecedented duration in the West and Mississippi Valley about 1,000 years ago (NOAA NCEI, n.d.b). This data indicates that we should be aware of the possibility of such droughts occurring in the future as well. The occurrence of such sustained drought conditions today would be a natural disaster of a magnitude unprecedented in the 20th century. Although severe droughts have occurred in the 20th century, a more long-term look at past droughts, when climate conditions appear to have been similar to today, indicates that 20th century droughts do not represent the possible range of drought variability.

4.3.2.4. Future Occurrence

It is difficult to forecast future drought events in Pennsylvania. According to the Pennsylvania Climate Impacts Assessment (2021), PDSI data for Pennsylvania from 1971 to 2020 indicates that drought conditions have decreased in the past 20 years relative to the most recent 30-year average. Even though the Commonwealth has experienced more precipitation and wet months, drought conditions persist.

In addition, based on data from 2000 to 2017, drought frequency by census tract shows the number of drought events as reported by the U.S. Drought Monitor (see Figure 4.3.2-3).

Please note, the data in Figure 4.3.2-3 shows the number of drought events over a 18-year period, while the data in Figure 4.3.2-2 shows the total number of drought emergencies by county for a 29-year period. The data was collected by different agencies using different periods of time and units of measurement. Combined this analysis suggests the Southeastern portion of the Commonwealth has the highest risk of drought. Since the data is based on different sources and methodologies, it should be considered as providing complementary information about drought risk in Pennsylvania. Overall, though, with all of the Commonwealth being in moderate or greater drought less than 7% of the time, the probability of future droughts is considered low but possible.

There is less consensus about precipitation changes than temperature changes among climate models. Despite these limitations, downscaled climate model data for the Commonwealth cited in the Pennsylvania Climate Impacts Assessment (2021) provides insight into potential future drought conditions. Climate models indicate that Pennsylvania could experience a slight

increase in drought conditions despite an overall increase in precipitation. Increasing temperatures are expected to reduce water availability. Consecutive dry days will increase over the century. Climate models project a 7% increase in consecutive dry days by mid-century and an 11% increase by the end of the century. Increased evapotranspiration due to higher temperatures is projected to create surface soil moisture deficits (Wehner et al. 2017) for much of the United States, but there is low confidence in seasonal precipitation deficits other than the Southwest. It is likely that agricultural droughts will occur more frequently and with higher magnitude with increased evapotranspiration especially in the late summer and early fall (see Figure 4.3.2-4 from the Fourth National Climate Assessment showing projected changes in soil moisture by the end of the century).

Figure 4.3.2-3 Total Reported Drought Events per Census Tract (FEMA NRI, 2021).

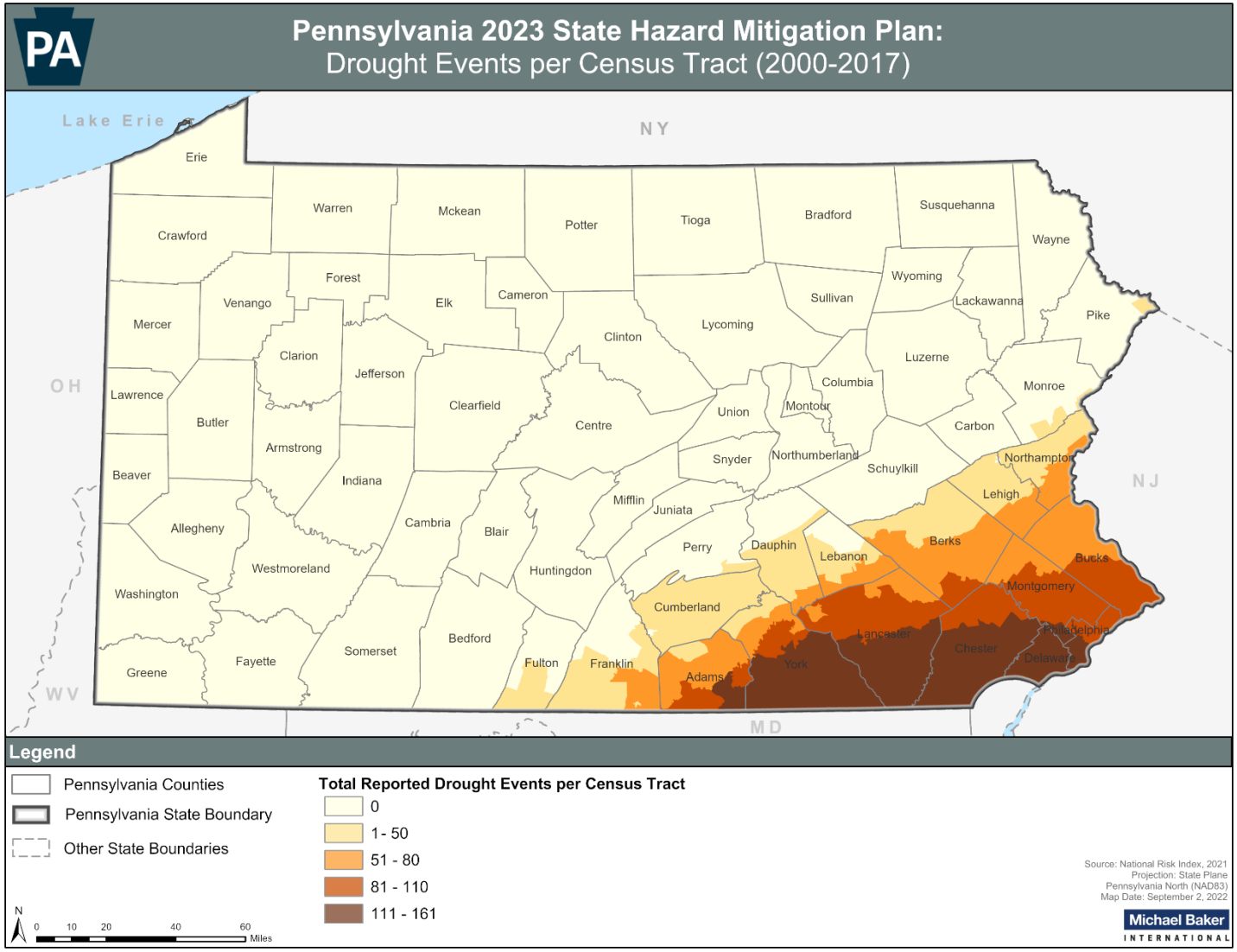
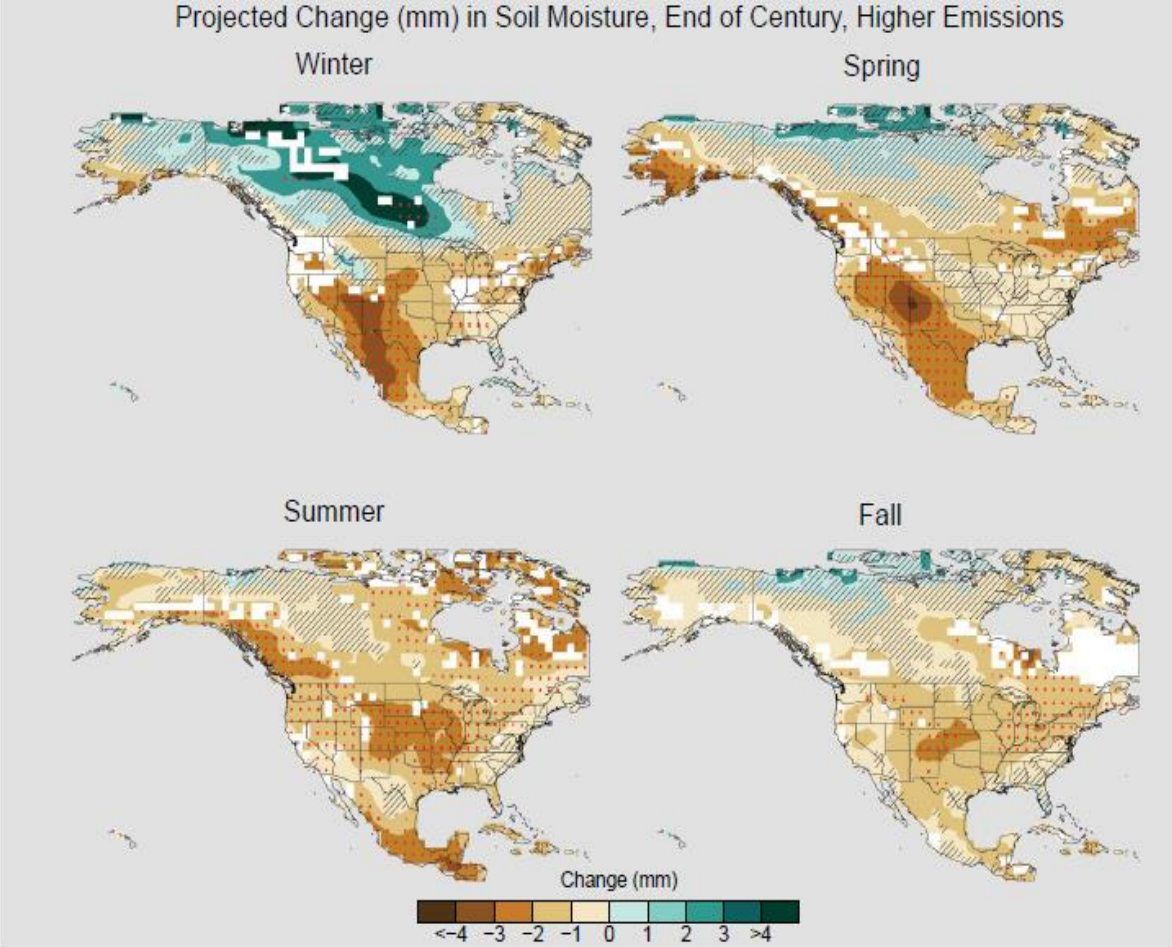


Figure 4.3.2-4 **Average Percent Changes in Surface Soil Moisture by the End of the Century Using CMIP5 Model Under RCP8.5 Scenario. Hashes Indicate Changes are Small Compared to Natural while Stippling Show Changes that are Larger than Natural Variation.**



4.3.2.5. State Facility Vulnerability Assessment and Loss Estimation

Drought does not pose a direct threat to state critical facility buildings – it affects land and water supply. Therefore, type, rather than location, was used to determine the vulnerability of state facilities to drought.

All critical facilities with type “agriculture” were determined to be vulnerable to drought, but no other types. There are 275 food and agriculture-related critical facilities, including seed producers, dairies, and other food producers; it can be expected that droughts will have either a direct effect on all critical facilities in this category by hindering production or an indirect effect by increasing the cost of food production inputs. The value for all these critical facilities, so a loss estimation could not be determined.

For state-owned or leased facilities, vulnerable structures were identified if the building use was “agricultural - animal facility”, “agricultural - nursery/greenhouse”, “agricultural – storage”, and/or

"land". There are 30 state facilities that are vulnerable to drought. This includes 38 percent of the structures owned or leased by the PA Department of Agriculture, and 9 structures of the Fish and Boat Commission. These facilities have a combined replacement value of over $10 million, which is less than 1 percent of the value of all state facilities. Nearly all of these facilities are owned by the state, with 29 of 30 reported as owned from the DGS inventory, totaling approximately 1.17 million building square footage The vulnerable state-owned or lease buildings are broken down by department in Table 4.3.2-4.

Table 4.3.2-4 Vulnerability of State Facilities to Drought.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	0	0%		
Department of Agriculture	6	38%	6	1,101,840
Department of Banking and Securities	0	0%		
Department of Community and Economic Development	0	0%		
Department of Conservation and Natural Resources	0	0%		
Department of Corrections	12	2%	12	36,533
Department of Education	0	0%		
Department of Environmental Protection	0	0%		
Department of General Services	2	2%	2	3,016
Department of Health	0	0%		
Department of Labor and Industry	0	0%		
Department of Military and Veterans Affairs	0	0%		
Department of Public Welfare	1	1%	0	0
Department of Revenue	0	0%		
Department of Transportation	0	0%		

Table 4.3.2-4 Vulnerability of State Facilities to Drought.				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Drug and Alcohol Programs	0	0%		
Emergency Management Agency	0	0%		
Executive Offices	0	0%		
Fish and Boat Commission	9	6%	9	26,333
Governor's Office	0	0%		
Historical and Museum Commission	0	0%		
Insurance Department	0	0%		
Liquor Control Board	0	0%		
Public School Employees' Retirement System	0	0%		
State Civil Service Commission	0	0%		
State Department	0	0%		
State Employees' Retirement System	0	0%		
State Police	0	0%		
State System of Higher Education	0	0%		
Thaddeus Stevens College of Technology	0	0%		
Treasury Department	0	0%		
Total	**30**	**1%**	**29**	**1,167,722**

4.3.2.6. Jurisdictional Vulnerability Assessment and Loss Estimation

As a hazard, droughts primarily impact water supply and agricultural land. Areas of the Commonwealth that rely on private wells are more impacted by water supply reductions than areas of the Commonwealth that rely on public water supply; frequently, these areas reliant on groundwater wells are more rural in nature. Table 4.3.2-3 shows the number of groundwater wells per county in Pennsylvania as reported to the Pennsylvania Groundwater Information System (PaGWIS). PaGWIS relies on voluntary submissions of well record data by well drillers; as a result, it is the best available data but is not completely comprehensive.

Table 4.3.2-5 Water Wells by County (PA DCNR, 2022d).

COUNTY	TOTAL WATER WELLS	COUNTY	TOTAL WATER WELLS
Adams	10,238	Lackawanna	8,198
Allegheny	6,583	Lancaster	39,698
Armstrong	2,178	Lawrence	6,575
Beaver	6,108	Lebanon	10,697
Bedford	9,665	Lehigh	13,421
Berks	22,654	Luzerne	9,255
Blair	5,453	Lycoming	7,250
Bradford	7,968	McKean	1,568
Bucks	25,041	Mercer	8,244
Butler	13,606	Mifflin	2,203
Cambria	6,870	Monroe	30,733
Cameron	731	Montgomery	24,463
Carbon	10,556	Montour	2,005
Centre	5,506	Northampton	11,612
Chester	48,633	Northumberland	3,845
Clarion	2,747	Perry	5,995
Clearfield	3,537	Philadelphia	8,679
Clinton	3,250	Pike	8,588
Columbia	2,916	Potter	4,090
Crawford	9,184	Schuylkill	8,312
Cumberland	16,172	Snyder	3,744
Dauphin	13,768	Somerset	4,191
Delaware	7,086	Sullivan	1,217
Elk	1,730	Susquehanna	6,348
Erie	9,811	Tioga	5,221
Fayette	1,891	Union	3,824
Forest	1,706	Venango	5,765
Franklin	13,402	Warren	3,525
Fulton	3,273	Washington	5,728
Greene	2,605	Wayne	5,803
Huntingdon	4,688	Westmoreland	8,421
Indiana	7,803	Wyoming	3,385
Jefferson	4,516	York	32,737
Juniata	1,901		
GRAND TOTAL – REPORTED WATER WELLS			***599,116***

For vulnerable populations, census tracts that recorded more than 110 drought events between 2000 and 2017 were counted as areas at high risk to drought. The populations of those entire census blocks are considered the vulnerable population. As shown in Table 4.3.2-6 about 17% of the state's population is vulnerable to drought, including the counties stretching from Philadelphia County to Adams County (Philadelphia, Chester, Delaware, Lancaster, York, and Adams).

Table 4.3.2-6 Estimated Populations Vulnerable to Drought in Each County.

COUNTY	VULNERABLE POPULATION	% OF TOTAL POPULATION
Adams	28,162	27%
Allegheny		0%
Armstrong		0%
Beaver		0%
Bedford		0%
Berks		0%
Blair		0%
Bradford		0%
Bucks		0%
Butler		0%
Cambria		0%
Cameron		0%
Carbon		0%
Centre		0%
Chester	427,620	80%
Clarion		0%
Clearfield		0%
Clinton		0%
Columbia		0%
Crawford		0%
Cumberland		0%
Dauphin		0%
Delaware	576,352	100%
Elk		0%
Erie		0%
Fayette		0%
Forest		0%
Franklin		0%
Fulton		0%
Greene		0%
Huntingdon		0%
Indiana		0%

Table 4.3.2-6 Estimated Populations Vulnerable to Drought in Each County.

COUNTY	VULNERABLE POPULATION	% OF TOTAL POPULATION
Jefferson		0%
Juniata		0%
Lackawanna		0%
Lancaster	138,042	25%
Lawrence		0%
Lebanon		0%
Lehigh		0%
Luzerne		0%
Lycoming		0%
McKean		0%
Mercer		0%
Mifflin		0%
Monroe		0%
Montgomery	73,138	9%
Montour		0%
Northampton		0%
Northumberland		0%
Perry		0%
Philadelphia	683,061	43%
Pike		0%
Potter		0%
Schuylkill		0%
Snyder		0%
Somerset		0%
Sullivan		0%
Susquehanna		0%
Tioga		0%
Union		0%
Venango		0%
Warren		0%
Washington		0%
Wayne		0%
Westmoreland		0%
Wyoming		0%
York	330,611	72%
Total	**2,256,986**	**17%**

Everyone is impacted by the effects of water supply reductions, but jurisdictions with large amounts of farmland and high agricultural yields are more likely to be affected by drought hazards. According to the 2017 US Department of Agriculture Agricultural Census, Pennsylvania sold over $7.8 billion worth of agricultural products. This census is released every five years, and the 2022 data is expected to be released in 2024. The top ten counties for agricultural production in the state are as follows:

1. Lancaster County (19.4% of state total sales)
2. Chester County (9.2% of state total sales)
3. Berks County (7.1% of state total sales)
4. Franklin County (6.1% of state total sales)
5. Lebanon County (4.5% of state total sales)
6. York County (3.4% of state total sales)
7. Cumberland County (2.8 % of state total sales)
8. Adams County (2.7% of state total sales)
9. Snyder County (2.6% of state total sales)
10. Perry County (2.2% of state total sales)

Normal precipitation estimates for the period 1991-2020 are available for National Weather Service offices and principal climatological stations through the NOAA. In addition, precipitation normals for select cities throughout the Commonwealth for the period 1991-2020 are available (Table 4.3.2-4). Of the eight areas listed, Pittsburgh and Avoca, PA typically experience the lowest levels of precipitation annually.

Table 4.3.2-7 Monthly and Annual Precipitation Normals for Select Cities in Pennsylvania, 1991 - 2020 (NOAA, 2021)

CITY	PRECIPITATION DEPTH (INCHES)												
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
Allentown, PA	3.3	2.77	3.63	3.67	3.65	4.4	5.3	4.56	4.84	4.14	3.24	3.86	47.36
Erie, PA	3.41	2.52	3.08	3.47	3.5	3.7	3.33	3.35	4.32	4.38	3.75	4.17	42.98
Harrisburg, PA	2.64	2.36	3.35	3.7	3.48	3.72	4.3	3.68	4.12	3.68	2.8	3.15	40.98
Philadelphia, PA	3.13	2.75	3.96	3.47	3.34	4.04	4.38	4.29	4.4	3.47	2.91	3.97	44.11
Pittsburgh, PA	2.96	2.62	3.15	3.32	3.83	4.12	4.26	3.52	3.3	2.83	2.86	2.84	39.61
Reading	2.97	2.61	3.53	3.35	3.51	4.77	4.77	4.49	4.88	3.8	3.02	3.51	45.21

Table 4.3.2-7	Monthly and Annual Precipitation Normals for Select Cities in Pennsylvania, 1991 - 2020 (NOAA, 2021)												
CITY	PRECIPITATION DEPTH (INCHES)												
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
Wilkes-Barre Scranton International Airport (Avaca, PA)	2.59	2.07	2.77	3.26	3.26	3.8	3.61	3.85	4.15	3.71	2.85	2.8	38.72
Williamsport, PA	2.99	2.39	3.29	3.62	3.83	3.92	4.3	3.8	4.54	3.69	3.09	3.26	42.72

Jurisdictional loss estimation stems from lost agricultural revenues statewide. Since droughts are large-scale, regional events that are likely to impact an entire county at a time, all agricultural yields in each county are potentially threatened by drought hazards. Table 4.3.2-8 enumerates each county's acreage of land contained in farms as well as the annual market value of all agricultural products sold, from 2017.

Table 4.3.2-8	Estimated Jurisdictional Losses Relating to Agricultural Production (USDA, Census of Agriculture, 2017).	
COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Adams	166,227	$207,566,000
Allegheny	28,970	$13,743,000
Armstrong	126,655	$39,768,000
Beaver	53,832	$23,653,000
Bedford	222,224	$115,273,000
Berks	224,722	$554,656,000
Blair	78,923	$107,178,000
Bradford	303,601	$132,640,000
Bucks	77,255	$75,757,000
Butler	133,954	$49,522,000
Cambria	79,341	$30,069,000
Cameron	5,278	$523,000
Carbon	19,498	$13,029,000
Centre	149,858	$91,478,000
Chester	150,514	$712,468,000
Clarion	100,344	$27,670,000
Clearfield	60,957	$28,670,000
Clinton	40,057	$45,561,000
Columbia	106,748	$67,287,000

Table 4.3.2-8 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA, Census of Agriculture, 2017).

COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Crawford	194,447	$107,270,000
Cumberland	169,654	$219,177,000
Dauphin	81,252	$93,074,000
Delaware	2,385	$9,494,000
Elk	22,982	$4,024,000
Erie	153,403	$82,040,000
Fayette	112,285	$28,836,000
Forest	4,170	$2,059,000
Franklin	269,530	$476,469,000
Fulton	100,465	$75,816,000
Greene	114,089	$16,435,000
Huntingdon	120,157	$92,132,000
Indiana	148,288	$71,985,000
Jefferson	80,411	$22,423,000
Juniata	85,640	$126,760,000
Lackawanna	36,556	$16,469,000
Lancaster	393,949	$1,507,207,000
Lawrence	82,125	$34,773,000
Lebanon	107,577	$350,804,000
Lehigh	74,511	$79,216,000
Luzerne	49,087	$17,793,000
Lycoming	186,130	$63,713,000
McKean	43,084	$5,516,000
Mercer	156,397	$65,748,000
Mifflin	80,970	$139,994,000
Monroe	27,607	$9,933,000
Montgomery	30,896	$35,374,000
Montour	38,635	$60,225,000
Northampton	59,195	$36,058,000
Northumberland	124,136	$154,583,000
Perry	114,746	$172,758,000
Philadelphia	284	$327,000
Pike	24,700	$892,000
Potter	97,780	$39,227,000
Schuylkill	96,886	$143,439,000
Snyder	98,978	$200,352,000
Somerset	219,046	$115,449,000
Sullivan	43,424	$12,182,000

Table 4.3.2-8 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA, Census of Agriculture, 2017).

COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Susquehanna	154,409	$49,775,000
Tioga	212,797	$92,255,000
Union	65,719	$147,420,000
Venango	53,338	$14,781,000
Warren	68,153	$21,257,000
Washington	190,447	$36,999,000
Wayne	100,696	$29,371,000
Westmoreland	144,278	$66,320,000
Wyoming	61,303	$13,243,000
York	252,713	$260,927,000
TOTAL	***7,278,668***	***$7,758,884,000***

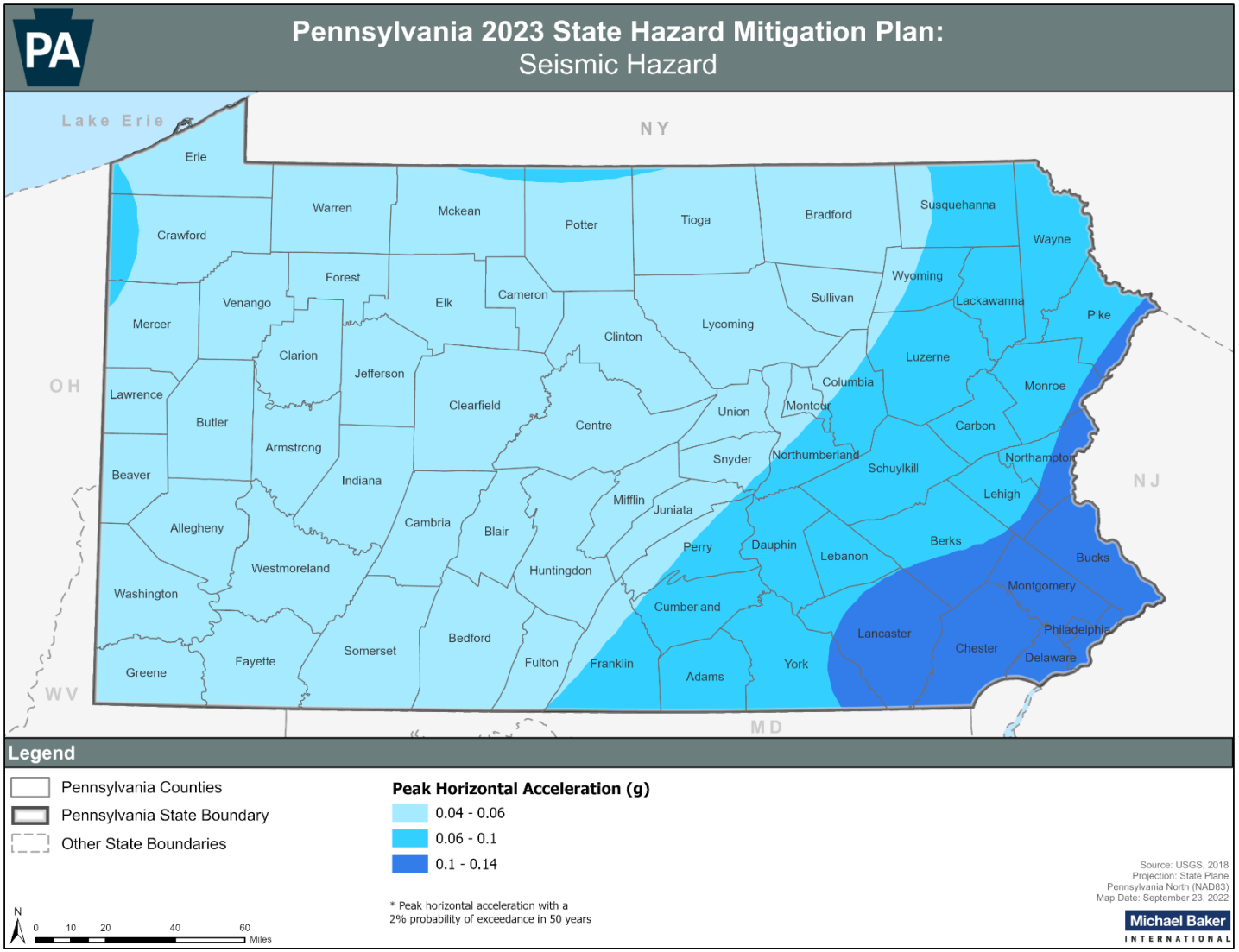
4.3.3. Earthquake

4.3.3.1. Location and Extent

An earthquake is the motion or trembling of the ground produced by sudden displacement of massive rocks called plates, usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. The impact of earthquakes can extend up to hundreds of thousands of square miles. Most earthquakes originate at faults, but not all faults are visible at the surface. Accordingly, the best guide to the distribution of earthquake hazard is often the distribution of past earthquakes (PA DCNR, 2003a). The closest fault line that might contribute to an earthquake in Pennsylvania is the Mid-Atlantic Ridge, which is approximately 2,000 miles to the east.

Earthquake events in Pennsylvania typically do not impact areas greater than 100 km from the epicenter. Pennsylvania's strongest earthquakes with in-state epicenters have persistently occurred in an area near Lancaster (PA DCNR, 2003a). Earthquakes originating from outside Pennsylvania can also impact the Commonwealth, as was the case with a magnitude 5.8 earthquake in Virginia in August 2011 (see Section 4.3.3.3). Earthquake hazards are highest in the northwestern and southeastern regions of the state, but are still possible in other areas. Historic occurrences and probabilities are discussed in upcoming section.

Figure 4.3.3-1 Relative Earthquake Hazard Zones of Pennsylvania (USGS, 2018).



Data on the focal depths of Pennsylvania earthquakes are limited. The only reliable instrumental data comes from close-in studies of aftershocks in Lancaster County and indicate an average focal depth of about 3 miles. In addition, some of the shocks that had relatively high epicentral intensities were felt over anomalously small areas, suggesting that these events were relatively shallow (PA DCNR, 2003a).

4.3.3.2. Range of Magnitude

Earthquake magnitude is often measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake. Table 4.3.3-1 summarizes Richter Scale magnitudes as they relate to the spatial extent of impacted areas. Based on historical events, earthquakes with epicenters in Pennsylvania have not exceeded a magnitude of 6.0.

Table 4.3.3-1 Richter Scale Magnitudes and Associated Earthquake Size Effects (PA DCNR, 2003a).

RICHTER MAGNITUDES	EARTHQUAKE EFFECTS
Less than 3.5	Generally, not 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 up to about 62 miles from epicenter.
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 hundreds of miles across.

The impact an earthquake event has on an area is typically measured in terms of earthquake intensity. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. A detailed description of the Modified Mercalli Intensity Scale is provided in Table 4.3.3-2. The earthquakes that occur in Pennsylvania tend to be relatively mild and cause minimal damage.

Table 4.3.3-2 Modified Mercalli Intensity Scale with Associated Impacts (PA DCNR, 2003a).			
SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
I	Instrumental	Usually detected only on seismographs.	<4.2
II	Feeble	Felt only by a few persons at rest, especially on upper floors of buildings.	
III	Slight	Felt quite noticeably indoors, especially on upper floors. Most people don't recognize it as an earthquake (i.e., a truck rumbling).	
IV	Moderate	Can be felt by people walking; dishes, windows, and doors are disturbed.	
V	Slightly Strong	Sleepers are awoken; unstable objects are overturned.	<4.8
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves; damage is slight.	<5.4
VII	Very Strong	Damage is negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, and considerable in poorly built or badly designed structures; some chimneys are broken.	<6.1
VIII	Destructive	Damage is slight in specially designed structures; considerable in ordinary, substantial buildings. Moving cars become uncontrollable; masonry fractures, poorly constructed buildings damaged.	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open; damage is considerable in specially designed structures; buildings are shifted off foundations.	
X	Disastrous	Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed along with foundations. Ground cracks profusely; liquefaction and landslides widespread.	<7.3

Table 4.3.3-2 Modified Mercalli Intensity Scale with Associated Impacts (PA DCNR, 2003a).			
SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
XI	**Very Disastrous**	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed.	<8.1
XII	**Catastrophic**	Total destruction; trees fall; lines of sight and level are distorted; ground rises and falls in waves; objects are thrown upward into the air.	>8.1

Earthquakes are also known to cause fatal loss and injury, including substantial property damages of tens of billions of dollars, while disrupting 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 the ground shaking, which is dependent upon amplitude and duration of the earthquake (PA DCNR, 2003a). Impacts to infrastructure could include train derailments, pipeline failures, and utility interruptions (Earle, 2015).

Environmental impacts of earthquakes can be numerous, widespread and devastating, particularly if indirect impacts are considered. Some secondary hazards caused by earthquakes may include fire, hazardous material release, landslides, flash flooding, avalanches, tsunamis, and dam failure (Earle, 2015). These secondary events could also result in disruptions to natural ecosystems, poor water quality, damage to vegetation, and the release of toxic materials and sewage.

The worst-case earthquake event to have occurred in Pennsylvania was the Pymatuning Earthquake in 1998. However, a potential worst-case scenario would be if a magnitude 6.1 or stronger earthquake occurred near one of Pennsylvania's nuclear facilities, as was the case in the Fukushima Earthquake in Japan in April 2011. This earthquake triggered a tsunami and multiple fires, and it also triggered a major nuclear disaster at the Fukushima Daiichi Nuclear Facility. The nuclear disaster caused permanent damage to some of the facility's reactors and disabled the- reactor cooling system, which led to releases of radioactivity and triggered a 30-km evacuation zone displacing 160,000 people during immediate evacuations in 2012. As of July 2020, over 41,000 people remained displaced due to the incident (WNA, 2022).

Table 4.3.3-3 Most Likely Lifelines Impacted by Earthquake		
Lifelines	Impact Type	Notes
Food, Water, Shelter		Anticipating causal, compounding, and cascading challenges with response and recovery, leading to complicated mitigation- for instance building water treatment plants to a higher earthquake standard.
Health and Medical		Personnel will likely be overutilized in response and recovery, leading to potential gaps in capability. As the extent is typically wide-ranging, external medical professionals and infrastructure will need to be identified, requested, trained, and then given prioritized deployment throughout the impacted area. Mitigation efforts will span workforce shortages, building health care facilities and roads to a higher standard, and decreasing supply chain disruptions.
Hazardous Materials		Anticipating a causal relationship. If a jurisdiction wants to encourage pipelines be built to a higher standard, or chemicals be stored in a more secure way, it is unclear how that mitigation would occur given the information sharing restrictions/ security.

Earthquakes can impact all seven of FEMA's Community Lifelines due to their destructive nature. All aspects of the Safety and Security lifeline are impacted as buildings may be severely damaged with residents needing assistance via police and fire departments. Government operations may be severely impacted depending on the location and severity of the event. The main impact of earthquakes is the damage to buildings, which can have both short- and long-term impacts on the availability of shelter. The Health and Medical lifeline is impacted via direct damage to health care facilities or public health impacts of contaminations. Earthquake damage can severely impact the Energy lifeline due to power outages and fuel shortages that may result either because of direct impact to facilities or the damage done to the electrical grid leading to increased usage. Damage to communications infrastructure can affect how alerts, warnings, and other messages are transmitted to the public and how 911 services operate. Transportation infrastructure is similarly at risk, specifically the use of roadways, bridges, mass transit, and railways that may be either partially impacted or destroyed. Lastly, the impact on hazardous materials is context-specific but may be very dangerous. Damage to facilities may lead to the release of contaminants, and with impacts to other lifelines the emergency response may be delayed.

The potential of earthquakes to lead or contribute to other hazards is high. Again, this potential is context-specific but the potential compounding impacts of an earthquake and additional hazards are severe. Earthquakes will likely lead to landslides, land subsidence, and structure collapses. Coastal erosion events may occur as well. Earthquakes can potentially cause flooding via damage to dams, levees, and other flood control infrastructure. Wildfires and urban fires or explosions may occur due to the cascading impacts of earthquake damage. As previously mentioned, hazardous substance releases may result depending on the location and severity of the earthquake, which may include releases from coal mines, both conventional and unconventional oil and gas wells, gas and liquid pipelines, and potentially nuclear facilities.

4.3.3.3. Past Occurrence

About 35 earthquakes have caused light damage in Pennsylvania since the beginning of the colonial period. Occasional broken windows, cracked plaster, and glassware toppled from shelves have characterized this damage. Nearly one half of these damaging events had out-of-state epicenters. Foremost among the class of distant shocks that were felt strongly in Pennsylvania were a trio of major earthquakes near New Madrid, Missouri, in 1811-12, and the Charleston, South Carolina, earthquake of 1886. More recently, a magnitude 5.8 earthquake with an epicenter in rural Louisa County, Virginia was felt throughout Pennsylvania, triggering evacuations, emergency bridge and tunnel inspections, and minor damage to buildings. This shallow earthquake occurring along the Spotsylvania Fault was felt as far north as Ontario, Canada and as far south as Alabama.

Figure 4.3.3-2 displays the location and magnitude of all earthquakes with epicenters in Pennsylvania recorded in the USGS Earthquake Catalog. This catalog includes all detectable earthquakes recorded in the Commonwealth from 1937 to October 2022. While 134 ground-shaking events were documented in this timeframe, only 18 had a magnitude of 3.0 or more. Most of these events occurred in the southeastern or far northwestern regions of the Commonwealth. Although the southeastern region is the most active, it is not known to have experienced an earthquake exceeding magnitude 4.7. However, DCNR found that “no obvious reason exists to conclude that an earthquake of magnitude between 5 and 6 could not occur there also” (PA DCNR, 2003a). The largest earthquake ever recorded, the Pymatuning Earthquake of September 25, 1998, was centered in the northwestern part of the state. The epicenter of this earthquake was near Jamestown, in Mercer County, and measured 5.1 on the Richter Scale according to DCNR’s catalog. USGS’ dataset, which was used for the map below and includes reviews by scientists, places the magnitude at 4.5. Damage reports suggested a maximum intensity of VI.

Table 4.3.3-3 shows a list of earthquakes by county from the same timeframe, also compiled by the United States Geological Survey. This list was compiled from both state and regional sources and includes 36 documented events. Since the timespan of seismic events is from 1937 to 2022, this list omits recorded seismic activity from the earlier days of our state’s history. A few notable events from this time period are discussed in the next paragraph.

Figure 4.3.3-2 Map of Earthquake Epicenters in Pennsylvania (USGS, 2022c).

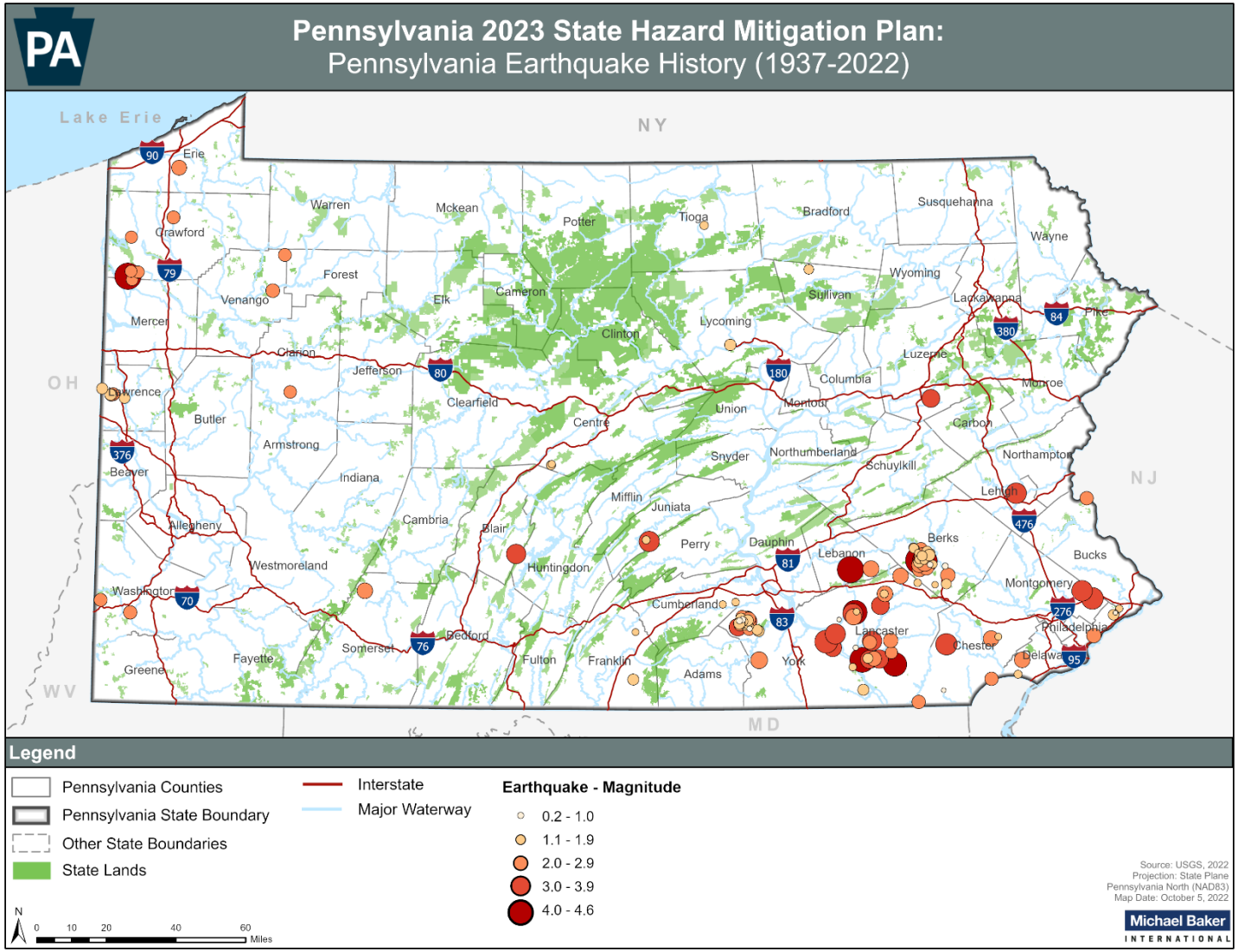


Table 4.3.3-4 Catalog of Earthquakes with Epicenters in Pennsylvania (DCNR, 2004) (USGS, 2022c)*				
COUNTY	DATE	LOCATION NEAREST EPICENTER	MAGNITUDE	INTENSITY**
Adams	05/26/1994	Biglerville	2.8	I-IV
	09/15/2019	*East Berlin*	*2.81*	*I-IV*
Berks	05/28/1906	Geigertown	unknown	III
	06/09/1937	Reading	unknown	II
	01/07/1954	Mount Pleasant	3.2	VI
	08/11/1954	Mohnton	3.3	IV
	06/25/1972	Reading	unknown	unknown
	08/12/1973	Reading	unknown	unknown
	05/10/1993	Sinking Spring	2.8	IV
	01/16/1994	Sinking Spring	4.6	V
	04/16/1994	Reading	2.3	I-IV
	05/07/1994	*Sinking Spring*	*2.5*	*I-IV*
	01/08/1995	Mohnton	2.5	I-IV
	04/08/1995	Robesonia	2.6	I-IV
	06/04/1995	Reading	2.7	I-IV
	02/03/1996	Sinking Spring	2.3	I-IV
	07/07/1996	Angelica	2.3	I-IV
	04/18/1999	Reading	1.9	I-IV
	10/22/1999	Reading	1.9	I-IV
Blair	07/15/1938	Entriken	3.3	VI
Bucks	12/27/1961	Croyden Heights	3.3	V
	05/12/1982	Penndel	2.4	II
	05/10/1984	Hatfield	2.2	I-IV
	02/02/1989	Perkasie	unknown	unknown
	05/15/1992	Milford	1.6	I-IV
	03/11/1997	Pineville	1.6	I-IV
Centre	03/25/1937	Philipsburg	unknown	unknown
	08/15/1991	Centre Hall	3	V
Chester	12/17/1752	Sadsburyville area	3.6	IV
	03/30/1990	Downingtown	1.8	I-IV
	10/17/1996	Nottingham	2.2	I-IV
	07/27/1999	Warwick	unknown	unknown
	01/25/2015	*Downingtown*	*2.64*	
Crawford	09/15/1852	Meadville	3.7	I-IV
	04/14/1985	Shermansville	3.2	I-IV
	09/25/1998	*Adamsville*	*4.5*	
	11/07/1998	Atlantic	2.3	I-IV
Delaware	12/08/1737	Media area	unknown	IV
	03/22/1763	Darby area	unknown	III

Table 4.3.3-4 Catalog of Earthquakes with Epicenters in Pennsylvania (DCNR, 2004) (USGS, 2022c)*				
COUNTY	DATE	LOCATION NEAREST EPICENTER	MAGNITUDE	INTENSITY**
	07/05/1996	Glen Mills	2.6	I-IV
Erie	09/27/1921	Erie	2.9	III
	10/29/1934	Lake Erie	3.2	V
	12/17/1990	Erie	2.5	III
	08/30/1998	Lake Erie	2.1	I-IV
	10/30/1999	Lake Erie	2.5	I-IV
Fayette	10/08/1965	Perryopolis	3.3	I-IV
Huntingdon	*07/15/1938*	*Markelsburg*	*3.3*	
	04/17/1991	*Mapleton*	*2.5*	
Lackawanna	09/27/1940	Fleetville	unknown	II
	01/22/1960	Archbald	3.4	I-IV
Lancaster	01/11/1798	Lancaster area	unknown	IV
	11/20/1800	Landisville	4.1	V
	01/27/1801	Lancaster area	unknown	IV
	03/19/1818	Lancaster area	unknown	III
	08/21/1820	Columbia	3.4	V
	05/04/1822	Lancaster area	unknown	unknown
	09/06/1829	Lancaster area	unknown	III
	02/05/1834	Quarryville	4	V
	09/17/0865	Martic Forge	unknown	unknown
	11/07/1866	Lancaster area	unknown	unknown
	03/09/1885	Lancaster area	unknown	IV
	09/27/1886	Washington Boro	unknown	IV
	12/08/1972	Akron	3.5	V
	07/06/1978	Martic Forge	3.1	V
	10/06/1978	East Petersburg	3	VI
	04/19/1984	*Conestoga*	*3*	*I-IV*
	04/23/1984	Marticville	4.2	VI
	09/19/1984	Lancaster	unknown	III
	05/02/1986	Marticville	2.5	IV
	07/03/1990	Reinholds	1.7	I-IV
	01/18/1994	Ephrata	2.6	I-IV
	05/18/1994	Strasburg	2.4	I-IV
	03/11/1995	Landisville	2.7	IV
	10/28/1996	Blainsport	2.6	I-IV
	11/14/1997	Lititz	3	IV
	03/22/2000	Lancaster	1.8	I-IV
	1/05/2000	Martic Forge	2.1	I-IV
	07/17/2001	Conestoga	1.8	I-IV

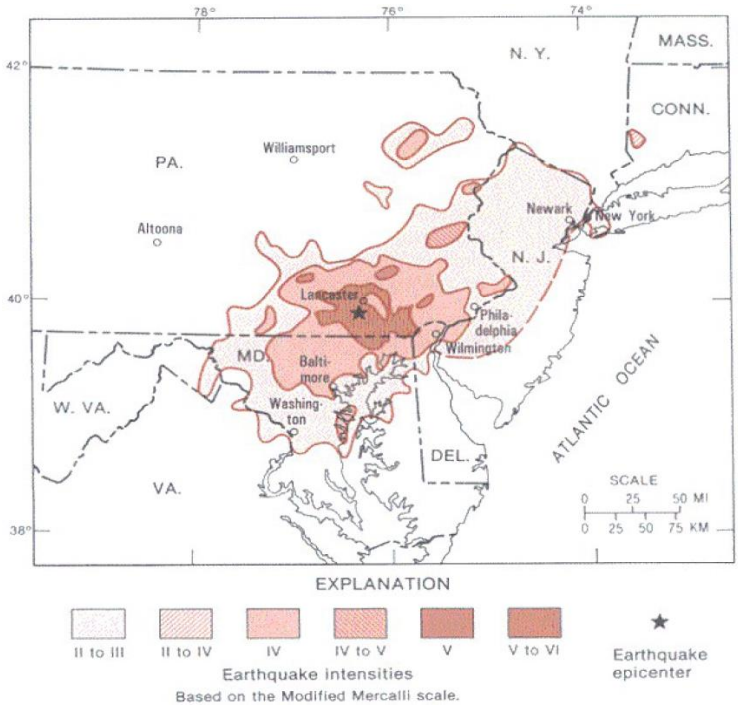
Table 4.3.3-4 Catalog of Earthquakes with Epicenters in Pennsylvania (DCNR, 2004) (USGS, 2022c)*				
COUNTY	DATE	LOCATION NEAREST EPICENTER	MAGNITUDE	INTENSITY**
	12/27/2008	*Landisville*	*3.37*	*I-IV*
Lebanon	01/15/1885	Schaefferstown	unknown	unknown
	05/12/1964	Cornwall	4.5	VI
Lehigh	05/31/1884	Allentown	unknown	V
	05/31/1908	Allentown	3.1	VI
	06/22/1928	Allentown	unknown	III
	11/23/1951	Allentown	3.3	IV
	09/15/1961	Bethlehem	4.3	V
Luzerne	*04/27/1974*	*Pardeesville*	*3*	*I-IV*
	08/15/1997	*Pardeesville*	*3*	*I-IV*
	02/24/2000	Penn Lake Park	2.3	I-IV
Lycoming	01/1/1907	SW of Williamsport	unknown	unknown
Mercer	08/17/1873	Sharon area	unknown	III
	12/15/1890	Greenville	2.9	II
	08/26/1936	Greenville	2.9	IV
	09/25/1998	Greenville (Osgood)	5.1	I-VI
Monroe	10/24/1942	Bartonsville	3.4	I-IV
Montgomery	03/05/1980	Abington (Horsham)	3.5	IV
	03/11/1980	*Willow Grove*	*3.7*	*I-IV*
Perry	*06/13/2019*	*Blain*	*3.44*	*I-IV*
Philadelphia	08/16/1724	Philadelphia area	unknown	IV
	11/27/1755	Philadelphia area	unknown	III
	03/23/1758	Philadelphia area	unknown	III
	10/30/1763	Philadelphia area	unknown	V
	04/25/1772	Philadelphia area	unknown	II
	11/22/1777	Philadelphia area	unknown	III
	11/29/1780	Philadelphia area	unknown	III
	03/17/1800	Philadelphia area	unknown	V
	11/29/1800	Philadelphia area	unknown	IV
	11/12/1801	Philadelphia area	unknown	III
	12/09/1811	Philadelphia area	unknown	III
	11/11/1840	Philadelphia area	unknown	V
Schuylkill	02/05/1944	Shenandoah	3.7	I-IV
	08/17/1955	Schuylkill Haven	1.8	I-IV
Somerset	02/03/1982	Jennerstown	2.6	III
Sullivan	10/28/1946	Forksville	3.6	I-IV
Susquehanna	08/14/1982	Hop Bottom	1.8	I-IV
Tioga	12/14/1990	Wellsboro	3	I-IV
	04/05/2018	*Liberty*	*2.6*	*I-IV*

Table 4.3.3-4 Catalog of Earthquakes with Epicenters in Pennsylvania (DCNR, 2004) (USGS, 2022c)*				
COUNTY	DATE	LOCATION NEAREST EPICENTER	MAGNITUDE	INTENSITY**
Warren	07/08/1995	Scandia	2.4	I-IV
Westmoreland	*10/06/2020*	*Bolivar*	*2.9*	*I-IV*
Wyoming	03/20/1950	Mill City	3.3	I-IV
York	03/08/1889	Wrightsville	4.3	VI
	10/06/1978	*East Prospect*	*2.93*	*I-IV*
	06/16/1997	Dillsburg	2.4	IV
	08/24/2000	York Haven	1.9	I-IV
	04/24/2009	*Franklintown*	*2.93*	*I-IV*
	10/25/2009	*Franklintown*	*2.76*	*I-IV*
	06/03/2010	*Franklintown*	*3.05*	*I-IV*
*Italicized entries identified through USGS. All other entries were identified in previous versions of the Pennsylvania State HMP.				
**Intensities listing a range were estimated based on the recorded magnitude.				

Very few earthquakes having a maximum intensity of IV or higher have been centered in areas outside the southeastern part of the Commonwealth. An earthquake shock on March 8, 1889, shook southeastern Pennsylvania, northern Maryland, and the northern tip of Delaware. Chimneys fell in Harrisburg and York, where the 1889 tremor was severe. Stover and others (1981) listed 10 historic earthquakes having maximum intensities of III or more and epicenters in the immediate vicinity of Philadelphia. The largest of these, a shock with a maximum intensity of approximately V, occurred on November 11, 1840. Small tremors in the Philadelphia area, such as the shocks on March 5 and March 11 in 1980, are often both felt and heard (Bischke, 1980). Witnesses usually describe the accompanying noise as a sonic boom or furnace explosion.

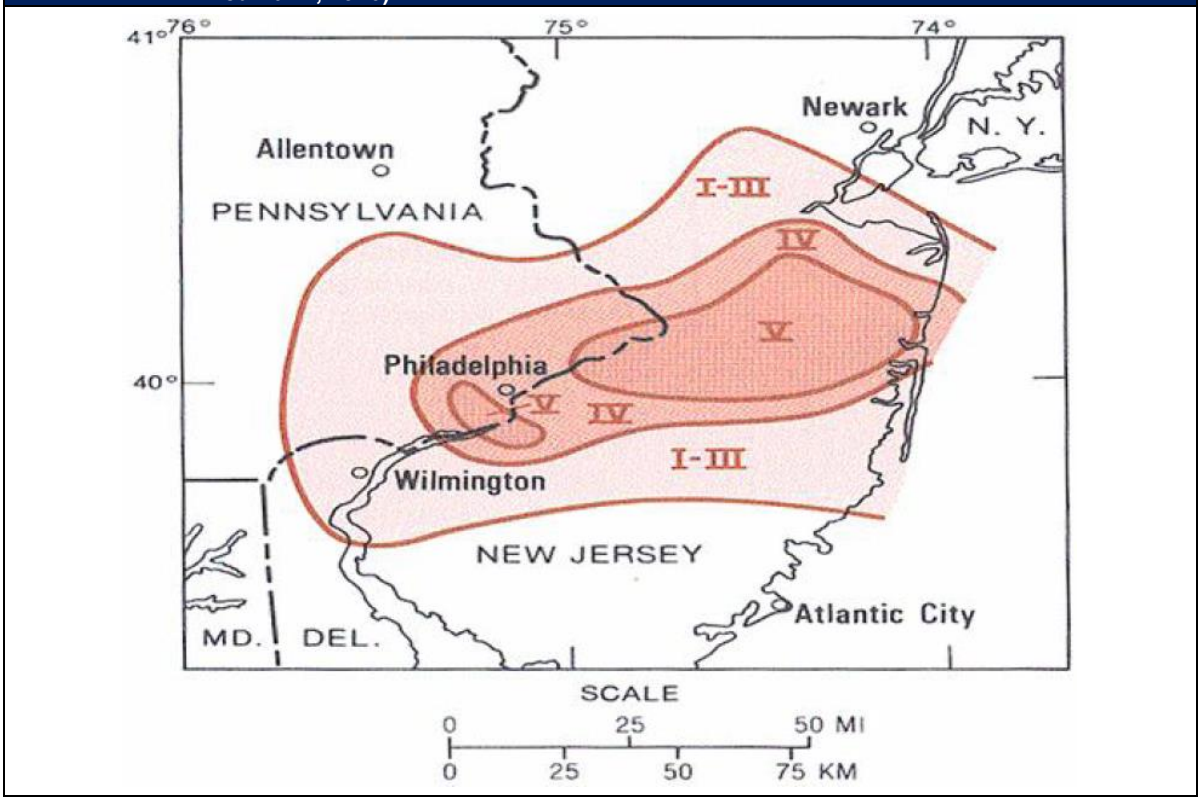
The most widely felt earthquake known to be centered in Pennsylvania occurred in the Lancaster area on April 23, 1984 (Armbruster and Seeber, 1987; Scharnberger and Howell, 1985). An isoseismal map for this event is included in Figure 4.3.3-3. More recently, an earthquake on January 16, 1994, measured 4.6 on the Richter Scale and caused damage exceeding two million dollars in the Reading area.

Figure 4.3.3-3 Isoseismal Lines of the Lancaster, PA Earthquake on April 23, 1984 (Modified from Stover, 1988).



Earthquakes whose epicenters fall outside of Pennsylvania can impact the Commonwealth as well. A cluster of historical epicenters in southeastern Pennsylvania is spatially associated with a seismic trend along the lower Delaware River, which continues in a northeasterly direction through New Jersey. One of the strongest shocks in this northeast-trending zone occurred on August 23, 1938 (see Figure 4.3.3-4). This tremor, which was centered in New Jersey about 31 miles northeast of Philadelphia, was the principal shock of a swarm of about a dozen tremors in the area that were felt in Philadelphia. The main shock of the swarm alarmed many people and broke a few windows in the Philadelphia area.

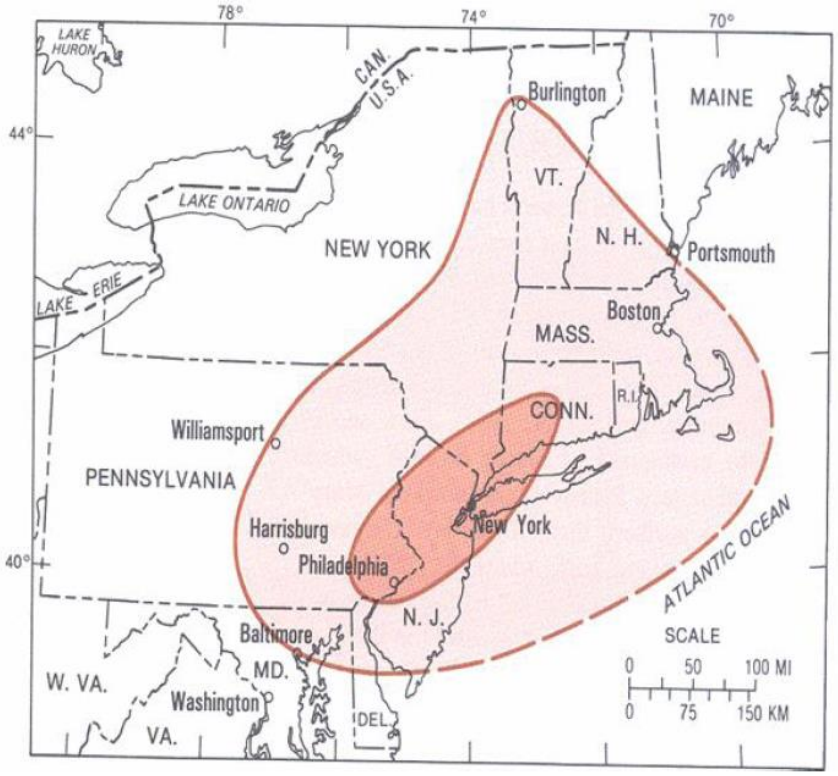
Figure 4.3.3-4 Isoseismal Lines of the New Jersey Earthquake on August 23, 1938 (Modified from Neumann, 1940).



The strongest, most widely felt shock known to have originated in the region covered by Figure 4.3.3-5 was the earthquake of August 10, 1884, which was centered in New Jersey about 50 miles northeast of Philadelphia. Contemporary newspapers contained reports that this earthquake caused a few chimneys to fall and glassware and other small objects to be upset in greater Philadelphia. Waves on the Delaware River were reported to have swamped small boats. Figure 4.3.3-5 is an adaptation of Rockwood's (1885) isoseismal map; the original map is the oldest known published isoseismal plot of a North American earthquake. The isoseismal lines in the figure exhibit southwest-northeast elongation that is characteristic of shocks in the region.

On October 9, 1871, an earthquake having a maximum intensity of VII struck Wilmington, Delaware, located about 25 miles southwest of Philadelphia. This shock, Wilmington's most famous earthquake, was felt in a northeast-trending, elliptically shaped area about 40 miles wide and 68 miles long; chimneys were thrown down in Oxford, Pennsylvania and doors and windows were rattled in Philadelphia. Another relatively strong earthquake centered near Wilmington occurred on February 28, 1973. The area characterized by intensity V, the highest intensity associated with this shock, extended northeasterly along both sides of the Delaware River to the vicinity of Philadelphia, where the shock cracked plaster and toppled glassware.

Figure 4.3.3-5 Isoseismal Lines of the New Jersey Earthquake on August 10, 1884 (Modified from a Publication by C.G. Rockwood, Jr., 1885).



4.3.3.4. Future Occurrence

The best available guides to the magnitude and frequency of seismic hazards in Pennsylvania are the probabilistic ground motion maps produced by the USGS. These maps display the intensity of ground motions for various probability levels, and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy. The latest available maps are the 2014 USGS National Seismic Hazard Maps.

While the overall impact of climate change on the frequency and impact of earthquakes is still being defined, there are some known links- such as with water table changes and the rapid movement of glaciers (NASA, 2019). Accordingly, droughts have been linked to increases in tectonic plate movement. While there are some possible (statistically insignificant) links between atmospheric pressure changes (e.g. from a hurricane) and the occurrence of an earthquake, no one has identified a direct, statistically significant correlation.

Figure 4.3.3-6 shows the peak ground acceleration (PGA) in Pennsylvania with a recurrence interval of 2,500 years (2% probability of exceedance in 50 years). PGA is expressed as a percentage of the force of gravity, or %g. Damage to buildings of poor construction generally begins at a PGA of 10% g. PGA values ranging from 10 to 14 percent, which correspond to intensities of VII, are shown in southeastern Pennsylvania. On the whole, the future probability of earthquakes in Pennsylvania can be considered *possible.*

Figure 4.3.3-6 Relative Earthquake Hazard Zones of Pennsylvania (USGS, 2018)

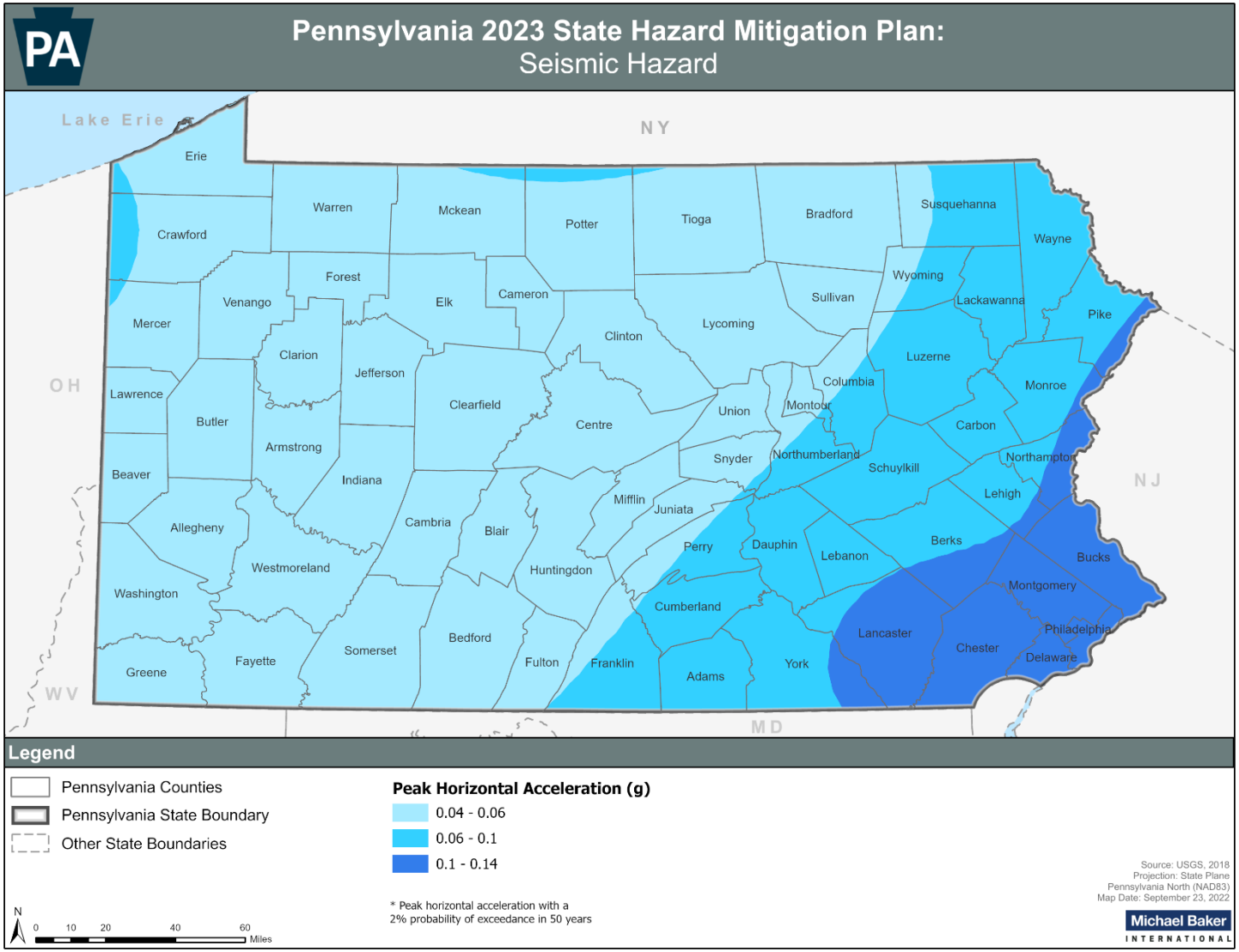
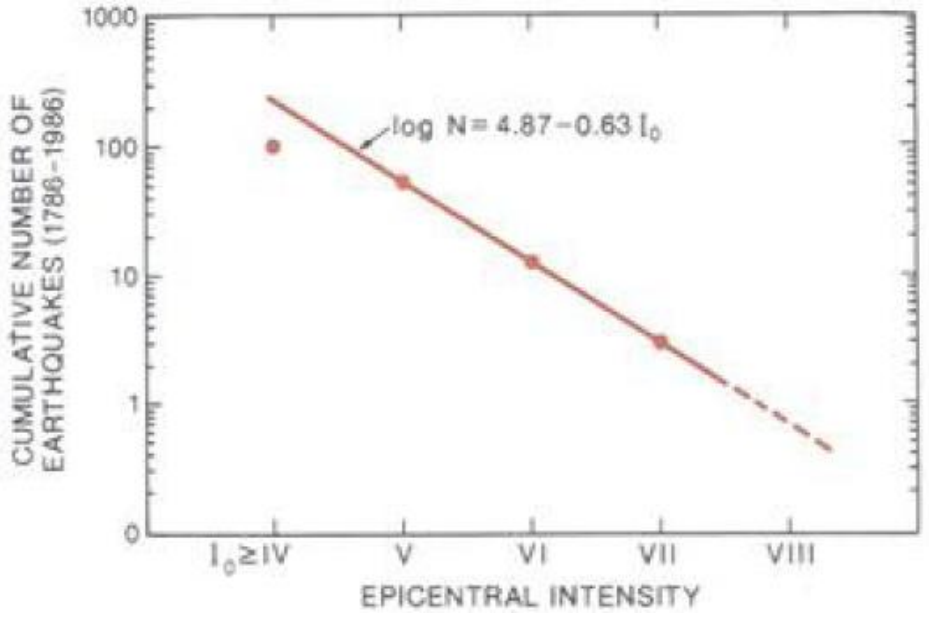


Figure 4.3.3-7 is a plot of the cumulative number (N) of earthquakes versus epicentral intensity (I_0) for the period 1786-1986 in the study region. The graph shows that there have been less earthquakes of intensity IV or lower than would be expected, which is probably due to the incomplete cataloging of intensity IV events in the eighteenth and nineteenth centuries.

Figure 4.3.3-7 Cumulative Number (N) of Earthquakes Versus Epicentral Intensity (I0) for the Period 1786 – 1986 in Pennsylvania and Adjacent Areas.



Pennsylvania has not experienced an earthquake of intensity VIII, the threshold of serious damage to ordinary structures, or greater in recorded history. It is estimated that, on average, three to four such events will take place over 1,000 years. This result is similar to Algermissen's (1969) estimate of 2.3 shocks per 100,000 km^2 [38,600 mi^2] with intensity ≥ VIII over a 1,000-year period across the East Coast. In 1979, Benjamin Howell, Jr. of Pennsylvania State University used extreme-value theory and certain assumptions about the maximum size of earthquakes in the region to estimate an average return period of between 100 and 300 years for earthquakes in Pennsylvania having a maximum intensity of VIII.

Extrapolation from the available earthquake record will be improved by a better understanding of seismogenic faults in the Commonwealth and by a more complete cataloging of the historical shocks. Felt-area estimates, magnitudes, and approximate focal depths can probably be developed for more of the pre-instrumental earthquakes. A thorough search of original sources for the eighteenth and nineteenth centuries would likely result in the discovery of many additional, previously unlisted earthquakes.

4.3.3.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to earthquakes, all structures located in areas characterized by high seismic hazard were identified. Relative earthquake hazard was derived from the 2018 USGS National Seismic

Hazard Map for the shaking event with a recurrence interval of 2,500 years (see Table 4.3.3-5). As described above, the intensity of ground-shaking is measured in terms of peak ground acceleration (PGA), and PGA is expressed as a percentage of the force of gravity (%g). For this analysis, vulnerable assets were defined as those located in areas with a PGA greater than or equal to 10% g. Note that the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 740, or 17 percent, are located in areas characterized by relatively high seismic hazard (Table 4.3.3-5). These facilities have a combined replacement value of more than $300 million, or approximately 8 percent of the known value of geolocated state facilities. Only 243 of these facilities are reported as owned by the state, with PennDOT and DGS being the majority of these vulnerable sites. The total reported building square footage of all vulnerable facilities is nearly 6.4 million.

Table 4.3.3-5 Vulnerability of State-Owned Facilities to Earthquake Events.

STATE CRITICAL FACILITY TYPE	# OF IMPACTED FACILITIES	% OF STRUCTURES FOR FACILITY TYPE	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	3	33%	0	77,511
Department of Agriculture	1	6%	0	3,398
Department of Banking and	1	50%	0	4,859
Department of Community and Economic Development		0%		
Department of Conservation and Natural Resources		0%		
Department of Corrections	19	3%	10	580,689
Department of Education	1	100%	1	0
Department of Environmental	1	8%	0	85,000
Department of General Services	45	34%	43	2,969,315
Department of Health	3	6%	0	56,161
Department of Labor and Industry	14	20%	0	171,791
Department of Military and	1	100%	0	2,500
Department of Public Welfare	26	27%	0	525,631
Department of Revenue	3	30%	0	20,115
Department of Transportation	171	10%	165	376,773
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	2	1%	2	1,504

Table 4.3.3-5 Vulnerability of State-Owned Facilities to Earthquake Events.				
STATE CRITICAL FACILITY TYPE	# OF IMPACTED FACILITIES	% OF STRUCTURES FOR FACILITY TYPE	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Governor's Office		0%		
Historical and Museum Commission	10	33%	1	2,730
Insurance Department		0%		
Liquor Control Board	181	33%	1	1,438,748
Public School Employees' Retirement System	1	17%	0	4,025
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System	1	25%	0	2,115
State Police	6	17%	0	70,142
State System of Higher Education	230	27%		
Thaddeus Stevens College of Technology	20	100%	20	2,200
Treasury Department				
Total	**740**	**17%**	**243**	**6,395,207**

Of the 13,448 geolocated critical facilities, 3,318 or 25 percent, are located in areas characterized by relatively high earthquake hazard (Table 4.3.3-6). These facilities have a combined replacement value of approximately $99.3 billion, or 25 percent of the known value of geolocated critical facilities.

Table 4.3.3-6 Vulnerability of State Critical Facilities to Earthquake Events.		
STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES	% OF STRUCTURES FOR FACILITY TYPE
Agriculture	87	32%
Banking	2	50%
Commercial	11	52%
Communication	88	16%
Dam	191	13%
Education (colleges and universities)	134	34%
Education (public schools)	1,656	35%
Emergency Operation Centers	10	14%
Energy	53	15%
Fire Station	467	18%

Table 4.3.3-6 Vulnerability of State Critical Facilities to Earthquake Events.		
STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES	% OF STRUCTURES FOR FACILITY TYPE
Government	2	8%
Hospitals	93	30%
National Monument or Icon	4	67%
Nuclear	2	40%
Police Station	275	21%
Transportation	166	24%
Water	77	12%
Total	**3,318**	**25%**

4.3.3.6.Jurisdictional Vulnerability Assessment and Loss Estimation

FEMA's Hazus software version 6.0 was used to estimate the relative vulnerability to earthquakes across the state. The methodology uses Hazus default data on seismic hazards and building stock data, user-defined essential facilities data, and the software's standard algorithms. The calculation algorithms quantify the potential losses associated with seismic hazards using information about shake probabilities, soil characteristics, and other parameters. As discussed in Section 4.1.4, Hazus was used to calculate two kinds of economic losses: 1) direct building losses, and 2) business interruption losses. Direct building losses consist of the damage to structures and their contents, while business interruption losses consist of the relocation expenses, employee wage loss, business income loss, and rental income loss that accrue during the time that businesses remain inoperable. For more information on the data and methodology used in this analysis, see Section 4.1.4.

The tables below show the average annualized earthquake losses for Pennsylvania aggregated to the county scale. While Table 4.3.3-7 shows potential direct building losses, Table 4.3.3-8 shows potential business interruption losses. According to the Hazus analysis, most of the potential loss is attributable to direct building losses, and most of the potential direct building loss is attributable to building damage. Figure 4.3.3-8 shows the spatial distribution of the total average annualized losses (the sum of direct building losses and business interruption losses). Note that losses are shown at the census tract level. While the county-level tables show the highest annualized losses in the most populous counties (i.e., Philadelphia, Allegheny, Montgomery, and Bucks Counties), the census-tract level map shows the highest annualized losses in census tracts located in Bucks, Delaware, Lancaster, and Lehigh Counties.

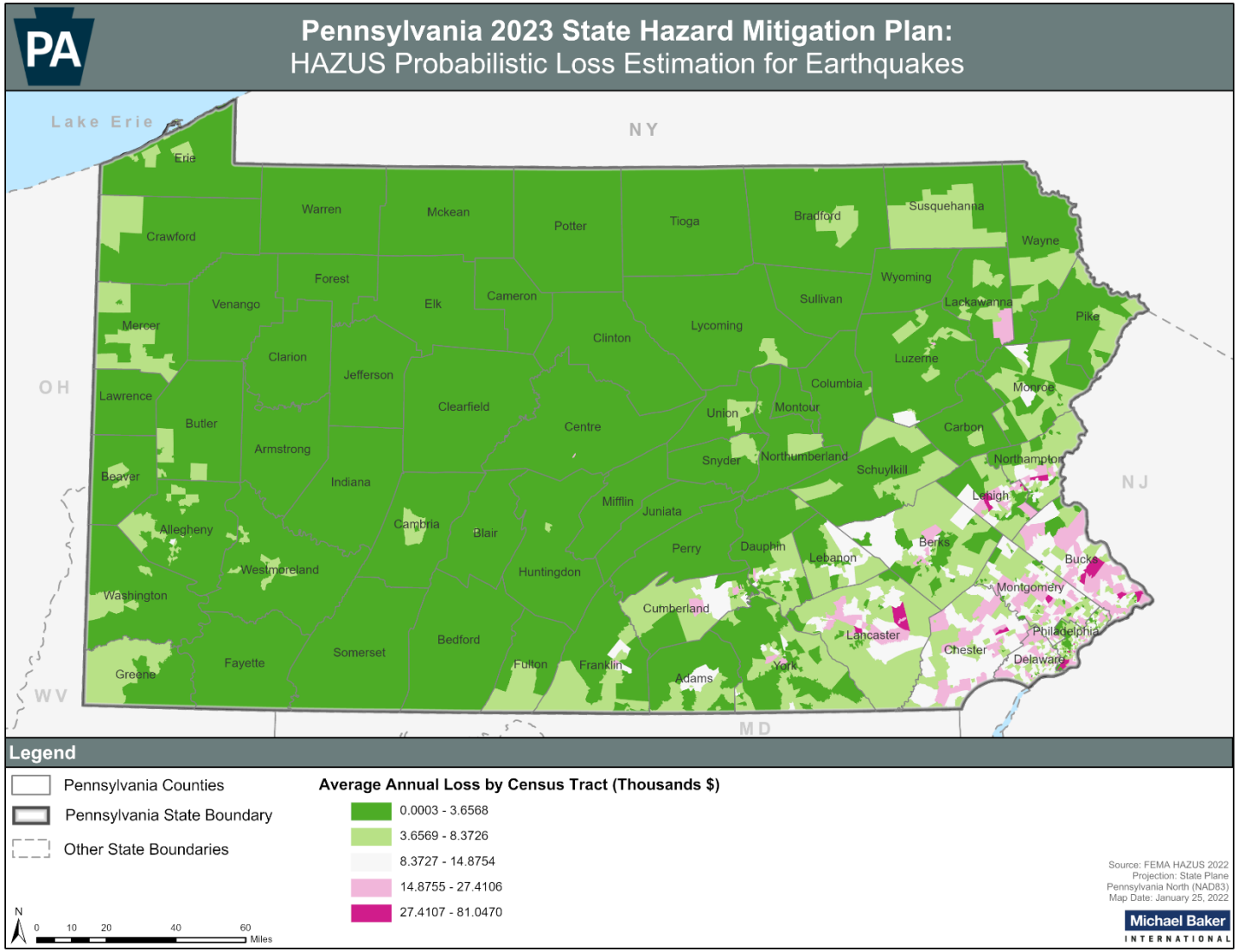
Table 4.3.3-7 Potential Direct Building Losses from Earthquake Hazards (Average Annualized Loss).				
COUNTY	BUILDING LOSS (THOUSANDS $)	CONTENTS LOSS (THOUSANDS $)	INVENTORY LOSS (THOUSANDS $)	TOTAL DIRECT BUILDING LOSSES (THOUSANDS $)
Adams	$71.9	$15.3	$1.6	**$88.8**
Allegheny	$329.5	$45.0	$3.6	**$378.2**
Armstrong	$12.3	$1.6	$0.1	**$14.0**
Beaver	$44.9	$6.8	$0.6	**$52.3**
Bedford	$12.1	$1.8	$0.2	**$14.0**
Berks	$338.5	$92.8	$9.6	**$440.9**
Blair	$31.1	$4.7	$0.7	**$36.4**
Bradford	$21.5	$3.1	$0.4	**$25.1**
Bucks	$1,160.1	$292.9	$23.7	**$1,476.7**
Butler	$65.0	$8.4	$0.5	**$73.9**
Cambria	$30.3	$4.4	$0.8	**$35.5**
Cameron	$0.9	$0.1	$0.0	**$1.1**
Carbon	$23.8	$4.9	$0.2	**$28.9**
Centre	$35.4	$6.1	$0.3	**$41.7**
Chester	$834.4	$244.0	$33.7	**$1,112.1**
Clarion	$9.4	$1.6	$0.6	**$11.7**
Clearfield	$13.8	$1.7	$0.1	**$15.6**
Clinton	$5.2	$0.8	$0.0	**$6.0**
Columbia	$23.3	$4.4	$0.3	**$28.1**
Crawford	$33.9	$6.0	$2.5	**$42.4**
Cumberland	$174.0	$35.6	$7.1	**$216.8**
Dauphin	$163.6	$36.7	$3.4	**$203.8**
Delaware	$971.2	$263.3	$15.1	**$1,249.6**
Elk	$7.3	$1.0	$0.0	**$8.4**
Erie	$73.9	$14.2	$1.3	**$89.4**
Fayette	$33.6	$5.1	$0.6	**$39.2**
Forest	$2.2	$0.3	$0.0	**$2.5**
Franklin	$87.1	$16.2	$2.4	**$105.7**
Fulton	$6.2	$1.2	$0.9	**$8.3**
Greene	$17.9	$2.9	$0.9	**$21.7**
Huntingdon	$10.0	$1.6	$0.1	**$11.6**
Indiana	$18.3	$2.8	$0.3	**$21.4**
Jefferson	$8.3	$1.2	$0.1	**$9.5**
Juniata	$5.9	$1.2	$0.1	**$7.2**
Lackawanna	$83.7	$16.5	$0.9	**$101.1**
Lancaster	$571.0	$154.9	$17.2	**$743.1**
Lawrence	$17.1	$2.5	$0.2	**$19.8**
Lebanon	$117.3	$28.7	$2.9	**$148.8**

Table 4.3.3-7 Potential Direct Building Losses from Earthquake Hazards (Average Annualized Loss).				
COUNTY	BUILDING LOSS (THOUSANDS $)	CONTENTS LOSS (THOUSANDS $)	INVENTORY LOSS (THOUSANDS $)	TOTAL DIRECT BUILDING LOSSES (THOUSANDS $)
Lehigh	$363.5	$93.1	$9.6	**$466.2**
Luzerne	$145.8	$30.8	$2.5	**$179.1**
Lycoming	$24.8	$4.0	$1.4	**$30.3**
McKean	$12.2	$2.3	$0.5	**$15.0**
Mercer	$45.5	$6.6	$0.7	**$52.8**
Mifflin	$11.3	$1.8	$0.2	**$13.2**
Monroe	$121.8	$26.9	$1.7	**$150.3**
Montgomery	$1,270.3	$331.1	$21.6	**$1,623.0**
Montour	$6.2	$1.1	$0.1	**$7.3**
Northampton	$289.9	$74.3	$5.7	**$369.9**
Northumberland	$34.4	$5.8	$0.3	**$40.5**
Perry	$11.1	$1.7	$0.1	**$12.9**
Philadelphia	$2,034.2	$582.3	$36.4	**$2,652.9**
Pike	$55.0	$10.2	$0.1	**$65.2**
Potter	$3.0	$0.5	$0.0	**$3.5**
Schuylkill	$52.6	$12.6	$1.8	**$67.0**
Snyder	$15.5	$2.6	$0.2	**$18.3**
Somerset	$24.7	$3.9	$1.4	**$30.0**
Sullivan	$2.9	$0.4	$0.1	**$3.3**
Susquehanna	$25.7	$4.9	$2.8	**$33.4**
Tioga	$10.8	$1.7	$0.2	**$12.7**
Union	$11.5	$2.0	$0.2	**$13.7**
Venango	$9.5	$1.5	$0.1	**$11.1**
Warren	$6.2	$0.9	$0.1	**$7.2**
Washington	$65.4	$9.4	$0.8	**$75.6**
Wayne	$33.3	$6.3	$0.6	**$40.2**
Westmoreland	$104.5	$14.5	$2.2	**$121.1**
Wyoming	$9.8	$1.4	$0.0	**$11.2**
York	$276.3	$68.7	$8.4	**$353.3**
Total	**$10,543.7**	**$2,635.2**	**$232.7**	**$13,411.6**

Table 4.3.3-8 Potential Business Interruption Losses from Earthquake Hazards (Average Annualized Loss).					
COUNTY	INCOME LOSS (THOUSAND $)	RELOCATION LOSS (THOUSAND $)	RENTAL INCOME LOSS (THOUSAND $)	WAGE LOSS (THOUSAND $)	TOTAL BUSINESS INTERRUPTION LOSSES (THOUSAND $)
Adams	$4.5	$14.7	$7.1	$6.4	**$32.8**
Allegheny	$23.1	$68.3	$28.6	$35.0	**$155.0**
Armstrong	$0.7	$2.8	$1.2	$1.0	**$5.6**
Beaver	$2.7	$8.8	$3.6	$4.3	**$19.5**
Bedford	$0.7	$2.7	$1.3	$1.1	**$5.8**
Berks	$23.0	$57.4	$25.4	$31.1	**$136.9**
Blair	$2.7	$7.8	$3.5	$3.7	**$17.8**
Bradford	$1.1	$5.3	$2.0	$1.6	**$10.0**
Bucks	$60.6	$163.4	$75.1	$87.7	**$386.8**
Butler	$3.0	$15.4	$6.0	$3.2	**$27.5**
Cambria	$2.1	$7.3	$3.0	$3.1	**$15.4**
Cameron	$0.0	$0.2	$0.1	$0.0	**$0.4**
Carbon	$1.2	$5.0	$2.2	$1.6	**$10.0**
Centre	$1.9	$9.5	$3.1	$2.8	**$17.3**
Chester	$31.0	$108.8	$41.4	$43.7	**$224.9**
Clarion	$0.6	$2.1	$0.9	$0.7	**$4.3**
Clearfield	$0.9	$3.7	$1.7	$1.0	**$7.3**
Clinton	$0.2	$1.3	$0.5	$0.2	**$2.3**
Columbia	$1.3	$5.8	$2.7	$1.3	**$11.1**
Crawford	$1.5	$6.7	$2.5	$1.6	**$12.4**
Cumberland	$11.9	$33.7	$15.6	$17.1	**$78.3**
Dauphin	$12.7	$31.9	$15.2	$18.7	**$78.5**
Delaware	$42.8	$132.6	$56.3	$63.6	**$295.3**
Elk	$0.4	$1.8	$0.8	$0.3	**$3.3**
Erie	$6.7	$16.8	$7.8	$9.0	**$40.2**
Fayette	$3.4	$8.1	$3.6	$4.6	**$19.8**
Forest	$0.1	$0.6	$0.3	$0.1	**$1.1**
Franklin	$6.1	$20.7	$9.5	$8.6	**$45.0**
Fulton	$0.2	$1.0	$0.3	$0.3	**$1.7**
Greene	$1.0	$3.8	$1.5	$1.3	**$7.7**
Huntingdon	$0.8	$2.6	$1.1	$1.3	**$5.9**
Indiana	$1.6	$4.6	$2.1	$2.1	**$10.4**
Jefferson	$0.5	$2.1	$1.0	$0.5	**$4.0**
Juniata	$0.4	$1.1	$0.5	$0.5	**$2.5**
Lackawanna	$6.7	$18.2	$8.5	$6.4	**$39.8**
Lancaster	$35.6	$98.2	$46.1	$57.5	**$237.5**
Lawrence	$1.0	$4.1	$1.7	$1.4	**$8.2**

Table 4.3.3-8 Potential Business Interruption Losses from Earthquake Hazards (Average Annualized Loss).					
COUNTY	INCOME LOSS (THOUSAND $)	RELOCATION LOSS (THOUSAND $)	RENTAL INCOME LOSS (THOUSAND $)	WAGE LOSS (THOUSAND $)	TOTAL BUSINESS INTERRUPTION LOSSES (THOUSAND $)
Lebanon	$7.8	$21.1	$9.4	$12.0	**$50.2**
Lehigh	$23.4	$62.8	$28.4	$37.5	**$152.1**
Luzerne	$9.1	$33.5	$14.9	$13.1	**$70.6**
Lycoming	$1.4	$5.3	$2.3	$1.8	**$10.8**
McKean	$0.8	$2.7	$1.2	$0.8	**$5.4**
Mercer	$2.3	$11.0	$4.3	$3.6	**$21.1**
Mifflin	$0.7	$2.6	$1.2	$1.1	**$5.5**
Monroe	$6.2	$20.9	$10.0	$8.0	**$44.9**
Montgomery	$60.9	$178.6	$78.9	$92.0	**$410.4**
Montour	$0.4	$1.4	$0.7	$0.6	**$3.1**
Northampton	$12.3	$50.8	$19.7	$20.1	**$102.9**
Northumberlan	$1.4	$8.7	$3.4	$1.2	**$14.7**
Perry	$0.5	$2.3	$0.9	$0.7	**$4.4**
Philadelphia	$129.1	$323.8	$143.5	$171.0	**$767.4**
Pike	$0.9	$10.9	$3.6	$1.2	**$16.6**
Potter	$0.2	$0.7	$0.4	$0.2	**$1.6**
Schuylkill	$2.9	$11.0	$5.0	$3.9	**$22.7**
Snyder	$1.1	$3.8	$1.5	$1.4	**$7.8**
Somerset	$1.4	$4.8	$2.4	$1.8	**$10.4**
Sullivan	$0.1	$0.7	$0.3	$0.2	**$1.2**
Susquehanna	$0.8	$4.6	$1.6	$0.6	**$7.6**
Tioga	$0.8	$2.7	$1.2	$0.9	**$5.6**
Union	$1.1	$2.8	$1.4	$1.2	**$6.5**
Venango	$0.6	$2.3	$1.0	$0.9	**$4.9**
Warren	$0.3	$1.4	$0.8	$0.4	**$2.9**
Washington	$4.6	$13.9	$5.8	$6.6	**$30.9**
Wayne	$2.0	$6.6	$3.0	$2.5	**$14.2**
Westmoreland	$7.1	$23.4	$9.8	$9.5	**$49.9**
Wyoming	$0.4	$2.4	$0.9	$0.4	**$4.2**
York	$17.3	$51.7	$22.1	$24.8	**$115.9**
Total	**$592.5**	**$1,748.1**	**$763.4**	**$844.4**	**$3,948.5**

Figure 4.3.3-8 Map of Average Annualized Losses for Earthquake Hazard (Hazus, 2022).



4.3.4. Extreme Temperature

4.3.4.1. Location and Extent

Pennsylvania can experience many different temperature extremes. Temperatures across the Commonwealth normally remain between 0°F and 100°F and average from near 47°F annually in the north-central mountains to 57°F annually in the extreme southeast. High temperatures of 90°F or above occur about 10 to 20 days per year at any one location; southeastern localities may experience as many as 35 high temperature days in a season while the extreme northwest experiences an average of three high temperature days annually. Ranges of daily temperature from maximum to minimum are commonly around 20°F during the summer and are several degrees less during the winter. Freezing temperatures occur on an average of 100 or more days per year, and the greatest number of occurrences is in the Appalachian Plateaus province in north-central Pennsylvania. The southeast (near sea level) and northwest (adjacent to Lake Erie) portions of the Commonwealth have the longest freeze-free period. Extreme temperature hazards are not tied to a specific temperature threshold; instead, these hazards occur when the temperature is extremely high or extremely low (PSC, n.d.).

Figure 4.3.4-1 and Figure 4.3.4-2 show the excessive cold/wind chill events and the heatwave events throughout Pennsylvania between 2005 and 2017. During July, the warmest month, high temperatures normally range from the upper-70s in northern areas of the Commonwealth to the mid-80s in southern areas. Minimum temperatures for this month range from the upper-60s in the southeast to the lower 50s in the north-central mountains. During January, the coldest month, most of the Commonwealth experiences low temperatures in the teens and high temperatures in the 30s. High temperatures usually remain near or below the freezing point during this month in northern sections of the Commonwealth. In southern sections, high temperatures hover in the mid- to upper-30s.

Figure 4.3.4-1 Map Showing Excessive Cold and Wind Chill Events throughout Pennsylvania by Census Tract Based on Data Collected from 2005 - 2017 (FEMA NRI, 2021)

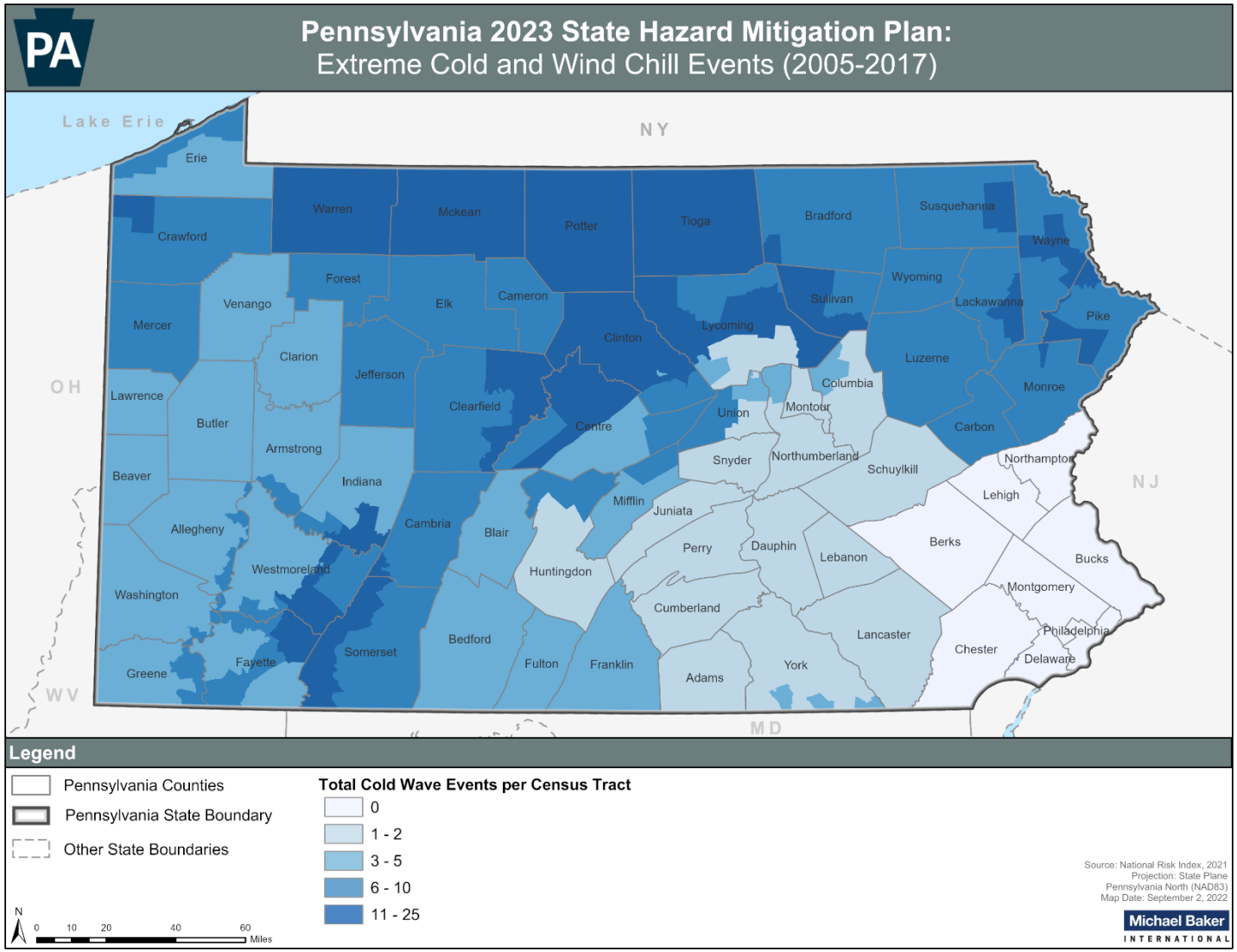
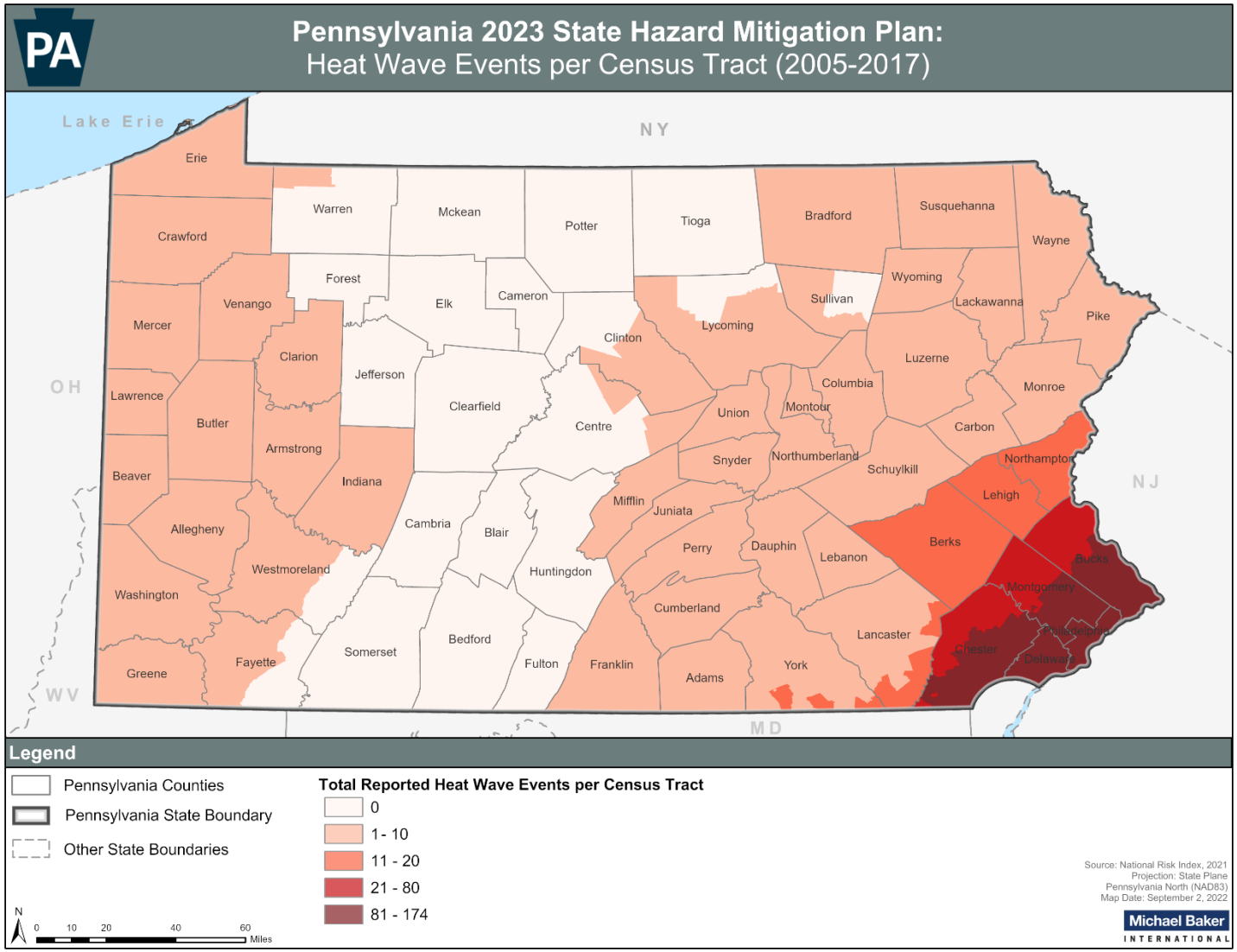


Figure 4.3.4-2 Map Showing Heatwave Events throughout Pennsylvania by Census Tract Based on Data Collected from 2005 - 2017 (FEMA NRI, 2021)

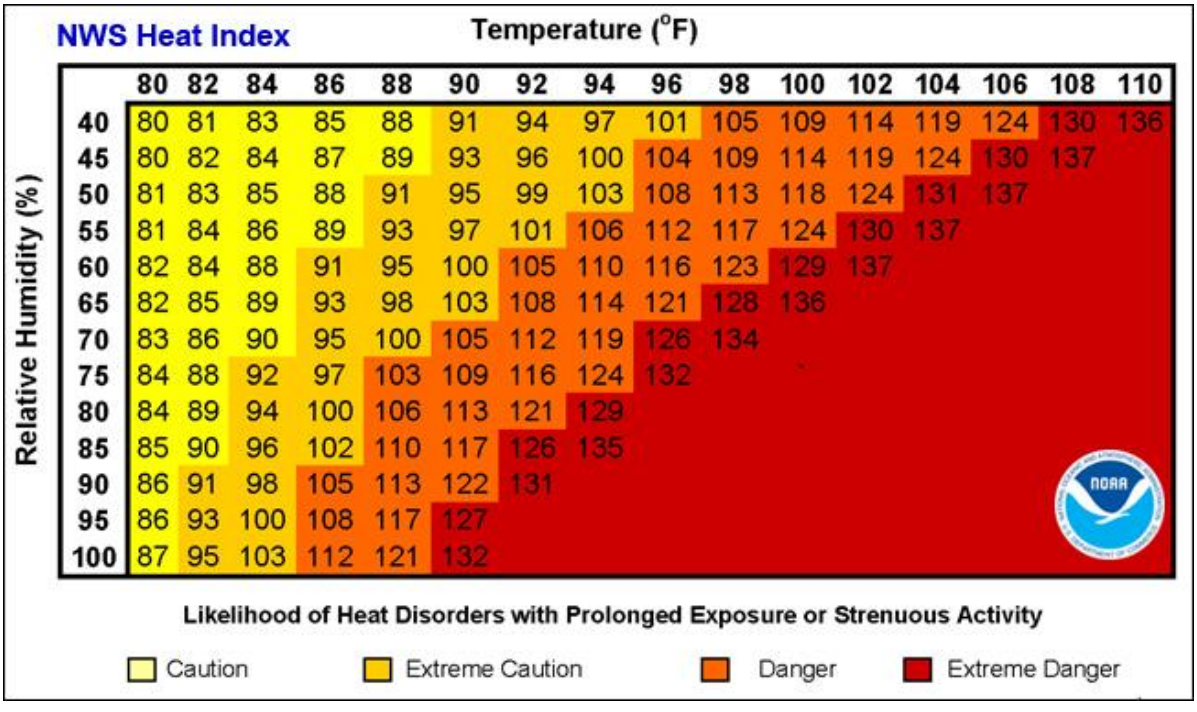


4.3.4.2. Range of Magnitude

Extreme temperatures can cause serious human risks. Extremely high temperatures cause heat stress. Major human risks for these temperatures include heat rash, sunburn, heat cramps, , heat exhaustion, heat stroke, and death (CDC, 2017a). The impacts of high temperatures will vary from person to person based on individual age, health, and other factors. Older adults, the very young, and people with mental illness and chronic disease are at highest risk to health-related impacts of extreme temperatures.

Temperature advisories, watches and warnings are issued by the National Weather Service relating the above impacts to the range of temperatures typically experienced in Pennsylvania. Exact thresholds vary across the Commonwealth, but in general *Heat Advisories* are issued when the heat index will be equal to or greater than 100°F, but less than 105°F, *Excessive Heat Warning*s are issued when heat indices will attain or exceed 105°F, and *Excessive Heat Watches*, are issued when there is a possibility that excessive heat warning criteria may be experienced within 12 - 48 hours (NOAA NWS State College, PA Weather Forecast Office, n.d.). The heat index is a measurement that takes into account both the temperature and relative humidity and is calculated as shown in Figure 4.3.4-3 (NOAA NWS, n.d.c). A study on heat-related morbidity and mortality in New England showed that adverse health impacts are associated with heat indexes lower than 100°F, and hypothesized that lowering the heat index threshold for a heat advisory below this would reduce the number of adverse health impacts (Wellenius, 2017).

Figure 4.3.4-3 National Weather Service's Heat Index Matrix (NOAA NWS, n.d.c)



Cold temperatures can be extremely dangerous to humans and animals exposed to the elements. Without heat and shelter, cold temperatures can cause hypothermia, frost bite, and death (NOAA NWS, n.d.a). Wind chill temperatures are often used in place of raw temperature values due to the effect of wind can have in drawing heat from the body under cold temperatures. These values represent what temperatures actually feel like to humans and animals under cold, windy conditions (NOAA NWS, n.d.a). Similar to high temperatures, the effect of cold temperatures will vary by individual.

In Pennsylvania, *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 vary based on regions. Wind Chill Advisories are issued in the southeast and western sections of Pennsylvania when wind chill values drop to -10°F. South-central to northern sections of the Commonwealth when wind chills drop to -15°F (NOAA NWS State College, PA Weather Forecast Office, n.d.c).

Temporary periods of extreme hot or cold temperatures typically do not have significant environmental impacts. However, prolonged periods of unusually hot days (also known as heat waves) or unusually cold days may damage crops, injure or kill livestock, and increase the risk of wildfires, dry up rivers and streams, and reduce water quality (U.S. EPA, 2022a; U.S. EPA, 2022b). Extreme air and soil temperatures damage crops by changing the rate at which plants uptake water through their root systems (Irmak, 2016). Warmer conditions also negatively impact the nutritional health and nectar intake of honeybees and other pollinators, which are critical for crop production and ecosystem function (Gill, 2022).

An important aspect of extreme temperatures and their impact is albedo, the amount of energy that is reflected by different surfaces. Darker surfaces, like paved roads and buildings, tend to absorb more energy and can contribute to temperature increases while lighter surfaces, particularly snow and ice cover, reflect more energy and contribute to temperature decreases (Perkins, 2019). The dominant surface type in an area can create a feedback loop that accelerates the impacts of temperature extremes. One example of this is the urban heat island effect, which occurs when developed areas have an abundance of paved surfaces and dark roof shingles that absorb a lot of energy and cause these areas to be hotter than surrounding areas with less developed area.

Extreme temperature events are also known to have an impact on utilities. For example, in times of extreme heat, increased use of air conditioners can cause overload existing utility grids and spur localized or regionalized brownouts. Extreme cold events, especially when coupled with severe winter weather, can cause utility pipes to burst and interrupt the distribution of utilities. Prolonged extreme temperature events can also spur fuel shortages. The impact of extreme temperatures on utilities will depend on the overall use and duration of the event (U.S. EPA, 2022a; U.S. EPA, 2022b).

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 would overwhelm the power grid, causing widespread blackouts, essentially cutting off vital HVAC services for Pennsylvanians. This kind of event could create a public health hazard for the elderly and children and would result in heat cramps, sunstroke, heat exhaustion, and death.

This situation would also be dangerous for hospitals and other healthcare facilities, particularly for those with chronic health conditions and other vulnerable populations. As noted above, industry accepted temperature thresholds for heat advisories may change in the future to reflect the potential adverse health impacts for temperatures below current guidelines.

Table 4.3.4-1 Most Likely Lifelines Impacted by Extreme Temperatures

Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and compounding impacts where community safety is threatened and government operations and facilities, including police and fire, are involved with response and recovery. Actions to protect communities may include organizing outreach to vulnerable communities and coordination with landlords and utility companies to ensure buildings are up-to-code and encourage special arrangements for extreme events.
Health and Medical		Anticipating a causal and cascading relationship for the Health and Medical lifeline, as extreme events will require medical care be administered in response and recovery and facilities themselves will require adequate heating and cooling infrastructure. In addition, potential issues with the power grid could lead to issues with hospital operations.
Energy		Anticipating a cascading relationship with the Energy lifeline as extreme temperatures will lead to a larger strain on the power grid due to increase usage of heating and cooling utilities in response. Mitigation for this lifeline may include increasing grid resilience and capacity to handle peak usage during extreme events.

Extreme temperatures impact all seven of FEMA's Community Lifelines. They directly impact safety and security by creating hostile environments and posing significant risk to people. They may put schools, government buildings, and services at risk. The Food, Water, Shelter lifeline is heavily impacted as the availability of water resources and the function of water infrastructure may be impacted by either heat waves or periods of significant cold temperatures. Shelter is impacted if homes and other buildings are not designed to handle temperatures and do not have sufficient heating or cooling systems. Agriculture is dependent on specific weather conditions, so extremes may be harmful to both animals and crops. The Health and Medical lifeline is also greatly impacted due to the risks to public health and the variety of care options

that may be compromised. Long-term care facilities will need to be equipped to handle temperature extremes and traveling to facilities may be difficult.

The greatest protection against temperature extremes for residents is adequate heating and cooling systems within their residences, but widespread and prolonged use may put strain on energy resources. Communications are impacted as it's important for proper warnings about dangerous conditions to reach all of those in danger and those that need help will need somewhere to reach out to. Extreme temperatures pose risks to the integrity of transportation infrastructure including roadways, mass transit, and railways. Air travel may be impacted as well.

Extremely hot temperatures and droughts are very closely linked. These two hazards can compound the impacts of the other, greatly increasing the risk associated with either. Other hazards that may be related to extreme temperatures include wildfires, urban fires/explosions, invasive species, and utility interruptions. High temperatures, especially for a prolonged period, may create environments more conducive to fire. Extremes of either type may allow invasives that are better prepared to out-compete native plants who are not as well-equipped. As previously mentioned, utilities and resources may become strained if temperatures stay at extreme levels for too long.

4.3.4.3. Past Occurrence

The highest temperature ever recorded was 111°F in Phoenixville, Chester County on July 9 and July 10, 1936, while the lowest temperature ever recorded was -42°F in Smethport, McKean County, on January 5, 1904 (NOAA SCEC, 2022).

Data from the National Centers for Environmental Information reports that there have been 106 extreme temperature episodes in Pennsylvania between 2000 and 2022, resulting in a total of 96 deaths and 103 injuries.

Sixty-six of these events have been a result of extreme cold/wind chill, resulting in four 0 direct deaths. The database reports one event in January 2000 and one in February 2007 which resulted in two deaths each.

There have been 40 extreme heat episodes, resulting in 92 deaths and 103 injuries across the state. The database reports an episode on June 21, 2011, that resulted in 25 deaths and 60 injuries across 10 counties. Past events typically affected multiple counties or the entire state (NCEI, 2022).

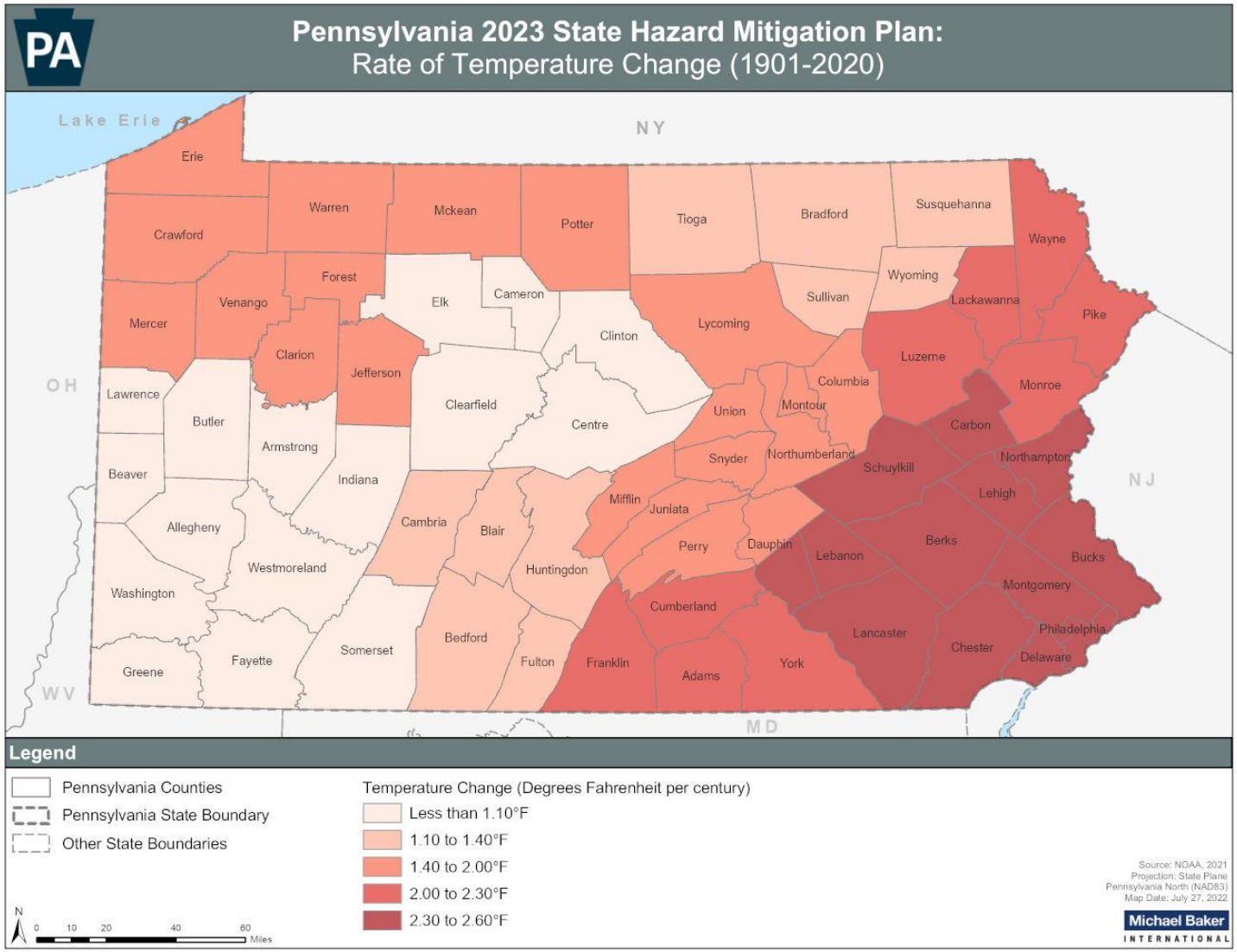
Pennsylvania was also the impetus for national action on extreme heat hazards. PEMA teamed with NOAA and the National Weather Service to develop the excessive heat descriptions and action thresholds that are now used nationwide.

4.3.4.4. Future Occurrence

Figure 4.3.4-4 shows how annual average air temperatures have changed in all Pennsylvania counties since 1901 based on data from the National Oceanic and Atmospheric Administration (NOAA, 2016). The highest rate of change is in the eastern and southeastern part of the state with a change of between 2 and 2.5°F, while counties by Lake Erie have changed 1.5-2°F.

Extreme temperatures mirror this pattern with the highest number of heat waves (Figure 4.3.4-2) and lowest number of cold waves (Figure 4.3.4-1) occurring in the southeast from 2005-2017 (NOAA 2016). The northernmost counties have the highest number of cold waves in the state. These trends are predicted to continue and intensify with the changing climate. In the highly urbanized southeast, the urban heat island effect is also a factor in extreme temperatures as increases in concrete/asphalt and reductions in green canopy result in urbanized areas registering a higher temperature than surrounding, vegetated suburban and rural areas.

Figure 4.3.4-4 Rate of Temperature Change in Pennsylvania Counties from 1901 to 2020 (NOAA, 2021)



According to the Fourth National Climate Assessment, which utilized the Intergovernmental Panel on Climate Change's Representative Concentration Pathways (RCP) 4.5 and 8.5 scenarios, the annual average temperature across the United States is projected to increase by 2.5°F (RCP 4.5) and 2.9°F (RCP 8.5) by 2021-2050, relative to 1976-2005. For the Northeast the change in annual average temperature is 3.98°F (RCP 4.5) and 5.09°F (RCP 8.5) by 2036-2065 and 5.27°F (RCP 4.5) and 9.11°F (RCP 8.5) by 2071-2100 (Vose et al. 2017).

However, extreme temperatures are projected to increase more than average and the number of days above 90°F will rise while heat waves will intensify. There is *very high confidence* in this projection. Specifically, for the Northeast, the coldest day is projected to change by 9.51°F, the warmest day by 6.51°F, with extreme cold waves (a 5-day, 1 in 10-year event) increasing by 15.93°F and extreme heat waves (a 5-day, 1 in 10-year event) increasing by 12.88°F (Vose et al. 2017). These changes are the difference between the average for 2036 – 2065 and the average for 1976 – 2005 under the RCP 8.5 scenario. Very rare extreme events (1 in 20-year) are projected to occur annually for maximum temperatures while minimums will not occur. These changes translate to about 20 – 30 more days above 90°F and 20 – 30 fewer days below freezing in the northeastern parts of the United States by mid-century (RCP 8.5) (Vose et al. 2017).

Focusing on Pennsylvania, Figure 4.3.4-5 shows the observed and projected temperature change for a low and high emissions scenario as compared to the 1901–1960 average. Temperatures in Pennsylvania have risen almost 2°F since the beginning of the 20th century. Much of the warming has been in the winter and spring, along with an increase in the number of warm nights (minimum temperature 70°F or higher) and decrease in number of very cold nights (minimum temperature 0°F or lower) (Frankson et al. 2022). According to the Pennsylvania Climate Impacts Assessment (2021), the annual mean temperature change across the state is projected to increase by about 5.9°F (3.3°C) by mid-century (2041-2070) (to 9.4°F (5.2°C) by the end-of-century (2070-2099) relative to 1971-2000. These statewide projections average the 50th percentile of the 32 climate models in the Localized Constructed Analogs (LOCA) dataset. Projections are based on RCP 8.5, the global "baseline" scenario. (Pennsylvania Department of Environmental Protection (DEP), 2021).(see Figure 4.3.4-6). With these changes, Philadelphia will have temperatures similar to historical Richmond, VA, while Pittsburgh will resemble Washington, DC (Shortle et al. 2015). There is not significant variation with season. It is *highly likely* that extreme temperatures will occur in the future.

Figure 4.3.4-5 Observed and Projected Temperature Change for Pennsylvania (Frankson et al. 2022).

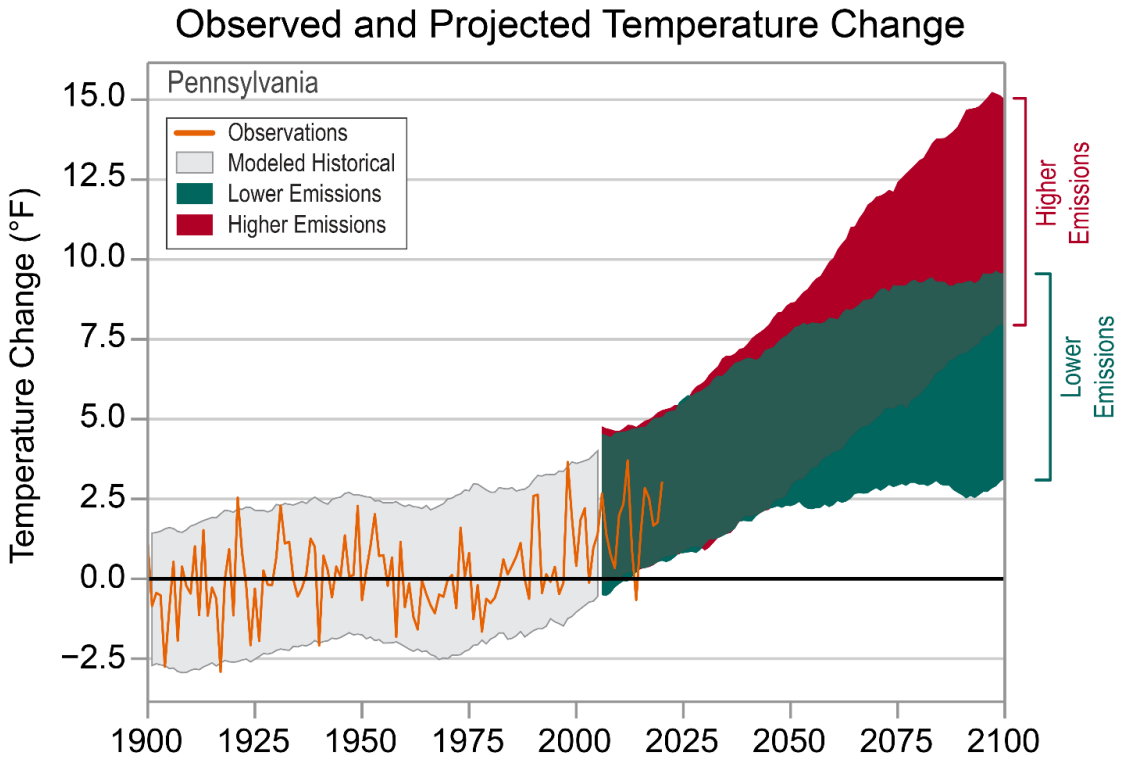
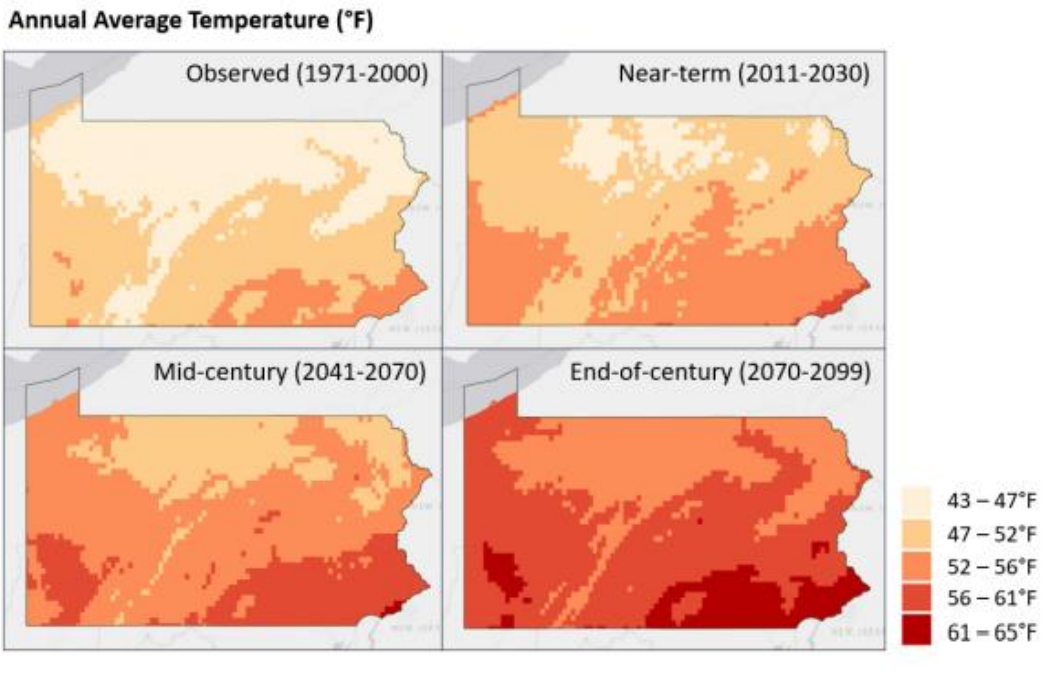


Figure 4.3.4-6 Observed and Projected Annual Average Temperatures in Pennsylvania. (Shortle et al., 2015)



Note: Based on 50th percentile of 32-model ensemble of LOCA downscaled data, RCP 8.5. The full range of observed and projected values is shown divided into equal increments.

4.3.4.5. State Facility Vulnerability Assessment and Loss Estimations

As described in Section 4.1, state and jurisdictional vulnerability assessments were completed by spatially overlaying hazards with census tracts and state critical facility layers in GIS. When spatial analysis determined that the hazard would impact a census tract within a county or the location of state critical facilities these locations were deemed vulnerable to the hazard. Loss estimates were prepared based on the value of the facilities impacted by census tract and by state critical facility. Each hazard uses a methodology that is specific to the type of risk it may cause; Table 4.2.2-2 includes a complete methodology description for vulnerability assessments and loss estimates for each hazard.

Extreme Heat

The vulnerability of state critical facilities was evaluated as facilities located within a census tract that experienced more than 80 heatwave events between 2005 and 2017. Using this criterion, a total of 2,259 vulnerable critical facilities have been identified as vulnerable. Due to the large number of schools and fire departments in the Commonwealth, it is unsurprising that those categories of facilities have the highest totals. Table 4.3.4-2 shows the vulnerability of state critical facilities by facility type. The estimated replacement cost of all state critical facilities at risk from extreme heat hazards is $69,811,290,099, which represents nearly 18 percent of the value of all the state's critical facilities.

Table 4.3.4-2 State Critical Facilities Vulnerable to Extreme Heat by Critical Facility Type		
STATE CRITICAL FACILITY TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	50	18%
Banking	2	50%
Commercial	11	52%
Communication	64	11%
Dam	91	6%
Education (colleges and universities)	109	27%
Education (public schools)	1,121	24%
Emergency Operation Center	6	8%
Energy	38	10%
Fire Station	285	11%
Government	2	8%
Hospital	76	24%
National Monument or Icon	4	67%
Nuclear	0	0%
Police Station	173	13%
Transportation	186	27%
Water	41	6%
TOTAL VULNERABLE CRITICAL FACILITIES	**2,259**	**17%**

Table 4.3.4-3 shows the state-owned or leased buildings that are vulnerable to extreme heat broken down by state department/agency. Of the 4,460 geolocated state facilities, 528, or 12 percent, are located within census tracts that experienced over 80 heatwave events between 2005 and 2017. The departments/agencies with the most affected structures are the Liquor Control Board, the PA State System of Higher Education, and the Department of Transportation. There were a reported 189 owned structures found to be vulnerable. The estimated replacement cost of all state owned and leased structures at risk from extreme heat hazards is $264 million, which represents almost seven percent of the value of all the state's structures. Overall, 5.97 million building square footage was reported to be found vulnerable to extreme heat.

Table 4.3.4-3 Estimated State-Owned or Leased Buildings Vulnerable to Extreme Heat for Each Department.				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	3	33%	0	77,511
Department of Agriculture		0%		
Department of Banking and Securities	1	50%	0	4,859

Table 4.3.4-3 Estimated State-Owned or Leased Buildings Vulnerable to Extreme Heat for Each Department.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Department of Community and Economic Development		0%		
Department of Conservation and Natural Resources		0%		
Department of Corrections	18	3%	10	574,515
Department of Education	1	100%	1	0
Department of Environmental Protection	1	8%	0	85,000
Department of General Services	45	34%	43	2,969,315
Department of Health	3	6%	0	56,161
Department of Labor and Industry	12	17%	0	160,426
Department of Military and Veterans Affairs	1	100%	0	2,500
Department of Public Welfare	22	22%	0	452,916
Department of Revenue	3	30%	0	20,115
Department of Transportation	131	8%	131	311,541
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	2	1%	2	1,504
Governor's Office		0%		
Historical and Museum Commission	8	27%	1	2,730
Insurance Department		0%		
Liquor Control Board	136	25%	1	1,193,489
Public School Employees' Retirement System	1	17%	0	4,025
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System	1	25%	0	2,115
State Police	4	11%	0	51,523
State System of Higher Education	135	16%		
Thaddeus Stevens College of Technology		0%		
Treasury Department	0	0		
Total	**528**	**12%**	**189**	**5,970,245**

Extreme Cold

The vulnerability of state critical facilities was evaluated as facilities that are located within census tracts that experienced more than 10 excessive cold or wind chill events between 2005 and 2017. Using this criterion, a total of 704 vulnerable critical facilities have been identified as vulnerable, which is about 5 percent of the critical facilities. The most affected critical facilities are dams, fire stations, and schools. Table 4.3.4-4 shows the vulnerability to extreme cold of state critical facilities by facility type. The estimated replacement cost of all 704 state critical facilities vulnerable to extreme cold/wind chills is $28,499,570,205, or about 7 percent of the total value of all state critical facilities.

Table 4.3.4-4 State Critical Facilities Vulnerable to Extreme Cold by Critical Facility Type

STATE CRITICAL FACILITY TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	7	3%
Banking		0%
Commercial		0%
Communication	38	7%
Dam	173	12%
Education (colleges and universities)	5	1%
Education (public schools)	141	3%
Emergency Operation Center	4	6%
Energy	48	13%
Fire Station	167	6%
Government		0%
Hospital	10	3%
National Monument or Icon		0%
Nuclear		0%
Police Station	55	4%
Transportation	8	1%
Water	48	8%
Total	**704**	**5%**

Table 4.3.4-5 shows the state-owned or leased buildings that are vulnerable to extreme cold broken down by department/agency. Of the 4,460 geolocated state facilities, 253, or 6 percent, are located within census tracts that experienced over 80 cold wave events between 2005 and 2017. The departments/agencies with the most affected structures are the Liquor Control Board, the PA State System of Higher Education, and the Department of Transportation. More than half of all the vulnerable facilities are owned by the Commonwealth (as opposed to leased structures). Overall, nearly 1.1 million square footage of building space is seen as vulnerable. The estimated replacement cost of all state owned and leased structures at risk from extreme cold hazards is $163,221,427which represents 4% of the value of all the state's structures.

Table 4.3.4-5 State-owned or leased buildings vulnerable to Extreme Cold by Department Type				
DEPARTMENT/AGENCY	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General		0%		
Department of Agriculture		0%		
Department of Banking and Securities		0%		
Department of Community and Economic Development		0%		
Department of Conservation and Natural Resources		0%		
Department of Corrections	20	3%	20	190,817
Department of Education		0%		
Department of Environmental Protection	1	8%	0	2,757
Department of General Services		0%		
Department of Health	4	8%	0	8,869
Department of Labor and Industry	6	9%	6	560,530
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	3	3%	0	14,075
Department of Revenue		0%		
Department of Transportation	149	9%	120	233,175
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	10	6%	10	20,550
Governor's Office		0%		
Historical and Museum Commission	2	7%	0	0
Insurance Department		0%		
Liquor Control Board	19	3%	0	49,036
Public School Employees' Retirement System		0%		
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System		0%		
State Police	1	3%	0	5,319
State System of Higher Education	38	4%		
Thaddeus Stevens College of Technology		0%		
Treasury Department		0%		
Total	**253**	**6%**	**156**	**1,085,128**

4.3.4.6. Jurisdictional Vulnerability Assessment and Loss Estimation

The vulnerability of jurisdictions to extreme temperature differs based on the type of temperature being examined. Extreme heat and extreme cold are the two temperature types being studied.

Extreme temperatures do not generally impact buildings; instead, they primarily impact people. In particular, the very old and the very young are vulnerable to temperature extremes. The total number of children and elderly residents in each county can be found in Table 2.3-1. Some hazards, including extreme heat and extreme cold, do not lend themselves to quantifying vulnerable structures and loss estimates. However, an effort was made to identify the locations, structures, and critical facilities that fall in areas expected to experience the highest and lowest temperatures statewide. Future SHMPs will work to better define vulnerability and losses for hazards expected to mainly impact health and social welfare.

Extreme Heat

For this analysis, areas vulnerable to extreme heat have been identified as census tracts that experienced more than 80 heatwave events between 2005 – 2017.

As stated above, during the years 2000 – 2017, the NCEI reported 35 extreme heat events in Pennsylvania resulting in 90 deaths and 103 injuries. It is evident from past events that extreme heat is dangerous and can cause human related illnesses and death. As temperature goes up so do the number of people hospitalized for heat related illnesses. Therefore, it is important to understand how many people are exposed to such conditions, and how many buildings exist, where potential problems could arise should power be lost. Additionally, extreme heat can cause damage to buildings or contents by overheating HVAC or air-conditioning systems, contributing to jurisdictional losses. It is unlikely that an entire building would be impacted in an extreme heat event, though. Jurisdictional loss estimates were identified at the tract level and aggregated at the county level to show the possible losses per county, Table 4.3.4-6 shows potential jurisdictional losses in each of these counties. By temperature, the six counties mostly likely to experience extreme heat are Bucks, Chester, Delaware, Lancaster, Montgomery, and Philadelphia. The county most prone to extreme heat is Philadelphia, with the highest populations, buildings and building costs. While these six counties are the most likely to experience higher temperatures, it does not mean they are the only ones vulnerable to extreme heat events. For instance, areas without widespread access to air conditioning and cooling systems may be vulnerable at lower temperatures. Communities may not have cooling centers and other infrastructure in place to support residents during these events.

Table 4.3.4-6 Vulnerability of People and Buildings to Extreme Heat

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Bucks	523,312	188,821	125,781,340	79%
Chester	362,326	127,110	104,483,353	72%

Delaware	576,352	190,740	118,654,633	100%
Montgomery	584,414	199,178	143,456,199	69%
Philadelphia	1,602,305	527,787	259,829,378	100%
Total	**3,648,713**	**1,233,640**	**752,205,778**	**28%**

Outside of GIS analysis, the EPA recognizes the urban heat island effect as a contributing factor to extreme heat events. This phenomenon is when areas that have significant amounts of dark or black surfaces, like blacktop and tar roofs, have cumulatively higher temperatures than surrounding communities with open and green space. Philadelphia is recognized as having a heat island and has worked with the EPA on mitigation programs for the heat island such as implementing white/reflective roofs and establishing cooling stations citywide during extreme heat events.

Extreme Cold

Vulnerability for extreme cold was classified as being located in a census tract that had more than 10 excessive cold and wind chill events between 2005 – 2017. Even though brick-and-mortar structures are not usually impacted by extreme cold, facilities need to be maintained to ensure that they operate in appropriate conditions for people. Nonetheless, facilities need to be maintained to ensure that they operate in appropriate conditions for people.

It is evident from this that extreme cold is dangerous and can cause death. Therefore, it is important to understand how many people are exposed to such conditions, and how many buildings exist, where potential problems could arise should power be lost. Additionally, extreme cold can cause damage to structures; for example, burst pipes will damage buildings and will necessitate repairs. It is unlikely that an entire building would be impacted in an extreme cold event. Jurisdictional loss estimates were identified at the tract level and aggregated at the county level to show the possible losses per county. Table 4.3.4-7 shows potential jurisdictional losses in extreme cold areas. Counties most prone to excessive cold and wind chills are Clearfield, Clinton, McKean, Tioga and Warren having high populations, buildings and costs associated to building exposure.

Table 4.3.4-7 Vulnerability of People and Buildings to Excessive Cold and Wind Chills

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSANDS $)	% OF TOTAL BUILDING VALUE
Adams				0%
Allegheny				0%
Armstrong				0%
Beaver				0%
Bedford				0%
Berks				0%
Blair				0%
Bradford	3,799	1,830	$828,656	6%
Bucks				0%

Table 4.3.4-7 Vulnerability of People and Buildings to Excessive Cold and Wind Chills				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSANDS $)	% OF TOTAL BUILDING VALUE
Butler				0%
Cambria	8,239	4,155	$1,606,246	5%
Cameron				0%
Carbon				0%
Centre	15,635	8,401	$2,616,160	9%
Chester				0%
Clarion				0%
Clearfield	22,325	8,762	$3,582,079	22%
Clinton	21,133	10,563	$3,724,062	59%
Columbia				0%
Crawford	4,506	3,136	$1,548,568	6%
Cumberland				0%
Dauphin				0%
Delaware				0%
Elk				0%
Erie				0%
Fayette	10,208	6,527	$2,258,874	9%
Forest				0%
Franklin				0%
Fulton				0%
Greene				0%
Huntingdon				0%
Indiana	9,552	5,199	$2,103,807	13%
Jefferson				0%
Juniata				0%
Lackawanna	14,733	7,201	$5,262,643	12%
Lancaster				0%
Lawrence				0%
Lebanon				0%
Lehigh				0%
Luzerne				0%
Lycoming	24,824	14,213	$5,367,250	25%
McKean	40,379	21,849	$8,638,561	100%
Mercer				0%
Mifflin				0%
Monroe	5,681	2,513	$653,895	2%
Montgomery				0%
Montour				0%
Northampton				0%

Table 4.3.4-7 Vulnerability of People and Buildings to Excessive Cold and Wind Chills				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSANDS $)	% OF TOTAL BUILDING VALUE
Northumberland				0%
Perry				0%
Philadelphia				0%
Pike	8,111	8,912	$3,648,818	22%
Potter	16,396	10,525	$2,819,003	100%
Schuylkill				0%
Snyder				0%
Somerset	14,872	11,441	$5,881,667	25%
Sullivan	2,574	3,417	$965,646	47%
Susquehanna	4,007	3,870	$1,727,730	13%
Tioga	40,950	23,696	$8,649,872	100%
Union				0%
Venango				0%
Warren	38,587	24,810	$7,440,243	100%
Washington				0%
Wayne	10,397	6,271	$2,214,623	19%
Westmoreland	16,008	9,921	$4,673,720	6%
Wyoming				0%
York				0%
Total	**332,916**	**197,212**	**$76,212,123**	**3%**

4.3.5. Flood, Flash Flood, Ice Jam

4.3.5.1. Location and Extent

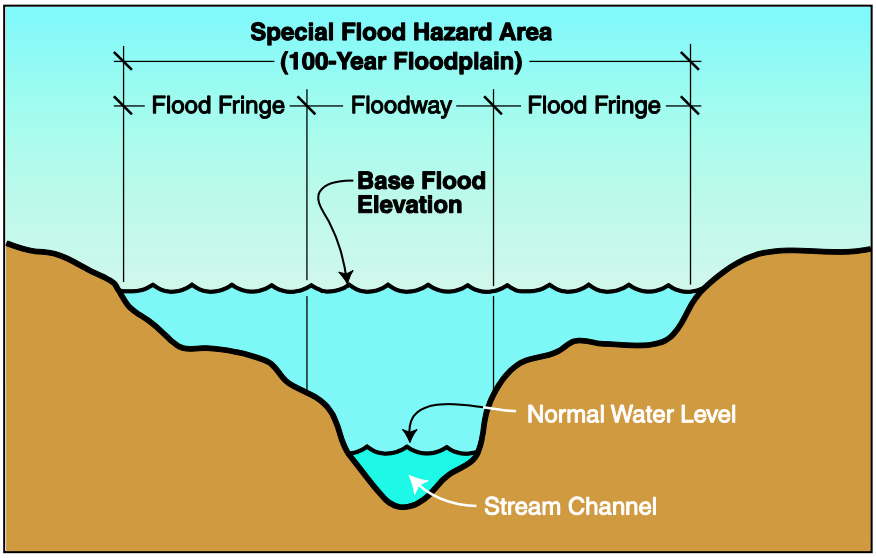
Flooding in Pennsylvania is usually associated with abnormally high and intense rainfall amounts. However, flooding can also be caused by sudden snowmelt, landslides (see Section 4.3.9), dam failures, lock failures, or levee failures. Heavy rainfall events have the potential to produce localized or widespread flooding. Cloudbursts, extremely intense rainfall events that are spontaneous and brief, may affect only a small watershed, and are considered insignificant regionally (World Meteorological Organization, 2012). Large events such as a broad-scale tropical storm lasting more than 24 hours may affect drainage basins several thousand square miles in size. In either case, flood sources in Pennsylvania include rivers, creeks, streams, and lakes. Riverine, as opposed to coastal, flood mechanisms cause most flooding in the Commonwealth. This is a function of having over 83,000 miles of river compared to 189 miles of coastline (National Wild and Scenic Rivers System, 2022; PA DEP CRM, 2022). However, portions of southeastern Pennsylvania along the Delaware River are subject to tidal or storm surge flooding (DCNR, 2019).

Flash flood conditions can result from a large amount of rainfall over a short time span. Though, a small amount of rain can also result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impervious surfaces such as large parking lots, paved roadways, or other densely developed areas.

This section focuses on riverine and storm-based flooding (including flash flooding), but floods of record caused by hurricanes and dam failures are also mentioned and cross-referenced to the appropriate hazard profile. Also, the role of dams and levees as flood protection methods is mentioned in this section. Please see Sections 4.3.7, 4.3.20, and 4.3.26 to get a full picture of flood impacts as hurricanes, dam failure, and levee failure all impact flooding.

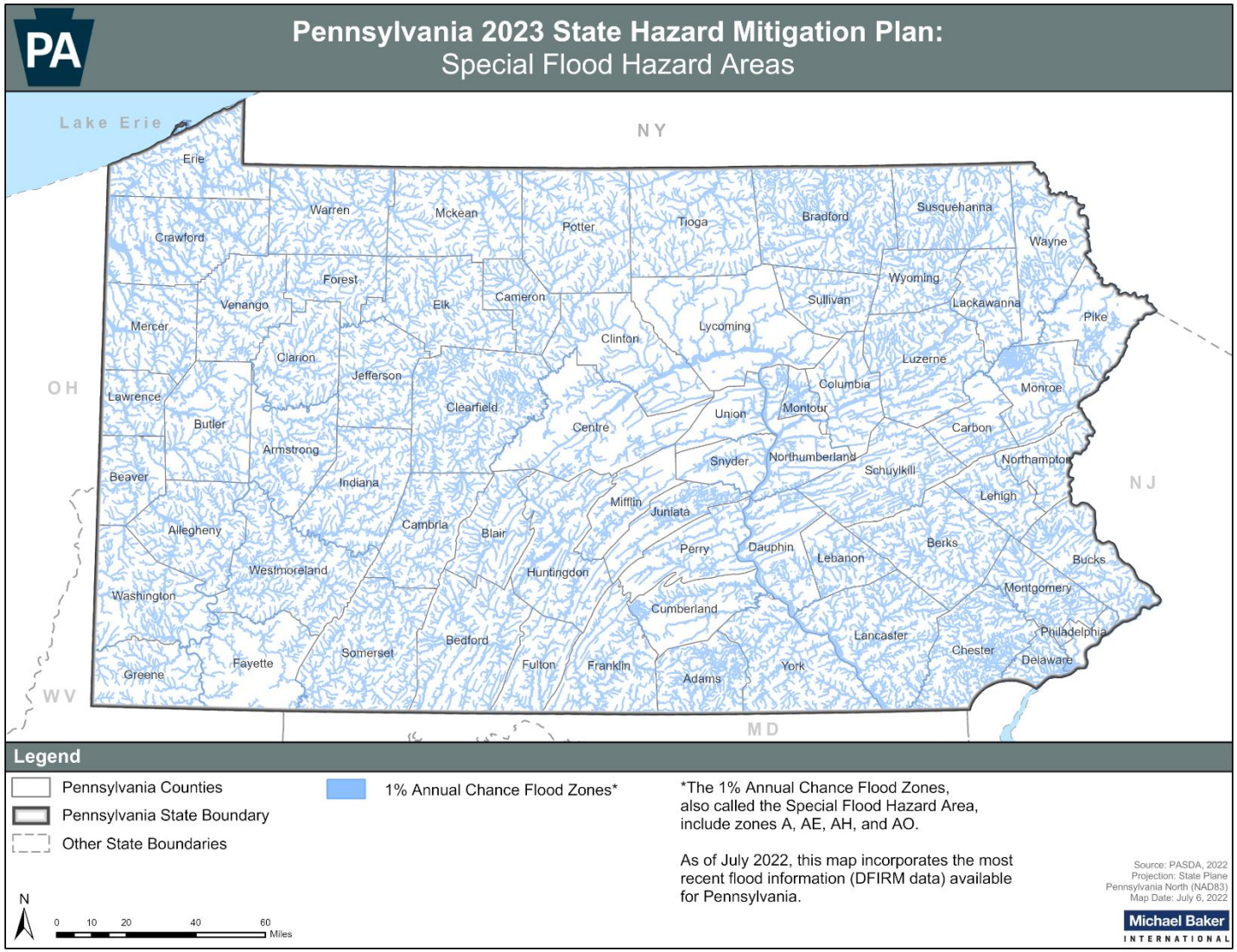
Floodplains found in lowlands, adjacent to rivers, streams, creeks, lakes, or other large water bodies are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. In assessing the potential spatial extent of flooding, it is important to know that a floodplain associated with a flood that has a 10% annual 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), for which Flood Insurance Rate Maps (FIRM) are published, identifies the 1%-annual-chance flood, which is used to delineate the Special Flood Hazard Area and identify Base Flood Elevations (FEMA, 2022e). Figure 4.3.5-1 illustrates these terms. For flash flooding, NOAA is developing modeling tools to predict water levels, debris flow, and advanced warning system.

Figure 4.3.5-1 Diagram Identifying Special Flood Hazard Area, 1%-Annual-Chance (100-Year) Floodplain, Floodway, and Flood Fringe



The Special Flood Hazard Area serves as the primary regulatory boundary used by FEMA and the Commonwealth. FIRMs, Flood Insurance Studies (FIS), and other flood hazard information for counties throughout Pennsylvania can be obtained from the FEMA Map Service Center (http://www.msc.fema.gov). These maps can be used to identify the expected spatial extent of flooding from a 1%- and 0.2%-annual-chance event. Figure 4.3.5-2 shows the location of Special Flood Hazard Areas throughout Pennsylvania. In Pennsylvania, the 1%-annual-chance zones include A, AE, AH, and AO. Note that there is typically higher uncertainty in the delineation of flood hazard areas in broad, flat floodplains in comparison to areas of steeper topography.

Figure 4.3.5-2 Special Flood Hazard Areas throughout Pennsylvania (FEMA, 2022f).



4.3.5.2. Range of Magnitude

Both localized and widespread floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents or bacteria and disease are spread by moving or stagnant floodwaters (Doocy et al., 2013). Most property damage results from inundation by sediment-filled water. A large amount of rainfall over a short time span, like a cloudburst, can result in flash flood conditions. Cloudbursts can lead to agricultural losses due to nutrient, seed, chemical, and crop losses from heavy precipitation (USDA, 2022). Small amounts of rain can result in floods in locations where the soil is frozen or saturated from a previous wet period or if the rain is concentrated in an area of impermeable surfaces such as large parking lots, paved roadways, or other impervious developed areas (MRCC, 2022).

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover, and rate of snowmelt (Doocy et al., 2013). Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Many areas of the Commonwealth have relatively steep topography, which promotes quick and flash surface water runoff. Most storms track from west to east, but some originate in the Great Lakes or Atlantic Ocean. Rapidly changing weather patterns and temperatures may cause large-scale snow-melting events in which ice jams in the receiving streams may aggravate the already serious problem of large water volumes contributed by thousands of small tributaries (NOAA NSSL, 2022d). Ice jams occur when pieces of floating ice accumulate and impair stream flow, which can either cause upstream flooding by holding water back or downstream flooding if the obstruction suddenly breaks and all the built-up water rushes downstream. They can occur in the early winter as water begins to freeze or in late spring as frozen areas begin to melt and break apart (National Weather Service, n.d.). An ice jam caused significant flooding in March of 1936, an event that is discussed in the next section.

Rainfall in Pennsylvania is about average for the eastern United States. The American Meteorological Society classifies rainfall intensity into three categories (2012):

- Light rain ï when precipitation rate is .01 to .10 inches/hour
- Moderate rain ï when precipitation rate is .11 to .30 inches/hour
- Heavy rain ï when precipitation rate is > .30 inches/hour

While significant flood events are typically associated with heavy rain, rainfall events of lesser intensity may also cause flooding given sufficient duration. Flood effects can be volume- or force-related, although both play a factor in all flooding events. Flood events that occur along larger streams with wide floodplains tend to result in large-scale inundations, causing widespread damage through soaking and silt deposits in homes, businesses, and industrial plants. The impacts of these events are typically a function of how much water was involved instead of the force of that moving water. On the other hand, flash floods resulting from bursts of heavy rainfall happen suddenly and powerfully as they sweep vehicles away, uproot trees, damage buildings and structures, and more (The Weather Channel, 2015). Flash floods are often unpredictable and, particularly if they occur at night, can cause major panic and loss of life due to low visibility (Ġpitalar et al., 2014). These events are common in hilly regions where

runoff paths are steep, allowing water to reach higher velocity as it flows over the ground. Frozen or very dry surfaces can increase normal runoff velocities as well, particularly in small drainage areas, as water is not able to infiltrate the soil easily (Chen et al., 2017). In addition to slopes and frozen ground, ice and debris jams in channels and culverts can lead to quick-rising floods if they significantly obstruct the flow of water (NOAA NSSL, 2022d).

Floods are naturally occurring events that benefit riparian systems that have not been disrupted by human actions; benefits include groundwater recharge and the introduction of nutrient rich sediment improving soil fertility (WMO, 2006). However, the destruction of riparian buffers, changes to land use and landcover throughout a watershed, and introduction of chemical or biological contaminants that often accompany human presence cause environmental harm when floods occur. Hazardous material facilities are potential sources of contamination during flood events (see Section 4.3.23). Other environmental impacts of flooding include: water-borne diseases, heavy siltation, erosion of streambanks and riverbeds, destruction of aquatic habitat, damage to water and sewer infrastructure located in floodplains, damage or loss of crops and vegetation, and drowning of both humans and animals (Washington State Department of Ecology, 2022). Extreme rain events can also lead to the failure of manure lagoons, which are typically built for 25-year storms. These failures can lead to significant runoff that may lead to harmful algae blooms in local waterways.

The worst flooding events experienced in Pennsylvania were the Johnstown Flood of 1889, Tropical Storm Agnes in 1972, and Tropical Storm Lee in 2011. Each of these events are discussed in Section 4.3.5.3 and Tropical Storms Agnes and Lee are also addressed in Section 4.3.7.

Table 4.3.5-1 Most Likely Lifelines Impacted by Floods, Flash Floods, and Ice Jams		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal, compounding, and cascading impacts where community safety is threatened and government operations and facilities, including police, fire, and search and rescue are involved with response and recovery. Actions to protect communities are focused on proper planning of development in or near the floodplain. This includes incorporating flood mitigation into local planning by including flood considerations in infrastructure development and improving stormwater management.
Food, Water, Shelter		Anticipating a causal, compounding, and cascading relationship for the Food, Water, Shelter lifeline in response and recovery. Flooding events present significant risk to buildings and the potential compounding and cascading impacts additional hazards and damage to infrastructure can create issues for food and water access. Ways to mitigate damage to this lifeline include limiting or restricting floodplain development and adopting building codes to ensure structures can withstand flood impacts.
Transportation		Anticipating a causal and compounding relationship for the Transportation lifeline in response and recovery due to direct damage from flooding and potential impacts of compounding hazards such landslides and transportation incidents. Potential mitigation actions should be focused on reducing impacts to roadways and inspections to ensure infrastructure meets specifications to handle severe impacts.
Hazardous Materials		Anticipating a causal, compounding, and cascading relationship for the Hazardous Materials lifeline in response and recovery due to potential contamination because of flood damage to facilities. Mitigation for this lifeline is similar to the others and should be focused on increasing the resiliency of sites through specific building codes and development regulations that either provide protection or result in hazardous sites being located outside flood hazard areas.

The potential impacts of flooding on Community Lifelines are very high. Not only is the safety of the community at risk, but the ability of the government to provide services may be compromised. Law enforcement, fire stations, and search and rescue may all be called into action to assist in both pre- and post-disaster assistance. The supply of food and water may be impacted depending on the severity and location of the flooding event, and people may be forced to flee their homes. Agricultural operations may be devastated by flooded fields and damaged equipment. Health care facilities may sustain damage and not be fully operational, the medical supply chain could be interrupted due to flooding cutting off access to certain areas, which could similarly impact emergency medical services. Flooding has the potential to severely impact both the power grid and fuel access, leaving areas without reliable access to energy. Communications infrastructure is similarly at risk, especially cable systems and others that rely on electricity. Alert and warning systems are important ways to disseminate information in all phases of a potential flooding event and 911 & Dispatch are valuable resources in reaching those that need help. Transportation infrastructure may be significantly impacted and potentially destroyed by severe floods, including airports and ports. Flooding also comes with risks associated with environmental contamination, and damage to facilities or locations that contain hazardous materials can lead to more severe impacts for those in the vicinity or downstream.

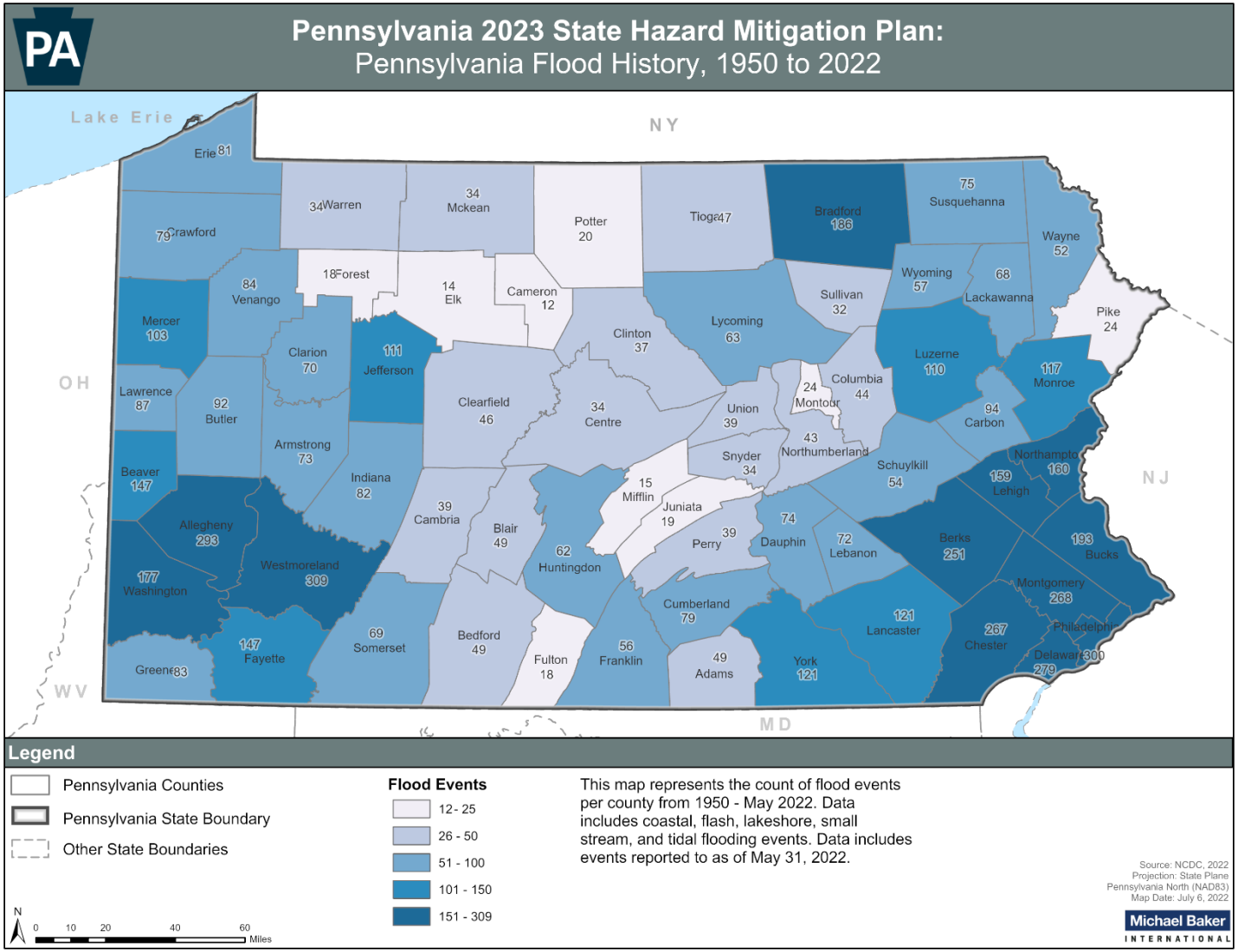
Flooding is closely linked with a multitude of other hazards. One hazard that flooding can directly cause is coastal erosion, with landslides and land subsidence also possible due to the wearing down of slopes and saturation of soil. Dam and levee failures may be causes of flooding themselves or worsen the impacts of a flooding event, with riverine flooding and intense precipitation being potential causes behind failures. Building and structure collapses are possible due to swiftly moving water and inundation. The environmental hazards associated with coal mining, both conventional and unconventional oil/gas wells, hazardous materials, and pipelines may be triggered due to flooding. Nuclear incidents may be possible if the flooding event is significant enough.

4.3.5.3.Past Occurrence

Pennsylvania has a long and continuous history of floods. A significant number of the Presidential Disaster and Emergency Declarations in Pennsylvania have been in response to hazard events related to flooding (see Table 4.2.1-1). Additional declarations issued for hurricane, tropical storm, or severe storm events were likely issued at least in part to flood impacts as well. Together, these events would account for the majority of Disaster and Emergency Declarations in the Commonwealth. Table 4.3.5-2 provides a tabulation of the number of flood events recorded for each county in the Commonwealth between 1996 and January 3, 2023. Figure 4.3.5-3 provides this information in map form for the period of 1996 until May 31, 2022. Allegheny, Chester, Montgomery, Philadelphia, and Westmoreland Counties have experienced the highest number of events over this 25-year period. A total of 27 counties have 67 events or more or an average of one flood event per year.

Table 4.3.5-2 Number of Flood Events by County between 1996 and January 2023 (NOAA NCEI, 2023			
COUNTY	NUMBER OF EVENTS	COUNTY	NUMBER OF EVENTS
Adams	54	Lackawanna	52
Allegheny	261	Lancaster	118
Armstrong	57	Lawrence	71
Beaver	96	Lebanon	71
Bedford	56	Lehigh	92
Berks	138	Luzerne	90
Blair	52	Lycoming	63
Bradford	126	McKean	35
Bucks	155	Mercer	80
Butler	79	Mifflin	17
Cambria	49	Monroe	66
Cameron	15	Montgomery	180
Carbon	63	Montour	29
Centre	36	Northampton	93
Chester	174	Northumberland	51
Clarion	46	Perry	41
Clearfield	53	Philadelphia	191
Clinton	39	Pike	25
Columbia	48	Potter	24
Crawford	83	Schuylkill	58
Cumberland	82	Snyder	35
Dauphin	72	Somerset	57
Delaware	157	Sullivan	33
Elk	18	Susquehanna	56
Erie	79	Tioga	48
Fayette	125	Union	46
Forest	18	Venango	71
Franklin	57	Warren	35
Fulton	24	Washington	115
Greene	58	Wayne	41
Huntingdon	70	Westmoreland	177
Indiana	62	Wyoming	56
Jefferson	54	York	121
Juniata	21	**TOTAL**	**4,920**

Figure 4.3.5-3 Pennsylvania Flood History, 1950 to 2022 (NCEI, 2022).



Previous versions of the SHMP found that approximately 57% flood events occur during the months of June, July, and August. Although most of the major historic Pennsylvania floods have occurred in the summer, occasionally flooding has been caused by a moderate warm winter rain following a deep snowpack. Floods in March 1936 were caused by a large accumulation of snow during a cold January, followed by a steady warming trend in February and rainfall. There was rapid snow and ice melting in almost all major watersheds in Pennsylvania. Ice jams caused enormous back-up effects on bridges, and many cities experienced the highest flood levels ever recorded. In reaction to this devastating event, major flood-control structures were built throughout much of Pennsylvania (Kiner, 2021a; Lewis, 2019). This type of flooding occurred again in January 1996 and led to the collapse of the Walnut Street Bridge in Harrisburg (Kiner, 2021b).

Pennsylvania has one of the most intense recorded rainfall events in the history of the U.S. In August 1942, more than 30 inches fell within a span of five hours near Smethport, a small town near the New York state border in McKean County (Eisenlohr, 1952). Whereas Smethport received the largest rainfall, it was estimated that more than 20 inches fell over a 200 square-mile area between Emporium and Austin. A peak flow rate of 80,000 cubic feet per second was estimated in Sinnemahoning Creek from high-water marks; almost ten times as large as any other flood recorded in that stream. The storm and resulting floods undoubtedly caused a large amount of destruction, but possibly owing to more pressing World War II problems, the event never received a great amount of publicity.

In June 1972, Tropical Storm Agnes caused widespread flooding that resulted in the largest total flood damage event in Pennsylvania. The storm lasted between two and three days, during which rainfall varied from four inches in western Pennsylvania up to 20 inches in some regions north of Harrisburg. Most major streams rose to record stages, causing hundreds of millions of dollars in damages in cities such as Wilkes-Barre, Lock Haven, and Harrisburg (Bailey and Patterson, 1975). In Pittsburgh, the Allegheny and Monongahela Rivers rose to within a few inches of the top of their banks. Pittsburgh avoided major flood damage due to the large capacities of several flood-control reservoirs, notably the Allegheny and Conemaugh which prevented an estimated $2.6 billion in flood damages (USACE, 2022a/b). In the Susquehanna River watershed, the recently completed Curwensville (Clearfield County), Foster Joseph Sayers (Centre County), and Alvin R. Bush (Clinton County) Dams, together with some older dams, held back a total volume of roughly 250,000 acre-feet (Bailey and Patterson, 1975). This reduced potential Susquehanna River stages by several feet, but storage volumes were not nearly large enough to prevent flooding in the downstream reaches of the river. Agnes caused 117 deaths, 48 of which were in Pennsylvania (Bailey and Patterson, 1975). More information regarding Tropical Storm Agnes can be found in Section 4.3.7.

Parts of Crawford, Venango, Clarion, Jefferson, and Forest Counties were devastated during a summer storm on June 9, 1981. Flash flooding occurred with recorded local rainfall totals of 4.5 inches in the City of Franklin and 6.4 inches in Cooperstown. One death and at least $65 million in damages were reported. Two Mile Run and Sage Run in Cranberry Township, Venango County, were especially hard hit. Flash floods of this kind are not uncommon across the

Allegheny Plateau in western Pennsylvania. Similar floods caused by intense rainfall over a limited area occurred include:

- Johnstown Flood of May 1889;
- Johnstown in July 1977 (78 deaths);
- Eastern Pennsylvania in August 1955 (101 deaths);
- East Brady, Armstrong County, in August 1980;
- Hyndman, Bedford County, in August 1984; and
- Northern suburbs of Pittsburgh in May 1986 (eight deaths) and 1987.

Oil City, located in western Pennsylvania, has historically been plagued with ice jams and ice-related flooding more than most other communities throughout the Commonwealth, with records showing that events have occurred from as far back as the mid-1800s. These floods have caused extreme hardships for the community and heavy economic and personal losses as well. To combat the constant issues, a floating ice control structure on the Allegheny River and a fixed concrete weir on Oil Creek were installed in the 1980s to eliminate flood-causing ice jams at the mouth of Oil Creek, and up until 2017 it was calculated that it had reduced flood damages by $23.5 million (Carr, et al., 2017).

In 2011, one of the worst flooding events in Pennsylvania history occurred when Tropical Storm Lee traveled through the state just days after Hurricane Irene dumped between two and eight inches of rain in eastern Pennsylvania (NOAA NWS, 2015a). With large portions of the Susquehanna River Basin already saturated by Irene, Lee's rain caused flash flooding and riverine flooding in and east of the Susquehanna River Valley. The heavy rain broke previous precipitation records set by the former worst-case, Tropical Storm Agnes, and caused multiple new floods of record throughout the state (Brown, 2011). According to the NWS, over 2,000 people were evacuated, and 3,000 homes and businesses flooded in Bradford County alone, with their agricultural community suffering around $7 million in crop damage. In Luzerne County, 60,000 people were evacuated and while the Wyoming Valley levee system held, unprotected communities saw flood depths worse than in Hurricane Agnes. Lee/Irene forced the first ever closure of the Bloomsburg Fair, since fairgrounds were covered in 10-12 feet of water.

There were ten fatalities statewide due to the storm: one in Bradford County, four in Dauphin, three in Lancaster, one in Lebanon, and one in Philadelphia. Of these fatalities, half occurred as a result of cars being washed away. The NWS reported at least 23,780 structures were affected by the event, with over 1,000 completely destroyed and nearly 8,000 substantially damaged. With the event occurring in the active growing season, there was widespread crop damage reported to the Department of Agriculture. The Commonwealth and many county EOCs were activated for extended periods, and the event received both a Presidential Emergency Declaration and a Declaration of Major Disaster. As of May 2012, damages (including debris removal, emergency protective measures, road repair, bridge repair, buildings, utilities, and parks) topped $200 million for this event (NOAA NWS, 2012).

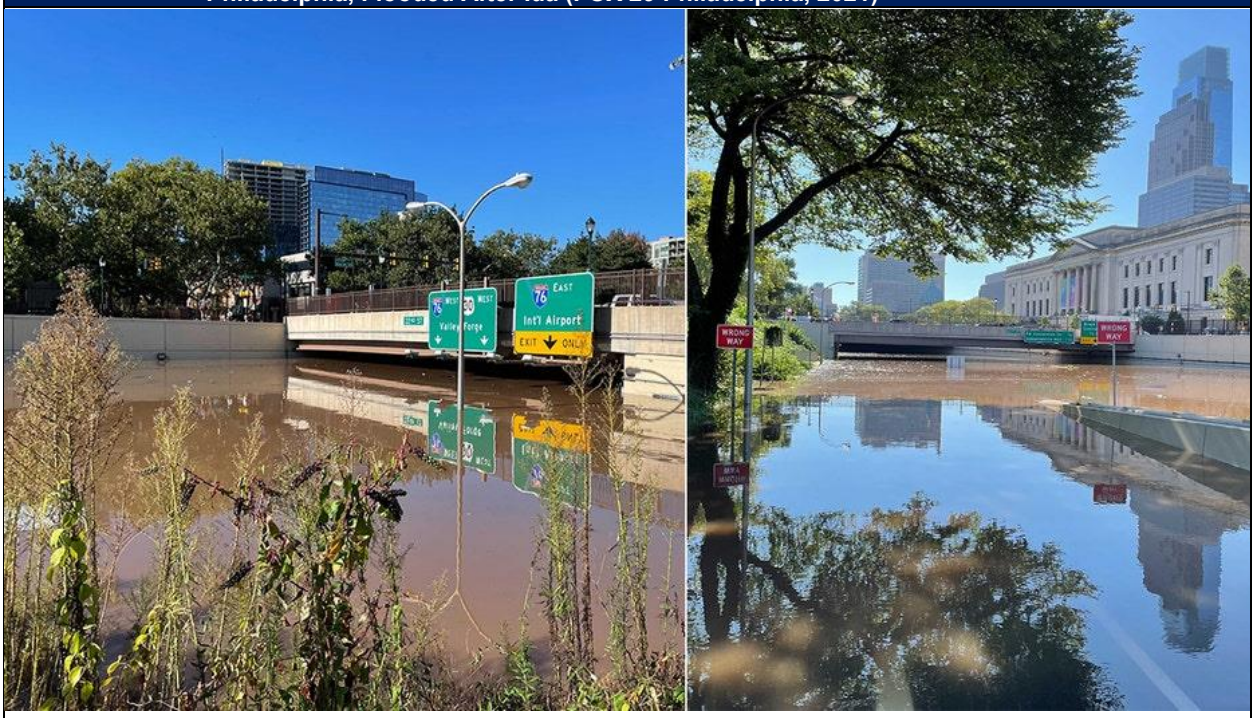
Pennsylvania has not since experienced a large-scale catastrophic flooding event to the scale of damage caused by Tropical Storm Lee in 2011. However, more recent flood events have resulted in significant damage. In April 2014, flooding in the greater Philadelphia region was

some of the worst since Tropical Storm Floyd in 1999 or Irene in 2011, causing over 1,000 people to be evacuated from their homes and approximately $4.5 million in property damage (NCEI, 2018). In November 2017, a flash flood in Erie County occurred when thunderstorms formed across the Ohio Valley and southern Great Lakes and the intensity of the rainfall ultimately overwhelmed storm drainage systems causing significant overland flooding (NCEI, 2018). In July and August of 2018, record-breaking rainfall across much of Pennsylvania led to rounds of flash, creek, and river flooding that were particularly destructive in parts of central and eastern Pennsylvania (Kellar, 2018).

According to NOAA, 2018 was the wettest year on record in Pennsylvania with 64.04òof precipitation, beating out the 61.00òfrom 2011 (NOAA NCEI, 2022a). In addition to record-breaking rainfall, 2018 was a year of record or near-record river flows at several locations throughout the Delaware River Basin, which extends from the headwaters of the Delaware River in New York through eastern Pennsylvania and western New Jersey to the Delaware Bay. An analysis of USGS flow data by the Delaware River Basin Commission found that 2018 flow rates were record-breaking or near record-breaking at several locations within the Delaware River Basin, including the Schuylkill River at Philadelphia (records date to 1932), the Delaware River at Montague, NJ (records date to 1940) and Trenton, NJ (records date to 1913), and the Lehigh River at Bethlehem (DRBC, 2019). Itôs difficult to attribute the rainfall or flow rates in a single year or even grouping of years to climate change, but the wettest 5-year interval in Pennsylvania history was 2016-2020 (NOAA NCEI, 2022a).

The most significant flooding event since the 2018 Plan occurred when Hurricane Ida traveled through the southeastern part of the Commonwealth in late August and early September of 2021. Some of the largest rainfall totals include 10òin Downingtown, 9òin Chester Springs, 8.2ò in Phoenixville, 7.95òin Quakertown, and 7.26òin Wester Chester and Kennett Square (NOAA, 2022). The storm led to record-high river flows, with the Schuylkill cresting at 26.85ôin Norristown (breaking 1972 record from Agnes) and the Perkiomen reaching 20.62ôin Graterford (Heinze, 2022). Flooding was devastating in Philadelphia, where the Schuylkill crested at 16.28ò, just below the 17òrecord set in 1869 but over 2òmore than what is considered a major flood; pictures from a flooded Vine Street Expressway went viral as a broken water pump meant the water had no other place to go (Kummer, 2021). More than 83,000 households across Bedford, Bucks, Chester, Delaware, Montgomery, Northampton, Philadelphia, and York counties applied for federal aid once an official disaster declaration was made, with over $265 million in assistance approved (FEMA, 2022g). Two groups particularly impacted were low-income households and renters as the storm wiped out their housing units and even forced them to compete for the same vacancies, showcasing how severe flooding events like Ida can exacerbate an already existing affordable housing crisis. Hundreds of residents across Philadelphia County and the surrounding suburbs were forced into county-funded hotels and even those receiving housing assistance struggled to use their housing vouchers for units, if there was any available at all (Rushing, 2021). The region is still feeling the effects of the storm as of Fall 2022.

Figure 4.3.5-4 Photos of the Vine Street Expressway, the Stretch of I-676 between I-95 and I-76 in Philadelphia, Flooded After Ida (FOX 29 Philadelphia, 2021)



In the last 30 years, flooding impacted Pennsylvania with state-wide declarations in January 1996, Hurricane Floyd in September 1999, Hurricane Isabel/Henri in September 2003, Hurricane Lee/Irene in 2011, Hurricane Sandy in 2012/2013, June and August 2018, and now Hurricane Ida in 2021. Flooding impacting another region of the country resulted in a Proclamation of Emergency for Hurricane Katrina in September 2005 for Pennsylvania to assist with mutual aid and housing evacuees. Since 2007, there have been a total of fourteen flood-related Disaster and Emergency Declarations, including hurricanes and severe storms, impacting Pennsylvania.

In addition, since 1978, there have been 76,995 total claims resulting in over $1.4 billion of total losses paid, as shown in Table 4.3.5-3. This is an increase of 6,866 claims and $228.4 million since the 2018 plan, 9.8% and 19.3% respectively. Based on the total number of claims, the average claims payment over this period is just over $18,000, an increase of around $1,500 from the 2018 plan. The effects of Ida can really be seen when continuing to compare each countyôs data between the two plans. The counties with the most claims since 2018 were Montgomery (1088), Allegheny (590), Bucks (546), Delaware (443), Philadelphia (437), and Chester (358). Twenty-one counties saw a double-digit percent increase in claims, with ten counties reporting over 15% more; the most notable one is the 40% increase from Philadelphia County. Montgomery County saw the biggest increase in money paid out with $66.4 million, followed by $26.7 million in Philadelphia, $18.2 million in Bucks, and over $16 million in

Delaware, Chester, and Allegheny. Philadelphia saw the biggest percentage increase with 135% more money compared to 2018 data. Other notable increases are Chesterôs 80%, Montgomeryôs 56%, and 50% in Tioga.

Itôs important to note that only looking at NFIP claims and money paid out does not represent the full impact of flood events in a community, as the program cannot pay claims if there is no policy in effect. Additional losses that were incurred by those without an NFIP policy may be paid either out-of-pocket or via a private insurance plan and therefore not counted in the data below. The potential impacts for households without insurance is potentially much greater as they must consume savings and be pushed into financial insecurity if they were not already there. Low-income households and renters are more likely to be without insurance and therefore may struggle more in recovering from the impacts of flooding (Kousky and Wiley, 2021).

Table 4.3.5-3 Historic NFIP Claims and Losses (FEMA, 2022h)

COUNTY	CLAIMS SINCE 1978	CHANGE FROM 2018 PLAN	TOTAL PAID SINCE 1978	CHANGE FROM 2018 PLAN
Adams	445	9.1%	$6,874,589.00	9.0%
Allegheny	4780	14.1%	$78,226,297.00	26.2%
Armstrong	517	4.7%	$6,226,025.00	13.1%
Beaver	845	10.0%	$13,502,852.00	17.0%
Bedford	1539	7.3%	$14,927,029.00	17.1%
Berks	1273	19.1%	$19,175,390.00	26.8%
Blair	1148	11.5%	$8,804,627.00	26.2%
Bradford	952	10.7%	$24,876,508.00	11.7%
Bucks	5244	11.6%	$147,253,920.00	14.2%
Butler	928	11.7%	$14,576,758.00	17.8%
Cambria	802	5.0%	$3,493,150.00	12.5%
Cameron	80	1.3%	$566,139.00	0.8%
Carbon	97	5.4%	$425,598.00	7.7%
Centre	367	7.0%	$3,172,589.00	5.7%
Chester	1944	22.6%	$36,821,956.00	80.3%
Clarion	176	4.8%	$2,929,235.00	15.3%
Clearfield	547	4.4%	$5,872,541.00	14.1%
Clinton	938	3.1%	$8,279,830.00	4.9%
Columbia	2264	7.4%	$63,814,569.00	6.5%
Crawford	436	7.4%	$1,874,579.00	15.3%
Cumberland	1579	2.9%	$16,315,496.00	2.0%
Dauphin	5523	4.2%	$89,617,717.00	3.5%
Delaware	2929	17.8%	$57,009,868.00	42.5%
Elk	308	5.8%	$7,318,304.00	3.9%
Erie	568	11.6%	$5,843,544.00	20.9%
Fayette	776	8.7%	$10,361,530.00	26.2%
Forest	23	4.5%	$190,074.00	0.1%

Table 4.3.5-3 Historic NFIP Claims and Losses (FEMA, 2022h)

COUNTY	CLAIMS SINCE 1978	CHANGE FROM 2018 PLAN	TOTAL PAID SINCE 1978	CHANGE FROM 2018 PLAN
Franklin	186	5.7%	$1,089,652.00	7.3%
Fulton	16	14.3%	$295,163.00	4.5%
Greene	252	7.7%	$3,303,573.00	16.2%
Huntingdon	576	6.3%	$9,828,544.00	3.8%
Indiana	394	7.7%	$2,031,346.00	13.8%
Jefferson	395	1.0%	$7,803,367.00	-0.1%
Juniata	211	2.4%	$1,087,380.00	0.7%
Lackawanna	1314	2.9%	$19,600,495.00	1.7%
Lancaster	2130	9.0%	$31,614,971.00	14.3%
Lawrence	154	10.8%	$1,127,658.00	7.1%
Lebanon	1032	6.3%	$16,635,396.00	9.7%
Lehigh	1121	18.1%	$14,480,761.00	45.3%
Luzerne	4116	3.1%	$92,324,199.00	1.9%
Lycoming	4009	1.7%	$58,050,795.00	0.9%
Mckean	181	1.7%	$998,529.00	0.5%
Mercer	129	4.9%	$929,670.00	3.7%
Mifflin	523	4.2%	$4,406,565.00	3.8%
Monroe	429	18.8%	$14,621,856.00	21.0%
Montgomery	6129	21.6%	$184,054,976.00	56.4%
Montour	147	8.1%	$3,165,400.00	9.1%
Northampton	1409	8.9%	$44,866,960.00	3.2%
Northumberland	1737	1.9%	$24,400,002.00	0.6%
Perry	769	1.6%	$7,570,692.00	-0.6%
Philadelphia	1524	40.2%	$46,559,059.00	134.9%
Pike	219	6.3%	$2,891,795.00	1.1%
Potter	72	2.9%	$521,646.00	13.0%
Schuylkill	1049	21.0%	$26,245,592.00	21.4%
Snyder	958	1.5%	$12,655,205.00	0.4%
Somerset	366	9.3%	$2,303,840.00	20.0%
Sullivan	146	8.1%	$4,072,852.00	20.2%
Susquehanna	461	10.8%	$12,346,220.00	16.2%
Tioga	214	20.2%	$1,802,134.00	49.8%
Union	1048	1.9%	$12,778,794.00	1.5%
Venango	479	6.7%	$6,368,686.00	3.4%
Warren	150	3.4%	$1,131,584.00	4.8%
Washington	977	8.1%	$16,792,074.00	20.1%
Wayne	217	2.4%	$4,512,578.00	2.2%
Westmoreland	1560	19.2%	$17,737,349.00	34.2%

Table 4.3.5-3 Historic NFIP Claims and Losses (FEMA, 2022h)				
COUNTY	CLAIMS SINCE 1978	CHANGE FROM 2018 PLAN	TOTAL PAID SINCE 1978	CHANGE FROM 2018 PLAN
Wyoming	1483	2.1%	$31,354,936.00	2.2%
York	1685	10.7%	$18,354,838.00	21.4%
TOTAL	**76,995**	**9.8%**	**$1,411,067,846.00**	**19.3%**

Figure 4.3.5-5 and Figure 4.3.5-6show total claims and total claims per 1,000 persons by county, respectively. The Delaware and Susquehanna River Basins made up most claims, with the Susquehanna Basin having higher number of claims per 1,000 persons. Delaware, Montgomery, and Bucks counties, part of the Philadelphia suburbs, form an area with many total claims. Lycoming County stands out as the only county in the highest category for both maps, but only had a 2% increase in claims and a 1% increase in losses paid since the last plan update. Wyoming County has by far the greatest claims per 1,000 people with 54.7. Like Lycoming County, they only saw a 2% increase in claims and 2% increase in losses paid since the 2018 plan. Other counties with high claims per 1,000 people are Colombia (34.62) and Bedford (31.96)

Figure 4.3.5-5 Total NFIP Claims by County since 1978 (FEMA, 2022h).

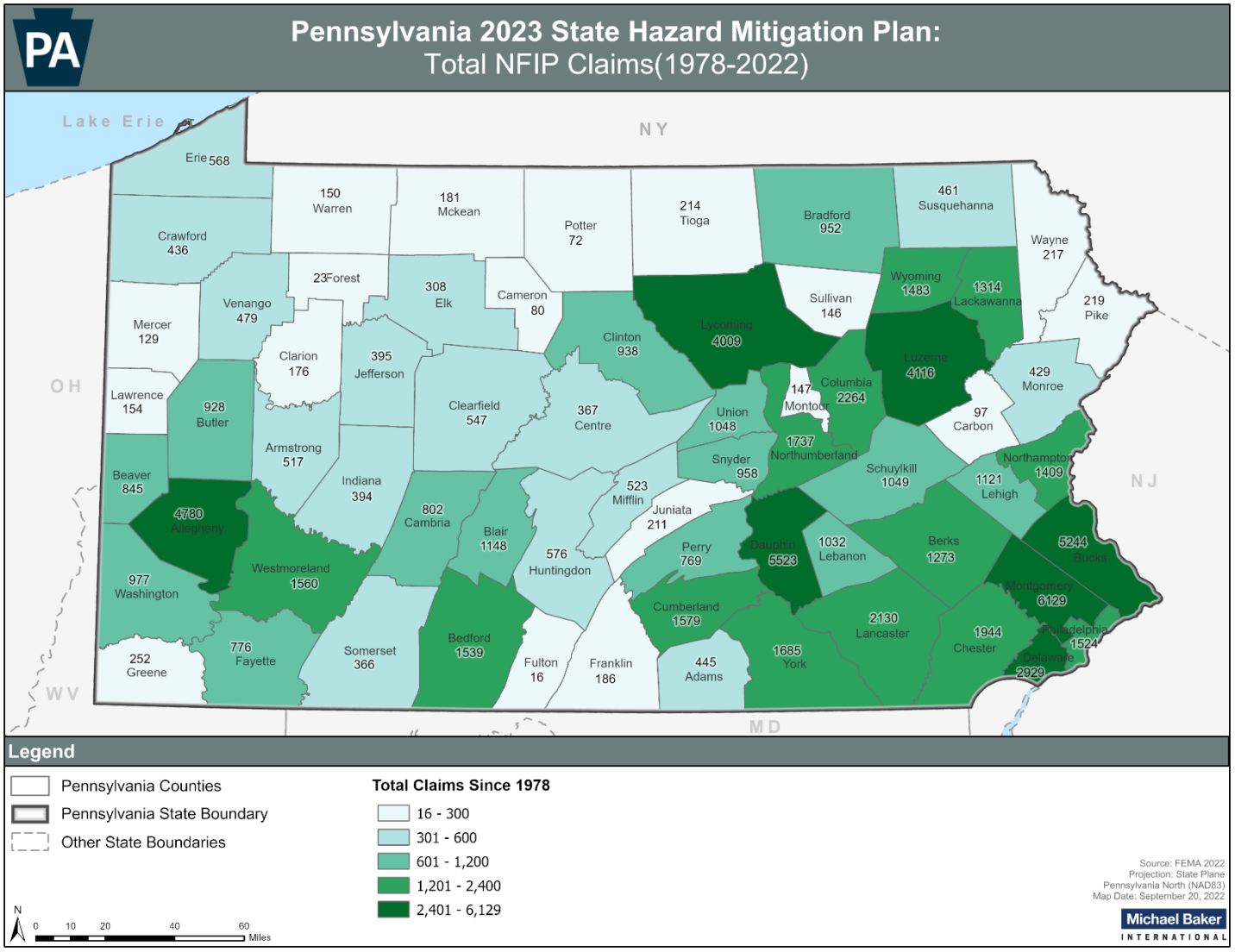
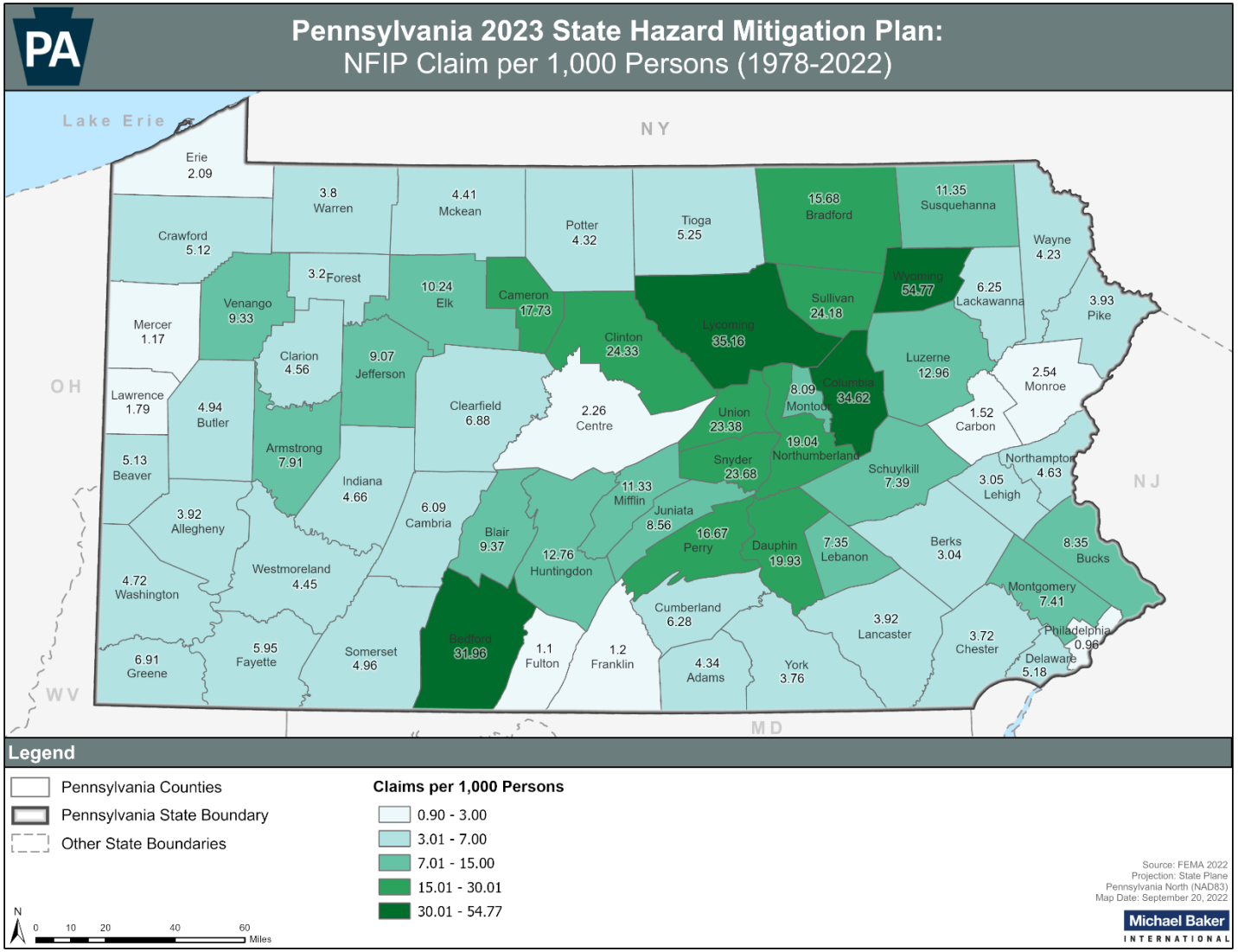


Figure 4.3.5-6 Total NFIP Claims per 1,000 Persons by County since 1978 (FEMA, 2022h).

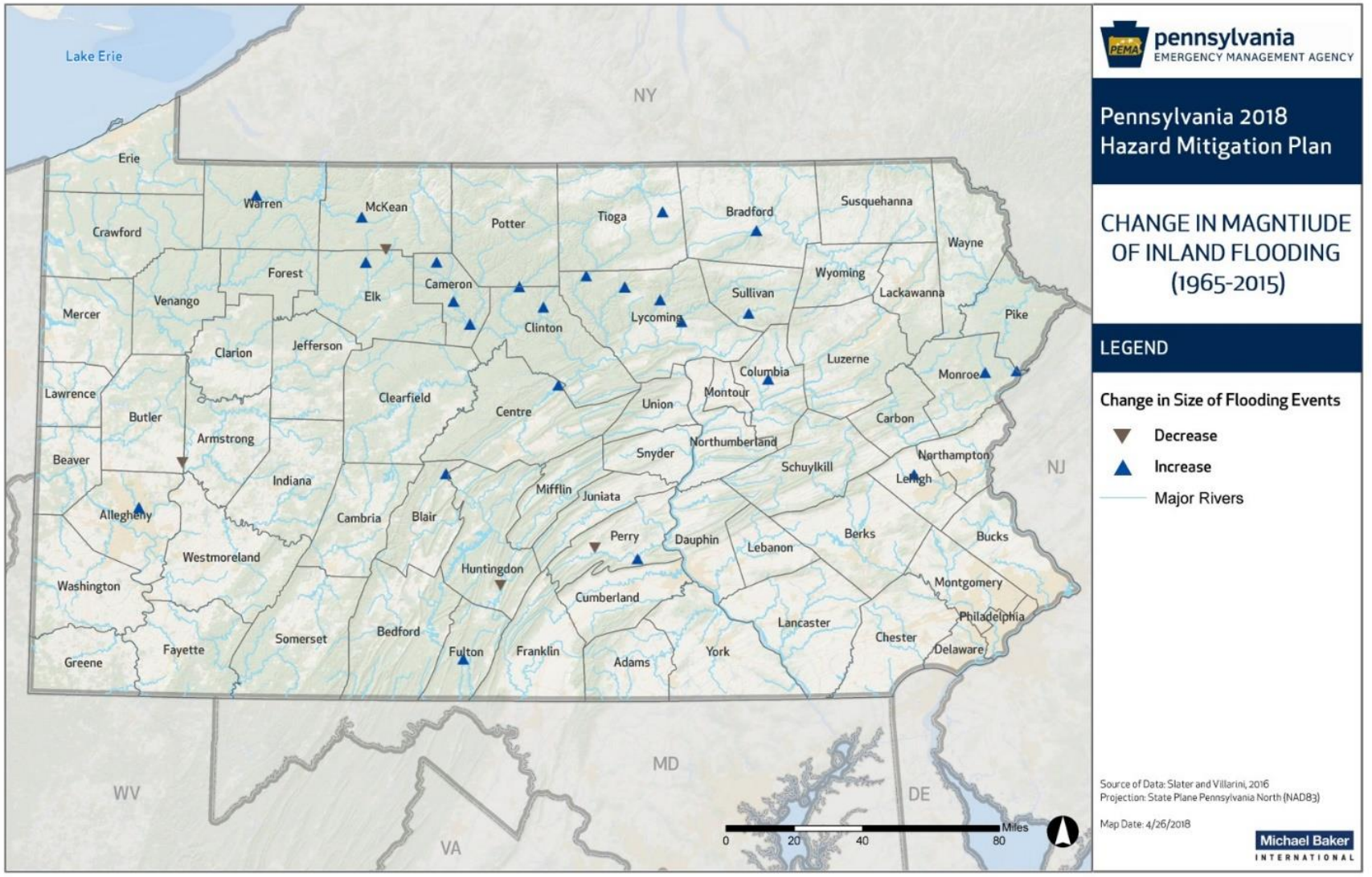


4.3.5.4. Future Occurrence

Flooding is currently the highest-risk hazard in Pennsylvania, and risks are projected to increase in the future (PA DEP, 2021b). It can happen during any season of the year, with serious flooding occurring along one or more of Pennsylvaniaâs major rivers or streams every two to three years. It is not unusual for such events to happen several years in succession. Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and related probability of occurrence. Historical records are used to determine the probability of occurrence (percent chance) for a flood of specific extent to occur. The change in magnitude of inland flooding from 1965 to 2015 (Figure 4.3.5-8) shows an increase in flood magnitude for most sites across Pennsylvania.

The NFIP recognizes the 1%-annual-chance flood, also known as the *base flood*, as the standard for identifying properties subject to federal flood insurance purchase requirements. A 1%-annual-chance flood is a flood which has a 1% chance of occurring over a given year. FIRMs published by FEMA can be used to identify areas subject to the 1%- and 0.2%-annual-chance flooding. Areas subject to 2%- and 10%-annual-chance events are not shown on maps; however, water surface elevations associated with these events are included in the flood source profiles contained in associated Flood Insurance Study Reports. The most recent Flood Insurance Study for each county in Pennsylvania is available from the FEMA Map Service Center (http://www.msc.fema.gov).

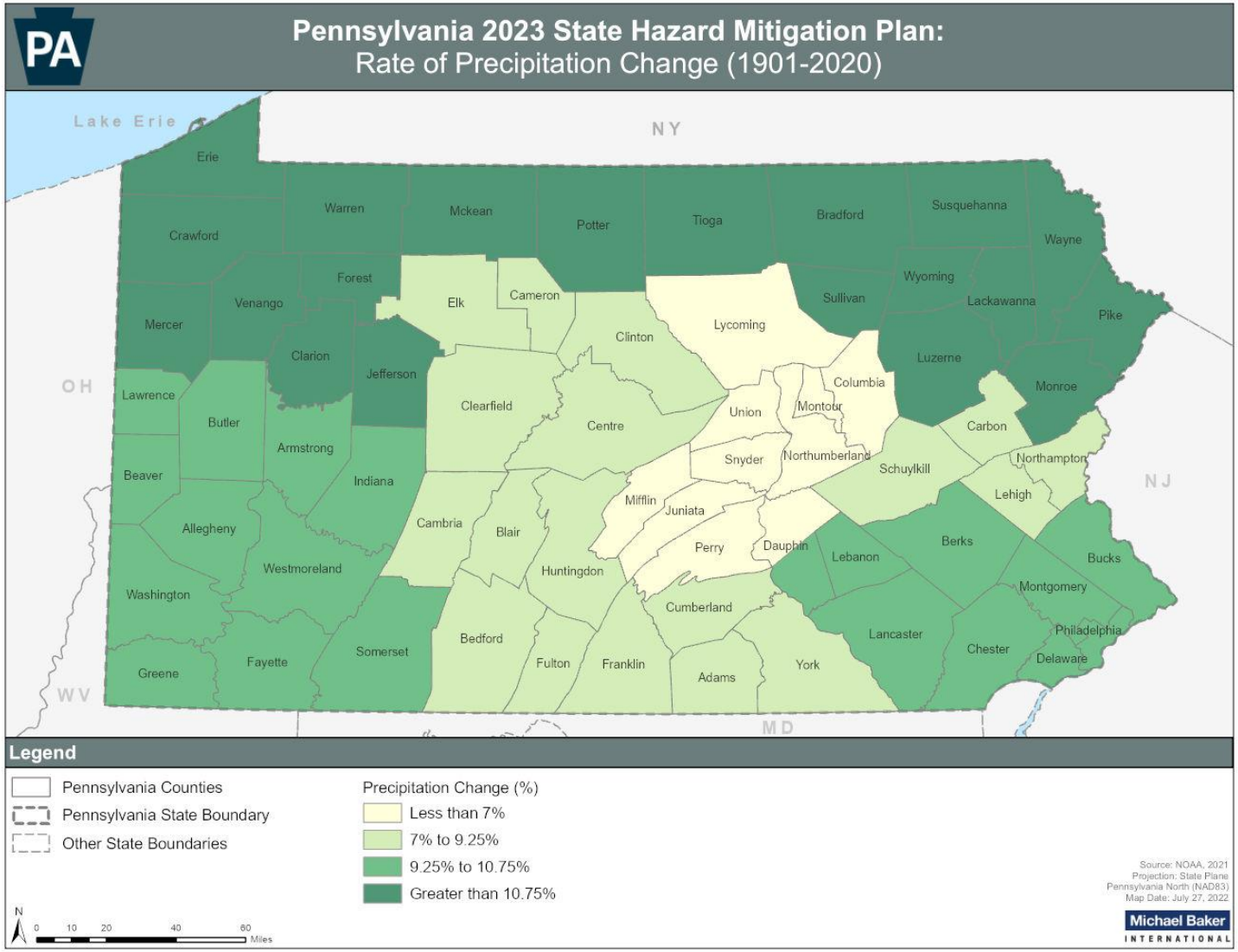
Figure 4.3.5-7 Change in Magnitude of Inland Flooding from 1965-2015 for Pennsylvania



Since heavy precipitation events can be precursors to, or causes of, flooding events, changes to precipitation rates can be illustrative of future potential occurrence of flooding conditions, although this relationship is complex as additional factors including soil moisture and land cover affect flooding occurrence as well. Figure 4.3.5-8 shows the rate of precipitation change from 1901 to 2020. The northern counties saw the most change with increases of 10.75% or more, while the southeastern and southwestern counties had increases of 9.25-10.75% and the central counties seeing the least change with 9.25% or less increases. The southwestern region saw the biggest change from the 2018 plan, as those counties were in the 5-6% category five years ago. The northeastern counties were the only ones with changes of 10% or more in the last plan, but they've been joined by several other counties at similar latitudes for this iteration.

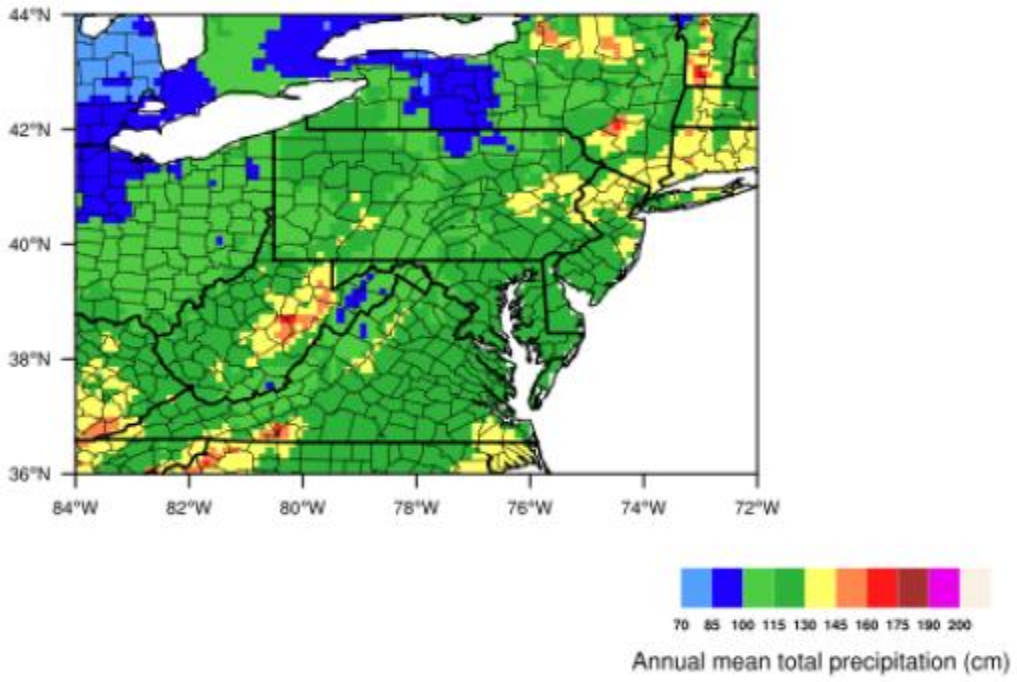
There are also some increasing trends in maximum streamflow in the Northeast United States consistent with this increase in observed extreme precipitation (Wehner et al. 2017). The trend of increased frequency and magnitude of heavy precipitation events is *highly likely* to continue (PA DEP, 2021b). This is due to the increase in atmospheric water vapor from a warming climate which results in a greater amount of rainfall falling in precipitation events. Globally, annual maximum daily precipitation increased 8.5% over the last 110 years, with extreme precipitation events increasing as well (Easterling et al. 2017).

Figure 4.3.5-8 Rate of Precipitation Change from 1901-2020 for Pennsylvania (NOAA, 2021).



The mean annual precipitation change for the eastern part of the state is projected to be between 10 and 12 percent, while the western half of the state is projected to see 8 to 10 percent increases by 2041-2070 relative to 1971-2000, as modeled with CMIP5 and statistically downscaled under the IPCC RCP8.5 emissions scenario (Shortle et al. 2015). Total annual precipitation projections for 2041-2070 are shown in Figure 4.3.5-9 with the east central areas of the state predicted to have the highest amounts of precipitation.

Figure 4.3.5-9 Projections of Annual Total Precipitation for 2041-2070 from the CMIP5 Statistically Downscaled Model under RCP8.5 Emissions Scenario (Pennsylvania Climate Impact Assessment Update, 2015)



Precipitation is expected to increase in all seasons with large increases in winter (14%) and small increases in summer and fall precipitation (Figure 4.3.5-10). It is highly likely that months of above-normal precipitation will increase (Shortle et al. 2015). Changes to runoff are more uncertain but expected to be a small to zero increase with the exception of the eastern part of the state which may have up to 15-20% increase (Figure 4.3.5-11). With highly likely increases in precipitation and potential significant increases in runoff for the eastern half of the state, it is highly *probable* there will be increased risk of flooding for many Pennsylvania counties in the future, especially in the winter and spring months. Consistent with increasing precipitation, the intensity and magnitude of river flooding is also expected to increase. Flash flooding risks are also expected to increase due to these changes in the amount and intensity of precipitation and changes to runoff volume.

Figure 4.3.5-10 Annual and Seasonal Precipitation Change by 2041-2070 Relative to Historical from CMIP5 Model Simulations (PA Climate Impacts Assessment Report Update, 2015)

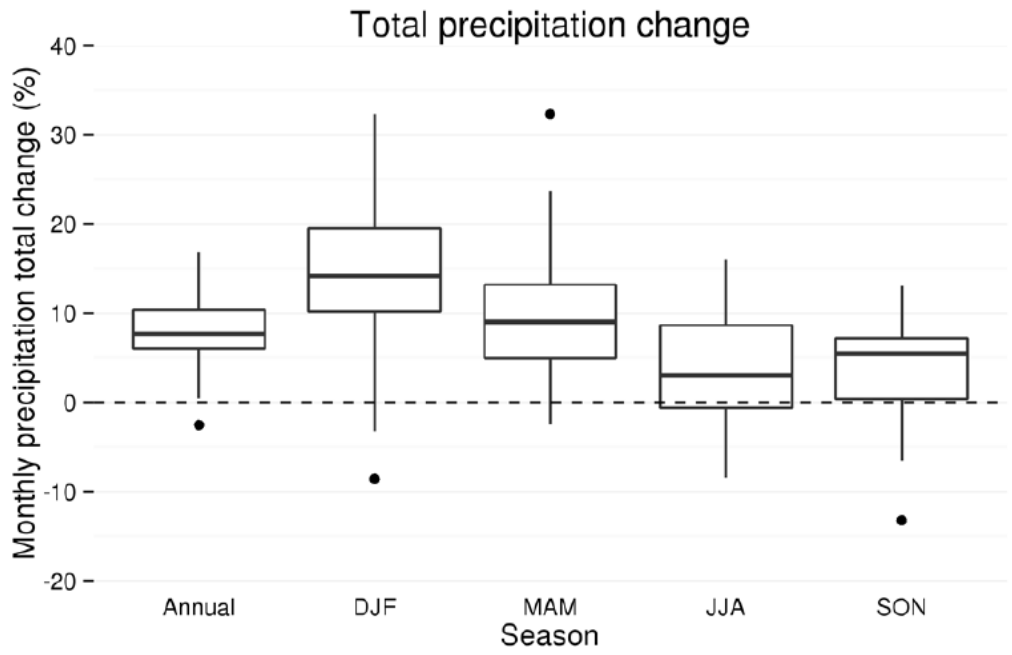
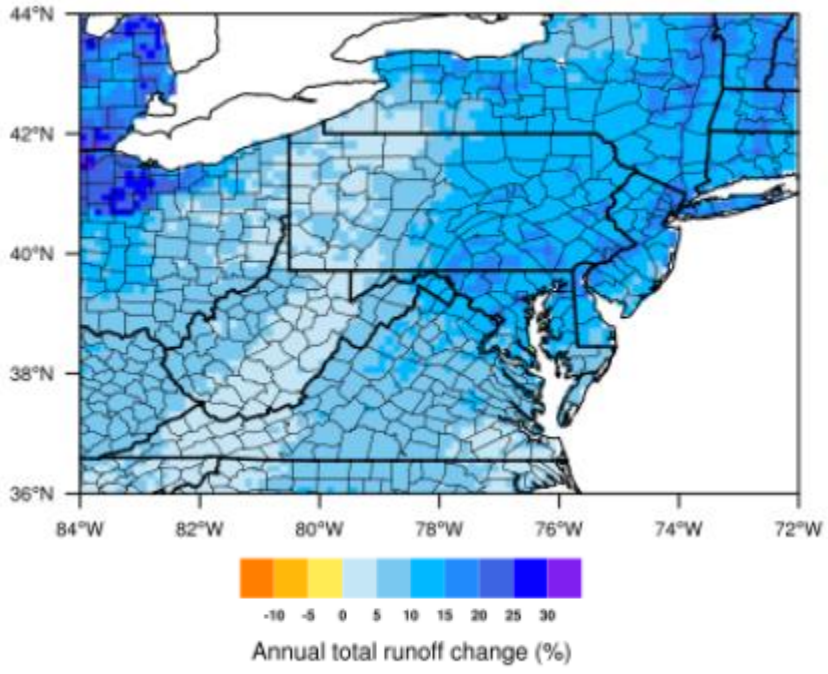
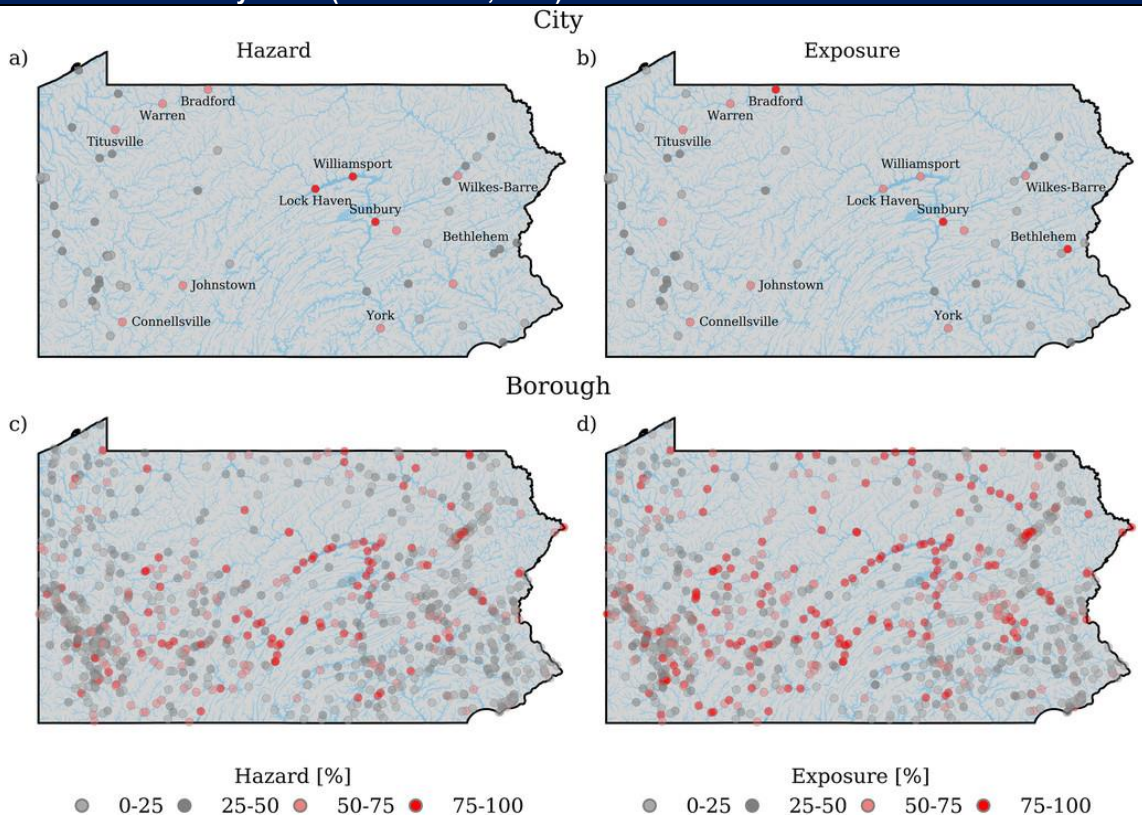


Figure 4.3.5-11 Projected Change in Annual Mean Runoff by 2041-2070 Compared to 1971-2000 from the CMIP5 Statistically Downscaled Model under the RCP8.5 Emissions Scenario (Pennsylvania Climate Impact Assessment Update, 2015)



A 2021 study completed by researchers at Pennsylvania State University and Dartmouth College attempted to project the hazard and exposure percentages of cities and boroughs throughout Pennsylvania in the year 2099 (Figure 4.3.5-12). Hazard percentage is defined as the area that would be inundated by 100-year flood and the exposure level is the population in that area, both standardized to the total area and total population. The analysis identified the Susquehanna River main stem, lower portion of Allegheny basin, and the central portion of the Delaware River basin as areas with particularly high flood risks. Most cities and boroughs are projected to face higher flood hazards and exposure under future conditions. Cities with a particularly high risk include Lock Haven, Williamsport, and Sunbury which are all situated along the west branch of the Susquehanna and have significant histories of flood events.

Figure 4.3.5-12 Projected Flood Hazard and Exposure in Year 2099 for All Cities and Boroughs in Pennsylvania. (Sharma et al., 2021)

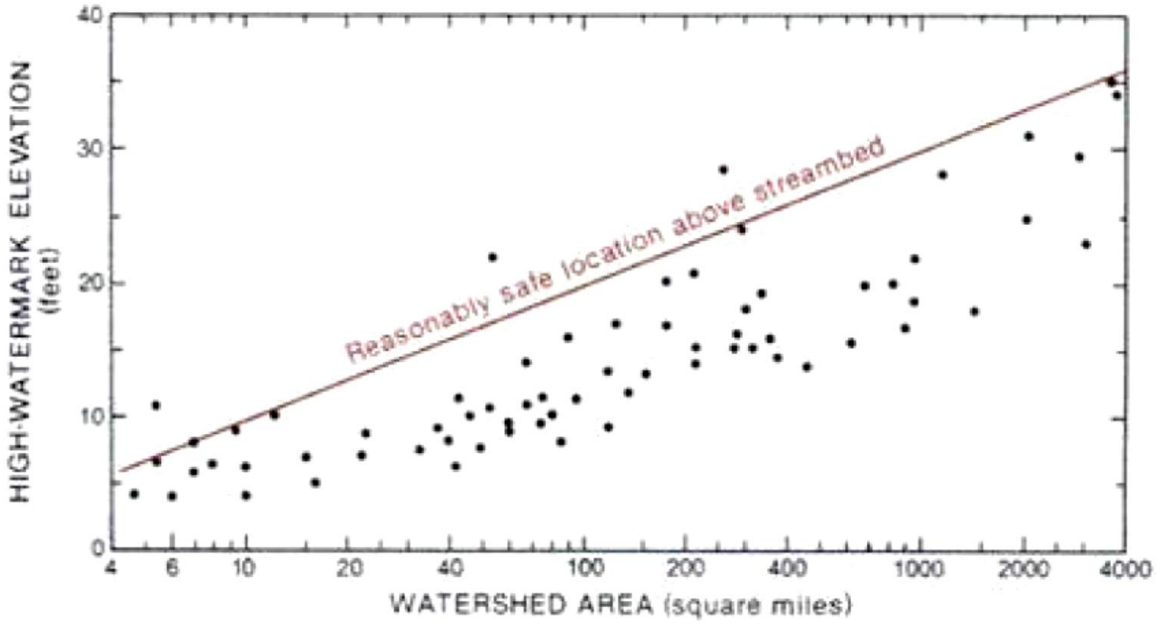


4.3.5.5. State Facility Vulnerability Assessment and Loss Estimation

A major concern for any activity near a stream is the areaôs vulnerability to flooding. While maps identifying the 1%- and 0.2%-annual-chance flood hazard areas, many unmapped floodplain areas are prone to flooding. The potential flooding depth above a streambed depends mostly, but not entirely on the upstream drainage area. The drainage area includes that portion of the watershed that is located upstream from a point of interest, excluding areas subject to the influence of major flood-control dams. Figure 4.3.5-13 shows a plot of historic high watermarks for Pennsylvania floods as a function of watershed area. Using historic high watermark elevations (above streambed), a ñreasonably safeò zone can be defined based on the area of a

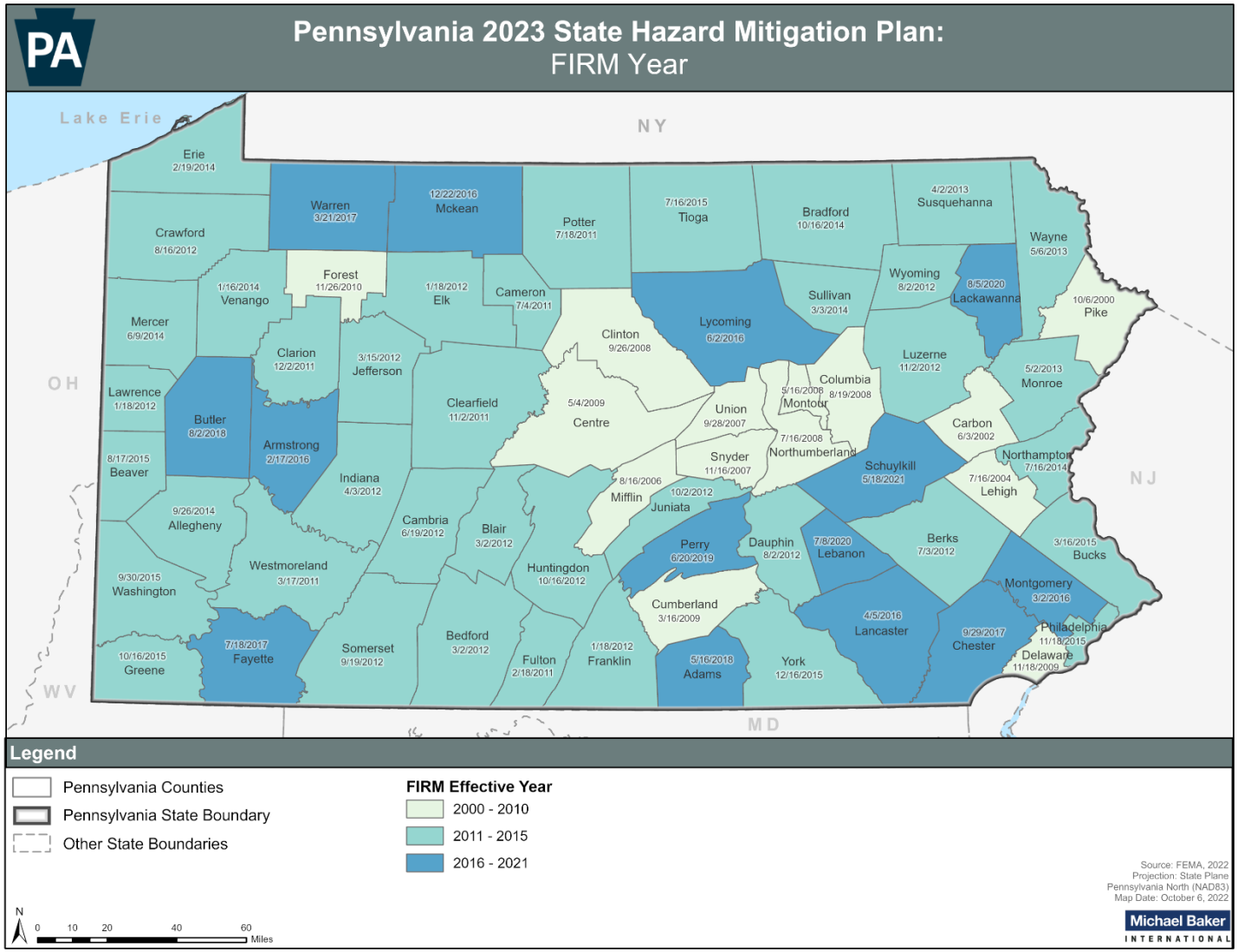
watershed in which a given property is located. For example, a resident of Millerstown in Allegheny County, which occupies about ten square miles of Bull Creek watershed, could feel relatively safe if located ten feet above the streambed, whereas a resident of Chadds Ford in Chester County, which occupies about 290 square miles of the Brandywine Creek watershed, should be located approximately twenty-five feet above the streambed. Note that this graph provides only a rough approximation of flood hazards. Detailed hydraulic and hydrologic analyses are needed to assess the impact of low-permeability soils, steep slopes, and dense urbanization on flood potential for a specific jurisdiction.

Figure 4.3.5-13 Plot of Historic High Watermarks in Pennsylvania vs. Watershed Area



The NFIP recognizes the 1%-annual-chance flood as the standard for identifying properties subject to federal flood insurance purchase requirements. Identifying these special flood hazard areas is essential when determining facilities that are vulnerable to flood. Therefore, the latest available flood information was obtained to assess vulnerability through GIS analysis. The most recent data for each county was collected and included a total of 61 effective FIRMs were used, as well as six pending and preliminary FIRMs. A map of counties and their FIRM status as of April 2018 is presented in Figure 4.3.5-14. Having new FIRM data available nearly statewide adds significant value to communitiesôability to discern flood risk. The effective and preliminary FIRM data is based on strong hydrologic and hydraulic modeling and presents a better, more up-to-date reflection of actual flood risk than the original Q3 maps.

Figure 4.3.5-14 FIRM Status by County as of October 2022 (FEMA, 2022h).



To assess the vulnerability of state-owned or leased facilities and critical facilities to flooding, all facilities located in areas characterized by high flood hazard were identified. High risk areas are defined as the 1%-annual-chance floodplain as depicted on effective and preliminary FIRMs. Additionally, the potential impact of climate change on the vulnerability of state assets to flood hazards was evaluated for three counties: Allegheny, Lycoming, and Delaware. These three counties were the sample counties selected for Phase 1 of the PennDOT Extreme Weather Vulnerability Study, published in March 2017. The PennDOT study developed planning-level estimates of the increase in the 1%-annual-chance floodplain based on projected climate change impacts on precipitation through 2050 and 2100. For this analysis, the projected increase in the 1%-annual-chance floodplain through 2100 was used to evaluate the potential impacts of climate change on flood vulnerability.

As shown in Table 4.3.5-3, 148 state-owned or leased facilities were identified in the current 1%-annual-chance floodplain. The highest concentration of which are facilities owned or leased by the Department of Transportation. The Liquor Control Board and the State System of Higher Education similarly have a relatively large number of facilities identified in the floodplain. However, state facilities identified as vulnerable to flooding represent only three percent of the total state-owned or leased structures. Approximately, one third of the facilities found to be vulnerable are owned by the state. The replacement value of the 148 total vulnerable facilities is estimated to be about $54.8 million, or 1.4 percent of the value of all state-owned or leased facilities. Overall, 1.9 million building square footage is reported to exist in the current 1%-annual-chance-floodplain.

Table 4.3.5-4 Vulnerability of State Facilities to Flood Hazard.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF DEPT STRUCTURES	# OF STRUCTURES THAT ARE OWNED	TOTAL REPROTED SQUARE FOOTAGE
Attorney General	1	11%	0	37,760
Department of Agriculture	3	19%	3	1,051,440
Department of Banking and Securities		0%		
Department of Community and Economic Development		0%		
Department of Conservation and Natural Resources	1	50%	1	0
Department of Corrections	3	0%	0	97,202
Department of Education		0%		
Department of Environmental Protection	1	8%	0	6,670
Department of General Services	1	1%	1	0
Department of Health	5	10%	0	36,003
Department of Labor and Industry	6	9%	0	143,972
Department of Military and Veterans Affairs		0%		

Table 4.3.5-4 Vulnerability of State Facilities to Flood Hazard.				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF DEPT STRUCTURES	# OF STRUCTURES THAT ARE OWNED	TOTAL REPROTED SQUARE FOOTAGE
Department of Public Welfare	5	5%	0	61,489
Department of Revenue		0%		
Department of Transportation	52	3%	44	306,639
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	14	9%	14	26,310
Governor's Office		0%		
Historical and Museum	4	13%	0	0
Insurance Department		0%		
Liquor Control Board	33	6%	0	120,047
Public School Employees' Retirement System		0%		
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement		0%		
State Police	1	3%	0	7,107
State System of Higher Education	17	2%		
Thaddeus Stevens College of Technology		0%		
Treasury Department	1	50%	0	2,183
Total	**148**	**3%**	**63**	**1,896,822**

Table 4.3.5-4 identifies state-owned or leased facilities in both the current and the projected 1%-annual-chance floodplain in Delaware, Allegheny, and Lycoming Counties. Of the 362 state-owned or leased facilities in Delaware, Allegheny, and Lycoming Counties, 12 are identified as vulnerable to flooding based on the existing floodplain. An estimated 59 additional state facilities are identified as vulnerable to future flood risk; this is a nearly 500 percent increase in the number of vulnerable structures. A total of 46 of the 59 additional facilities identified are those owned or leased by the Department of Corrections. The replacement value of the 12 facilities currently in the floodplain is estimated to be $101,000, or less than one percent of the value of all state-owned or leased facilities in the three counties. The replacement value of the 71 facilities identified as vulnerable to future flood risk is $92,400,410, or 43 percent of the value of all state-owned or leased facilities.

Table 4.3.5-5 Vulnerability of State Facilities to Flooding (Delaware, Allegheny, Lycoming Counties Only)

DEPARTMENT	NUMBER OF STRUCTURES	NUMBER OF VULNERABLE STRUCTURES TO CURRENT FLOOD RISK	NUMBER OF VULNERABLE STRUCTURES TO FUTURE FLOOD RISK
Attorney General	1	0	0
Department of Agriculture	1	0	0
Department of Corrections	53	0	46
Department of Environmental Protection	1	0	0
Department of General Services	8	0	0
Department of Health	2	1	1
Department of Labor & Industry	7	0	1
Department of Public Welfare	8	0	2
Department of Revenue	2	0	0
Department of Transportation	169	5	13
Executive Offices	1	0	0
Historical and Museum Commission	3	0	1
Liquor Control Board	100	5	6
Public School Employees' Retirement System	1	0	0
State Employees' Retirement System	1	0	0
State Police	3	0	0
State System of Higher Education	17	1	1
Treasury Department	1	1	1
Total	**362**	**12**	**71**

With respect to critical facilities, the types of facilities most vulnerable to flooding include dams, transportation facilities, and water facilities (Table 4.3.5-5).

Table 4.3.5-6 Vulnerability of Critical Facilities to Flooding		
TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF STRUCTURES BY TYPE
Agricultural	14	5%
Banking		0%
Commercial		0%
Communication	17	3%
Dam	437	29%
Education (colleges and universities)	13	3%
Education (public schools)	60	1%
Emergency Operation Center	2	3%
Energy	39	11%
Fire Station	145	6%
Government		0%
Hospital	4	1%
National Monuments or Icon		0%
Nuclear		0%
Police Station	61	5%
Transportation	261	38%
Water	285	45%
Total	**1,338**	**10%**

A total of 1,338 critical facilities were identified in the existing 1%-annual-chance floodplain. The total replacement cost of these critical facilities is estimated to be nearly $55 billion, or about 14 percent of the total value of all critical facilities in the Commonwealth.

Table 4.3.5-6 identifies critical facilities in both the current and the projected 1%-annual-chance floodplain in Delaware, Allegheny, and Lycoming Counties. Of the 1,719 critical facilities in Delaware, Allegheny, and Lycoming Counties, 163 are identified as vulnerable to flooding based on the existing floodplain and 190 are identified as vulnerable to future flood risk. This represents a 17 percent increase in the number of vulnerable structures. The types of facilities most vulnerable to projected future flood risk remain the dams, fire stations, water facilities, and transportation facilities.

Table 4.3.5-7 Vulnerability of Critical Facilities to Flooding (Delaware, Allegheny, Lycoming Counties Only)			
TYPE	NUMBER OF STRUCTURES	NUMBER OF VULNERABLE STRUCTURES TO CURRENT FLOOD RISK	NUMBER OF VULNERABLE STRUCTURES TO FUTURE FLOOD RISK
Agricultural	23	3	3
Banking	1	0	0
Commercial	7	0	0
Communication	70	1	1
Dam	67	19	19
Education (colleges and universities)	66	0	2
Education (public schools)	620	1	3
Emergency Operation Center	3	0	0
Energy	29	4	9
Fire Station	336	16	23
Government	2	0	1
Hospital	49	0	0
Police Station	188	10	10
Transportation	204	96	104
Water	54	13	15
Total	**1,719**	**163**	**190**

The replacement value of the 163 critical facilities currently at risk to flooding is estimated to be about $3 billion, or 6 percent of the value of all critical facilities in Delaware, Allegheny, and Lycoming Counties. With the additional 27 critical facilities identified in the projected 1%-annual-chance floodplain, the estimated replacement value of total structures exposed to future flood risk increases to approximately $5.3 billion, or 10.5 percent of the value of all critical facilities in the three counties.

4.3.5.6. Jurisdictional Vulnerability Assessment and Loss Estimation

The 2023 Plan incorporates a Statewide Level 2 Hazus Flood Study. A Level 2 Hazus study is defined as one in which the user supplements the Hazus default data with more recent, more local, and/or more accurate data. For this Level 2 analysis, the latest available FEMA flood maps and the best available ground elevation data were used to derive local flood depths

As discussed in Section 4.1.4, Hazus measures social impact in terms of displaced households and shelter requirements, and economic impact in terms of 1) direct building losses and 2) business interruption losses. Direct building losses consist of the damage to structures and their contents, while business interruption losses consist of the relocation expenses, employee wage loss, business income loss, and rental income loss that accrue during the time that a business remains inoperable. For more information on the data and methodology used in this analysis, see Section 4.1.4.

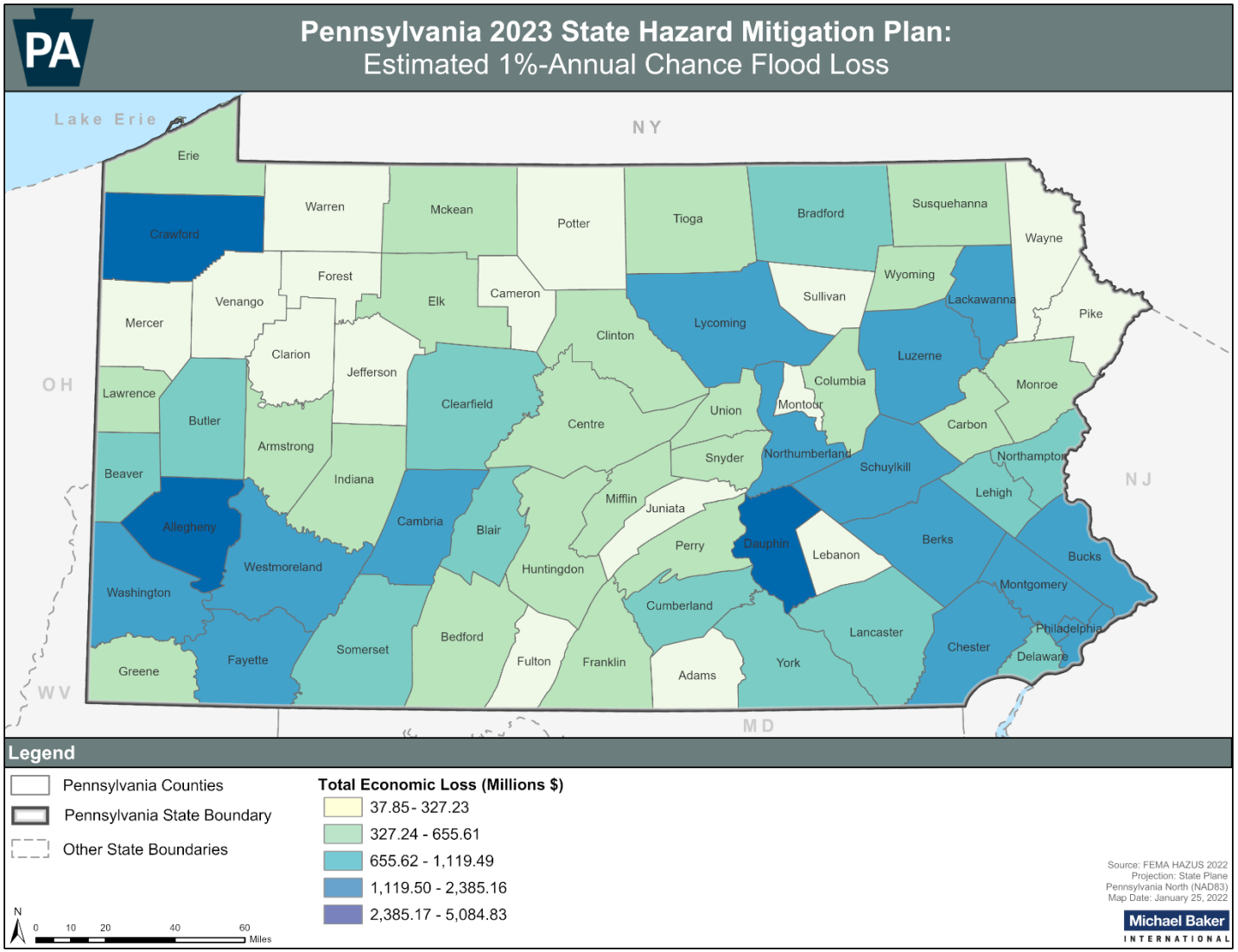
Estimated total economic losses for a 1%-annual-chance flood event across the entire Commonwealth sum to $59,549,930,000 of which $29,108,060,000 are building-related losses. The 1%-annual-chance flood simulation estimated the displacement of 86,045 households and a corresponding shelter requirement of 40,742 people. Allegheny and Dauphin Counties are expected to see the highest total economic loss in a 1% annual-chance flood event. This data is also mapped in Figure 4.3.5-15.

Table 4.3.5-8 Potential Social and Economic Losses Due to Flood Hazards (1%-annual-chance flood).					
COUNTY	NO. OF BUILDINGS AT LEAST MODERATELY DAMAGED	HOUSEHOLDS DISPLACED	SHELTER REQUIREMENTS (PEOPLE)	TOTAL ECONOMIC LOSSES (MILLION $)	DIRECT BUILDING LOSSES (MILLION $)
Adams	47	453	249	198.76	89.72
Allegheny	1,150	4,470	2,879	5,084.83	2,404.52
Armstrong	321	1,014	534	559.24	265.78
Beaver	189	707	415	837.40	479.19
Bedford	301	900	459	590.71	326.04
Berks	165	1,572	597	1,320.89	592.43
Blair	210	1,670	779	761.59	296.52
Bradford	229	1,110	417	708.56	322.25
Bucks	932	3,561	1,771	1,822.82	965.84
Butler	329	992	510	739.57	428.91
Cambria	621	1,785	905	2,188.58	874.27
Cameron	195	313	79	172.99	117.35
Carbon	128	543	269	369.07	201.80
Centre	185	990	483	575.50	175.90
Chester	240	1,712	1,049	1,614.73	896.26
Clarion	15	141	57	123.02	63.73
Clearfield	244	926	448	730.90	260.88
Clinton	399	1,409	383	644.03	360.72
Columbia	259	1,037	409	603.16	365.70
Crawford	475	7,765	490	3,184.00	1,156.54
Cumberland	347	1,316	791	710.82	348.47
Dauphin	1,247	2,726	1,133	3,974.40	1,916.63
Delaware	521	2,561	1,995	1,119.49	679.01
Elk	124	366	171	424.36	195.99
Erie	78	679	702	383.34	147.44
Fayette	409	1,139	737	1,515.15	599.40

Table 4.3.5-8 Potential Social and Economic Losses Due to Flood Hazards (1%-annual-chance flood).					
COUNTY	NO. OF BUILDINGS AT LEAST MODERATELY DAMAGED	HOUSEHOLDS DISPLACED	SHELTER REQUIREMENTS (PEOPLE)	TOTAL ECONOMIC LOSSES (MILLION $)	DIRECT BUILDING LOSSES (MILLION $)
Forest	151	83	22	125.77	55.39
Franklin	82	736	557	472.31	202.92
Fulton	4	90	54	63.68	45.34
Greene	89	396	124	481.68	255.74
Huntingdon	220	834	330	486.37	222.03
Indiana	97	729	466	407.61	195.39
Jefferson	201	526	201	254.69	121.64
Juniata	68	452	204	327.23	197.48
Lackawanna	1,229	2,652	960	1,472.47	793.21
Lancaster	219	2,145	1,490	1,014.64	581.58
Lawrence	118	459	310	392.54	170.49
Lebanon	80	556	425	310.64	151.28
Lehigh	240	1,413	862	823.83	457.08
Luzerne	786	2,327	1,365	1,503.52	657.53
Lycoming	1,079	2,791	642	1,605.54	944.96
McKean	176	750	404	501.17	232.30
Mercer	106	359	289	225.93	113.43
Mifflin	185	772	397	593.99	250.72
Monroe	127	818	728	655.61	286.53
Montgomery	727	4,119	2,206	2,385.16	1,332.09
Montour	71	288	130	215.91	114.91
Northampton	350	1,489	650	1,056.78	538.62
Northumberland	578	1,432	479	1,318.92	789.04
Perry	134	556	164	384.46	147.20
Philadelphia	782	3,575	1,817	1,552.98	981.77

Table 4.3.5-8 Potential Social and Economic Losses Due to Flood Hazards (1%-annual-chance flood).					
COUNTY	NO. OF BUILDINGS AT LEAST MODERATELY DAMAGED	HOUSEHOLDS DISPLACED	SHELTER REQUIREMENTS (PEOPLE)	TOTAL ECONOMIC LOSSES (MILLION $)	DIRECT BUILDING LOSSES (MILLION $)
Pike	47	1	133	105.31	60.22
Potter	237	618	179	299.19	117.48
Schuylkill	739	2,012	687	1,313.60	580.05
Snyder	222	703	127	631.66	324.47
Somerset	247	879	529	860.59	449.76
Sullivan	31	99	32	100.48	34.11
Susquehanna	113	562	190	423.71	251.07
Tioga	232	789	418	601.00	214.50
Union	235	970	384	379.42	200.82
Venango	117	321	201	265.83	117.21
Warren	235	723	314	244.87	115.19
Washington	483	1,853	702	1,366.22	630.12
Wayne	46	236	140	265.40	134.50
Westmoreland	760	2,068	1,329	1,812.46	867.09
Wyoming	108	453	224	456.86	215.98
York	159	1,395	1,128	919.91	443.22
TOTAL	**21,270**	**86,037**	**40,704**	**59,637.85**	**29,125.75**

Figure 4.3.5-15 Hazus-Calculated Loss Estimates by County (Hazus, 2022).



As discussed in Section 4.1.3, the 2023 SHMP recognized the importance of protecting not just lives and property, but sense of place as well. To this end, historic assets were also included in the assessment of jurisdictional vulnerability to flooding. The data source and definition of historic assets is described further in Section 4.1.3. Table 4.3.5-9 shows the number and percent of historic assets in each county located in FEMA's 1%-annual-chance floodplain. A total of 15,512 historic assets are subject to high flood hazard. Allegheny, Centre, Chester, Dauphin, Luzerne, and Montgomery counties have the largest numbers of historic assets vulnerable to flooding, with 631,707, 607, 611, 538, and 538 vulnerable historic assets, respectively. It is important to note again that the 2023 plan decided to analyze all historic assets, which includes buildings, objects, districts, sites, and more. Some of these specifically can be historic trails or places which have a further reach then individual structures. In addition, in some counties more than a quarter of all historic assets lie in the 1-percent-annual-chance floodplain. The highest of these counties being Cameron, Juniata, and Warren.

Table 4.3.5-9 Vulnerability of Historic Assets to Floods (PHMC 2022).

COUNTY	AT-RISK HISTORIC ASSETS	% OF COUNTY HISTORIC ASSETS
Adams	209	5%
Allegheny	631	5%
Armstrong	92	16%
Beaver	86	12%
Bedford	440	9%
Berks	369	8%
Blair	106	9%
Bradford	210	24%
Bucks	463	11%
Butler	141	16%
Cambria	567	20%
Cameron	89	32%
Carbon	45	20%
Centre	707	9%
Chester	607	6%
Clarion	65	5%
Clearfield	188	15%
Clinton	218	26%
Columbia	369	17%
Crawford	182	10%
Cumberland	259	14%
Dauphin	611	29%
Delaware	262	12%
Elk	89	14%
Erie	163	6%
Fayette	276	12%

Table 4.3.5-9 Vulnerability of Historic Assets to Floods (PHMC 2022).		
COUNTY	AT-RISK HISTORIC ASSETS	% OF COUNTY HISTORIC ASSETS
Forest	73	21%
Franklin	105	8%
Fulton	88	10%
Greene	169	16%
Huntingdon	336	12%
Indiana	165	11%
Jefferson	87	12%
Juniata	201	31%
Lackawanna	208	10%
Lancaster	374	7%
Lawrence	100	27%
Lebanon	124	4%
Lehigh	177	10%
Luzerne	538	19%
Lycoming	359	5%
McKean	95	29%
Mercer	100	12%
Mifflin	150	27%
Monroe	230	13%
Montgomery	538	10%
Montour	63	28%
Northampton	248	13%
Northumberland	278	24%
Perry	194	20%
Philadelphia	201	3%
Pike	60	18%
Potter	230	20%
Schuylkill	181	26%
Snyder	188	20%
Somerset	182	13%
Sullivan	62	17%
Susquehanna	211	14%
Tioga	188	28%
Union	139	26%
Venango	87	21%
Warren	87	39%
Washington	262	9%
Wayne	146	26%
Westmoreland	395	7%

Table 4.3.5-9 Vulnerability of Historic Assets to Floods (PHMC 2022).		
COUNTY	AT-RISK HISTORIC ASSETS	% OF COUNTY HISTORIC ASSETS
Wyoming	182	21%
York	267	4%
Total	**15,512**	**10%**

The National Flood Insurance Program identifies repetitive loss (RL) and severe repetitive loss (SRL) properties. The following definition of RL and SRL properties from the Hazard Mitigation Assistance (HMA) Unified Guidance from February 2015 reflects changes made in the Biggert-Waters Flood Insurance Reform Act of 2012:

- A **repetitive loss** property is a structure covered by a contract for flood insurance made available under the NFIP that:

  (a) Has incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and

  (b) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage. (Please note: Homes are eligible for ICC coverage after first loss however cost for ICC is part of all policies.)
- A **severe repetitive loss** property is a structure that:

  (a) Is covered under a contract for flood insurance made available under the NFIP; and

  (b) Has incurred flood related damage

    (i) For which 4 or more separate claims payments (includes building and contents) have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or

    (ii) For which at least 2 separate claims payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

Table 4.3.5-10 and Table 4.3.5-11 show the number and type of RL and SRL properties, respectively, for each county in Pennsylvania. This data was obtained from PEMA in November 2022.

Information within each of the data sources has improved over the last 10 years. Database updates were completed as part of disaster recovery projects in the Commonwealth at the local, state and federal level. Though the databases have improved, information on mitigation does not exactly match between PIVOT (previously Bureaunet) and PEMA tracking, ICC, and GSTF. The mitigation strategy reflects both the progress made and the continuing need for updates to capture all mitigation in the Commonwealth.

Table 4.3.5-9 shows the number RL properties, total losses, building payments, and contents payments for each county in Pennsylvania. As of May 2023, Pennsylvania had 9,275 repetitive loss properties with 28,200 total losses and approximately $841 million in total paid claims. The

numbers reported in the 2018 plan were 8,039 properties, 22,400 losses, and $614.5 million in claims paid. Of the 9,275 properties, 1,106 have been mitigated which is 12 percent. Of the 8,039 properties reported in the 2018 plan, 1,410 properties had been mitigated, which was 18 percent. Completing FEMA Form AW-501 was a task promoted in grant related presentations for recent Disaster Declarations in the Commonwealth.

Table 4.3.5-10 Repetitive Loss Properties, Losses, and Payments by County (May 2023)

COUNTY	PROPERTIES	TOTAL LOSSES	TOTAL BUILDING PAYMENTS	TOTAL CONTENTS PAYMENTS
Adams	36	129	$2,434,066.12	$415,038.52
Allegheny	491	1,429	$21,671,504.34	$9,259,089.91
Armstrong	44	110	$2,490,833.11	$793,477.11
Beaver	99	349	$6,328,002.60	$1,593,789.56
Bedford	114	354	$4,467,284.42	$1,443,711.87
Berks	107	285	$4,452,889.80	$1,375,618.21
Blair	127	350	$3,512,058.11	$843,129.19
Bradford	107	304	$7,348,501.54	$1,870,746.00
Bucks	893	2,925	$96,562,256.56	$19,887,255.54
Butler	75	291	$4,227,738.40	$931,990.14
Cambria	31	83	$469,465.25	$139,961.63
Cameron	9	22	$245,693.55	$78,327.61
Carbon	7	15	$104,567.32	$14,576.05
Centre	25	57	$570,612.22	$787,676.83
Chester	219	730	$14,784,345.38	$5,881,382.88
Clarion	16	44	$702,135.55	$342,944.03
Clearfield	61	150	$1,435,642.57	$135,675.63
Clinton	76	192	$2,545,601.59	$663,472.56
Columbia	426	1,172	$36,541,874.03	$6,573,529.05
Crawford	29	78	$499,983.66	$74,274.99
Cumberland	176	546	$10,220,395.72	$2,118,712.77
Dauphin	780	2,168	$45,831,446.95	$8,546,539.82
Delaware	356	1,253	$28,950,488.53	$10,568,243.24
Elk	33	97	$1,551,770.89	$895,117.01
Erie	53	143	$2,077,322.66	$797,073.30
Fayette	69	206	$3,984,288.59	$1,691,520.79
Forest	0	0	$0.00	$0.00
Franklin	8	20	$146,434.23	$16,525.26
Fulton	1	3	$66,990.92	$0.00
Greene	39	104	$1,111,934.22	$264,795.31
Huntingdon	61	166	$3,605,564.93	$2,105,653.14
Indiana	38	96	$832,038.93	$63,143.93

Table 4.3.5-10 Repetitive Loss Properties, Losses, and Payments by County (May 2023)				
COUNTY	PROPERTIES	TOTAL LOSSES	TOTAL BUILDING PAYMENTS	TOTAL CONTENTS PAYMENTS
Jefferson	45	118	$1,512,607.71	$713,874.36
Juniata	17	40	$327,393.04	$68,566.95
Lackawanna	148	387	$7,121,843.41	$4,016,691.66
Lancaster	182	649	$12,408,930.94	$3,544,467.85
Lawrence	19	48	$409,636.60	$75,328.21
Lebanon	89	254	$5,821,991.47	$1,740,435.40
Lehigh	112	387	$5,880,090.57	$3,654,619.20
Luzerne	468	1,486	$37,270,564.93	$9,445,603.74
Lycoming	567	1,622	$27,227,997.35	$5,026,937.65
Mckean	13	31	$396,811.65	$66,183.13
Mercer	12	42	$372,484.54	$192,055.32
Mifflin	48	112	$1,195,753.41	$446,030.14
Monroe	47	136	$6,827,404.20	$2,388,888.33
Montgomery	768	3,006	$103,296,995.41	$30,076,909.73
Montour	16	37	$843,241.81	$107,793.36
Northampton	290	854	$31,340,290.73	$5,697,351.91
Northumberland	254	714	$13,487,518.35	$3,256,528.44
Perry	101	274	$4,848,615.69	$489,596.89
Philadelphia	145	471	$17,954,573.65	$6,744,981.39
Pike	33	75	$1,304,859.12	$208,305.13
Potter	3	8	$130,901.73	$28,243.18
Schuylkill	103	272	$10,082,719.64	$5,599,240.85
Snyder	165	472	$7,202,294.05	$1,081,399.88
Somerset	25	70	$592,430.85	$62,042.80
Sullivan	21	53	$1,548,872.87	$399,240.37
Susquehanna	88	216	$4,642,623.80	$1,664,114.05
Tioga	20	50	$735,139.14	$175,317.41
Union	127	354	$5,501,119.89	$858,119.17
Venango	50	133	$1,329,439.71	$2,428,326.46
Warren	11	23	$171,366.07	$45,537.58
Washington	102	287	$5,015,730.34	$2,403,485.33
Wayne	36	101	$2,966,430.63	$401,166.01
Westmoreland	167	465	$8,497,003.49	$3,705,563.53
Wyoming	169	523	$12,331,263.97	$3,144,336.63
York	208	579	$8,666,872.18	$1,837,667.23
TOTAL	**9,275**	**28,220**	**$659,037,545.63**	**$181,967,941.15**

A sub-set of the repetitive loss properties is severe repetitive loss properties; the Commonwealth has 1,514 severe repetitive loss properties with 8,095 total losses and approximately $336.7 million in total paid claims. The numbers reported in the 2018 plan were 476 properties, 2,612 losses, and $76.8 million in paid claims.

Table 4.3.5-10 illustrates the number of properties, losses, and payments by county in Pennsylvania. Of the 1,497 SRL properties, 246 have been mitigated, or 16 percent of all SRL properties, as documented on the PEMA Mitigated Properties spreadsheet included in *Appendix G – Repetitive Loss and Severe Repetitive Loss Properties Inventory*. The numbers reported in the 2018 plan were 476 properties, 76 mitigated (16%). Like the RL property data, this data was obtained from PEMA in May 2023.

Table 4.3.5-11 Severe Repetitive Loss Properties, Losses, and Payments by County (May 2023)

COUNTY	PROPERTIES	TOTAL LOSSES	TOTAL BUILDING PAYMENTS	TOTAL CONTENTS PAYMENTS
Adams	11	61	$1,260,768.51	$240,957.45
Allegheny	51	300	$5,026,615.20	$3,483,009.84
Armstrong	5	20	$688,327.60	$208,419.10
Beaver	19	138	$2,715,427.97	$833,140.60
Bedford	22	107	$1,603,807.89	$591,948.02
Berks	8	35	$491,516.74	$69,278.30
Blair	21	81	$1,117,906.69	$349,847.15
Bradford	12	66	$1,694,029.04	$399,662.59
Bucks	234	1175	$53,643,102.51	$10,390,153.06
Butler	17	124	$1,195,711.29	$502,273.50
Chester	39	236	$3,658,193.16	$3,804,224.23
Clarion	2	10	$67,798.15	$216,851.30
Clearfield	3	9	$68,768.42	$15,089.28
Clinton	4	21	$280,956.04	$42,805.89
Columbia	57	236	$8,945,748.93	$2,856,924.67
Crawford	2	10	$76,825.95	$432.56
Cumberland	17	94	$1,537,473.38	$398,295.45
Dauphin	54	265	$7,917,598.31	$1,485,923.27
Delaware	86	496	$17,558,330.29	$6,987,624.84
Elk	6	20	$317,443.87	$190,331.40
Erie	4	24	$689,537.25	$219,882.15
Fayette	13	68	$2,271,169.01	$1,408,317.84
Franklin	1	1	$1,861.83	$0.00
Greene	4	16	$176,090.87	$55,424.44
Huntingdon	5	28	$1,436,503.63	$1,589,472.47
Indiana	1	4	$29,950.98	$0.00
Jefferson	3	8	$131,087.77	$14,022.42

Table 4.3.5-11 Severe Repetitive Loss Properties, Losses, and Payments by County (May 2023)				
COUNTY	PROPERTIES	TOTAL LOSSES	TOTAL BUILDING PAYMENTS	TOTAL CONTENTS PAYMENTS
Lackawanna	17	80	$3,329,401.65	$2,916,899.45
Lancaster	34	258	$4,834,865.01	$2,207,490.69
Lebanon	18	73	$2,193,298.52	$416,759.96
Lehigh	23	147	$2,865,827.13	$2,002,338.57
Luzerne	100	489	$15,081,838.76	$4,697,447.90
Lycoming	86	366	$7,554,096.70	$1,410,850.68
McKean	1	5	$92,039.04	$35,774.44
Mercer	3	22	$222,426.70	$180,662.14
Mifflin	2	5	$90,962.28	$19,446.78
Monroe	12	46	$4,471,266.85	$968,784.43
Montgomery	228	1554	$56,889,325.57	$17,747,705.93
Northampton	71	278	$12,617,449.63	$2,223,762.59
Northumberland	33	160	$3,982,057.65	$1,239,692.58
Perry	7	42	$997,045.30	$128,362.97
Philadelphia	33	182	$8,414,478.16	$4,414,589.81
Pike	2	6	$436,816.41	$93,812.09
Potter	1	4	$108,358.34	$16,947.28
Schuylkill	9	37	$1,367,853.25	$291,629.71
Snyder	12	67	$1,063,416.82	$160,644.86
Somerset	1	7	$57,917.45	$16,585.05
Sullivan	2	6	$193,573.20	$50,632.91
Susquehanna	7	20	$614,909.43	$130,687.05
Tioga	1	5	$123,358.90	$38,522.96
Union	14	59	$1,347,209.14	$304,510.10
Venango	2	11	$127,275.75	$107,948.02
Warren	6	49	$784,717.21	$230,633.53
Washington	5	19	$1,153,309.34	$185,909.80
Wayne	11	69	$1,253,677.25	$251,614.38
Westmoreland	35	178	$4,670,187.46	$1,459,543.31
Wyoming	23	112	$2,105,645.72	$577,092.69
York	14	86	$1,729,890.97	$459,088.31
TOTAL	**1514**	**8095**	**$255,377,046.87**	**$81,340,682.79**

Figure 4.3.5-16 displays the number of RL and SRL properties by county, while Figure 4.3.5-17 displays the per capita number of RL and SRL properties by county. The number of RL and SRL properties per county serves as an indicator of the relative economic vulnerability of Pennsylvania jurisdictions to flood hazards, while the number of properties per capita serves as

an indicator of the relative social vulnerability of Pennsylvania jurisdictions. In counties with more RL and SRL properties per capita, a greater share of residents is affected by repetitive flooding. Some of the more populous counties in the state's southeast rank among the highest counties in terms of economic vulnerability, but rank lower in terms of social vulnerability.

The counties with the most RL properties are Allegheny, Bucks, Columbia, Dauphin, Luzerne, Lycoming, and Montgomery counties. These seven counties are home to 47 percent of all RL properties. Forest County is the only county in Pennsylvania without an RL property. The seven counties with the most RL properties also make up 53.5% of SRL properties within the Commonwealth. Nine counties have no SRL properties at all. This number was twenty-three in the 2018 plan. Bucks, Dauphin, Montgomery, Lycoming, Luzerne, Columbia, Allegheny, Delaware, Northampton, and Northumberland are among the counties which the Commonwealth has targeted to provide mitigation options to property owners since they have the highest numbers of RL properties.

The mitigation of RL and SRL properties is a high priority, especially since the losses experienced by these tend to be high and frequent. Losses avoided during the Severe Storms and Flooding from DR 4149 and DR 4292 for RL and SRL properties are estimated at $6.9 million. These avoided losses represent an order-of-magnitude approximation based on RL and SRL properties mitigated prior to these disasters in the disaster-declared counties, regardless of their location vis-¨ -vis the disaster-related flooding. This analysis provides a generalized idea of the losses that may have been prevented by mitigating RL and SRL structures and can help community members, local officials, and floodplain managers understand in conceptual terms how much less money may be paid out due to a flood because of mitigation activity. Table 4.3.5-12 shows the latest payment prior to these flood disasters for RL and SRL structures in the declared counties. A more robust loss avoidance study would incorporate the following information:

- Property location
- Pre-mitigation structure type
- Pre-mitigation square footage
- Pre-mitigation first floor elevation
- Post-mitigation first floor elevation
- Pre-mitigation number of floors
- Elevation certificates
- Detailed flood depth data for Sandy-impacted areas
- Data on structure and contents replacement value
- Defined depth-damage curves (used to define the relationship between flood depth and structure damage).

Table 4.3.5-12	Losses Avoided in Severe Storms and Flooding from DR 4149 and DR 4292. Data from PA RL & SRL Inventory.		
COUNTY	LAST BUILDING PAYMENT PRIOR TO DR 4149 & DR 4292	LAST CONTENTS PAYMENT PRIOR TO DR 4149 AND DR 4292	LAST TOTAL PAYMENT PRIOR TO DR 4149 AND DR 4292
Allegheny	$408,753	$113,400	$522,153
Bradford	$612,502	$83,627	$696,129
Centre	$15,000	$0	$15,000
Clearfield	$31,556	$15,711	$47,266
Clinton	$3,682	$9,414	$13,096
Crawford	$33,870	$5,869	$39,739
Fayette	$0	$0	$0
Huntingdon	$53,908	$23,363	$77,270
Jefferson	$130,972	$75,034	$206,006
Lawrence	$0	$0	$0
Lycoming	$2,364,747	$425,571	$2,790,318
Sullivan	$46,032	$21,220	$67,253
Venango	$639,089	$1,712,954	$2,352,043
Wayne	$78,016	$14,420	$92,436
Total	**$4,418,127**	**$2,500,582**	**$6,918,709**

PEMA has worked to mitigate RL and SRL properties since the inception of the SRL and Repetitive Flood Claims (RFC) grant programs. Since 2008, emphasis has been placed on mitigating SRL properties in particular. Fifty of the 76 SRL mitigated properties are identified as having been mitigated through PEMA and FEMA. Additionally, 1,295 of the mitigated RL properties have been mitigated using PEMA and FEMA grant program funding.

Figure 4.3.5-16 Repetitive Loss and Severe Repetitive Loss Properties by County (FEMA, 2022h).

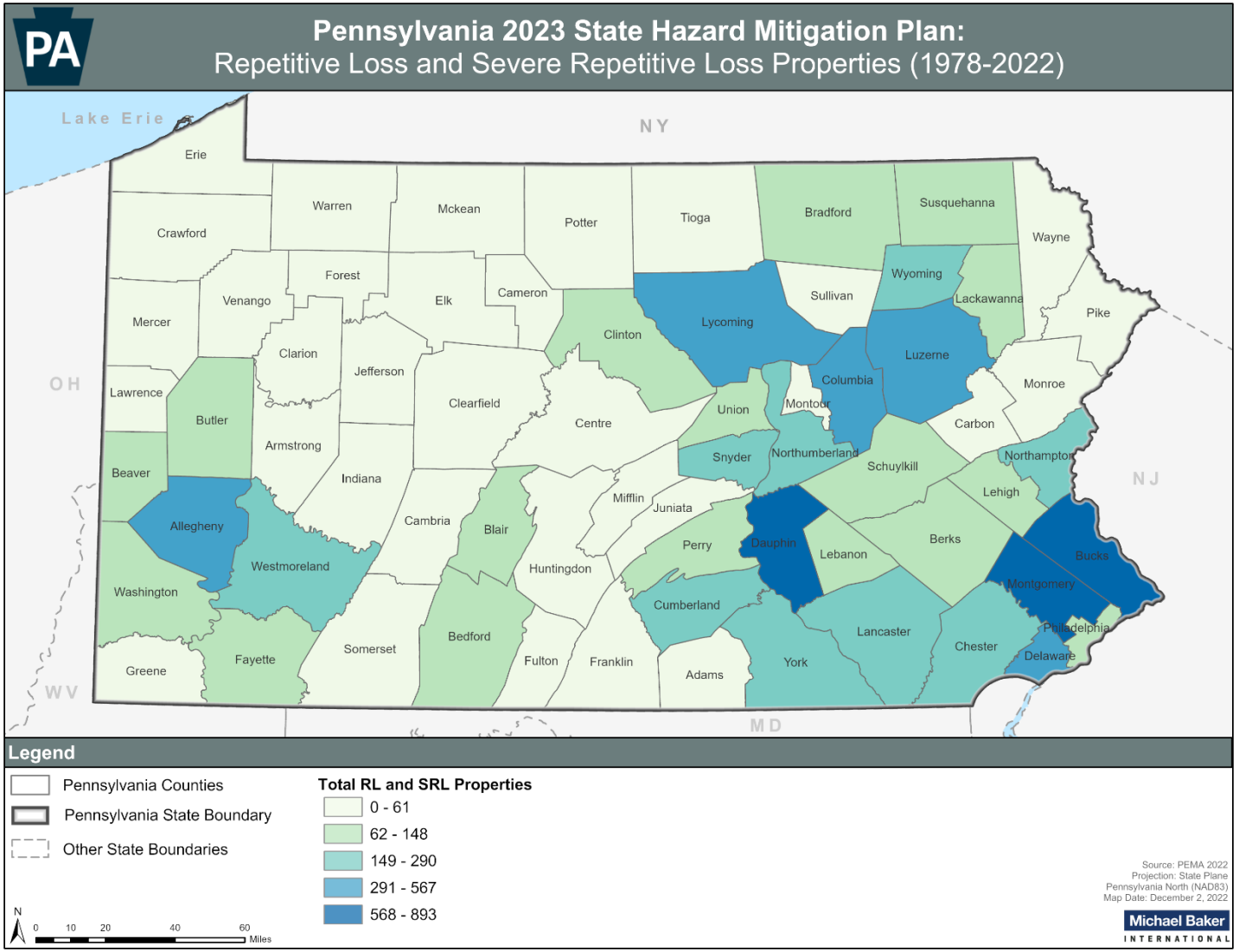
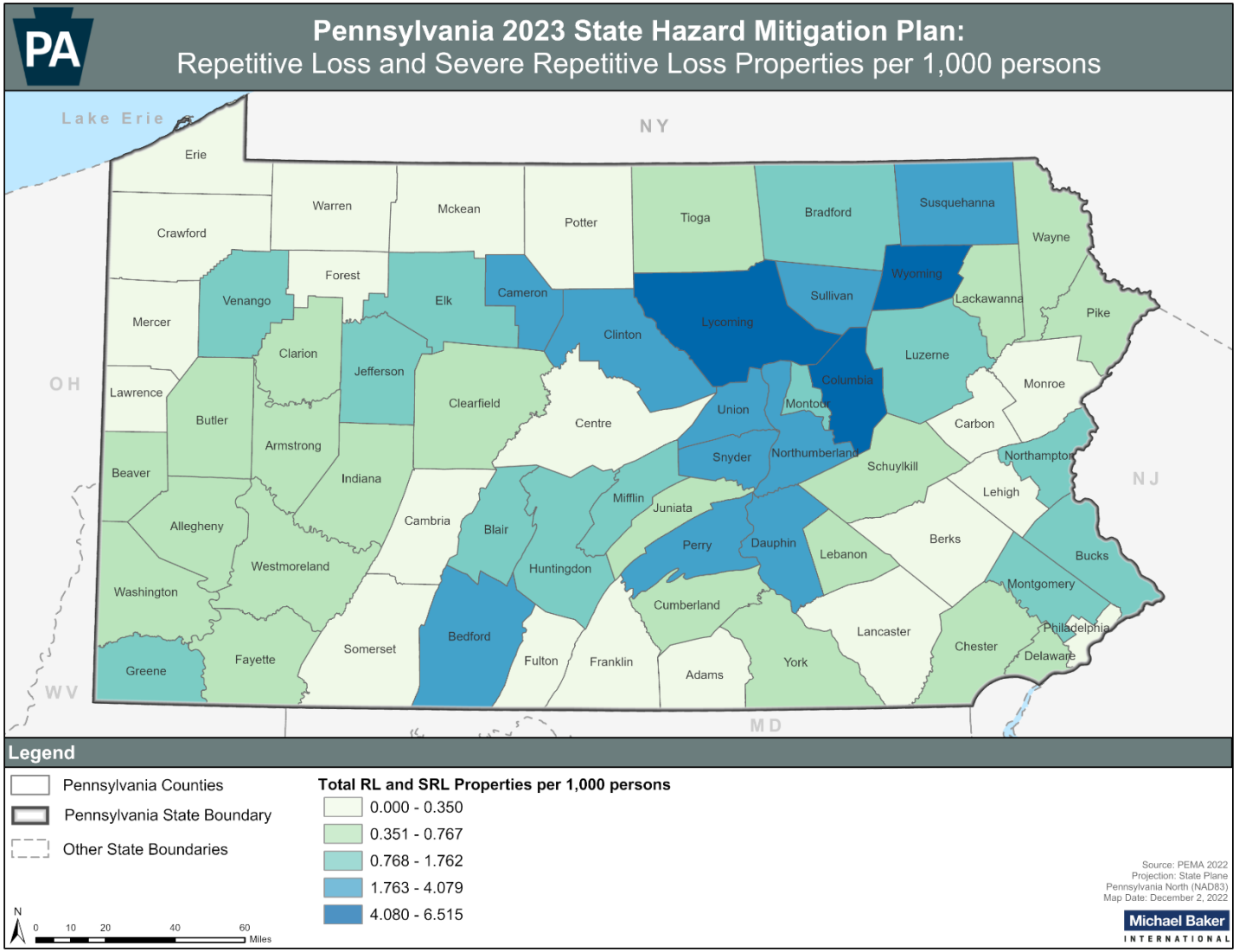


Figure 4.3.5-17 Repetitive Loss and Severe Repetitive Loss Properties per 1,000 Persons by County (FEMA, 2022h).



According to the National Centers for Environmental Information (formerly the National Climatic Data Center), previous flood events occurring between 1950 and 2018 have caused over $1 billion in property damage, over $3 million in crop damage, 89 deaths, and 166 injuries. Note that the quality of this data is uncertain; many events are listed as having caused no property or crop damage. This may mean estimates are conservative.

The SBA provides low-interest loans to residential homeowners and small businesses located in SBA-approved disaster areas who have incurred eligible property and/or business losses. Individual Assistance funds are provided by FEMA to homeowners and renters living in Presidentially declared disaster areas who have incurred eligible housing damages. Public Assistance funds are re-imbursements provided by FEMA to the Commonwealth and its agencies, local governments, and certain non-profits for the repair, reconstruction, etc. of public infrastructure having incurred eligible damage in Presidentially declared disaster areas. Such reimbursements include, but are not limited to, repairs for the eligible costs of repairs for highways, roads, bridges, water and sewer facilities and certain costs to provide emergency assistance during and immediately after a disaster event. Hazard mitigation funds are made available through the FEMA Hazard Mitigation Grant Program based on a percentage of the total federal cost of a Presidentially declared disaster awarded to the Commonwealth for eligible hazard mitigation activities. All of these funds are summarized in Table 4.3.5-13. The largest distribution of funds occurred in response to significant flood events in September 2004 and June 2006.

Table 4.3.5-13 Summary of Funds Distributed in Pennsylvania as a Result of Flood-Related Disaster Declarations between 2003 and 2023 (PEMA, 2013 and FEMA, 2023b)

YEAR	DECLARATION		NUMBER OF COUNTIES DECLARED	INDIVIDUAL ASSISTANCE APPLICANTS	SMALL BUSINESS ADMIN.	INDIVIDUAL ASSISTANCE $	PUBLIC ASSISTANCE $	HAZARD MITIGATION	TOTAL ASSISTANCE
	DATE	NUMBER							
2003	8/23/2003	DR-1485	11	2,010	$1,712,000	$2,965,355	$4,880,320	$3,104,189	**$12,661,864**
	9/26/2003	DR-1497	1	674	$843,500	$1,009,837	$0	$83,000	**$1,936,337**
2004	8/6/2004	DR-1538	3	11,284	$5,500,000	$10,000,000	$0	$1,000,000	**$16,500,000**
	9/19/2004	DR-1555	10	2,766	$1,751,400	$3,500,000	$0	$370,000	**$5,621,400**
	9/19/2004	DR-1557	54	43,509	$74,900,000	$86,800,000	$112,300,000	$16,700,000	**$290,700,000**
2005	4/14/2005	DR-1587	9	3,103	$4,600,000	$3,800,000	$27,300,000	$1,300,000	**$37,000,000**
2006	7/4/2006	DR-1649	28	13,889	$57,000,000	$206,000,000	$106,900,000	$9,700,000	**$379,600,000**
2007	2/23/2007	DR-1684	8	0	$0	$0	$15,600,000	$2,700,000	**$18,300,000**
2008	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2009	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2010	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2011	4/25/2011	DR-4003	5	*none*	*none*	*none*	$10,568,582	$1,724,035	**$12,292,617**
	8/26/2011	DR-4025	14	18,283	$82,500,000	$41,734,054	$29,638,679	$14,956,724	**$168,829,457**
	9/3/2011	DR-4030	32	25,406	$50,400,000	$103,554,187	$147,395,311	$51,007,332	**$352,356,830**
2012	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2013	1/10/2013	DR-4099	18	*none*	*none*	*none*	$10,741,638	$2,623,955	**$13,365,593**
	10/1/2013	DR-4149	11	*none*	N/A	*none*	$12,166,334	$2,261,550	**$14,427,884**
2014	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2015	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2016	12/2/2016	DR-4292	4	*none*	N/A	*none*	$29,343,705	$2,498,000	**$31,841,705**
2017	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2018*	*11/27/18*	*DR-4408*	*11*	*none*	*none*	*none*	$80,279,879	$8,374,721	**$88,654,600**
2019	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***

2020	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
2021	9/10/21	DR-4618	13	43,195	TBD	$128,484,267	$33,815,315	$4,252,157	**$166,551,739**
2022	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
TOTALS			**243**	**164,119**	**$279,206,900**	**$587,847,700**	**$620,929,763**	**$43,968,896**	**$1,610,640,026**

*As of March 6, 2018. Note: Data for disaster declarations from 2006 through January 2013 were obtained from the 2013 SHMP. Data for disaster declarations from October 2013 through 2022 were obtained from FEMA. Please note that the data in Tables 4.3.5-12 and Table 6.3-5 was pulled during different time periods and reflects similar, but not exactly the same numbers, for Public Assistance funding.

The most effective solution to reducing flood damages is to minimize development in the floodplain. However, this is often challenging in the face of development pressure. Programs of floodplain zoning and flood insurance have been successful in reducing, but not eliminating, losses.

The USACE, the U.S. Department of Agriculture's Natural Resources Conservation Service (formerly the Soil Conservation Service), and the Pennsylvania Department of Environmental Protection have constructed many flood protection projects throughout the Commonwealth. Most of the projects consist of concrete floodwalls, concrete channels, compacted earth levees, channel improvements, or any combination of these methods. All of the current flood protection projects were constructed because that particular community had a history of flooding and the main purpose of these projects was to prevent recurrent flood damages. Although flood protection projects are still constructed today, many of the existing projects were built in the 1940's, 1950's and 1960's. These projects need rehabilitation and, in some cases, major improvements are needed due to the many watershed changes that have occurred since their original construction. Other potential ways of eliminating flood damages involve either a watershed approach (this could consist of many small projects throughout the watershed to detain or protect an area) or a non-structural solution. Non-structural alternatives can include buyouts (purchase flood-prone homes and businesses and remove them from the floodplain), flood warning systems, elevate structures, or flood-proof structures. Future flood protection feasibility studies should consider all of the potential alternatives for flood damage reduction.

Large flood-control reservoirs can be highly effective in storing storm runoff and thus reducing downstream flood magnitudes. The Kinzua Dam serves as a good example of efficient flood control provided by large dams. With over 500,000 acre-feet of active flood-storage capacity, the Kinzua Dam is capable of reducing flood peaks on the Allegheny River near West Hickory, Forest County. The flood-peak reduction varies between 40 percent for the 50%-annual-chance flood and 60 percent for the 1%-annual-chance flood. A number of large flood control dams have been constructed throughout Pennsylvania. These are multi-purpose dams constructed by the USACE and provide Pennsylvania residents with excellent recreational opportunities as well as save millions of dollars in reduced flood damages. Coordination between agencies regarding flood risks from potential flood-control structure failures remains significant.

4.3.6. Hailstorm

4.3.6.1. Location and Extent

Hailstorm events can occur in all areas of Pennsylvania. Hail precipitation is often produced at the front of a severe thunderstorm system or in conjunction with a tornado event when ice crystals form within a low-pressure front as warm air rises into the upper atmosphere and is cooled (NOAA NSSL, 2022a). Frozen droplets gradually accumulate on the ice crystals until, having developed sufficient weight, they fall as precipitation in the form of balls or irregularly shaped masses of ice. Hailstones are formed most commonly in thunderstorms with intense updraft, high liquid water content, large vertical extent, large water droplets, and cloud layers below freezing (NOAA NWS, 2022a).

4.3.6.2. Range of Magnitude

Hail is described qualitatively and quantitatively by its size and can range from 0.2 inches to 4.5 inches; as shown in Table 4.3.6-1. The size of hail is dependent on the strength of the upward air movement along the front of a thunderstorm, called the updraft. Weaker updrafts create smaller hailstones while strong updrafts keep them afloat, granting more time for hailstones to grow (NOAA NWS, 2022a).

Table 4.3.6-1 Hailstone Size and Relationship to Updraft Speed (NOAA NWS, 2022a).

HAILSTONE SIZE	MEASUREMENT (INCHES)	UPDRAFT SPEED (MPH)
BB	< 0.25	< 24
Pea	0.25	24
Marble	0.50	35
Dime	0.70	38
Penny	0.75	40
Nickel	0.88	46
Quarter	1.00	49
Half Dollar	1.25	54
Walnut	1.50	60
Golf Ball	1.75	64
Hen Egg	2.00	69
Tennis Ball	2.50	77
Baseball	2.75	81
Tea Cup	3.00	84
Grapefruit	4.00	98
Softball	4.50	103

Hailstorms can cause significant damage to crops, livestock and property, depending on the size, duration, and intensity of hail precipitation. Damage to trees, shrubbery, and other vegetation may occur during hailstorm events. Unless there are compounding stresses, natural vegetation can typically recover over time following an event. However, crops such as corn and soybeans can be damaged to the point of total loss, particularly if an event occurs later in the growing season.

Automobiles and aircraft are particularly susceptible to damage. Also, people are at risk for serious injury if they don't seek immediate shelter. Since hail precipitation usually occurs during thunderstorm events, the impacts of other hazards associated with thunderstorms (i.e., strong winds, intense precipitation, etc.) often occur simultaneously.

A potential worst-case scenario of a hailstorm would be if a storm carrying hail of over one inches were to occur over a prolonged period in an agricultural area of one of the Commonwealth's predominantly agricultural counties such as Lancaster or Cumberland. Because hail can cause significant crop damage, a storm of this magnitude would potentially destroy agricultural yields and result in significant lost revenue, as well as property damage and injuries.

Hailstorms have the potential to impact all seven FEMA Community Lifelines. Hail itself presents a danger to the community and their physical health. Damage may also be done to homes, businesses, and agricultural operations. Health care facilities may be damaged, and while fatalities are not common from hailstorms, they may occur. Severe hailstorms may damage the power grid and lead to electricity being unavailable for a time. Similarly, communications infrastructure like satellites may be damaged. As previously mentioned, automobiles and airplanes are two modes of transportation that are particularly susceptible to hailstorms.

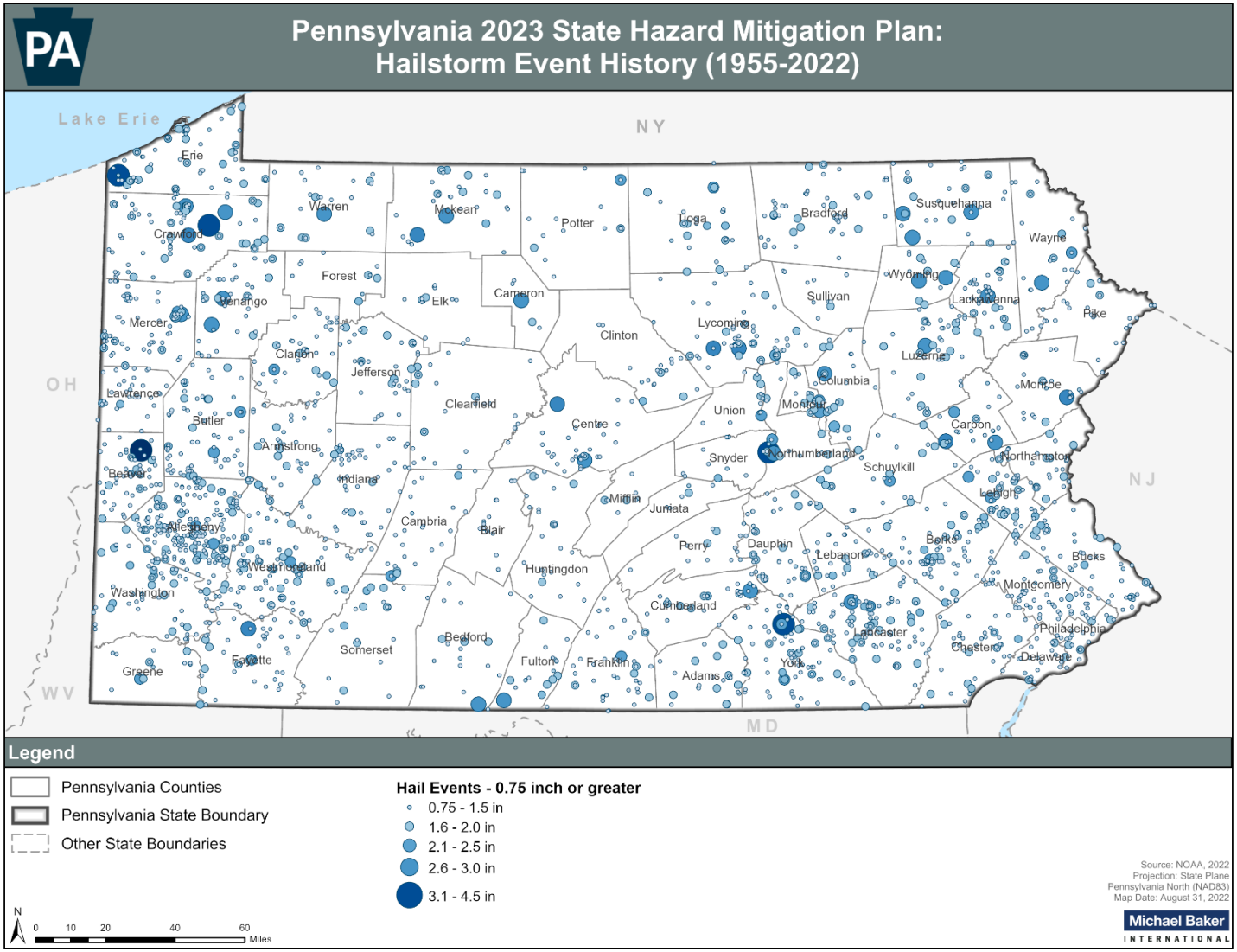
Hailstorms typically occurring during thunderstorms closely links this hazard to both the lightening and tornado hazards. Impacts associated with those hazards may occur during hailstorms, but not because of the hail itself. Hailstorms themselves can cause transportation incidents both on roadways and in the air and may lead to utility interruptions if power stations and other parts of the infrastructure are impacted.

Table 4.3.6-2 Most Likely Lifelines Impacted by Hailstorms		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and compounding impacts where community safety may be threatened due to potential harm from hail and associated weather conditions. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the dangers and best safety precautions.
Food, Water, Shelter		Anticipating a causal and compounding relationship for the Food, Water, Shelter lifeline in response and recovery. Hailstorms and associated conditions such as lightning and high winds can cause significant damage to agricultural operations and can potentially damage property as well. Mitigation actions for this lifeline should be focused on protecting buildings from hail damage and exploring insurance options for agricultural operations.
Transportation		Anticipating a causal and compounding relationship for the Transportation lifeline in response and recovery due to potential damage to automobiles and airplanes.

4.3.6.3. Past Occurrence

Figure 4.3.6.1 shows a map of the number of recorded hailstorm events by location and magnitude between 1955 and 2022. Hailstorms tend to happen in the western and eastern regions of the Commonwealth and less so throughout the center, especially in the north. Previous versions of the SHMP found that approximately 96 percent of hailstorm events occurred during the months of April, May, June, July, August, and September. In addition, approximately 87 percent of historic events occurred during the afternoon or evening. Both of these results are consistent with the relationship between hail and thunderstorms, which most often occur during late spring, summer, and early fall months. Hail size varies throughout the state, but some patterns can be seen. The southeast tends to have smaller hail sized events, with larger hail sized events occurring in the west to northwest, and central regions. The largest event on record is 4.5 inches that took place in Beaver County in 1956. Four other events on record possessed hail greater than 4 inches, which were in York and Erie County in 1980, Crawford County in 2010, and Northumberland County in 2019.

Figure 4.3.6-1 Number of Hailstorm Events by County between 1955 and 2022 (NOAA NCEI, 2022c).



The Storm Events Database maintained by the NCEI includes damage estimates for all hailstorms reported by local field offices since 1955. A list of all damages aggregated to the county scale is provided in Table 4.3.6-3.

Table 4.3.6-3 Hail Events per County, 1955 - 2022 (NOAA NCEI, 2022c).

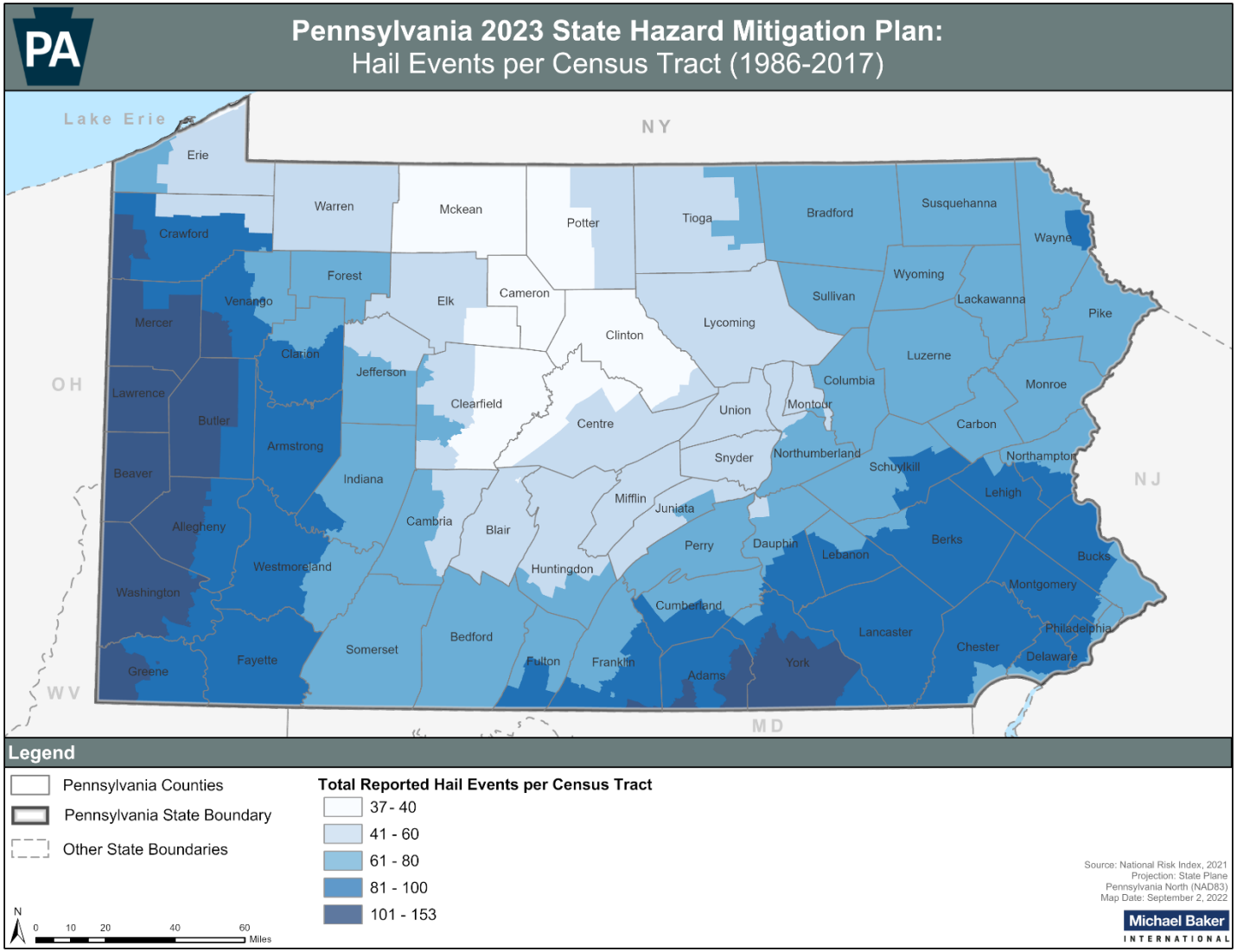
COUNTY	HAIL EVENTS	PROP. DAMAGE	CROP DAMAGE
Adams	49	$15,000	$0
Allegheny	377	$6,000	$0
Armstrong	57	$5,000	$0
Beaver	131	$1,000	$0
Bedford	41	$10,000	$50
Berks	131	$0	$0
Blair	26	$0	$0
Bradford	82	$88,000	$0
Bucks	91	$0	$400,000
Butler	158	$51,500	$500,500
Cambria	47	$0	$0
Cameron	11	$0	$0
Carbon	41	$1,050,000	$0
Centre	73	$20,000	$4,000
Chester	96	$100	$0
Clarion	54	$10,000	$0
Clearfield	36	$2,000	$0
Clinton	37	$7,500	$0
Columbia	46	$0	$0
Crawford	177	$1,961,000	$15,000
Cumberland	58	$0	$0
Dauphin	78	$0	$0
Delaware	56	$0	$0
Elk	18	$0	$0
Erie	191	$1,580,000	$2,010,000
Fayette	103	$1,000	$0
Forest	15	$10,000	$0
Franklin	84	$0	$0
Fulton	20	$2,000	$0
Greene	32	$0	$0
Huntingdon	40	$0	$0
Indiana	87	$100,000	$0
Jefferson	74	$0	$0
Juniata	14	$0	$0
Lackawanna	72	$25,000	$0

Table 4.3.6-3 Hail Events per County, 1955 - 2022 (NOAA NCEI, 2022c).			
COUNTY	HAIL EVENTS	PROP. DAMAGE	CROP DAMAGE
Lancaster	187	$5,000	$0
Lawrence	80	$5,000	$0
Lebanon	50	$5,000	$0
Lehigh	78	$125,000	$50,000
Luzerne	90	$43,000	$1,000
Lycoming	111	$350,000	$500,000
McKean	55	$30,000	$0
Mercer	143	$35,000	$4,000
Mifflin	19	$40,000	$0
Monroe	52	$0	$0
Montgomery	118	$0	$0
Montour	16	$0	$0
Northampton	57	$250,000	$0
Northumberland	35	$0	$0
Perry	32	$15,000	$0
Philadelphia	44	$0	$0
Pike	59	$15,000	$1,000
Potter	33	$0	$0
Schuylkill	50	$500	$0
Snyder	23	$500	$5,000
Somerset	35	$0	$5,000
Sullivan	18	$0	$0
Susquehanna	71	$76,000	$0
Tioga	53	$10,000	$0
Union	15	$0	$0
Venango	82	$12,000	$0
Warren	41	$0	$0
Washington	116	$0	$0
Wayne	52	$50,000	$0
Westmoreland	257	$0	$0
Wyoming	25	$2,000	$0
York	152	$4,000	$0
Total	**4,952**	**$6,018,100**	**$3,495,550**
Damage results of $0 indicate that no reported damage values were provided by the NCEI, not necessarily that the event did not cause any damage.			
Event counts may include multiple reports from same storm, just in different parts of the county.			

4.3.6.4. Future Occurrence

Hailstorm events are expected to continue to occur annually, primarily between April and August, throughout Pennsylvania. Using events reported between 1986 and 2017, Figure 4.3.6-2 shows the total reported hail events per census tract across Pennsylvania. The southeast and west sections of the Commonwealth can expect to experience a higher number of hailstorm events compared to other areas of Pennsylvania. The probability of future hail events can be considered *likely* according to the Risk Factor Methodology (see Section 4.1).

Figure 4.3.6-2 Hail Events per Census Tract in Pennsylvania (National Risk Index, 2021).



4.3.6.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to hailstorms, all structures located in high hazard census tracts were identified. Hailstorm hazard was characterized based on the National Risk Index, which estimated the number of hail events in each census tract between 1986 and 2017. All census tracts with a maximum number of hail events exceeding 100 were defined as high hazard census tracts, and all structures within these census tracts were identified as vulnerable facilities. Note the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 566, or 13 percent, are located within census tracts characterized by high hailstorm hazard (Table 4.3.6-4). These facilities have a combined replacement value of nearly $133 million, or approximately 3.4% of the known value of geolocated state facilities. The total reported building square footage of these facilities is over 2.6 million. Of the 566 facilities found to be vulnerable, 347, or 61%, are reported to be owned by the commonwealth.

Table 4.3.6-2 Vulnerability of State Facilities to Hailstorms.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	2	22%	0	41,763
Department of Agriculture		0%		
Department of Banking and Securities		0%		
Department of Community and Economic Development		0%		
Department of Conservation and Natural Resources		0%		
Department of Corrections	82	12%	76	913,735
Department of Education		0%		
Department of Environmental Protections	2	15%	0	11,807
Department of General Services	3	2%	0	282,015
Department of Health	8	17%	0	49,659
Department of Labor and Industry	10	14%	0	105,682
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	10	10%	0	218,791
Department of Revenue	1	10%	0	8,200
Department of Transportation	270	16%	256	557,655
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	15	10%	15	22,415
Governor's Office		0%		
Historical and Museum Commission	2	7%	0	0

Table 4.3.6-2 Vulnerability of State Facilities to Hailstorms.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Insurance Department		0%		
Liquor Control Board	73	13%	0	391,815
Public School Employees' Retirement System	1	17%	0	2,631
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System		0%		
State Police	1	3%	0	15,118
State System of Higher Education	85	10%		
Thaddeus Stevens College of Technology		0%		
Treasury	1	50%	0	2,183
Total	**566**	**13%**	**347**	**2,623,469**

Of the 13,448 geolocated critical facilities, 1,819 or 14 percent, are located within census tracts characterized by high hailstorm hazard (Table 4.3.6-5). These facilities have a combined replacement value of approximately $48.5 billion, or 12% of the known value of geolocated critical facilities.

Table 4.3.6-5 Vulnerability of Critical Facilities to Hailstorms.

TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	36	13%
Banking	1	25%
Commercial	5	24%
Communication	66	12%
Dam	192	13%
Education (colleges and universities)	57	14%
Education (public schools)	579	12%
Emergency Operation Center	7	10%
Energy	35	10%
Fire Station	352	13%
Government	2	8%
Hospital	41	13%
National Monument or Icon		0%
Nuclear	1	20%
Police Station	197	15%
Transportation	173	26%
Water	75	12%
Total	**1,819**	**14%**

4.3.6.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to hailstorms, the population, building counts, and building value of all high hazard census tracts were aggregated to the county scale. As in the state vulnerability assessment, high hazard census tracts were defined as those in which the maximum number of hail events in each census tract between 1986 and 2017 exceeded 100. Twelve counties in Pennsylvania are significantly impacted by hailstorm hazards.

Table 4.3.6-6 Vulnerability of People and Buildings to Hailstorms.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSANDS $)	% OF TOTAL COUNTY BUILDING VALUE
Adams	56,465	23,462	9,983,507	49%
Allegheny	600,080	243,835	133,952,932	51%
Beaver	168,155	74,647	34,155,970	100%
Butler	158,291	62,177	37,593,346	83%
Crawford	8,042	7,996	2,962,099	12%
Franklin	14,101	5,624	2,282,672	7%
Greene	7,700	3,713	2,091,935	22%
Lawrence	86,035	39,355	14,655,316	100%
Mercer	105,894	50,560	26,399,021	95%
Venango	3,706	2,266	708,355	7%
Washington	157,097	72,490	35,299,561	77%
York	352,138	125,444	65,499,041	78%
State Total	**1,717,704**	**711,569**	**365,583,755**	**13%**

Damage to crops and vehicles often represent the most significant impacts of hailstorms. While all jurisdictions are vulnerable to the effects of hailstorms, jurisdictions with a high percentage of farmland and high agricultural yields are particularly vulnerable. Across all communities in Pennsylvania, hailstorm events between 1955 and 2022 have caused $6,018,100 in reported property damage and $3,495,550 in reported crop damage (NCEI, 2022). According to the Storm Events Database maintained by the NCEI, the hailstorm events that produced the most property and crop damage occurred in Erie County. In one hailstorm, for example, dime size hail reported over a large area damaged an estimated 3,000 acres of grapes on 24 farms and destroyed an estimated 25 percent of the grape crop. The resulting financial loss was estimated to be approximately $2 million.

From the perspective of potential agricultural losses, relative jurisdictional vulnerability can be determined by comparing each jurisdictionôs farmland acreage and agricultural production. Table 4.3.6-7 summarizes the county-level data provided by the USDAôs 2017 Census of Agriculture. This census is released every five years, and the 2022 data is expected to be released in 2024. According to the 2017 Census of Agriculture, the counties with the highest

agricultural production (measured by market value) are Lancaster, Chester, and Berks. The market value of agricultural products in each of these counties exceeds $500 million.

Table 4.3.6-7 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA Census of Agriculture, 2017)

COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Adams	166,227	$207,566,000
Allegheny	28,970	$13,743,000
Armstrong	126,655	$39,768,000
Beaver	53,832	$23,653,000
Bedford	222,224	$115,273,000
Berks	224,722	$554,656,000
Blair	78,923	$107,178,000
Bradford	303,601	$132,640,000
Bucks	77,255	$75,757,000
Butler	133,954	$49,522,000
Cambria	79,341	$30,069,000
Cameron	5,278	$523,000
Carbon	19,498	$13,029,000
Centre	149,858	$91,478,000
Chester	150,514	$712,468,000
Clarion	100,344	$27,670,000
Clearfield	60,957	$28,670,000
Clinton	40,057	$45,561,000
Columbia	106,748	$67,287,000
Crawford	194,447	$107,270,000
Cumberland	169,654	$219,177,000
Dauphin	81,252	$93,074,000
Delaware	2,385	$9,494,000
Elk	22,982	$4,024,000
Erie	153,403	$82,040,000
Fayette	112,285	$28,836,000
Forest	4,170	$2,059,000
Franklin	269,530	$476,469,000
Fulton	100,465	$75,816,000
Greene	114,089	$16,435,000
Huntingdon	120,157	$92,132,000
Indiana	148,288	$71,985,000
Jefferson	80,411	$22,423,000
Juniata	85,640	$126,760,000
Lackawanna	36,556	$16,469,000
Lancaster	393,949	$1,507,207,000

Table 4.3.6-7 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA Census of Agriculture, 2017)		
COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Lawrence	82,125	$34,773,000
Lebanon	107,577	$350,804,000
Lehigh	74,511	$79,216,000
Luzerne	49,087	$17,793,000
Lycoming	186,130	$63,713,000
McKean	43,084	$5,516,000
Mercer	156,397	$65,748,000
Mifflin	80,970	$139,994,000
Monroe	27,607	$9,933,000
Montgomery	30,896	$35,374,000
Montour	38,635	$60,225,000
Northampton	59,195	$36,058,000
Northumberland	124,136	$154,583,000
Perry	114,746	$172,758,000
Philadelphia	284	$327,000
Pike	24,700	$892,000
Potter	97,780	$39,227,000
Schuylkill	96,886	$143,439,000
Snyder	98,978	$200,352,000
Somerset	219,046	$115,449,000
Sullivan	43,424	$12,182,000
Susquehanna	154,409	$49,775,000
Tioga	212,797	$92,255,000
Union	65,719	$147,420,000
Venango	53,338	$14,781,000
Warren	68,153	$21,257,000
Washington	190,447	$36,999,000
Wayne	100,696	$29,371,000
Westmoreland	144,278	$66,320,000
Wyoming	61,303	$13,243,000
York	252,713	$260,927,000
TOTAL	***7,278,668***	***$7,758,884,000***

4.3.7. Hurricane, Tropical Storm, Nor'easter

4.3.7.1. Location and Extent

Pennsylvania does not have any open-ocean coastline. However, the impacts of coastal storm systems such as hurricanes, tropical storms, and nor'easters can extend well inland. Tropical storm systems (i.e., hurricanes, tropical storms, tropical depressions) impacting Pennsylvania develop in tropical or sub-tropical waters of the Atlantic Ocean, Gulf of Mexico, or Caribbean Sea (NOAA NOS, 2021).

Nor'easters are extra-tropical storms which typically develop from low-pressure centers off the Atlantic Coast between Georgia and New Jersey during the winter months (NOAA NWS, 2022b). Extra-tropical is a term used to describe a hurricane or tropical storm has lost its 'tropical' characteristics due to being fueled by cold air instead of warm; while the name has changed, the storm system may still have tropical storm or hurricane force winds (Morgan, 2014).

In some cases, the center of circulation for these storm systems where wind and precipitation effects are often most intense can track inland and move directly through Pennsylvania. However, due to the size of these storms, the Commonwealth is more often affected when circulation centers pass at a distance of several hundred miles. In either case, these coastal storms are regional events that can impact very large areas hundreds to thousands of miles across over the life of the storm. These storms have the potential to impact all communities across Commonwealth.

4.3.7.2. Range of Magnitude

Intense precipitation and wind resulting in flood and wind damage (see Sections 4.3.5 and 4.3.14 respectively) are the most common impacts associated with coastal storm systems in Pennsylvania.

Tropical cyclones with maximum sustained winds of less than 39 miles per hour (mph) are called *tropical depressions*. A *tropical storm* is a cyclone with maximum sustained winds between 39 – 74 mph. These storms sometimes develop into *hurricanes* with wind speeds in excess of 74 mph (NOAA NHC, 2022). The impacts associated with hurricanes and tropical storms are primarily wind damage and flooding. It is not uncommon for tornadoes to develop during these events. The overall environmental impacts associated with coastal storms in Pennsylvania are consistent with those described for flood hazards in Section 4.3.5 and wind hazards in Section 4.3.14. The impact tropical storm or hurricane events have on an area is typically measured in terms of wind speed. Expected damage from hurricane force winds is measured using the Saffir-Simpson Scale. Table 4.3.7-1 lists Saffir-Simpson Scale categories with associated wind speeds and expected damages. Categories 3, 4 and 5 are classified as "major" hurricanes; however, even Category 1 storms can have potentially significant storm surge. Though not part of the Saffir-Simpson Scale, NOAA does look at storm surge while

estimating potential damage too. In Pennsylvania, storm surge is a risk for the tidal portions of the Delaware River (NOAA NHC, 2022).

Table 4.3.7-1 Saffir-Simpson Scale Categories with Associated Wind Speeds and Damages (NOAA NHC, 2022).

STORM CATEGORY	WIND SPEED (mph)	DESCRIPTION OF DAMAGES
1	74-95	**Very dangerous winds will produce some damage**: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110	**Extremely dangerous winds will cause extensive damage**: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111-129	**Devastating damage will occur**: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130-156	**Catastrophic damage will occur**: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	>156	**Catastrophic damage will occur**: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Nor'easters develop as extra-tropical cyclonic weather systems over the Atlantic Ocean and are capable of producing winds equivalent to hurricane or tropical storm force. Precipitation from nor'easters may also come in the form of heavy snow or ice (see Section 4.3.16). Nor'easters are typically much larger than hurricanes, often with diameters 3 or 4 times larger that place more areas at risk. In addition, they move slower than hurricanes and may linger for days and through multiple tide cycles, increasing the amount of damage they may do (Flood Panel, n.d.).

Beyond the environmental impacts of hurricanes, tropical storms, and nor'easters, Hurricane Sandy (aka, Sandy) demonstrated the wide-ranging impacts of coastal storms. In addition to the flooding and wind-related impacts, Sandy illustrated the fuel and supply chain issues that can occur during a large, regional coastal storm. During and for weeks after the storm, both vehicles and generators could not be fueled. Transportation ground to a halt as well, with major roadway

damage and limited power supply to enable safe traffic flow. The duration of Sandy also showed the long-term vulnerability of shelters in many states; few locations were equipped to shelter Sandy evacuees for the three weeks or more needed to get evacuees into temporary housing. The fuel shortages and widespread utility interruptions caused by Sandy illustrated the overall vulnerability of populations in hospitals and nursing homes; these populations are typically difficult to relocate and/or evacuate because of their medical needs, and electric power is frequently needed to keep these populations medically stable.

Table 4.3.7-2 Most Likely Lifelines Impacted by Hurricanes, Tropical Storms, and Nor'Easters		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal, compounding, and cascading impacts where community safety is threatened and government operations and facilities, including police, fire, and search and rescue are involved with response and recovery. Actions to protect communities are focused on increasing risk awareness through outreach, assisting vulnerable populations, and ensuring structures are built to high enough standards to withstand storm impacts.
Food, Water, Shelter		Anticipating a causal, compounding, and cascading relationship for the Food, Water, Shelter lifeline in response and recovery. Severe storm events present significant risk to buildings and the potential compounding and cascading impacts from additional hazards and damage to infrastructure can create issues for food and water access. Mitigation efforts for this lifeline may be adopting and enforcing building codes and retrofitting buildings to increase their resilience.
Energy		Anticipating a causal, compounding, and cascading relationship for the Energy lifeline in response and recovery due to potential outages across the power grid and issues of fuel availability either due to direct damage or increased usage. Mitigation for this lifeline may include activities such as burying overhead power lines, installing grid redundancies, and inspecting infrastructure to ensure it meets specifications.
Transportation		Anticipating a causal and compounding relationship for the Transportation lifeline in response and recovery due to direct damage from storms conditions, and potential impacts of compounding hazards such as flooding and transportation incidents. Potential mitigation actions should be focused on reducing impacts to roadways and inspections to ensure infrastructure meets specifications to handle severe storm impacts.
Hazardous Materials		Anticipating a causal and compounding relationship for the Hazardous Materials lifeline in response and recovery due to damage to facilities and other storage areas from storm or flooding damage. Mitigation for this lifeline is enforcing building codes and retrofitting facilities to increase resilience.

The destructive power and cascading impacts of hurricanes, tropical storms, and nor'easters means that they can impact not only all seven Community Lifelines but nearly every subcomponent. The safety and security of communities that are directly impacted by these storms may be at risk, including interruptions to government services and the need for law enforcement, fire service, and search and rescue to be engaged. Access to food and water may be interrupted, while housing may be damaged and agricultural operations halted. Health care facilities are susceptible to damage from storms and emergency medical services may be interrupted or unable to reach who needs it. The medical supply chain may be interrupted in a similar way that the food supply chain is interrupted, restricting access to essential resources. Both energy and communications infrastructure may be damaged by the impacts of a storm, removing access to electricity, and damaging the ability of the government the relay information or for organize a response. Transportation infrastructure and vehicles that use it may be severely damaged, restricting use for a prolonged period and heavily impacting the movement of responders and supplies. Finally, hazardous materials releases are possible if damage to facilities and non-fixed sites are damage enough to lose containment.

Hurricanes, tropical storms, and nor'easters are closely linked with flooding and coastal erosion. These hazards are likely to occur during or after a storm. Additional weather events such as hailstorms, tornadoes/windstorms, and lightning strikes may occur alongside storms like these. The impact these storms can have may lead to other hazards such as dam and levee failures, landslides, land subsidence, building and structure collapses, transportation incidents, environmental hazards and contaminations, and utility interruptions.

4.3.7.3. Past Occurrence

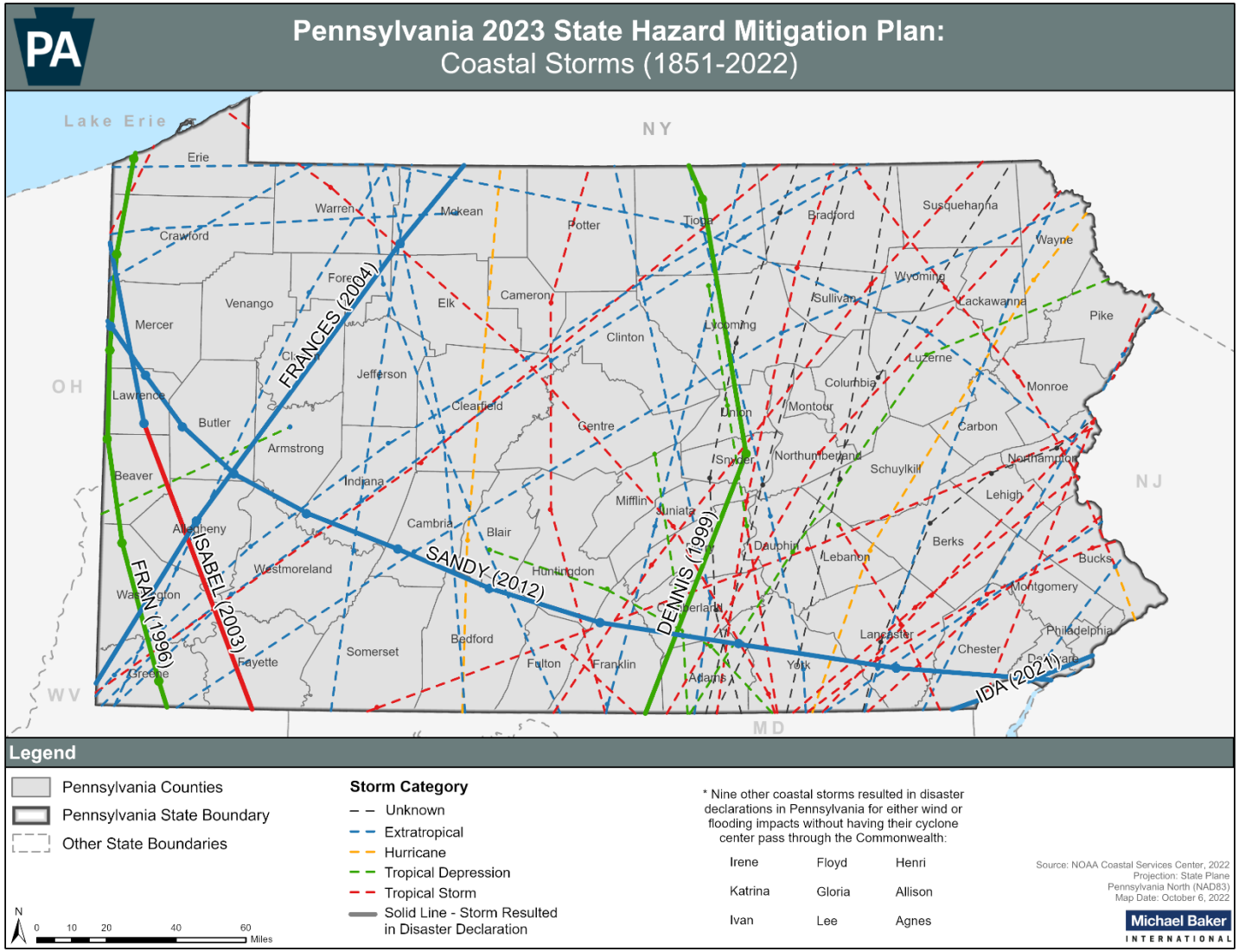
As shown in Section 1, 13 Presidential Disaster Declarations, 4 Presidential Emergency Declarations and two additional Gubernatorial Declarations have been made since 1955 due to coastal storm events in Pennsylvania. Using data from the National Oceanic and Atmospheric Administration, a query was performed for historic tropical cyclone events that tracked directly through Pennsylvania. Twenty-four unnamed storms tracked through Pennsylvania between 1876 and 1952. Since 1952, 25 named tropical cyclones have tracked through Pennsylvania; a summary of these storms is provided in Table 4.3.7-3 with storm category as recorded over Pennsylvania. A map of all events since 1851 is provided in Figure 4.3.7-1.

Table 4.3.7-3 Tropical Cyclone Events Which Tracked through Pennsylvania between 1952 and Present (NOAA OCM, 2022). Note that Events with Circulation Centers that did not Move through Pennsylvania are not Included in this Table, but are Identified in Text.

YEAR	EVENT (STORM CATEGORY)
1952	Able (TS)
1954	Hazel (E)
1955	Connie(TS)
1955	Diane (TS)
1957	Audrey (E)
1959	Gracie (E)
1968	Candy (E)

1979	David (TS)
1979	Frederic (TS)
1988	Chris (TD)
1989	Hugo (TS)
1992	Danielle (TS)
1994	Beryl (TD)
1996	Fran (TD)
1999	Dennis (TD)
2002	Isidore (TD)
2003	Isabel (TS)
2004	Frances (E)
2006	Ernesto (E)
2012	Sandy (E)
2017	Nate (E)
2018	Florence (E)
2020	Isaias (TS)
2021	Fred (TD)
2021	Ida (E)
E = Extratropical storm, TD = Tropical depression, TS = Tropical storm	

Figure 4.3.7-1 Map Showing Historical Coastal Storm Events which Tracked through Pennsylvania (NOAA, 2022).



The last storm in the table, Hurricane Ida, resulted in severe flooding and five tornadoes across the southeast region of Pennsylvania. There were more than 110,000 power outages, issues at 60 water and wastewater plants, and two dams almost failed (McDaniel and Terruso, 2021). The combination of the Schuykill River's storm surge cresting at 16.35 feet, the highest on record since 1869, and the failure of a local pumping station resulted in the now infamous photos of the Vine Street Expressway and surrounding areas completely flooded (Billy Penn, 2022). After a federal state of emergency was officially declared, 83,000 households applied for FEMA assistance with $265 million in federal funds being allocated through various recovery programs (FEMA, 2022i).

It is important to note that and Figure 4.3.7-1 and Figure 4.3.7-2 identify only events with centers of circulation that passed over the Commonwealth. Tropical cyclone events which may have affected Pennsylvania but did not have circulation centers that crossed through the Commonwealth are not provided here due to space limitations. Storms of this type, however, have had serious impacts on Pennsylvania. Perhaps the best example of this is Hurricane Agnes (1972). While it caused billions in damages in the state, the storm track for Agnes remained to the east of Pennsylvania and New Jersey until making landfall near New York City and traveling into upstate New York. Although storm damages were serious over the entire Commonwealth, both the eastern and western portions escaped the extreme rainfall and losses that were suffered in central areas. Other tropical cyclones which did not track through Pennsylvania but caused significant damage to communities in the Commonwealth include Fay (2020), Sandy (2012), Lee/Irene (2011), Ivan (2004), Allison (2001), Floyd (1999) and Eloise (1975).

4.3.7.4. Future Occurrence

One approach to determining the future probability of hurricanes is to examine the frequency and spatial distribution of past hurricanes. This is the approach FEMA applied in developing its National Risk Index (NRI). To determine the spatial distribution of hurricane hazard, FEMA calculated the maximum number of hurricane paths overlapping each census tract over the available period of record. Data on hurricane paths were derived from NOAA's National Hurricane Center "Best Track" Data Archive and were available for 1851 to 2022 for the Atlantic. Figure 4.3.7-2 shows the distribution of hurricane hazard in Pennsylvania based on these historic observations. The areas most likely to be affected by a hurricane are confined to two narrow bands along the state's eastern and southern borders. Note that this figure does not provide information on the probability of various storm intensities. Studies investigating the probability of future occurrence of nor'easters have not been identified.

Hurricane activity in the North Atlantic has increased since the 1970s, with storms migrating northward and generating more destructive potential (Kossin et al. 2017 & Shortle et al. 2015). However, activity does vary year to year, due to factors such as natural variability in ocean circulation, volcanic eruptions, and Saharan dust. In addition, changing climatic conditions have led to more favorable conditions for large storms.

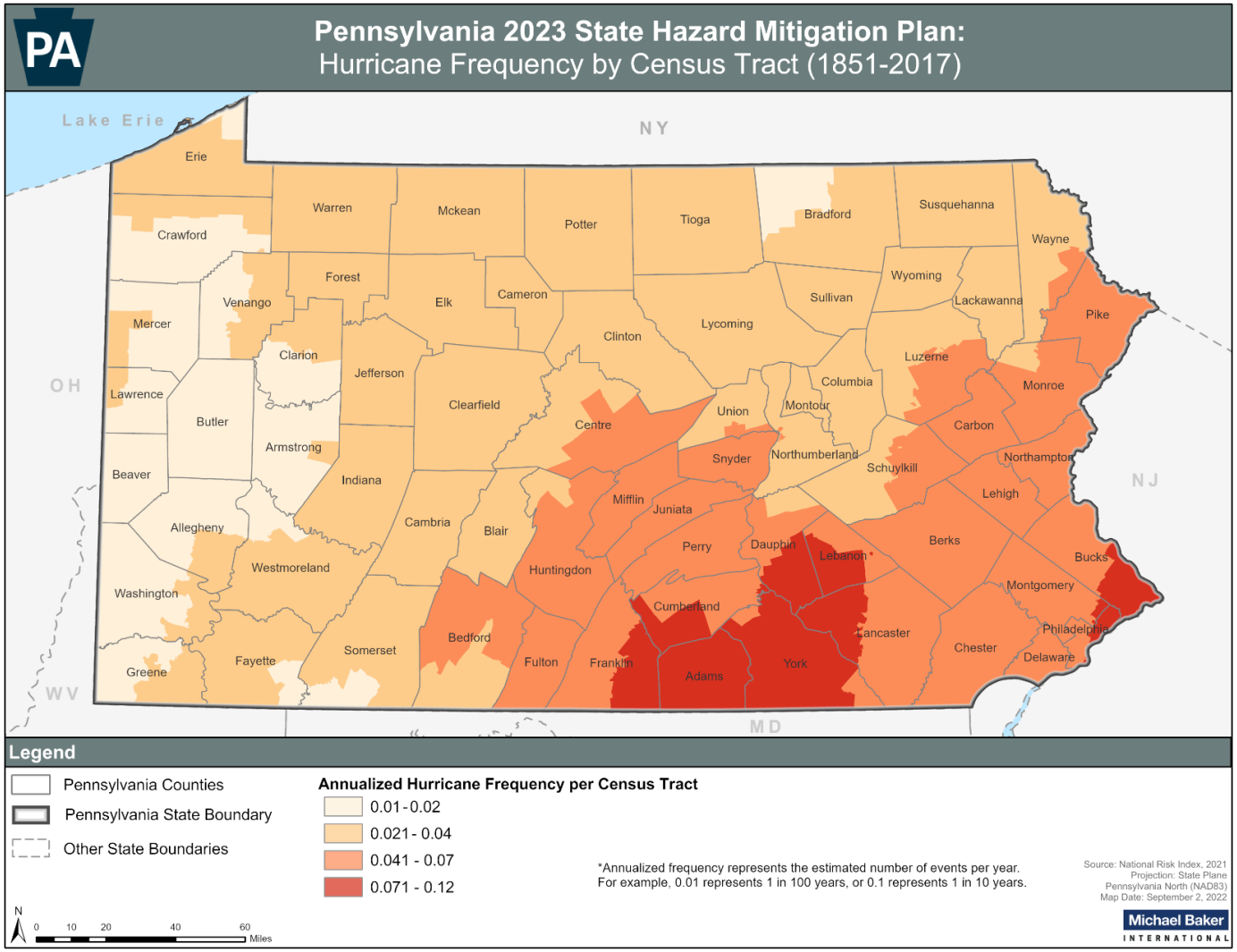
The relationship between climate change and hurricanes is complex due to the variety of potential factors that impact their development. For example, dust from the Sahara Desert that

is lifted high in the atmosphere during a particularly hot and dry summer can inhibit the development of some hurricane formation. Consensus does seem to be that future storms will produce more precipitation. This is because warming sea and air temperatures allow for more moisture in the air, providing more fuel for potential storms. The warming of the Atlantic, which is partially due to human activity like the production of greenhouse gases, has already been associated with an increase in extreme precipitation events in the northeast United States since 1996 (Huang et al., 2018). Global storm intensity is also expected to increase as a larger proportion of storms will reach Category 4 and 5 levels, but regional projections are more uncertain due to the complexity of factors. There is also a tentative connection with a general slowdown of atmospheric circulation due to warming in the Arctic, which may lead to these stronger storms lingering longer in each place.

The larger rainfall totals, stronger winds, potentially lingering storm paths, and higher storm surges will greatly increase the destructive potential of storms. The effect of having more intense Category 4 and 5 storms may increase potential damage in the Atlantic 30% by 2100 (see NOAA GFDL's site for more details here https://www.gfdl.noaa.gov/global-warming-and-hurricanes/). As storms get stronger, building codes should follow suit. A 2017 study from the University of Pennsylvania found that homes built in Florida after the implementation of a statewide building code in 2002 experienced significantly less damage (Done, Simmons, Czajkowski, 2018). In addition to those impacts, storm activity has been occurring before the official start of hurricane season (June 1st) more and more frequently, potentially signaling an extended season each year (Truchelut, et al. 2022).

Research done by the U.S. Department of Energy's Argonne National Laboratory found that counties located near large estuaries along the Atlantic coast, such as the Delaware Bay, may experience an increase in nor'easter activity and intensity. The research utilized high-resolution model projections that helped capture detailed assessments and cyclone frequencies, intensities, and resulting storm surges (Spizzirri, 2021). Nor'easters already occur at a higher rate than hurricanes (Flood Panel, n.d.).

Figure 4.3.7-2 Hurricane Frequency by Census Tract across Pennsylvania between 1851 - 2017 (FEMA NRI, 2021).



4.3.7.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to hurricanes, all structures located within a census tract with low to moderate hurricane frequency between 1851 and 2017 were identified (see Table 4.3.7-1). For this assessment, low to moderate frequency is considered greater than .07 annual frequency of hurricane events. This selection represents an estimation of seven or more hurricane events per 100 years. The results of this assessment represent the potential impacts to state assets based on location, but do not account for other factors such as the age or intended use of buildings.

Of the 4,460 geolocated state facilities, 399, or about 9 percent, are located within census tracts with low to moderate annual frequency. These facilities have a combined replacement value of more than $2 billion, or approximately 52% of the known value of geolocated state facilities. It is important to note again, that not all state owned or leased facilities possessed building replacement values, so the actual percentage of building replacement values will differ than these estimates. Around 53% of vulnerable facilities are owned, with 211 reported to be owned by the commonwealth. Overall, the 399 vulnerable facilities total nearly 10.82 million square feet of building space.

Table 4.3.7-1 Vulnerability of State Facilities to Hurricanes.

TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	2	22%	0	53,603
Department of Agriculture	7	44%	7	1,074,976
Department of Banking and Securities	1	50%	0	44,961
Department of Community and Economic Development	1	25%	0	3,521
Department of Conservation and Natural Resources	1	50%	0	37,703
Department of Corrections	27	4%	22	298,606
Department of Education		0%		
Department of Environmental	1	8%	0	5,137
Department of General Services	75	57%	69	7,590,608
Department of Health	3	6%	0	7,813
Department of Labor and Industry	12	17%	0	245,827
Department of Military and Veterans		0%		
Department of Public Welfare	9	9%	0	139,376
Department of Revenue	2	20%	0	101,325
Department of Transportation	119	7%	107	517,497
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	5	3%	5	9,610

Table 4.3.7-1 Vulnerability of State Facilities to Hurricanes.				
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Governor's Office		0%		
Historical and Museum Commission	2	7%	1	2,730
Insurance Department	2	100%	0	42,511
Liquor Control Board	73	13%	0	472,249
Public School Employees' Retirement	1	17%	0	70,693
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System	2	50%	0	55,323
State Police	4	11%	0	45,554
State System of Higher Education	50	6%		
Thaddeus Stevens College of		0%		
Treasury Department		0%		
Total	**399**	**9%**	**211**	**10,819,623**

Of the 13,448 geolocated critical facilities, 1,565 or 12 percent, are located within census tracts with low to moderate annual frequency (Table 4.3.7-4). These facilities have a combined replacement value of more than $43 billion, or approximately 12% of the known value of geolocated critical facilities.

Table 4.3.7-2 Vulnerability of Critical Facilities to Hurricanes.		
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	49	18%
Banking	1	25%
Commercial	2	10%
Communication	48	9%
Dam	90	6%
Education (colleges and universities)	45	11%
Education (public schools)	656	14%
Emergency Operation Center	8	11%
Energy	43	12%
Fire Station	248	9%
Government	17	68%
Hospital	39	13%
National Monument or Icon	1	17%
Nuclear	1	20%
Police Station	130	10%

Table 4.3.7-2 Vulnerability of Critical Facilities to Hurricanes.		
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Transportation	111	16%
Water	76	12%
Total	**1,565**	**12%**

4.3.7.6. Jurisdictional Vulnerability Assessment

FEMA's Hazus software version 6.0 was used to estimate the relative vulnerability to earthquakes across the state. The methodology uses Hazus default data on hurricane wind hazards and building stock, user-defined essential facilities data, and the software's standard algorithms. The calculation algorithms quantify the potential losses associated with hurricane winds using information about sea surface temperature, central pressure, translation speed, and surface roughness. As discussed in Section 4.1.4, Hazus was used to calculate two kinds of economic losses: 1) direct building losses, and 2) business interruption losses. Direct building losses consist of the damage to structures, contents, and inventory; while business interruption losses consist of the relocation expenses, employee wage loss, business income loss, and rental income loss that accrue during the time that businesses remain inoperable. For more information on the data and methodology used in this analysis, see Section 4.1.4.

The tables below show the average annualized hurricane wind losses for Pennsylvania aggregated to the county level. While Table 4.3.7-3 shows potential direct building losses, Table 4.3.7-4 shows potential business interruption losses. According to the Hazus analysis, most of the potential loss is attributable to direct building losses, and most of the potential direct building loss is attributable to building damage. Overall, nearly 80% of the total annualized losses are related to direct building losses. Figure 4.3.7-3 shows the spatial distribution of the total average annualized losses (the sum of direct building losses and business interruption losses). Note that losses are shown at the census tract level. Both the county-level tables and the census-tract level map show the highest annualized losses in the populous counties in the state's southeast (i.e., Philadelphia, Bucks, Montgomery, and Delaware Counties).

Table 4.3.7-3 Potential Direct Building Losses from Hurricane Wind Hazards (Average Annualized Loss).				
COUNTY	BUILDING LOSS (THOUSAND $)	CONTENTS LOSS (THOUSAND $)	INVENTORY LOSS (THOUSAND$)	TOTAL DIRECT BUILDING LOSSES (THOUSAND $)
Adams	$71.9	$15.3	$1.6	$88.8
Allegheny	$329.5	$45.0	$3.6	$378.2
Armstrong	$12.3	$1.6	$0.1	$14.0
Beaver	$44.9	$6.8	$0.6	$52.3
Bedford	$12.1	$1.8	$0.2	$14.0
Berks	$338.5	$92.8	$9.6	$440.9
Blair	$31.1	$4.7	$0.7	$36.4
Bradford	$21.5	$3.1	$0.4	$25.1

Table 4.3.7-3 Potential Direct Building Losses from Hurricane Wind Hazards (Average Annualized Loss).

COUNTY	BUILDING LOSS (THOUSAND $)	CONTENTS LOSS (THOUSAND $)	INVENTORY LOSS (THOUSAND$)	TOTAL DIRECT BUILDING LOSSES (THOUSAND $)
Bucks	$1,160.1	$292.9	$23.7	$1,476.7
Butler	$65.0	$8.4	$0.5	$73.9
Cambria	$30.3	$4.4	$0.8	$35.5
Cameron	$0.9	$0.1	$0.0	$1.1
Carbon	$23.8	$4.9	$0.2	$28.9
Centre	$35.4	$6.1	$0.3	$41.7
Chester	$834.4	$244.0	$33.7	$1,112.1
Clarion	$9.4	$1.6	$0.6	$11.7
Clearfield	$13.8	$1.7	$0.1	$15.6
Clinton	$5.2	$0.8	$0.0	$6.0
Columbia	$23.3	$4.4	$0.3	$28.1
Crawford	$33.9	$6.0	$2.5	$42.4
Cumberland	$174.0	$35.6	$7.1	$216.8
Dauphin	$163.6	$36.7	$3.4	$203.8
Delaware	$971.2	$263.3	$15.1	$1,249.6
Elk	$7.3	$1.0	$0.0	$8.4
Erie	$73.9	$14.2	$1.3	$89.4
Fayette	$33.6	$5.1	$0.6	$39.2
Forest	$2.2	$0.3	$0.0	$2.5
Franklin	$87.1	$16.2	$2.4	$105.7
Fulton	$6.2	$1.2	$0.9	$8.3
Greene	$17.9	$2.9	$0.9	$21.7
Huntingdon	$10.0	$1.6	$0.1	$11.6
Indiana	$18.3	$2.8	$0.3	$21.4
Jefferson	$8.3	$1.2	$0.1	$9.5
Juniata	$5.9	$1.2	$0.1	$7.2
Lackawanna	$83.7	$16.5	$0.9	$101.1
Lancaster	$571.0	$154.9	$17.2	$743.1
Lawrence	$17.1	$2.5	$0.2	$19.8
Lebanon	$117.3	$28.7	$2.9	$148.8
Lehigh	$363.5	$93.1	$9.6	$466.2
Luzerne	$145.8	$30.8	$2.5	$179.1
Lycoming	$24.8	$4.0	$1.4	$30.3
McKean	$12.2	$2.3	$0.5	$15.0
Mercer	$45.5	$6.6	$0.7	$52.8
Mifflin	$11.3	$1.8	$0.2	$13.2
Monroe	$121.8	$26.9	$1.7	$150.3

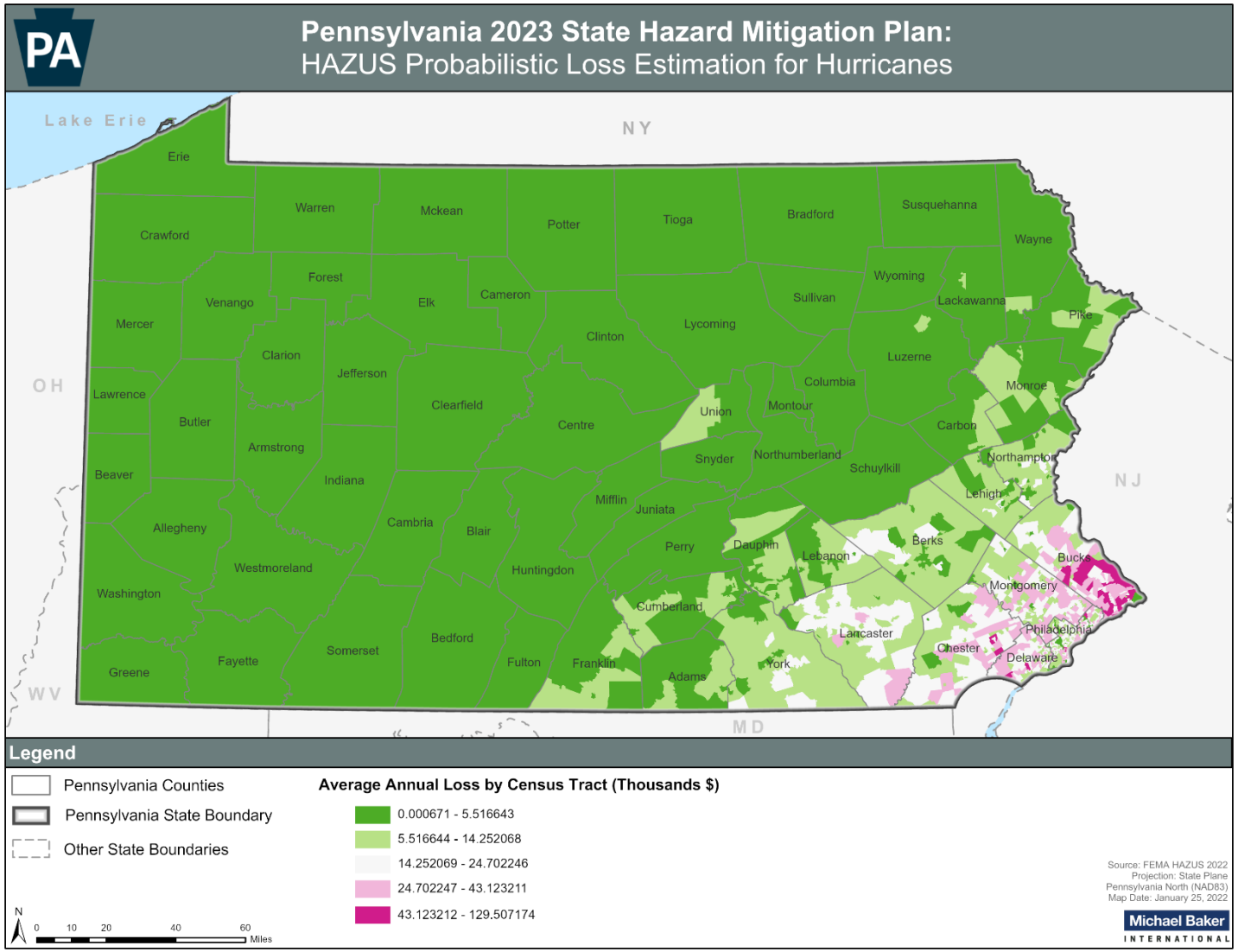
Table 4.3.7-3 Potential Direct Building Losses from Hurricane Wind Hazards (Average Annualized Loss).

COUNTY	BUILDING LOSS (THOUSAND $)	CONTENTS LOSS (THOUSAND $)	INVENTORY LOSS (THOUSAND$)	TOTAL DIRECT BUILDING LOSSES (THOUSAND $)
Montgomery	$1,270.3	$331.1	$21.6	$1,623.0
Montour	$6.2	$1.1	$0.1	$7.3
Northampton	$289.9	$74.3	$5.7	$369.9
Northumberland	$34.4	$5.8	$0.3	$40.5
Perry	$11.1	$1.7	$0.1	$12.9
Philadelphia	$2,034.2	$582.3	$36.4	$2,652.9
Pike	$55.0	$10.2	$0.1	$65.2
Potter	$3.0	$0.5	$0.0	$3.5
Schuylkill	$52.6	$12.6	$1.8	$67.0
Snyder	$15.5	$2.6	$0.2	$18.3
Somerset	$24.7	$3.9	$1.4	$30.0
Sullivan	$2.9	$0.4	$0.1	$3.3
Susquehanna	$25.7	$4.9	$2.8	$33.4
Tioga	$10.8	$1.7	$0.2	$12.7
Union	$11.5	$2.0	$0.2	$13.7
Venango	$9.5	$1.5	$0.1	$11.1
Warren	$6.2	$0.9	$0.1	$7.2
Washington	$65.4	$9.4	$0.8	$75.6
Wayne	$33.3	$6.3	$0.6	$40.2
Westmoreland	$104.5	$14.5	$2.2	$121.1
Wyoming	$9.8	$1.4	$0.0	$11.2
York	$276.3	$68.7	$8.4	$353.3
Total	**$10,543.7**	**$2,635.2**	**$232.7**	**$13,411.6**

Table 4.3.7-4	Potential Business Interruption Losses from Hurricane Wind Hazards (Average Annualized Loss).				
COUNTY	INCOME LOSS (THOUSAND $)	RELOCATION LOSS (THOUSAND $)	RENTAL INCOME LOSS (THOUSAND $)	WAGE LOSS (THOUSAND $)	TOTAL BUSINESS INTERRUPTION LOSSES (THOUSAND $)
Adams	$4.5	$14.7	$7.1	$6.4	$32.8
Allegheny	$23.1	$68.3	$28.6	$35.0	$155.0
Armstrong	$0.7	$2.8	$1.2	$1.0	$5.6
Beaver	$2.7	$8.8	$3.6	$4.3	$19.5
Bedford	$0.7	$2.7	$1.3	$1.1	$5.8
Berks	$23.0	$57.4	$25.4	$31.1	$136.9
Blair	$2.7	$7.8	$3.5	$3.7	$17.8
Bradford	$1.1	$5.3	$2.0	$1.6	$10.0
Bucks	$60.6	$163.4	$75.1	$87.7	$386.8
Butler	$3.0	$15.4	$6.0	$3.2	$27.5
Cambria	$2.1	$7.3	$3.0	$3.1	$15.4
Cameron	$0.0	$0.2	$0.1	$0.0	$0.4
Carbon	$1.2	$5.0	$2.2	$1.6	$10.0
Centre	$1.9	$9.5	$3.1	$2.8	$17.3
Chester	$31.0	$108.8	$41.4	$43.7	$224.9
Clarion	$0.6	$2.1	$0.9	$0.7	$4.3
Clearfield	$0.9	$3.7	$1.7	$1.0	$7.3
Clinton	$0.2	$1.3	$0.5	$0.2	$2.3
Columbia	$1.3	$5.8	$2.7	$1.3	$11.1
Crawford	$1.5	$6.7	$2.5	$1.6	$12.4
Cumberland	$11.9	$33.7	$15.6	$17.1	$78.3
Dauphin	$12.7	$31.9	$15.2	$18.7	$78.5
Delaware	$42.8	$132.6	$56.3	$63.6	$295.3
Elk	$0.4	$1.8	$0.8	$0.3	$3.3
Erie	$6.7	$16.8	$7.8	$9.0	$40.2
Fayette	$3.4	$8.1	$3.6	$4.6	$19.8
Forest	$0.1	$0.6	$0.3	$0.1	$1.1
Franklin	$6.1	$20.7	$9.5	$8.6	$45.0
Fulton	$0.2	$1.0	$0.3	$0.3	$1.7
Greene	$1.0	$3.8	$1.5	$1.3	$7.7
Huntingdon	$0.8	$2.6	$1.1	$1.3	$5.9
Indiana	$1.6	$4.6	$2.1	$2.1	$10.4
Jefferson	$0.5	$2.1	$1.0	$0.5	$4.0
Juniata	$0.4	$1.1	$0.5	$0.5	$2.5
Lackawanna	$6.7	$18.2	$8.5	$6.4	$39.8

Table 4.3.7-4	Potential Business Interruption Losses from Hurricane Wind Hazards (Average Annualized Loss).				
COUNTY	INCOME LOSS (THOUSAND $)	RELOCATION LOSS (THOUSAND $)	RENTAL INCOME LOSS (THOUSAND $)	WAGE LOSS (THOUSAND $)	TOTAL BUSINESS INTERRUPTION LOSSES (THOUSAND $)
Lancaster	$35.6	$98.2	$46.1	$57.5	$237.5
Lawrence	$1.0	$4.1	$1.7	$1.4	$8.2
Lebanon	$7.8	$21.1	$9.4	$12.0	$50.2
Lehigh	$23.4	$62.8	$28.4	$37.5	$152.1
Luzerne	$9.1	$33.5	$14.9	$13.1	$70.6
Lycoming	$1.4	$5.3	$2.3	$1.8	$10.8
McKean	$0.8	$2.7	$1.2	$0.8	$5.4
Mercer	$2.3	$11.0	$4.3	$3.6	$21.1
Mifflin	$0.7	$2.6	$1.2	$1.1	$5.5
Monroe	$6.2	$20.9	$10.0	$8.0	$44.9
Montgomery	$60.9	$178.6	$78.9	$92.0	$410.4
Montour	$0.4	$1.4	$0.7	$0.6	$3.1
Northampton	$12.3	$50.8	$19.7	$20.1	$102.9
Northumberlan	$1.4	$8.7	$3.4	$1.2	$14.7
Perry	$0.5	$2.3	$0.9	$0.7	$4.4
Philadelphia	$129.1	$323.8	$143.5	$171.0	$767.4
Pike	$0.9	$10.9	$3.6	$1.2	$16.6
Potter	$0.2	$0.7	$0.4	$0.2	$1.6
Schuylkill	$2.9	$11.0	$5.0	$3.9	$22.7
Snyder	$1.1	$3.8	$1.5	$1.4	$7.8
Somerset	$1.4	$4.8	$2.4	$1.8	$10.4
Sullivan	$0.1	$0.7	$0.3	$0.2	$1.2
Susquehanna	$0.8	$4.6	$1.6	$0.6	$7.6
Tioga	$0.8	$2.7	$1.2	$0.9	$5.6
Union	$1.1	$2.8	$1.4	$1.2	$6.5
Venango	$0.6	$2.3	$1.0	$0.9	$4.9
Warren	$0.3	$1.4	$0.8	$0.4	$2.9
Washington	$4.6	$13.9	$5.8	$6.6	$30.9
Wayne	$2.0	$6.6	$3.0	$2.5	$14.2
Westmoreland	$7.1	$23.4	$9.8	$9.5	$49.9
Wyoming	$0.4	$2.4	$0.9	$0.4	$4.2
York	$17.3	$51.7	$22.1	$24.8	$115.9
Total	**$592.5**	**$1,748.1**	**$763.4**	**$844.4**	**$3,948.5**

Figure 4.3.7-3 Map of Average Annualized Losses for Hurricane Wind Hazard (Hazus, 2022).



As discussed in Section 4.1.3, the 2023 SHMP recognized the importance of protecting not just lives and property, but sense of place as well. To this end, historic assets were also included in the assessment of jurisdictional vulnerability to hurricane winds. The data source and definition of historic assets is described further in Section 4.1.3. Table 4.3.7-5 shows the number and percent of historic assets in each county located in census tracts characterized by high hurricane risk. As in the state vulnerability assessment, high risk census tracts were identified based on the hazard values available through FEMA's National Risk Index (FEMA NRI, 2021). A total of 18,831, or about 12%, historic assets are located in high hazard census tracts, with York County being the highest.

Table 4.3.7-5 Vulnerability of Historic Buildings to Hurricane Winds (PHMC, December 2022).

COUNTY	AT-RISK HISTORIC ASSETS	% OF COUNTY HISTORIC ASSETS
Adams	3,838	100%
Allegheny	0	0%
Armstrong	0	0%
Beaver	0	0%
Bedford	1	0%
Berks	0	0%
Blair	0	0%
Bradford	0	0%
Bucks	2,465	61%
Butler	0	0%
Cambria	0	0%
Cameron	0	0%
Carbon	0	0%
Centre	0	0%
Chester	2	0%
Clarion	0	0%
Clearfield	0	0%
Clinton	0	0%
Columbia	0	0%
Crawford	0	0%
Cumberland	389	21%
Dauphin	1,430	68%
Delaware	0	0%
Elk	0	0%
Erie	0	0%
Fayette	1	0%
Forest	0	0%
Franklin	587	47%
Fulton	1	0%

Table 4.3.7-5 Vulnerability of Historic Buildings to Hurricane Winds (PHMC, December 2022).		
COUNTY	AT-RISK HISTORIC ASSETS	% OF COUNTY HISTORIC ASSETS
Greene	0	0%
Huntingdon	0	0%
Indiana	0	0%
Jefferson	0	0%
Juniata	0	0%
Lackawanna	0	0%
Lancaster	828	15%
Lawrence	0	0%
Lebanon	2,168	72%
Lehigh	0	0%
Luzerne	0	0%
Lycoming	0	0%
McKean	0	0%
Mercer	0	0%
Mifflin	0	0%
Monroe	0	0%
Montgomery	122	2%
Montour	0	0%
Northampton	0	0%
Northumberland	1	0%
Perry	0	0%
Philadelphia	878	14%
Pike	0	0%
Potter	0	0%
Schuylkill	0	0%
Snyder	0	0%
Somerset	1	0%
Sullivan	0	0%
Susquehanna	0	0%
Tioga	0	0%
Union	0	0%
Venango	0	0%
Warren	0	0%
Washington	0	0%
Wayne	0	0%
Westmoreland	0	0%
Wyoming	0	0%
York	6,119	94%
Total	18,831	12%

4.3.8. Invasive Species

4.3.8.1. Location and Extent

An invasive species is any living species that is not native to an ecosystem and causes damage. The environment, the economy, and even human health can be impacted by invasive species. Often, an invasive species spreads and reproduces quickly. They are not limited to organisms that originate from a foreign country; invasive species can come from a different region in the United States (National Wildlife Federation, 2018). Pennsylvania hosts several invasive pathogens, insects, plants, invertebrates, fish, and mammals. These species have largely been introduced by the actions of humans.

Pennsylvania Governor's Invasive Species Council (PGISC), also referenced as the Governor's Invasive Species Council of Pennsylvania (PISC), is the lead organization for invasive species threats. The PISC recognizes two types of invasive species: Aquatic and Terrestrial (PISC, 2017).

- ***Aquatic Invasive Species*** are nonnative species that have part or all of their life cycle in water and threaten the diversity or abundance of native species, the ecological stability of the infested waters, human health and safety, or commercial, agriculture, aquaculture, or recreational activities dependent on such waters.
- ***Terrestrial Invasive Species*** are nonnative species that complete their lifecycle on land instead of in an aquatic environment and whose introduction does or is likely to cause economic or environmental harm or harm to human health.

PISC identifies many species threats that are now or could potentially become significant in Pennsylvania. These species are listed in Table 4.3.8-1

Table 4.3.8-1 Established (*) and Emerging Invasive Species in the Commonwealth.

AQUATIC INVASIVE SPECIES		
Amphibians and Reptiles		
Red-Eared Slider	Yellow-bellied Slider	
Fishes, Diseases, Invertebrates		
Alewife*	New Zealand Mudsnail	Western Mosquitofish
Allegheny Crayfish*	Northern Snakehead	Zebra Mussel
Asiatic Clam*	Oriental Weatherfish	White Perch
Bloody-Red Shrimp	Quagga Mussel	White River Crayfish
Chinese Mysterysnail	Rainbow Smelt	Gill Lice
Common Carp*	Red Swamp Crayfish	Koi Herpesvirus
Fishhook Waterflea	Round Goby	Largemouth Bass virus*
Freshwater Tubenose Goby	Rudd	VHS Disease
Goldfish	Rusty Crayfish	Whirling Disease*
Grass Carp	Scud; Amphipod; A Euryhaline	
Greenside Darter	Spiny Waterflea	
Japanese Mysterysnail	Sea Lamprey*	

Table 4.3.8-1 Established (*) and Emerging Invasive Species in the Commonwealth.		
Mud Bithynia	Virile Crayfish	
Mammals and Birds		
Mute Swan		
TERRESTRIAL INVASIVE SPECIES		
Human and Animal Pathogens		
Plant Pathogens		
Beech Bark Disease*	Corn tar spot	Strawberry fruit rot
Beech Leaf Disease	Oak Wilt	
Birds		
European Starling	House sparrow	
Insects and Other Invertebrates		
Allium leaf miner	Emerald ash borer*	Lily leaf beetle
Balsam woolly adelgid*	Fall armyworm	Spongy moth*
Brown marmorated stinkbug*	Hammerhead worms, Broadhead planarians	Spotted-wing drosophila*
Cherry curculio	Hemlock woolly adelgid	Spotted lanternfly
Crazy snake worm	Introduced pine sawfly*	Viburnum leaf beetle
Elm zigzag sawfly	Japanese beetle*	Walnut twig beetle
Elongate hemlock scale*	Jumping worms	
Higher Mammals		
Wild boar/Feral Swine		

Table 4.3.8-2 below shows the highest priority invasive plant species for the PISC, based on 2021 survey of PISC members. The cutoff chosen for this table was a score of 5.5, which is considered medium priority. Beyond just this priority score, the table also shows PA Noxious Weed Rank, Invasive Assessment Score, and DCNR's Ranking. The PA Noxious Weed Rank is a class that on the Pennsylvania Controlled Plant and Noxious Weed List under authority of the Agricultural Code Title 3 Chapter 15. The Invasive Assessment Score is an evaluation of ecological and biological characteristics that determine invasiveness and potential impacts using the New York State assessment template, with score above 80 representing very high-risk species. DCNR ranks species on their threat to state lands and natural areas, with 1 being a severe threat, 2 a significant threat, and 3 a lesser threat. Species that score highly on all are Kudzu, Hydrilla, and European Water Chestnuts. All 3 were above a 7.0 on PISC Priority, A-ranked on the Noxious Weed List, given a score above 80 on the Invasive Assessment Score, and ranked as a severe threat by DCNR. Tree-of-Heaven is the top priority species for the PISC and a severe threat for DCNR, but wasn't ranked in the most dangerous categories on the Noxious Weed List or the Invasive Assessment Score.

Table 4.3.8-2 Priority Invasive Plant Species (PISC, 2022)

COMMON NAME	ACQUATIC OR TERRESTRIAL	PISC PRIORITY SCORE	PA NOXIOUS WEED RANK	INVASIVE ASSESSMENT SCORE	DCNR RANK
Tree-of-Heaven	Terrestrial	9.1	B	68	1
Mile-A-Minute	Terrestrial	8.7	B	91	1
Giant hogweed	Terrestrial	8.6	A	72	1
Purple Loosestrife	Aquatic	8.3	B	91	1
Kudzu	Terrestrial	8.1	A	84	1
Japanese Knotweed	Terrestrial	8.0	B	98	1
Japanese Stiltgrass	Terrestrial	7.9	B	85	1
Japanese Barberry	Terrestrial	7.8	B	91	1
Common Reed	Aquatic	7.8	Under Review	92	1
Hydrilla	Aquatic	7.4	A	91	1
Oriental Bittersweet	Terrestrial	7.3	B	87	1
Wavyleaf Basketgrass	Terrestrial	7.3	B	70	1
Poison Hemlock	Terrestrial	7.3	B		1
Giant Knotweed	Terrestrial	7.2	B	98	1
Reed Canary Grass	Terrestrial	7.2		78	2
European Water Chestnut	Aquatic	7.1	A	82	1
Russian Olive	Terrestrial	6.6		68	2
Hybrid Knotweed	Terrestrial	6.6	B	98	1
Parrot Feather Watermilfoil	Aquatic	6.5	B	77	1
Autumn Olive	Terrestrial	6.4		94	2
Japanese Honeysuckle	Terrestrial	6.4		84	1
Multiflora Rose	Terrestrial	6.2	B	89	1
Garlic Mustard	Terrestrial	6.1	B	84	1
European Barberry	Terrestrial	6.1		69	1
Glossy Buckthorn	Terrestrial	6.0	B	73	1
Goatsrue	Terrestrial	6.0	A	60	1
Callery Pear	Terrestrial	5.8	B	65	2
Common Buckthorn	Terrestrial	5.8	B	81	1
Japanese Angelica Tree	Terrestrial	5.5	B	80	1

Harmful algae blooms (HABs) also present invasive risk to ecosystems. HABs are when algae or cynobacteria grow rapidly and have the ability to harm people, animals and the local ecology. They occur in both fresh water and salt water. HAB appears in the form of foam, scum, paint or mats on the surface of water. It can form in different colors (CDC, 2023a). Harmful algae typically blooms when water temperatures are warmer. Warm water favors HABs for many reasons, including that warmer temperatures prevent water from mixing, warmer water is easier for small organisms, such as algae, to move through, and algae blooms absorb sunlight (EPA, 2023). As climate changes, HABs are able to thrive in, and invade ecosystems that they previously could not inhabit. While algae blooms are more common in the summertime, they can also be found in other seasons especially as the climate is changing. HABs also prefers salty water.

The location and extent of these invasive threats depends on the preferred habitat of the species as well as the species' ease of movement and establishment. Kudzu vine, an aggressive vascular plant that was first introduced to the United States at the 1876 Centennial Exposition in Philadelphia and was promoted for erosion control to Southern farmers, grows incredibly quickly and has been known to overtake trees, buildings, utility lines, road signs, and more (Center for Aquatic and Invasive Plants, 2018). As previously stated, most new introductions of invasive species occur because of human activity. There are a few key pathways to introduction into Pennsylvania (PISC, 2017):

- Contamination of internationally traded products
- Hull fouling
- Ship ballast water release
- Hitchhiking on boats or fishing gear
- 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 spread of invasives can be limited by state agency activity. One example is the plum pox virus which was found in 1999 but had disappeared by 2006 after quarantine efforts (Crable, 2021). However, sometimes state action is not enough. First discovered in Berks County in 2014, the spotted lanternfly is now under a quarantine by the Pennsylvania Department of Agriculture in 45 counties, up from the 13 that were reported in the 2018 plan and even more counties expected to join in the future (PA Department of Agriculture, 2022c).

4.3.8.2. Range of Magnitude

The magnitude of invasive species threats ranges from nuisance to widespread killer and can have economic, health, and environmental impacts (PISC, 2017). Non-native honeysuckles compete against native plants and provide lower levels of nutrition for birds than those natives (Schneck, 2019). Other invasive species can cause significant changes in the composition of Pennsylvania ecosystems. For example, the spotted lanternfly will inflict weeping wounds on trees, which not only distresses the tree but the sap will attract other insects, especially ants and wasps. A study by Penn State found that it could cost the state's economy $325 million annually (Duke, 2020). Another insect originally from Asia, the Emerald Ash Borer, has a 99% mortality rate for any ash tree it infects (PISC, 2017). Hydrilla grows aggressively in shallow water areas, forming thick mats that block sunlight and displace native species. They have also been shown to alter the physical and chemical characteristics of water bodies (USGS, 2020). Zebra and quagga mussels may clog freshwater intake pipes, filtration systems, beaches, boat ramps, and docks by biofouling (Pennsylvania Fish and Boat Commission, 2022a). Red Swamp and White

River Crayfish may cause serious economic damage to agricultural production and water management structures such as dams and flood control structures due to their consumption of crops and burrowing behavior (Pennsylvania Fish and Boat Commission, 2022b). 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 or after a wildfire, as the already weakened state of the native ecosystem causes it to succumb to an infestation more easily (Flory, et. al, 2022). Microbial species can also be invasive and cause widespread illness or death in humans. Among the animal invasive pathogens profiled by the USDA's National Invasive Species Information Center are Avian Influenza, West Nile Virus, and Zika Virus Disease.

There is a wide range of environmental impacts caused by invasive species. The aggressive nature of many invasive species can cause significant reductions in biodiversity by crowding out native species, like the kudzu vine has done across the Southeastern United States (Center for Aquatic and Invasive Plants, 2018). This can affect the health of individual host organisms as well as the overall well-being of the affected ecosystem, as the interdependency of organisms and natural systems is disrupted. Beyond causing human, animal, and plant harm, there are secondary impacts of invasive species that go beyond harm to host species and ecosystems – for example, the impacts caused by invasive species that attack forests. Pennsylvania's forests prevent soil degradation and erosion, protect watersheds, stabilize slopes, and absorb carbon dioxide emissions (PA DCNR, 2022e). The key role of forests in the hydrologic system means that if forest land is wiped out, the effects of erosion and flooding will be amplified. There is also an impact on agricultural harvests like honey, potatoes, and stone fruits. As a state with strong agricultural production, Pennsylvania is at risk of significant economic disruption from invasive species (Duke, 2020).

HABs have many risks. Depending on the type of algae, HABs can have significant impacts on health through water pollution. HABs produce toxins that can cause sickness or even lead to death. For example, if someone eats seafood contaminated by algae toxins, they can be impacted to the toxins (NIEHS, 2021). Populations may be more vulnerable if they rely on seafood or if their water is not tested for pollution. HABs are also a risk to ecosystems because they can deplete oxygen in the water. Algae blocks oxygen and slight, which can kill off fish and other organisms (NIEHS, 2021). They also have potential impacts to the economy. For example, fisheries can be significantly impacted if algae are impacting the ecosystems they are harvesting. If a fishery has to close, it can cause millions of lost revenues per week (NEIHS, 2021).

A possible worst-case scenario would be if the spotted lanternfly continued to spread to the rest of the Commonwealth, and then ultimately, to the rest of the country. Unfortunately, this scenario seems to be playing out now. The potential for hundreds of millions of dollars and thousands of jobs lost annually is possible in this scenario, and that is just for Pennsylvania. The losses would be multiplied significantly if the spread reaches across the entire country.

Table 4.3.8-3 Most Likely Lifelines Impacted by Invasive Species

Lifelines	Impact Type	Notes
Food, Water, Shelter	⚠	Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery due to potential impacts for agricultural operations and water resources. Mitigation actions for these impacts may be increasing awareness of the risks invasives pose for agricultural operations and developing response plans for outbreaks,
Health and Medical	⧉	Anticipating a cascading relationship for the Health and Medical lifeline in both response and recovery due to potential microbial species that may cause illnesses and even death. Mitigation actions for health and medical impacts are similar to above as the focus should be on increasing awareness and developing response plans that may include species quarantine and further action when certain invasives are discovered.

There are no direct hazard links through invasive species, but there is potential for pandemics or infectious disease events to occur because of certain species. Some species may also lead to mass food contamination if impacting agricultural operations.

4.3.8.3.Past Occurrence

Invasive species have been entering the Commonwealth since the arrival of early European settlers, but not all occurrences have required government action. The first invasive species outbreak requiring state attention occurred in 1862 when legislation was enacted to provide for the destruction of and to prevent the spread of Canada Thistle, Johnson Grass, and Marijuana. Since then, there have been 26 acts and quarantines enacted to prevent the spread of invasive species. As illustrated in Table 4.3.8-4, the volume of acts and quarantines has increased since 2000 (PISC, 2013).

Table 4.3.8-4 Previous Occurrences of Invasive Species Events Requiring State Action or Quarantine.

YEAR	SPECIES	YEAR	SPECIES
1911	Chestnut Blight Disease	2003	Black Carp, Bighead Carp, Silver Carp
1917	Tuberculosis	2005	Eurasian Watermilfoil
1919	European Wart Disease of the Potato	2006	Chronic Wasting Disease
1923	Japanese Beetle	2006	Scrapie
1925	European Corn Borer	2006	Vesicular Stomatitis
1927	Canada Thistle, Wild Garlic, Orange Hockweed, King-Devil, Sow Thistle, Field Bindweed	2007	Emerald Ash Borer
1933	White Pine Blister	2007	Feral Pig
1933	Gypsy Moth	2008	Viral Hemorrhagic Septicemia Virus
1935	Mosquitos	2009	Avian Influenza
1953	Black Stem Rust	2009	Tuberculosis
1983-84	Avian Influenza	2009	Emerald Ash Borer (expansion of previous quarantine)
1992	Pine Shoot Beetle	2009	West Nile encephalitis, Chronic Wasting Disease, Spring Viremia of Carp, Viral Hemorrhagic Septicemia, Lymphocitic Choriomeningitis Virus, Equine Rhinopneumonitis
1996	Reptile and Amphibian Species	2010	Emerald Ash Borer (expansion of quarantine to Allegheny, Armstrong, Beaver, Bedford, Butler, Indiana, Juniata, Lawrence, Mercer, Mifflin, Washington and Westmoreland Counties)
1999	Plum Pox Virus	2014	Thousand Canker Disease
		2014	Spotted Lanternfly

The PISC has begun tackling human and animal pathogens, aquatics, insects, mammals, plant pathogens, and vascular plants through management programs between the PA Fish and Boat Commission, the Game Commission, the Department of Agriculture, and DCNR. Notably, the PISC lists management programs for feral swine, kudzu, giant hogweed, mile-a-minute, emerald ash borer, plum pox virus, zebra and quagga mussels, and viral hemorrhagic septicemia under its “completed actions.” This does not mean that these threats have been eliminated; rather, it indicates that there is an active management plan in place to reduce future occurrences.

4.3.8.4.Future Occurrence

According to the PISC, the probability of future occurrence for invasive species threats is on the rise because of the growing volume of transported goods, increasing technology, 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 countries and regions. In 2020 Pennsylvania imported over $84 billion in goods from abroad, which was dominated by pharmaceuticals and machinery but still included agricultural, forestry, and fisheries goods that commonly carry unknown pests (globalEDGE, 2020).

Furthermore, climate change can contribute to the introduction of new invasive species by modifying competition in a way that native species are more susceptible to expansion of existing invaders or the addition of new invaders (Finch et. al, 2021). The reverse may also be true in some cases. As maximum and minimum seasonal temperatures change and growing seasons lengthen, pests are given more time to outcompete native species in areas with previously inhospitable climates; these shifts are expected to impact the Northeastern and Midwest regions the most (NISAW, 2021). Heightened levels of CO2, which invasive pests contribute to if they have significant negative impacts on tree populations, can also have a dramatic positive effect on invasive plants that are already outcompeting native species (Finch et. al, 2021). Climate change might lead to more droughts, making freshwater saltier, and a more suitable environment for HAB. Also, algae need carbon dioxide to thrive. Higher levels of carbon dioxide in the air due to climate change can increase algae growth. It is predicted that climate change will cause algae blooms to continue to occur more often and some impacts can even already be seen. Impacts from climate change such as increased agricultural runoff, increased impervious surface runoff and increased water temperatures are encouraging the growth of more algae blooms (EPA, 2023). For more information on recent changes in extreme temperatures, see Section 4.3.4. In addition, wildfire events, which invasive species can make more probable by killing off natives and providing more fuel, and drought conditions leave more bare ground available for invasives to utilize (Finch et. al 2021). All of these changes may shift the dominance of ecosystems in favor of nonnative species over time, but how that will actually play out is difficult to predict due to how many different factors are involved for each type of species and the context in which they are present.

Recent state actions to combat the growing threat of invasive species include a 2017 executive order to expand PISC, the 2017 Noxious Weed Act to help protect farms and properties from some of the most invasive plant species of concern, and the Invasive Species Management Plan released in April 2010. This plan outlines the Commonwealth's goals for the management of the spread of nonnative invasive species and creates a framework for responding to threats through research, action, and public outreach and communication. More information on the Management Plan can be found online at http://www.invasivespeciescouncil.com. Pennsylvania also has an Aquatic Invasive Species Management Plan as well as a Rapid Response Plan. Individual management plans by PISC member agencies and organizations will also help to reduce the number and/or magnitude of invasive species threats in the future. In addition to these more official actions, June 17, 2022, was the First Pennsylvania Native Species Day, which included events in several state parks focused on education and volunteer activities such as pulling nonnative invasive plants (Schneck, 2022).

4.3.8.5. State Facility Vulnerability Assessment and Loss Estimation

Invasive species do not pose a direct threat to state critical facility buildings. However, the critical facilities inventory developed for this plan update identifies 275 agricultural critical facilities. It can be expected that invasive species will have either a direct effect on critical facilities in this category by hindering production or an indirect effect by increasing the cost of food production inputs. However, the exact vulnerability depends on the species in question.

State facility vulnerability is low for invasive species when referring to buildings owned by the state, but the buildings owned and leased by the Department of Conservation and Natural Resources, Game Commission, and Fish and Boat Commission are potentially more at risk if they are sited in Pennsylvania's wild and natural areas. There is a risk of Quagga mussels damaging facilities in Blair, Bucks, Erie, and Lancaster counties. Table 4.3.8-5 below includes the number of state facilities located in each of those counties.

Table 4.3.8-5 State Facilities in Blair, Bucks, Erie, and Lancaster Counties

COUNTY	STATE FACILITY	STATE HIGHER EDUCATION	TOTAL
Blair	58	0	58
Bucks	83	0	83
Erie	141	62	203
Lancaster	69	90	159

Additionally, while they are not identified as state critical facilities, the Commonwealth owns and administers 2.5 million acres of state forests that provide clean water, recreational opportunities, habitat for wildlife, and places to enjoy the tranquility of nature. These forests are constantly vulnerable to invasive species threats.

The Pennsylvania Wilds Initiative, a consortium of thirteen counties in north-central Pennsylvania with significant forest resources, recently indicated that their 2 million acres of public natural landscape represent a $126 million-dollar state investment (PA Wilds, 2018). An aggressive invasive species threat to these or other state-owned lands could result in significant economic loss. Additionally, the total value of Pennsylvania's agricultural products is nearly $6 billion; an invasive species that affects agricultural products and production can cause significant losses to the Commonwealth's economy.

In addition to the potential losses to state facilities, combatting invasive species is an expensive task. In its Invasive Species Management Plan, DNCR reports spending $220,000 in 2011 alone to suppress the Hemlock Woolly Adelgid. Other forest pest surveys cost $500,000 per year, and the gypsy moth suppression program ranges from $500,000 to $10 million annually. Currently, DNCR is working to revise and update its invasive species plan. Should the invasive species threat grow, the budgets of DCNR and other state agencies could be strained. These programs could cause an undue burden on budgets.

4.3.8.6. Jurisdictional Vulnerability Assessment and Loss Estimation

Nationally, the United States Department of Agriculture estimates that lost agricultural production, pest management costs, and monetary losses from decreased tourism and recreation surpass $138 billion annually. In Pennsylvania, losses will differ from jurisdiction to jurisdiction depending on the aggressiveness of the invasive species of concern. Jurisdictional losses due to invasive species threats stem from three sources: (1) lost revenue from diseased, damaged, or deceased crops, livestock, lumber, or other agricultural commodities; (2) economic losses from the cost of eradication programs; and (3) losses in the form of illness or death of humans.

From the perspective of potential agricultural losses, relative jurisdictional vulnerability could be determined by comparing each jurisdiction's timber and agricultural production. County-by-county estimates for the market value of timber, lumber and wood products are unavailable, but DCNR estimates that the total value of the state's wood products is $11.5 billion (PA DCNR, 2017). County-by-county estimates of farmland acreage and the market value of agricultural products (excluding timber) are presented in Table 4.3.8-6. The counties with the highest agricultural production and the greatest potential agricultural losses are Lancaster, Chester, and Berks. The market value of agricultural products in each of these counties exceeds $500 million.

Table 4.3.8-6 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA Census of Agriculture, 2017)

COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Adams	166,227	$207,566,000
Allegheny	28,970	$13,743,000
Armstrong	126,655	$39,768,000
Beaver	53,832	$23,653,000
Bedford	222,224	$115,273,000
Berks	224,722	$554,656,000
Blair	78,923	$107,178,000
Bradford	303,601	$132,640,000
Bucks	77,255	$75,757,000
Butler	133,954	$49,522,000
Cambria	79,341	$30,069,000
Cameron	5,278	$523,000
Carbon	19,498	$13,029,000
Centre	149,858	$91,478,000
Chester	150,514	$712,468,000
Clarion	100,344	$27,670,000
Clearfield	60,957	$28,670,000
Clinton	40,057	$45,561,000
Columbia	106,748	$67,287,000
Crawford	194,447	$107,270,000
Cumberland	169,654	$219,177,000

Table 4.3.8-6 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA Census of Agriculture, 2017)		
COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Dauphin	81,252	$93,074,000
Delaware	2,385	$9,494,000
Elk	22,982	$4,024,000
Erie	153,403	$82,040,000
Fayette	112,285	$28,836,000
Forest	4,170	$2,059,000
Franklin	269,530	$476,469,000
Fulton	100,465	$75,816,000
Greene	114,089	$16,435,000
Huntingdon	120,157	$92,132,000
Indiana	148,288	$71,985,000
Jefferson	80,411	$22,423,000
Juniata	85,640	$126,760,000
Lackawanna	36,556	$16,469,000
Lancaster	393,949	$1,507,207,000
Lawrence	82,125	$34,773,000
Lebanon	107,577	$350,804,000
Lehigh	74,511	$79,216,000
Luzerne	49,087	$17,793,000
Lycoming	186,130	$63,713,000
McKean	43,084	$5,516,000
Mercer	156,397	$65,748,000
Mifflin	80,970	$139,994,000
Monroe	27,607	$9,933,000
Montgomery	30,896	$35,374,000
Montour	38,635	$60,225,000
Northampton	59,195	$36,058,000
Northumberland	124,136	$154,583,000
Perry	114,746	$172,758,000
Philadelphia	284	$327,000
Pike	24,700	$892,000
Potter	97,780	$39,227,000
Schuylkill	96,886	$143,439,000
Snyder	98,978	$200,352,000
Somerset	219,046	$115,449,000
Sullivan	43,424	$12,182,000
Susquehanna	154,409	$49,775,000
Tioga	212,797	$92,255,000
Union	65,719	$147,420,000

Table 4.3.8-6 Estimated Jurisdictional Losses Relating to Agricultural Production (USDA Census of Agriculture, 2017)		
COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Venango	53,338	$14,781,000
Warren	68,153	$21,257,000
Washington	190,447	$36,999,000
Wayne	100,696	$29,371,000
Westmoreland	144,278	$66,320,000
Wyoming	61,303	$13,243,000
York	252,713	$260,927,000
TOTAL	***7,278,668***	***$7,758,884,000***

4.3.9. Landslide

4.3.9.1. Location and Extent

A landslide is the downward and outward movement of rock or soil, or both, reacting under the force of gravity. Landslides can be classified into different types on the basis of the type of movement (fall, topple, slide, spread, or flow) and the type of material (rock, soil, debris, etc.) involved. Drawings of each type are included in Table 4.3.9-1 to better show the impacts of different kinds of landslides, and types of movement and the locations they are likely to occur are described in Table 4.3.9-2. Landslides may also form a complex failure encompassing more than one type of movement, such as a rockslide and a debris flow (USGS, 2008).

Fall: Begins with the detachment of soil or rock, or both, from a steep slope along a surface on which little or no shear displacement has occurred. The material subsequently descends mainly by falling, bouncing, or rolling.

Slide: A downslope movement of a soil or rock mass occurring on surfaces of rupture or on relatively thin zones of intense shear strain.

Table 4.3.9-1 Drawings of Types of Landslides (USGS, 2008)

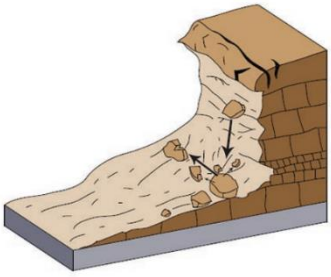
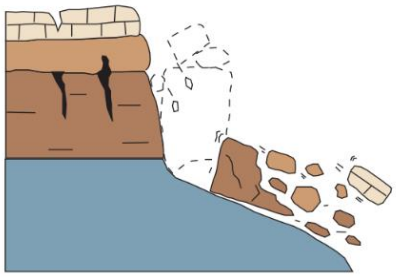
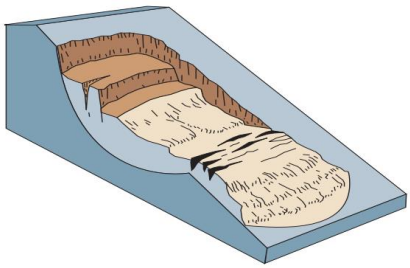
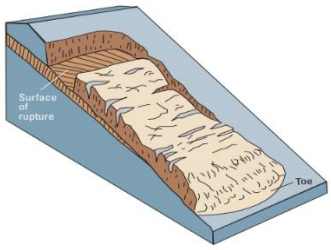
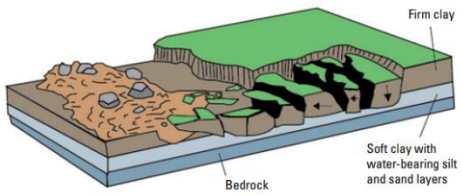
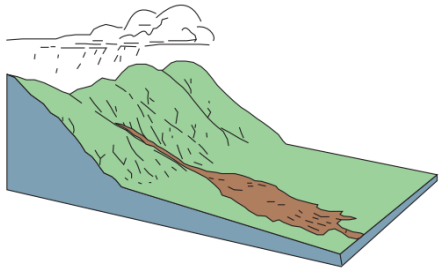
FALL	TOPPLE	ROTATIONAL SLIDE
		
TRANSLATIONAL SLIDE	**SPREAD**	**FLOW**
		

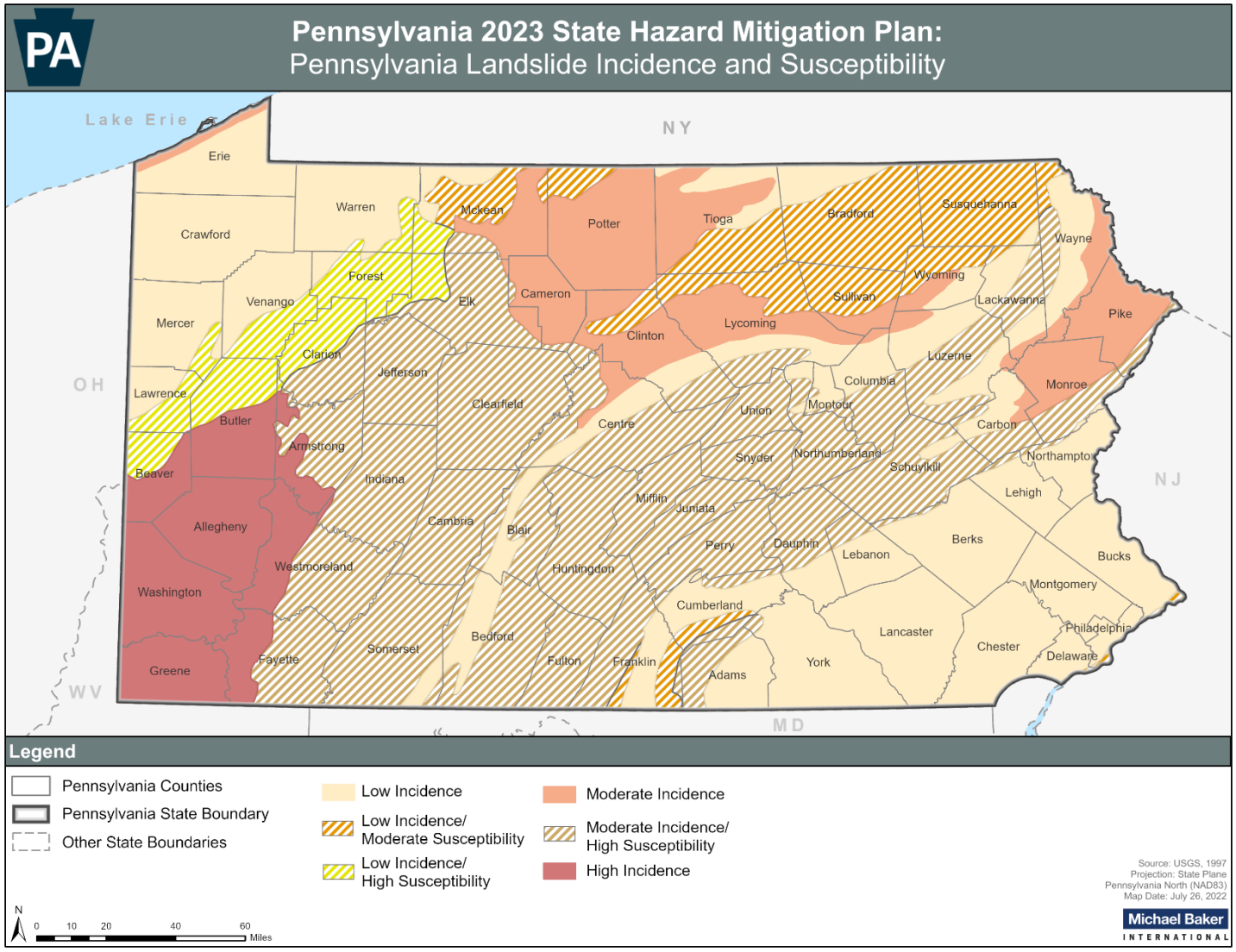
Table 4.3.9-2 Type of Landslides and their Characteristics (USGS, 2008)		
TYPE	DESCRIPTION	LOCATION
Fall		
Rockfall	Abrupt, downward movements of rock or earth, or both, that detach from steep slopes or cliffs.	Common on steep or vertical slopes and along rocky banks of rivers and streams.
Topple	The forward rotation out of a slope of a mass of soil or rock around a point or axis below the center of gravity of the displaced mass.	Along both stream and river courses and road cuts where the banks are steep.
Slide		
Rotational Slide	A landslide on which the surface of rupture is curved upward, and the slide movement is more or less rotational about an axis that is parallel to the contour of the slope.	These are associated with slopes ranging from about 20 to 40 degrees. They are also the most common type of landslide occurring in “fill” materials.
Translational Slide	The mass of land moves out, or down and outward, along a relatively planar surface with little rotational movement or backward tilting.	This is one of the most common types of landslides worldwide. They are found in all types of environments and conditions.
Spread	An extension of a cohesive soil or rock mass combined with the general subsidence of the fractures mass of cohesive material into softer underlying material.	They usually occur on very gentle slopes or essentially flat terrain, especially where a stronger upper layer of rock or soil undergoes extension and moves above an underlying softer, weaker layer. These landslides are known to occur where there are liquefiable soils. They are common in, but not restricted to areas of seismic activity.
Flow	A spatially continuous movement in which the surfaces of shear are short-lived, closely spaced, and usually not preserved. Debris flows, also known as “mudslides,” are a form of rapid mass movement in which loose soil, rock, and sometimes organic matter combine with water to form a slurry that flows downslope.	Flows are prevalent in steep gullies and canyons; they can be intensified when occurring on slopes or in gullies that have been denuded of vegetation due to wildfires or forest logging.

Landslides typically occur when some factor (e.g., increased water content or change in load) causes the force of gravity to outweigh the forces working to hold material in place, resulting in the downslope movement of the subject material. Several natural and human factors may contribute to or influence landslides. These factors include topography, geology, precipitation, steepness of cut and fill slopes, and cut-slope stability (DCNR, 2022f). Rockfalls and other slope failures occur in areas of Pennsylvania with moderate to steep slopes. Many slope failures are associated with precipitation events – periods of sustained above-average precipitation, severe rainstorms, or snowmelt events. Other natural causes of instability and potential failures are waterbodies like rivers or streams wearing down slopes and undercutting slope bases and vibrations from seismic events, although earthquake-induced landslides are not very common in

Pennsylvania (Delano and Wilshusen, 2001). Human activities like excavation or irrigation can contribute to landslides. In addition, manmade slopes such as along highways or through development can have adverse impacts by altering the natural slope gradient, increasing soil water content, or removing vegetation cover (Delano and Wilshusen, 2001). The type of slide they induce is dependent on the specific location and context. For example, seismic activity can lead to each type of slide identified in Table 4.3.9-1 with an exception for flows, as they are typically associated with precipitation events but can also be the result of other types of landslides.

Figure 4.3.9-1 shows the range of landslide susceptibility and incidence for Pennsylvania indicating the areas that are most vulnerable to landslide events. Landslides have occurred in many parts of Pennsylvania but are most abundant and most troublesome in much of the Appalachian Plateaus physiographic province of western and north-central Pennsylvania. This region is recognized as one of the major areas of landslide susceptibility and severity in the United States (Baker and Chieruzzi, 1959; Radbruch-Hall et al., 1982). The southwest region of the state has the highest risk of landslide, impacting the following counties: Greene, Washington, Allegheny, Butler, Beaver, Westmoreland, Armstrong, and Fayette. The Monongahela River Valley of northern West Virginia and southwestern Pennsylvania has a special place in landslide folklore. The name “Monongahela” is derived from an American Indian word that is translated as “river with the sliding banks” or “high banks which break off and fall down” (Espenshade, 1925).

Figure 4.3.9-1 Landslide Susceptibility and Incidence across Pennsylvania (USGS, 1997).



4.3.9.2. Range of Magnitude

Impacts from landslides can be dependent on the type of landslide event (USGS, 2008):

- Fall: The volume of material in a fall can vary substantially, from individual rocks or clumps of soil to massive blocks tens of thousands of cubic feet in size. Falling materials can be life-threatening. Falls can damage property beneath the fall-line of large rocks. Boulders can bounce or roll great distances and damage structures or kill people. Damage to roads and railroads is particularly high: rockfalls can cause deaths in vehicles hit by rocks and can block highways and railroads.
- Topple: Can be extremely destructive, especially when failure is sudden and (or) the velocity is rapid.
- Rotational Slide: Can be extremely damaging to structures, roads, and lifelines but are not usually life-threatening if movement is slow. Structures situated on the moving mass also can be severely damaged as the mass tilts and deforms. The large volume of material that is displaced is difficult to permanently stabilize. Such failures can dam rivers, causing flooding.
- Translational Slide: May initially be slow, damaging property and (or) lifelines; in some cases, they can gain speed and become life-threatening. They also can dam rivers, causing flooding.
- Spread: Can cause extensive property damage to buildings, roads, railroads, and lifelines. Can spread slowly or quickly, depending on the extent of water saturation of the various soil layers. Lateral spreads may be a precursor to earthflows.
- Flow: Can be lethal because of their rapid onset, high speed of movement, and the fact that they can incorporate large boulders and other pieces of debris. They can move objects as large as houses in their downslope flow or can fill structures with a rapid accumulation of sediment and organic matter. They can affect the quality of water by depositing large amounts of silt and debris.

In the United States alone, landslides have been known to cause up to $3.5 billion in damages, and nearly 25 to 50 deaths annually (USGS, 2004).

Landslides cause damage to transportation routes, utilities and buildings. They can also create travel delays and other side effects. Fortunately, deaths and injuries due to landslides are rare in Pennsylvania. Almost all of the known deaths due to landslides have occurred when rockfalls or other slides along highways have involved vehicles. Landslides can also damage pipeline infrastructure and lead to more damage, which happened in 2018 when a slide caused a gas explosion in Beaver County (Rubinkam, 2020). Storm-induced debris flows are the only other type of landslide likely to cause death and injuries. As residential and recreational development increases on and near steep mountain slopes, the hazard from these rapid events will also increase. In addition, landslides can potentially have disastrous flood effects when they descend into water bodies, diverting or entirely blocking water flows.

Figure 4.3.9-2 Damage to a Private Home in Pittsburgh

(Photograph by *Leslee Schaffer, The Northside Chronicle. February 2019*)

The effect of landslides on the human population in Pennsylvania is substantial. However, cost data for historical landslide damages is sparse. Landslide damage estimates for Allegheny County (Pittsburgh and suburbs) from 1970-1976 estimate that annual costs ranged from $1.3 to $4.0 million over this 7-year period, averaging $2.2 million per year (PEMA, 2007). The maximum annual cost of $4.0 million occurred in 1972, the year of Tropical Storm Agnes. Data from the Pennsylvania Department of Transportation (PennDOT) indicate that $6.0 million was spent to repair landslide damage along state roads in Allegheny County during the 6.5-year period from January 1971 through July 1977. Costs to private citizens (e.g., transportation delays or detours) are not included in these estimates.

The Pennsylvania Department of Transportation and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in known landslide-prone areas. A 1991 estimate showed an average of $10 million per year is spent on landslide repair contracts across the Commonwealth and a similar amount is spent on mitigation costs for grading projects (PA DCNR, 2009a).

In 2018, Pennsylvania submitted a federal disaster aid request for Allegheny and Westmoreland counties due to landslides and infrastructure damage that resulted from severe weather throughout February, March, and April of that year. A Joint Preliminary Damage Assessment conducted by PEMA, FEMA, and both county and local officials placed the costs associated with the disaster request at $22 million (Hess, 2018).

The impact of landslides on the environment depends on the size and specific location of the event. In general, impacts include changes to topography, damage or destruction of vegetation, potential diversion or blockage of water in the vicinity of streams, rivers, etc., and increased sediment runoff both during and after event.

Table 4.3.9-3 Most Likely Lifelines Impacted by Landslide		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating causal impacts in response and recovery where community safety may be threatened due to the potential lethal impacts of landslides and government personnel will be called into action in response. Monitoring landslide risks, mapping vulnerable areas, and awareness outreach to help people become more aware of erosion risks in their area are potential mitigation actions to protect communities.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery as landslides can cause significant damage to buildings and other structures. Mitigation actions for this lifeline should be focused on promoting site and building residing standards to minimize risk and even removing existing building from hazard areas.
Transportation		Anticipating a causal relationship for the Transportation lifeline in response and recovery due to potential damage to transportation infrastructure. Mitigation actions for this lifeline may be stabilizing hazard areas near infrastructure, promoting site design standards, and potentially removing infrastructure.

Landslides present a serious danger to the safety of the communities they occur in, and severe events may require search and rescue missions. As showcased above through pictures, landslides potentially impact the Food, Water, Shelter lifeline through the danger they present to housing and other buildings. Health care facilities are not immune to damage in this way, and the potentially life-threatening situations will require emergency health services. Energy infrastructure is also vulnerable to landslides and both electricity and fuel access may be restricted. Communications infrastructure is in a similar position, with the potential for landslides to damage certain aspects enough to restrict communications. Alerts, warnings, messages may be needed to inform the public of dangerous situation. The damage potential of landslides also extends to land-based transportation infrastructure and hazardous materials facilities.

Two hazards that closely linked to landsides are land subsidence and building or structure collapses. These two are likely to result from landslide events. Potential impacts for landslides extend to more hazards, with events possibly leading to dam and levee failure, flooding, environmental contamination, transportation incidents, and utility interruptions.

4.3.9.3. Past Occurrence

Pennsylvania has a long history of landslide activity. This has resulted from a combination of the state's humid temperate climate, locally steep and rugged topography, and great diversity in the erosion and weathering characteristics of near-surface sedimentary rocks. Human activities such as commercial, industrial, and residential developments, transportation, and mining often compound landslide problems. Precipitation events which have triggered significant landslides in Pennsylvania include: Tropical Storm Agnes in June 1972, the Johnstown (Cambria County) storm in July 1977, and the East Brady (Armstrong County) storm in August 1980.

More recently, 2018 was a record year for landslides in the greater Pittsburgh area. According to the mayor of Pittsburgh, the city was already five times over budget for landslide remediation by mid-April. The causes of the increased landslide activity included record rainfall, the annual freeze-thaw cycle, and a record number of water breaks (90.5 WESA, 2018). Landslide events across the region resulted in damaged vehicles, closed roads, and home evacuations. Among the most destructive was a landslide along Route 30 in East Pittsburgh that collapsed a 300-foot section of the roadway which was open to public two months later after a $7,000,000 project.

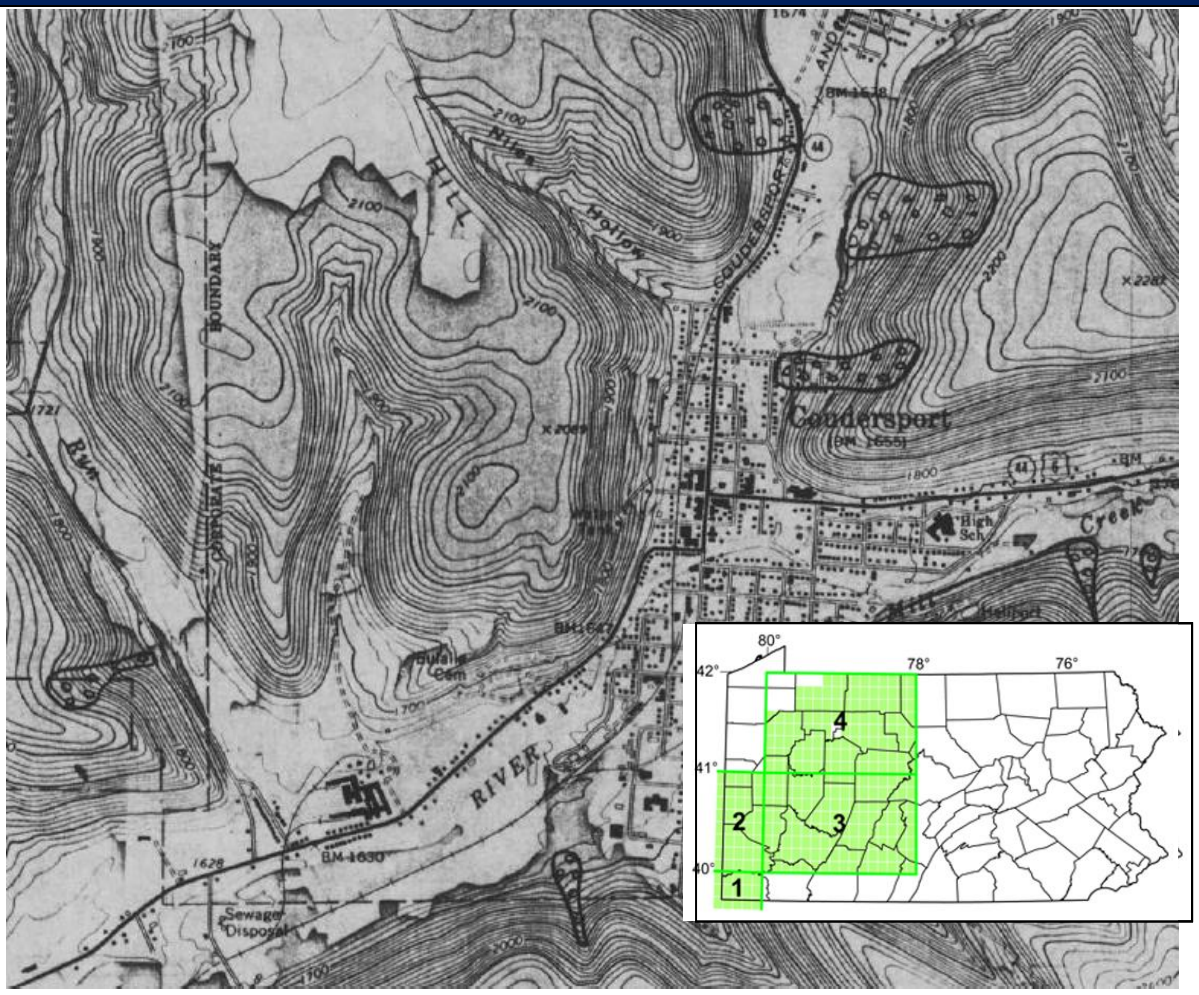
Figure 4.3.9-3 Photo Showing Damage to PA Route 30 due to Landslide Incidents.

(Photograph by *Gov. Tom Wolf/Flickr. 90.5 WESA. April 11, 2018*)

A comprehensive inventory of landslide events across the Commonwealth is not available, and the USGS does not maintain a formal inventory of landslides. Instead, the USGS Landslide Hazards Program collects data as events are reported to the agency. However, the USGS

created landslide inventory maps in the late 1970s and early 1980s for areas of central and western Pennsylvania as part of an Appalachians-wide study of landslides. An example of one of these maps is shown in Figure 4.3.9-4, alongside an index for the areas maps are available for. Additional maps are available at: http://www.dcnr.state.pa.us/topogeo/hazards/landslides/slidepubs.aspx.

Figure 4.3.9-4 Example of Landslide Inventory Map for Coudersport, PA from USGS Open File Map 81-238 (G-16 by John S. Pomeroy, 1981). An Index Map Showing the Coverage of the Inventory is also Provided (PA DCNR, 2009a).



The NCEI has also begun capturing landslides as they occur in conjunction with severe storms. There are only two landslides recorded in the NCEI database. Landslides are sometimes anecdotally reported in the NCEI under descriptions for other events as they occur with them, such as floods or heavy rain. On July 4, 2011, isolated severe thunderstorms caused two landslides in Allegheny County. The first was a mudslide onto Forward Avenue in Pittsburgh that caused $5,000 in property damage. The second landslide reported with these

thunderstorms was a rockslide on Bigelow Boulevard and Herron Avenue, also in Pittsburgh, which caused $10,000 in property damage. No injuries or fatalities were reported in either event.

Historically, Pennsylvania has experienced two catastrophic landslide events which resulted in multiple fatalities. In December 1942, a 150-cubic-yard rockslide along a highway near Ambridge, Beaver County, crushed a bus. Twenty-two people were killed and four were injured (Ackenheil, 1954; Gray et al., 1979). In February 1983, a 300-cubic yard rock fall occurred in Pittsburgh during remedial excavation of a highway slope that had a long history of rock falls. This rock fall crushed three vehicles, killing two people and injuring one. These events can be considered worst-case scenarios for Pennsylvania. In addition, every year one or more construction workers are typically killed or injured in cave-ins of trenches or other excavations in Pennsylvania.

The Southwestern Pennsylvania Commission (SPC) converted 125 USGS topographic maps in the southwest Pennsylvania that USGS had classified as active or recently active landslide events (SPC, 2017). SPC then digitized USGS's topographic maps and identified 4,565 sites from the maps where landslides had occurred in the past so that these locations would be further reviewed when they are in the proximity of future infrastructure projects. Considering all landslides are a significant hazard, SPC is attempting to increase the use and availability of accurate data to assist planners in making the most informed decisions. Table 4.3.9-4 below displays the summary of landslide events in southwestern Pennsylvania, with the majority of instances taking place in Greene County. There has not been a more recent update.

Table 4.3.9-4 Landslides in Southwestern Pennsylvania (Southwestern Pennsylvania Commission, 2017)

COUNTY	NUMBER OF LANDSLIDES	ACRES LOST
Allegheny	578	850
Armstrong	235	457
Beaver	213	132
Butler	63	40
Fayette	14	24
Greene	1,379	2,556
Indiana	47	47
Lawrence	3	10
Washington	1,945	3,075
Westmoreland	88	131
Total:	**4,565**	**7,322**

4.3.9.4. Future Occurrence

Landslides are often triggered by periods of heavy rainfall or rapid snow thaw, and often worsen the effects of flooding. The expected increases in precipitation due to climate change, most

notably through extreme precipitation events, in the state could lead to a greater risk of landslides by saturating soils and increasing instability.

Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, and developed hillsides where leach-field septic systems are used. Considering frequent landslide events have occurred throughout the southwestern region of Pennsylvania, future occurrences can be expected in those same areas. Areas that are typically considered safe from landslides include areas that have not moved in the past, relatively flat-lying areas without sudden changes in slope, and areas at the top or along ridges, set back from the tops of slopes. As residential and recreational development increases on and near steep mountain slopes, the hazards from these rapid events will also increase.

Using Figure 4.3.9-1, it is evident that the probability of future occurrence of landslide events varies depending on location. Additionally, of the events that do occur, the size and impact of those events also varies. The occurrence of landslide events ranges from low in southeastern and northwestern Pennsylvania to high in southwestern Pennsylvania. Studies investigating the probability of future occurrence of landslide events have not been identified. Based on historical events, knowledge of the topography of the Commonwealth, and input from the SPT, the annual occurrence of a landslide event of any magnitude is considered *highly likely* as defined by the Risk Factor Methodology (see Section 4.1). While landslides will continue to occur across Pennsylvania, the damage and magnitude of the events will continue to vary widely.

There is work and discussions ongoing for ways to mitigate these issues, specifically in Allegheny County and the Pittsburgh area. A project to stabilize Mount Washington is in the design stages, with three sites identified. Conversations with FEMA have been held to discuss grant funding to support evacuation planning for landslides as well. Additionally, a case study on Route 30 and GIS coordination group at the state level have been discussed.

Also, the University of Pittsburgh and its Consortium for Impactful Resilient Infrastructure Science and Engineering (IRISE) hosted a workshop in November 2019 to address approaches to managing landslide risks. There were participants from academia and both the public and private sector. It was broken into four sessions: Historical Perspective & Identification, Prediction, Remediation, and Prioritization, Managing Risk, and a Future Needs Panel Discussion. Collaboration such as this will help develop greater understanding and capacity to address landslide risks in the future.

4.3.9.5. State Facility Vulnerability Assessment and Loss Estimation

The vulnerability of state-owned or leased facilities and critical facilities to landslide was evaluated by identifying facilities located in areas classified as *high incidence* (more than 15% of the land involved in landslides) or *high susceptibility* by USGS (Figure 4.3.9-1). Note that the vulnerability of individual state facilities will depend on many different site-specific characteristics, including local topography and soil type. For example, facilities located on steep slopes or built on loose soils are more likely to experience landslides. Additionally, facilities located in valleys are more likely to be buried by debris flow from upslope. The results of this

assessment represent the potential impacts to state assets based on regional landslide incidence and susceptibility, but do not account for these site-specific factors.

Of the 4,460 geolocated state facilities, 2,183, or 49 percent, are located in areas characterized by high landslide hazard (Table 4.3.9-5). More than 78 percent of these vulnerable facilities belong to just three entities: PennDOT, Department of Corrections, and the Pennsylvania State System of Higher Education. The state facilities vulnerable to landslide hazard have a combined replacement value of more than $1.1 billion, or approximately 29% of the known value of geolocated state facilities. A total of 1,338 of the 2,183 total vulnerable facilities are reported to be owned by the state. Of all the state owned or leased facilities, a total of 13.61 million reported square feet of building space is found to be vulnerable.

Table 4.3.9-5 Vulnerability of State Facilities to Landslide

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT AR E OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	4	44%	0	64,855
Department of Agriculture	3	19%	1	67,228
Department of Banking and Securities		0%		
Department of Community and Economic Development	2	50%	0	3,214
Department of Conservation and Natural Resources		0%		
Department of Corrections	408	59%	399	6,631,711
Department of Education		0%		
Department of Environmental Protection	7	54%	1	172,146
Department of General Services	10	8%	6	1,546,000
Department of Health	23	48%	0	56,630
Department of Labor and Industry	30	43%	8	837,931
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	44	45%	0	671,737
Department of Revenue	3	30%	0	16,531
Department of Transportation	925	55%	844	2,047,835
Drug and Alcohol Programs		0%		
Emergency Management Agency	8	100%	8	109,430
Executive Offices	2	100%	0	39,265
Fish and Boat Commission	71	46%	70	150,275
Governor's Office	1	100%	0	535
Historical and Museum Commission	10	33%	1	1,500
Insurance Department		0%		

Table 4.3.9-5 Vulnerability of State Facilities to Landslide				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT AR E OWNED	TOTAL REPORTED SQUARE FOOTAGE
Liquor Control Board	236	43%	0	996,767
Public School Employees' Retirement System	3	50%	0	7,173
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System	1	25%	0	2,318
State Police	17	47%	0	184,208
State System of Higher Education	373	44%		
Thaddeus Stevens College of Technology		0%		
Treasury Department	2	100%	0	7,483
Total	**2,183**	**49%**	**1,338**	**13,614,772**

Of the 13,448 geolocated critical facilities, a total of 6,021, or 45 percent of the total, were identified as vulnerable to landslide hazard (Table 4.3.9-6). Dams, public schools, and fire stations were identified as having the highest numbers of vulnerable structures, with 712, 1,729 and 1,353 vulnerable structures, respectively. Water facilities were identified as having the highest percentage of total structures vulnerable to landslide, with 54 percent of all structures in high hazard areas. The critical facilities vulnerable to landslide hazard have a combined replacement value of more than $199 billion, or approximately 50 percent of the known value of geolocated critical facilities.

Table 4.3.9-6 Vulnerability of Critical Facilities to Landslide		
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	99	36%
Banking	1	25%
Commercial	5	24%
Communication	272	49%
Dams	712	48%
Education (colleges and universities)	156	39%
Education (public schools)	1,729	37%
Emergency Operation Centers	34	48%
Energy	190	52%
Fire Stations	1,353	52%
Government	5	20%

Table 4.3.9-6 Vulnerability of Critical Facilities to Landslide		
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Hospitals	123	40%
National Monuments or Icons	1	17%
Nuclear	2	40%
Police Stations	636	49%
Transportation	358	53%
Water	345	54%
Total	**6,021**	**45%**

4.3.9.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to landslide hazard, all census tracts with centers located in areas classified by the USGS as *high incidence* or *high susceptibility* were identified. The population, building counts, and building value of all vulnerable census tracts were then aggregated to the county scale (Table 4.3.9-7). As noted above, landslides are a highly localized hazard and the estimates presented here are general estimates based on broad regional conditions. In addition, the vulnerability of people and buildings to landslide hazard is shaped by local land development regulations and permitting and enforcement processes. Municipalities that adopt and enforce subdivision and land development regulations to limit development in landslide-prone areas can significantly reduce vulnerability to landslides. The results of this assessment represent the potential impacts to buildings and people based on regional landslide incidence and susceptibility, but do not account for these site-specific and municipality-specific factors.

The counties with the largest numbers of vulnerable people and buildings are Allegheny, Westmoreland, and Luzerne Counties. Across the state, the total exposed building value for buildings located in high hazard census tracts is more than $946 billion, which represents about 35 percent of the total building value in Pennsylvania.

Table 4.3.9-7 Vulnerability of People and Buildings to Landslide by County.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSANDS $)	% OF TOTAL BUILDING VALUE
Adams	21,456	9,828	3,856,534	19%
Allegheny	1,249,907	517,299	262,225,147	100%
Armstrong	65,530	34,121	12,446,068	100%
Beaver	168,155	74,647	34,155,970	100%
Bedford	33,902	20,618	8,627,747	71%
Berks	786	347	126,512	0%
Blair	47,581	22,525	12,078,847	44%
Bradford				0%
Bucks				0%

Table 4.3.9-7 Vulnerability of People and Buildings to Landslide by County.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSANDS $)	% OF TOTAL BUILDING VALUE
Butler	193,593	78,114	45,408,133	100%
Cambria	133,467	67,698	33,263,669	100%
Cameron	74	61	22,193	2%
Carbon	45,760	21,539	7,468,975	66%
Centre	146,022	46,486	28,644,390	94%
Chester				0%
Clarion	37,191	20,673	8,205,840	100%
Clearfield	80,509	34,194	16,568,610	100%
Clinton	6,651	3,218	1,070,449	17%
Columbia	52,121	21,991	10,550,216	83%
Crawford				0%
Cumberland	29,287	12,264	5,061,268	9%
Dauphin	73,321	32,907	17,122,610	27%
Delaware				0%
Elk	30,871	19,829	8,257,691	99%
Erie				0%
Fayette	128,758	68,169	24,764,847	100%
Forest	6,267	5,708	1,750,433	86%
Franklin	22,826	12,685	4,966,220	16%
Fulton	14,556	9,993	4,575,717	100%
Greene	35,887	17,638	9,452,108	100%
Huntingdon	44,088	20,959	7,959,176	100%
Indiana	83,148	38,631	16,650,945	100%
Jefferson	44,472	28,330	8,093,150	100%
Juniata	23,482	11,888	4,341,292	100%
Lackawanna	155,352	56,643	28,738,272	63%
Lancaster				0%
Lawrence	29,489	14,153	5,019,442	34%
Lebanon	3,073	1,710	991,053	3%
Lehigh	2,579	1,251	535,934	1%
Luzerne	254,208	99,192	44,865,047	79%
Lycoming	14,494	6,238	2,633,070	12%
McKean	6,061	3,674	1,475,420	17%
Mercer	15,043	6,151	3,821,721	14%
Mifflin	46,143	22,882	9,250,718	100%
Monroe	86,077	33,738	17,966,198	48%
Montgomery				0%
Montour	12,047	4,831	2,432,540	73%

Table 4.3.9-7 Vulnerability of People and Buildings to Landslide by County.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSANDS $)	% OF TOTAL BUILDING VALUE
Northampton	4,322	1,788	563,764	1%
Northumberland	86,365	37,323	19,727,815	95%
Perry	45,809	22,217	8,263,642	100%
Philadelphia				0%
Pike	18,238	10,990	4,524,857	27%
Potter				0%
Schuylkill	138,698	66,765	28,386,390	96%
Snyder	39,723	15,403	8,691,215	100%
Somerset	72,878	43,171	22,426,138	97%
Sullivan				0%
Susquehanna	1,836	774	353,228	3%
Tioga				0%
Union	42,200	13,153	6,812,084	99%
Venango	9,963	6,683	2,186,864	22%
Warren	621	614	116,168	2%
Washington	209,274	99,395	45,713,731	100%
Wayne	10,147	4,101	1,581,798	13%
Westmoreland	354,424	170,039	80,296,372	100%
Wyoming				0%
York	8,983	3,363	1,427,710	2%
TOTAL	**4,487,715**	**1,998,602**	**946,515,948**	**35%**

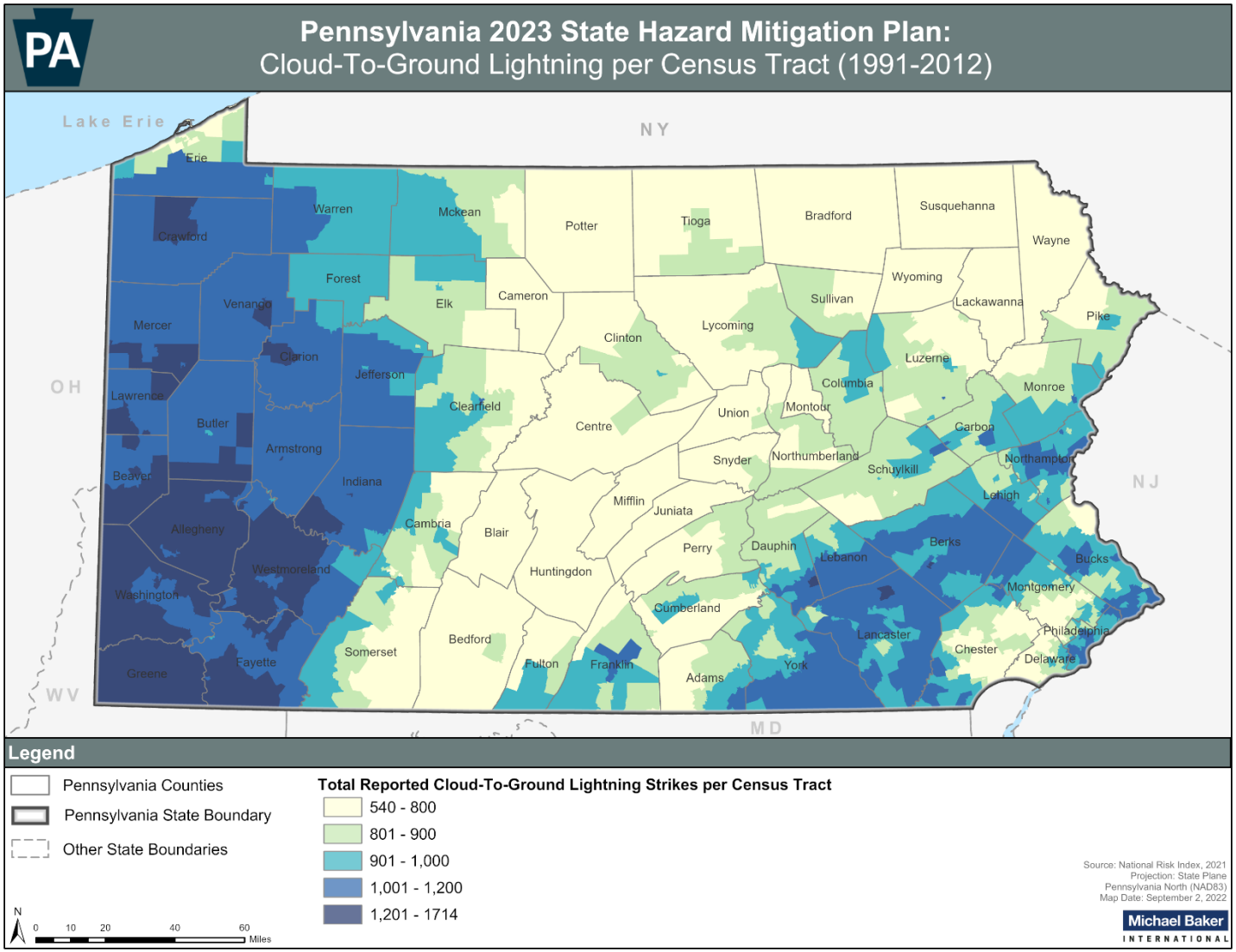
4.3.10. Lightning Strike

4.3.10.1. Location and Extent

Lightning events occur across the entire Commonwealth. Although different areas experience varying event frequencies, lightning strikes occur primarily during the summer months. While the impact of flash events is highly localized, strong storms can result in numerous widespread events over a broad area. Further, lightning often strikes outside the area of heavy rain and may strike as far as ten miles from any rainfall. In addition, the impacts of an event can be serious or widespread if lightning strikes a particularly significant location such as a power station or large public venue (NOAA NWS, 2022c).

Figure 4.3.10-1 below illustrates the density of cloud-to-ground lightning strikes by Census Tract based on flashes that occurred between 1991 and 2012. The data was obtained from FEMA's National Risk Index in 2021. The map indicates that relatively more lightning flashes occur in southwestern Pennsylvania and in some areas throughout the greater Lancaster region. Eastern and southeastern Pennsylvania are at greater risk for death, injury, or damage to lightning than central and north-central sections of the Commonwealth due to higher population density.

Figure 4.3.10-1 Cloud-to-Ground Lightning Strikes by Census Tract, 1991-2012 (National Risk Index, 2021).



4.3.10.2. Range of Magnitude

Each year in the United States, lightning is responsible for an average of 47 deaths, injuries to hundreds more, and millions of dollars in property damage (NOAA NWS, 2018a). In many cases, lightning events have caused heart damage, but inflated lungs and brain damage have also been observed. Loss of consciousness, amnesia, paralysis, and burns are reported by many who have survived. In addition to the health risks for people, deaths and injuries to animals, thousands of forest and brush fires, as well as millions of dollars in damage to buildings, communications systems, power lines, and electrical systems are also the result of lightning.

Between 1959 and 2022, Pennsylvania had 139 total lightning deaths. This is the ninth highest number of total lightning deaths among all states. It represents approximately 3% of all lightning deaths that occurred throughout the U.S. over that 57-year period. However, when considering population density, Pennsylvania ranked 38th among all states in terms of lightning deaths per year (Vaisala, 2017).

A worst-case lightning event would be lightning striking in a large crowd or gathering of people as might be found at a large sporting event or outdoor concert. This could result in mass deaths or injuries.

Depending on what the lightning hits, that lifeline sector may be hit the hardest. Depending on how that sector responds, that impacts recovery and mitigation via casual, cascading, and compounding impacts.

Table 4.3.10-1 Most Likely Lifelines Impacted by Lightning Strike		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and compounding impacts where community safety may be threatened due to potential harm from lightning and associated weather conditions or wildfires. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the dangers and best safety precautions.
Energy		Anticipating a causal relationship for the Energy lifeline in response and recovery. Lightning strikes may cause significant damage to electrical utilities and cause outages. Mitigation may look like installing lightning protection devices and methods near critical infrastructure points.
Communications		Anticipating a causal and cascading relationship for the Communications lifeline in response and recovery due to potential damage to communications infrastructure and the impact for emergency response. Protecting critical communication infrastructure through surge protection and other methods installed on communications infrastructure would be a way to mitigate these impacts.

Lightning strikes have the potential to impact FEMA Community Lifelines related to public safety and energy production. As covered above, lightning can directly lead to serious injuries and death along with the potential to start fires. These fires can lead to cascading impacts on housing and agriculture. Both energy and communications infrastructure and aerial transportation are particularly susceptible to lightning strikes.

Lightning strikes may be directly responsible for wildfire, urban fire/explosion, and utility interruption hazards.

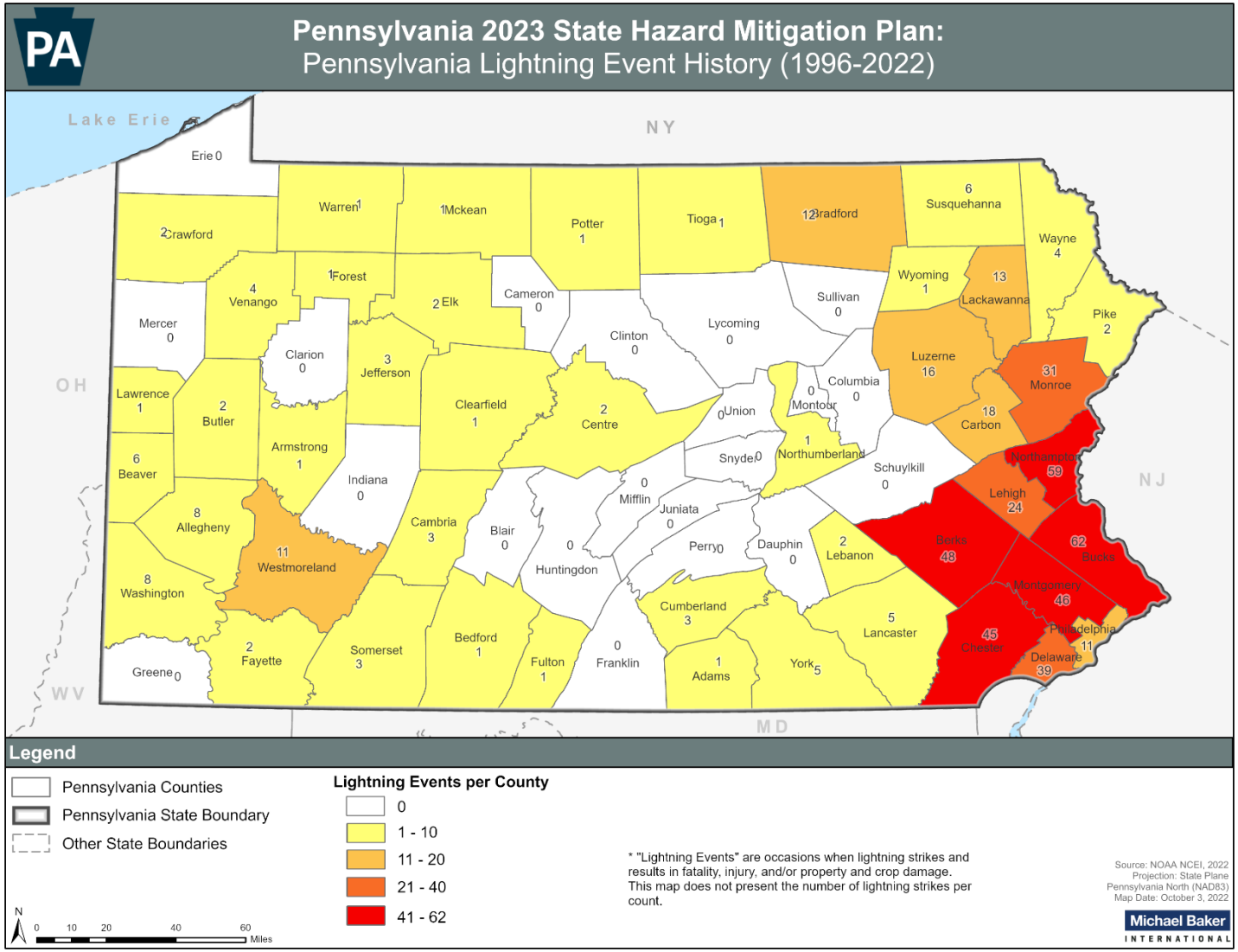
4.3.10.3. Past Occurrence

Records from the National Centers for Environmental Information (NCEI) (formerly the National Climatic Data Center) show that there were 520 lightning events in the 67 counties across Pennsylvania between 1996 and 2022. A lightning “event” is defined as a sudden electrical discharge from a thunderstorm that results in fatality, injury, and/or property or crop damage (NOAA NWS, 2021). The NCEI storm events database starting tracking lightning events in 1996. Of these 67 counites, 21 have reported no events, 32 counties reported 1 to 10 events, 7 counties reported 11 to 29 events, and 7 counties have reported 30 or more events over the 27-year period. Bucks and Northampton Counties have both reported the most events with 62 and

59 events, respectively (see Figure 4.3.10-2). The counties with the most events are located in the southeast of the state, most likely due to the density of development with more structures that may attract strikes and then be registered in the database. Evaluation of previous versions of the SHMP show that while the absolute number of events have changed for individual counties, the basic pattern of vulnerability across the Commonwealth has remained relatively consistent. The recording of lightning events is highly subjective and therefore lightning vulnerability is clearly epistemic.

During the years from 1996 to 2022, the NCEI reports that, in Pennsylvania, lightning has caused 25 deaths and 211 injuries. There has been $17,083,540 of property damage done, along with $300,000 of crop damage. The highest reported loss in property damage ever occurred in Braddock Borough, Allegheny County in 1995 when lightning caused $5 million dollars in damage after striking a deodorizer manufacturing plant. The subsequent fire completely engulfed and destroyed the entire facility.

Figure 4.3.10-2 Pennsylvania Lightning Event History, 1996-2022 (NCEI, 2022).



4.3.10.4. Future Occurrence

Figure 4.3.10-1 shows the frequency of cloud-to-ground lightning flashes in Pennsylvania between 1991 and 2012. While the map should not be used to predict future lightning activity, it provides a basic estimate of the number of lightning strikes that can be expected. As shown, in Pennsylvania, these values range from 540 to 1,714 lightning strikes within a census tract during this 22-year period.

It is worth noting that, while lightning flashes appear to be more frequent in western Pennsylvania, lightning strike events which result in damage, injury, or death, as shown in Figure 4.3.10-2, appear to be more common in southeastern Pennsylvania. This is due to denser populations with an increased number of associated properties or structures in these areas.

The number of lightning events are influenced by the frequency of thunderstorms. Therefore, potential future changes in climate and weather conditions may impact the future occurrences of lightning strikes. According to the Pennsylvania Climate Impacts Assessment Update, thunderstorms are projected to increase in frequency (Shortle et al, 2015). However, the future occurrence of lightning activity is not forecasted as lightning strikes are frequent and widespread and forecasters' understanding of the cloud electrification process is incomplete (NOAA NSSL, 2018).

4.3.10.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to lightning, all said facilities located in areas characterized as high risk were identified. High-risk areas are those where the maximum number of reported lightning strikes was greater than 1,200 between 1991 and 2012. These areas were then intersected with state-owned or leased facilities and critical facilities. However, it should be noted that the precise vulnerability of lightning strikes will depend on a facility's height, surrounding buildings, as well as the absence or presence of a lightning rod or other lightning channeling technology in the structure.

As provided in Table 4.3.10-2, 488 state-owned or leased facilities were identified in areas at high risk to lightning, the highest concentration of which are structures owned or leased by the Department of Transportation. The Liquor Control Board similarly has a large number of facilities identified as vulnerable. The replacement value of the 488 total vulnerable facilities is estimated to be more than $278 million, or seven percent of the value of all state-owned or leased facilities. The total reported square footage of building space is over 4.8 million, with 333 of the 488 vulnerable facilities reported to be owned by the state.

Table 4.3.10-2 Vulnerability of State Facilities to Lighting.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF DEPARTMENT STRUCTURES	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	2	22%	0	49,724
Department of Agriculture	1	6%	0	2,975

Table 4.3.10-2 Vulnerability of State Facilities to Lighting.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF DEPARTMENT STRUCTURES	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Department of Banking and Securities		0%		
Department of Community and Economic Development		0%		
Department of Conservation and Natural		0%		
Department of Corrections	119	17%	114	1,958,041
Department of Education		0%		
Department of Environmental Protection	1	8%	0	33,090
Department of General Services	8	6%	5	1,371,839
Department of Health	5	10%	0	15,214
Department of Labor and Industry	3	4%	0	124,695
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	11	11%	0	217,451
Department of Revenue	2	20%	0	11,350
Department of Transportation	221	13%	214	425,371
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices	1	50%	0	11,282
Fish and Boat Commission		0%		
Governor's Office		0%		
Historical and Museum Commission	1	3%	0	0
Insurance Department		0%		
Liquor Control Board	105	19%	0	546,349
Public School Employees' Retirement System	1	17%	0	2,631
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System		0%		
State Police	4	11%	0	49,637
State System of Higher Education	2	0%		
Thaddeus Stevens College of Technology		0%		
Treasury Department	1	50%	0	2,183
Total	**488**	**11%**	**333**	**4,821,832**

With respect to critical facilities, the types of facilities most vulnerable to lightning strikes include fire departments, schools, police departments, and dams (Table 4.3.10-3). Any of the 29 food

and agriculture facilities that raise livestock may be more vulnerable to lightning strikes as these animals tend to shelter under trees in storm situations. Should lightning strike the tree, it could kill all the animals under it at once. Additionally, one nuclear facility was identified as at-risk, which represents 20 percent of all structures for that facility type.

Table 4.3.10-3 Vulnerability of Critical Facilities to Lightning.

TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF STRUCTURES BY TYPE
Agricultural	29	11%
Banking	1	25%
Commercial	5	24%
Communication	68	12%
Dam	223	15%
Education (colleges and universities)	66	17%
Education (public schools)	629	13%
Emergency Operation Center	5	7%
Energy	46	13%
Fire Station	456	17%
Government	2	8%
Hospital	53	17%
National Monument or Icon		0%
Nuclear	1	20%
Police Station	213	16%
Transportation	220	32%
Water	98	15%
Total	**2,115**	**16%**

A total of 2,115 critical facilities were identified in areas at high risk to lightning. The total replacement cost of these critical facilities is estimated to be more than $65.5 billion, or nearly 17 percent of the total value of all critical facilities in the Commonwealth. Note that losses due to lightning strikes will differ based on the magnitude of the event and the lightning protection measures on a given facility.

4.3.10.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To determine jurisdictional vulnerability to lightning strikes, GIS analysis was conducted to identify all Census Tracts located within areas characterized as high risk to lightning. As previously defined, high-risk areas are those where the maximum number of reported lightning flashes was greater than 1,200 between 1991 and 2012. The total population and buildings within these Census Tracts were summed by County to determine the total vulnerable population and the total number and value of vulnerable buildings. Table 4.3.10-4 shows the results of this assessment.

Table 4.3.10-4 Vulnerability of People And Buildings to Lightning.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Adams				0%
Allegheny	1,205,972	497,476	253,279,266	97%
Armstrong	2,797	1,414	528,947	4%
Beaver	86,214	39,004	16,988,434	50%
Bedford				0%
Berks	9,554	3,820	1,455,114	2%
Blair				0%
Bradford				0%
Bucks				0%
Butler	82,595	30,137	20,801,867	46%
Cambria				0%
Cameron				0%
Carbon				0%
Centre				0%
Chester				0%
Clarion	3,822	1,995	798,966	10%
Clearfield				0%
Clinton				0%
Columbia				0%
Crawford	14,883	7,086	3,702,367	15%
Cumberland				0%
Dauphin	4,417	1,235	770,831	1%
Delaware				0%
Elk				0%
Erie				0%
Fayette	57,950	30,053	10,653,664	43%
Forest				0%
Franklin				0%
Fulton				0%
Greene	35,904	17,643	9,453,141	100%
Huntingdon				0%
Indiana	10,257	5,204	1,979,925	12%
Jefferson				0%
Juniata				0%
Lackawanna				0%
Lancaster	6,002	2,544	1,168,771	1%
Lawrence	18,362	8,948	3,042,662	21%

Table 4.3.10-4 Vulnerability of People And Buildings to Lightning.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Lebanon				0%
Lehigh				0%
Luzerne				0%
Lycoming				0%
McKean				0%
Mercer	37,492	17,684	9,290,816	33%
Mifflin				0%
Monroe				0%
Montgomery				0%
Montour				0%
Northampton	2,122	867	502,975	1%
Northumberland				0%
Perry				0%
Philadelphia				0%
Pike				0%
Potter				0%
Schuylkill				0%
Snyder				0%
Somerset				0%
Sullivan				0%
Susquehanna				0%
Tioga				0%
Union				0%
Venango	2,795	1,359	463,638	5%
Warren				0%
Washington	127,586	61,540	27,987,167	61%
Wayne				0%
Westmoreland	265,528	125,361	60,468,863	75%
Wyoming				0%
York				0%
Total	**1,974,252**	**853,370**	**423,337,414**	**16%**

A total of 30 counties were identified as including census tracts characterized by high lightning hazard. The assessment found that 1,974,252 people and more than 853,000 buildings are located in these high-risk census tracts. The largest concentrations of vulnerable population and buildings are in Allegheny and Westmoreland Counties, which include urban and suburban areas with high population and structure densities.

The total value of all vulnerable buildings in all high-risk areas is estimated to be $423 billion, which is 16 percent of the total value of all buildings in the Commonwealth. The jurisdiction most threatened by lightning strikes in terms of the dollar value of loss is Allegheny County, with an estimated $253 billion in exposed building value, representing about 97% of the building value in the county.

Losses due to lightning can be lessened by installing surge protection on critical electronic lighting or information technology systems. Lightning protection devices and methods such as lightning rods and grounding can be installed on a community's communications infrastructure and other critical facilities to reduce losses.

4.3.11. Pandemic, Emerging, Zoonotic, and Infectious Disease

4.3.11.1. Location and Extent

This section pertains to a number of different diseases, viruses, bacteria, parasites, and fungi that can be transmitted through a variety of means (animals to people, people to people), and highlights emerging and increasing risks. While it's called Pandemic and Infectious Disease, it incorporates pandemics, emerging, zoonotic, and infectious diseases as different agencies reference different components therein. For the purposes of this plan, pandemic is defined as a disease outbreak affecting or attacking a large number of people across an extensive region, including several countries, and/or continent(s). It is further described as extensively epidemic. Generally, pandemic diseases cause sudden, pervasive illness in all age groups on a global scale (USDHS, 2022). Infectious diseases are also highly virulent and can be spread from person-to-person. Zoonotic diseases are those that occur when bacteria are passed from animals to humans (CDC, 2021a).

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 water (Van Seventer & Hochberg, 2017).

Historically, the Commonwealth is primarily concerned with three diseases with pandemic and infectious potential: Zika virus, West Nile virus, and influenza. Zika virus is an illness that is spread primarily through mosquito bites but can also be transmitted through sexual intercourse or blood transfusion or passed from mother to child in the womb. The virus first became a public health concern after the 2015 outbreak in Brazil. Zika infection during pregnancy can cause serious birth defects, including microcephaly and other severe brain defects. In addition, Zika infection may be linked to an increased incidence of Guillain-Barre syndrome – a relatively uncommon neurological disease (CDC, 2019a).

West Nile virus is a zoonotic, vector-borne disease that can cause headache, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and, in its most serious form, death. This virus is spread via mosquito bite and is therefore aided by warm temperatures and wet climates conducive to mosquito breeding. It may also be spread between humans. West Nile virus has been detected in all 67 counties at least once in the past 10 years.

The virus is highly temporal with most cases occurring between April and October (PA DEP, 2022e).

Pandemic influenza 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 (Knobler, Mack, Mahmoud, et al, 2005). In 2009, H1N1 (swine) flu broke out into pandemic proportions, but now has been reduced to a regular human flu virus that circulates each season (CDC, 2010). According to the federal government's Pandemic Influenza Plan 2017 Update, "pandemic influenza viruses can originate anywhere, vary in severity and population penetration, and each pandemic will differ in its range and impact" (USDHHS, 2017).

Influenza, also known as the flu, is a contagious disease that is caused by the influenza virus and most commonly attacks the respiratory tract in humans. Influenza is considered to have pandemic potential if it is novel, meaning that people have no immunity to it, virulent, meaning that is causes deaths in normally healthy individuals, and easily transmittable from person-to-person. Different strands of influenza mutate over time and replace older strands of the virus and thus have drastically different effects. The 2017 update of the U.S. Department of Health and Human Services' Influenza Pandemic Plan included the potential impact of moderate, severe, and very severe influenza pandemics across the country. These estimates are shown in Table 4.3.11-1.

Table 4.3.11-1 Estimated Illness, Types of Medical Care, and Deaths from a Moderate to Very Severe Influenza Pandemic (USDHHS, 2017)

PANDEMIC SEVERITY (BASED ON MULTIPLE FACTORS)	PERCENT OF US POPULATION WITH CLINICAL ILLNESS	ILLNESS	OUTPATIENT MEDICAL CARE	HOSPITALI-ZATION	ICU CARE	DEATHS
Moderate	20%	64,000,000	32,000,000	800,000	160,000	48,000
	30%	96,000,000	48,000,000	1,200,000	240,000	72,000
Severe	20%	64,000,000	32,000,000	3,800,000	1,200,000	510,000
	30%	96,000,000	48,000,000	5,800,000	1,700,000	770,000
Very Severe	20%	64,000,000	32,000,000	7,700,000	2,300,000	1,300,000
	30%	96,000,000	48,000,000	11,500,000	3,500,000	1,930,000

In late 2019 and early 2020, a novel coronavirus spread into a worldwide pandemic. Named COVID-19, this type of coronavirus is a new virus that causes respiratory illness and is extremely contagious even prior to exhibiting symptoms or if the infected person is asymptomatic and can be fatal. The virus is believed to have originated in the Wuhan province

of China, quickly spreading to nearby countries in late 2019 and the whole world by March 2020. Flu like in nature, symptoms of COVID-19 virus include fever, cough, shortness of breath, and diarrhea. In extreme COVID-19 cases that require hospitalization, patients require ventilators to support breathing and may pass away from the virus or related reasons (CDC, 2022a).

Ticks are also potential vectors for zoonotic diseases, including Lyme disease. Lyme disease symptoms include a rash that gets bigger over time, which can look either like a bull's eye or a round or oval shape darker than your skin tone. It is possible to contract Lyme disease and not develop a rash. Additional symptoms include fever, headache, body aches, swollen joints and tingling in hands and feet. Lyme disease can be treated with antibiotics. Pennsylvania had the most Lyme disease cases in the country each year between 2009 and 2020, except for 2012 when Massachusetts had 95 more. Pennsylvania had three years (2016-2018) in that timeframe with over 10,000 cases each; no other state had a year over 5,500 (CDC, 2022b).

Lyme disease isn't the only tickborne disease or virus that ticks can transmit to humans, and there are others that can be more dangerous. The following list contains additional tickborne diseases and their symptoms (PA DOH, n.d.a):

- Anaplasmosis – A disease transmitted by deer ticks, may cause fever, chills, headache, muscle aches, nausea, and abdominal pain. It can be treated with antibiotics.
- Babesiosis – A disease caused by a parasite transmitted by deer ticks, may cause fever, chills, sweats, headaches, achy joints, fatigue, nausea, and abdominal pain. It can be treated with antiparasitic medications.
- Powassan Virus – A rare virus transmitted by deer ticks that causes headache, fever, vomiting, and weakness. Cases can be severe and even life threatening, with supportive care as the only treatment.
- Enrlichiosis – A bacterial disease transmitted by lone star ticks, may cause headaches, fever, chills, muscle aches, nausea, diarrhea, confusion, and a rash. It can be treated with antibiotics.
- Rocky Mountain Spotted Fever (RMSF) – A bacterial disease transmitted by dog ticks, may cause headache fever, rash, nausea, and muscle pain. Cases can become severe and life threatening but can be treated with antibiotics.

4.3.11.2. Range of Magnitude

The magnitude of a pandemic or infectious disease threat in the Commonwealth will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. In the case of West Nile virus, slightly less than 80 percent of cases are clinically asymptomatic. Approximately 20 percent of cases result in mild infection, called West Nile fever, lasting two to seven days. However, one in 150 cases result in severe neurological disease or death. Since the appearance of West Nile virus in Pennsylvania in 2000, the worst year was 2003 when 237 Pennsylvanians were infected with the virus and 9 people died. The virus is typically more serious in older adults (PA DEP, 2022e).

Pandemic influenza is more easily transmitted from person-to-person than West Nile, but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time (Doshi, 2008). The magnitude of a pandemic may be exacerbated by the fact that an influenza pandemic will cause outbreaks across the United States, limiting the ability to transfer assistance from one jurisdiction to another. Additionally, effective preventative and therapeutic measures, including vaccines and other medications, will likely be in short supply or will not be available (USDHHS, 2017).

The 1918 Spanish flu pandemic remains the worst-case pandemic event on record both in Pennsylvania and worldwide. While mortality figures were probably under-reported, in the first month of the pandemic alone, 8,000 Pennsylvanians died from the flu or its complications (CDC, 2019b). As the densest city in the Commonwealth, Philadelphia experienced particularly high losses from this event.

First reaching the commonwealth in March 2020, COVID-19 is still impacting populations in Pennsylvania at the time of this plan development. This virus quickly became a great concern in early months of the pandemic due to its high rates of transmission, and high incidence of mortality in addition to so little being known about it. The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Most people infected with COVID-19 will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness (PA DOH, 2023a). Some people who have been infected with COVID-19 can experience long-term effects from the infection, known as post-COVID conditions (PCC) or long COVID. PCCs can include a wide range of ongoing health problems that can last weeks, months, or years. Some general symptoms of PCC can include ongoing fatigue, symptoms that get worse with physical or mental activity, fever, difficulty breathing, chest pain, heart palpitations, headache, dizziness, diarrhea, and joint or muscle pain. These are more often found in people who had severe COVID-19 illness, but anyone who has been infected with COVID-19 can experience PCCs. Those not vaccinated and who become infected may have a higher risk of developing PCCs, compared to people previously vaccinated. In some cases, a person with PCCs may not have tested positive for the virus or known they were infected (CDC, 2022c).

Viruses like COVID-19 constantly change through mutation, which sometimes result in a new variant of the virus. Some changes and mutations may allow the virus to spread more easily or make it resistant to treatments and vaccines. It is essential to track and monitor the incidence of variants during a pandemic to effectively respond to changing trends in transmission and patient care (CDC, 2023b). Variants are designated as:

- Variant Being Monitored (VBM): Variants where data indicates there is a potential or clear impact on approved or authorized medical countermeasures or that have been associated with more severe disease or increased transmission but are no longer detected, or are circulating at very low levels in the United States.
- Variant of Interest (VOI): A variant with specific genetic markers that have been associated with changes to receptor binding, reduced neutralization by antibodies

generated against previous infection or vaccination, reduced efficacy of treatments, potentially diagnostic impact, or predicated increase in transmissibility or disease severity.

- Variant of Concern (VOC): A variant for which there is evidence of an increase in transmissibility, more severe disease (for example, increased hospitalizations or deaths), significant reduction in neutralizations by antibodies generated during previous infection or vaccination, reduced effectiveness of treatments or vaccines, or diagnostics detection failures.

Variants can have multiple lineages or groups of lineages in which there are further mutations in the genetic code. As of February 2022, the CDC was tracking 11 VBMs and one VOC related to COVID-19. Several changes have been made to SARS-CoV-2 variant classifications as their transmission rates increase or decrease. On November 30, 2021, the Omicron variant of SARS-Cov-2 was classified as a VOC. On April 14, 2022, the Delta variant was downgraded from a VOC to a VBM (CDC, 2023c).

There are several actions individuals and communities can take to reduce transmission of COVID-19 and reduce risk for severe illness from the virus. Personal Protective Equipment (PPE) such as N95 face masks can reduce spread by protecting the wearer from airborne particles; source control measures such as cloth facemasks reduce spread by providing a barrier that prevents large respiratory droplets from traveling onto others (CDC, 2020). Both disposable and reusable options of masks are available. When there were shortages of PPE at the beginning of the pandemic, communities shifting to reusable cloth masks helped save limited resources for hospitals and care centers (CDC, 2022d).

People infected with the COVID-19 virus can isolate themselves to prevent spreading the virus to others. Those with symptoms are recommended to isolate themselves for a minimum of five days and should remain in isolation until the individual is fever-free for 24 hours and symptoms are improving (CDC, 2022e).

Contact tracing is a practice that can help reduce the spread of infectious disease. Someone who tests positive for COVID-19 identifies people they have been in close contact with recently to the contact tracer. The contact tracer then takes the time to reach out to each identified person to notify them that they may have been exposed to COVID-19. They can refer individuals to different support services as needed, with the primary goal to get the individual tested for COVID-19 and following isolation guidelines to stop the spread (CDC, 2022f). Many communities employed contact tracers through public health departments, medical facilities, or non-profit organizations.

Mass quarantine orders were enacted at the beginning of the COVID-19 pandemic to reduce wide-spread transmission of the virus. Governor Tom Wolf issued the first stay-at-home order for Pennsylvania on March 23, 2020, for seven counties which was then expanded to all 67 counties in the Commonwealth on April 1st. Schools were moved to virtual settings, non-essential businesses were closed, and all essential state services were continued operation (Governor Tom Wolf, 2020). People were advised to practice social distancing; only leaving the

house for essentials like grocery shopping, and no gathering even in small groups. Even when going on walks, health care professionals recommended that individuals wear masks and remain six feet apart to slow the spread of transmission. On May 31, 2021, the stay-at-home order and any other mitigation order except face mask wearing for the Commonwealth of Pennsylvania was lifted (Commonwealth of Pennsylvania, 2023).

There are four approved or authorized COVID-19 vaccines in the United States. Two are mRNA vaccines, one is a protein subunit vaccine, and one is a viral vector vaccine. People who are up to date on COVID-19 vaccines and boosters have lower risk of severe illness, hospitalization and death from COVID-19 than those who are unvaccinated or who have only received the primary series. Updated COVID-19 boosters can help restore protection that has decreased since previous vaccination. Updated COVID boosters provide added protection against the recent Omicron subvariants that are more contagious than the previous ones (CDC, 2022g).

There are different testing options to identify current infection with COVID-19. The two main types of tests are nucleic acid amplification tests (NAATs) and antigen tests. NAATs, such as PCR-based tests, are most often performed in a laboratory. They are typically the most reliable tests for people with or without symptoms. Antigen tests are rapid tests which product results in 15-30 minutes. They are less reliable than NAATs, especially for people who do not have symptoms. Antigen tests are also produced for at-home self-test options. This provides options for people to take a test without having to go to a specific testing site (CDC, 2022h). Testing for COVID-19 is essential for people to know if they should practice quarantine or isolation.

Treatments for COVID-19 are still being developed and tested; however, some antivirals in development have been authorized for emergency use before full certification through the FDA. Health compromised individuals, such as those with chronic health conditions that make it more likely to get very sick, can access these treatments to reduce chances of hospitalization and death. Treatment must be started within days after first developing symptoms to be effective. Many over the counter medications can help reduce symptoms in more mild cases (CDC, 2023d).

Strains on the public health system from COVID-19 impacted treatment options for non-COVID medical scenarios. For example, many hospitals put a hold on elective admissions, surgeries, and procedures while dealing with the highest peaks of COVID-19 patients. Hospitals in Pennsylvania are allowed to offer these services again; however, many individuals are still putting these procedures off due to fears of COVID-19 in medical facilities (PA DOH, 2022a).

The World Health Organization (WHO) reports that a great number of people have reported psychological distress and symptoms of depression, anxiety, or post-traumatic stress due to COVID-19. There are a variety of reasons for this. Extended school and university closures have left young people vulnerable to social isolation and disconnectedness. High volumes of health care workers are experiencing increased stress and anxiety as they are on the front lines of the pandemic. This is due to both strain on the healthcare system from increased needs and decreased capacity, and emotional strain from witnessing health impacts from COVID-19. The

Hospital and Healthsystem Association of Pennsylvania (HHAP) reported that health care workers took extended leaves of absence or left the workforce altogether due to these concerns and the difficulty of securing childcare (HHAP, 2021). While mental health needs have risen, mental health services have been severely disrupted. This was most difficult early on in the pandemic when staff and infrastructure were redeployed for COVID-19 relief (WHO, 2022a).

Since the onset of the COVID-19 pandemic, concerns have arisen surrounding the stockpiling of medical equipment such as PPE to ensure hospitals and other health care facilities are adequately prepared before and during similar events. There are ongoing discussions on how the best ways to move forward with developing these stockpiles. There are challenges for health care facilities to consistently maintain a 30-day supply of PPE, including the costs, space required, and potential need for increased security. Concerns were also raised about the delivery of critical medications to healthcare facilities. Open and Closed Point of Dispensing (POD) initiatives may be an additional consideration.

COVID-19 serves as a current day case study to the widespread impacts that a pandemic can have beyond changes to community health. Operations for all industry sectors globally were impacted by the pandemic. While this section focuses on impacts of COVID-19 to industry sectors in Pennsylvania, regional and global impacts to staffing and supply chains influenced the Commonwealth's response and recovery capabilities. Also note that responding to pandemic events can be made more challenging as other hazards arise, and vice versa. Specific examples of cascading impacts are included in the following discussion.

In 2021, the United Way for Pennsylvania conducted a survey among Pennsylvania residents to identify COVID-19 impacts one year into the pandemic (United Way, 2021). This survey was designed to gather information on impacts on socially vulnerable populations, which were identified as Asset Limited, Income Constrained, and Employed (ALICE) families. The report notes that nearly two million families in Pennsylvania are at or below the ALICE threshold, roughly 39% of the commonwealth's population. Key findings on major impacts from COVID-19 include:

- Widespread financial vulnerability and housing instability due to loss or change of jobs. This can impact those without prior savings much more dramatically.
- Difficulty accessing needed service such as childcare. This directly impacts the economy as people are unable to return to work without these services.
- Greatest impacts on those without internet or technology that allows them to tele-work, or take tele-health appointments, for example.

The most immediate impact to the economy was through widespread unemployment. When stay-at-home orders were issued, only essential workers were permitted to go to their job site for work. Where possible, many people shifted to tele-working, where they can perform their job functions at the home with computers and other technology. However, jobs that cannot be performed at one's home were shut down for several months to over a year. The unemployment rate in April 2020 jumped from 5.2% in March to 16.5%, the highest rate ever seen in Pennsylvania. The unemployment rate slowly decreased, returning to pre-COVID levels by

September 2021. By December 2022, the unemployment rate dropped below 4% (at 3.9%) for the first time since records have been kept for the Commonwealth (US BLS, 2023). This indicates that Pennsylvania's workforce is steadily recovering from COVID-19 challenges.

Staffing shortages have impacted most sectors in Pennsylvania. Larger portions of the work force need to call out of work to care for themselves or family members infected with COVID-19. Health compromised individuals may be unable to work. Shortages can cause major operational disruptions or delays. This issue was compounded in the health care sector, as employees on the front lines became ill and therefore exacerbated already existing workforce shortages. For example, transportation providers across the commonwealth reported having difficulty getting enough drivers to staff their service needs. This impacted all kinds of providers, including fixed-route providers, paratransit providers, and school bus drivers. Note that staffing shortages existing before COVID-19 were exacerbated throughout the pandemic.

Staffing shortages and disruptions in transportation systems caused a variety of supply chain delays throughout the COVID-19 pandemic. One major area is lumber (Helper & Soltas, 2021). Stakeholders in the housing and economic development sectors note that project costs are more difficult to estimate with lumber supply delays. The estimated cost today may be very different from the actual cost when the developer is able to purchase materials, and the materials are in stock. Delays and shortages in different goods and materials has impacted nearly every industry sector. Note that this challenge can make implementing mitigation actions for any hazard take longer and cost more than pre-COVID estimates.

Communities across the Commonwealth experienced a variety of COVID-19 related challenges in the housing sector. Loss of jobs and income caused housing instability for many populations. Pennsylvania administered emergency rental and mortgage payment assistance programs to help individuals cover housing costs during the most challenging months of the pandemic (PA DHS, 2023). As noted above, supply chain delays and shortages have made housing development more uncertain. This is a particular challenge when it comes to repairing or replacing units that were damaged or lost due to other hazards, such as flooding or winter storms. Stakeholders in Pennsylvania's housing sector reported that access to affordable housing has been made more difficult during COVID-19, partly due to these same cascading impacts. Staffing shortages, supply delays, and uncertain costs make it more difficult to develop affordable housing units, or replace affordable units lost to other hazards. Shortages in affordable housing prior to the start of the COVID-19 pandemic have only been worsened. Housing arrangements can also influence the risk level someone has to get infected with COVID-19. In June 2021, PEMA reported that roughly 21% of COVID-19 cases in Pennsylvania were located in Long Term Care Facilities. Individuals in assisted living facilities and group living quarters have a much higher risk to infection based on their proximity to larger numbers of people when trying to isolate.

Stakeholders in Pennsylvania note that absenteeism impacted the infrastructure sector due to shortages of workers for water-treatment plants. Cross-county and intra-state work share agreements to move available employees where needed during COVID helped to resolve this

issue. Challenges noted above related to difficulty implementing mitigation actions have impacted the infrastructure sector as well.

While COVID-19 or pandemic events do not cause environmental harm themselves, capacity in the environmental sector was similarly reduced. Several studies have found that the global socio-economic disruptions from the COVID-19 pandemic have directly and indirectly impacted community's abilities to implement projects that can improve environmental conditions such as air and water quality, reduction of noise, and restoration of ecology (Rume & Didar-Ul Islam, 2020).

Table 4.3.11-2 Most Likely Lifelines Impacted by Pandemic, Emerging, Zoonotic, and Infectious Diseases

Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and cascading impacts where community safety is threatened due to disease, with the administration of government services being negatively impacted because of widespread illness. Mitigation for this lifeline should be focused on developing response plans to ensure services are able to be administered even during potential staffing shortages or regulations.
Food, Water, Shelter		Anticipating a cascading relationship for the Food, Water, Shelter lifeline in response and recovery. Widespread disease outbreaks and resulting staffing issues will cause issues at different points along the commercial food supply chain. Agricultural production may be impacted as well.
Health and Medical		Anticipating a causal and cascading relationship for the Health and Medical lifeline in response and recovery due to direct impacts from the increase in patients, potential staffing issues, and supply chain disruptions that may also result as disease impacts become more widespread. Mitigation actions for this lifeline should be focused on stockpiling critical resources and developing procedures to respond to emergency staffing issues.

Pandemics and other infectious disease events impact people's health and the ability of both private and public entities to administer services and maintain infrastructure. This hazard impacts the Safety and Security lifeline tremendously, with significant risk to the community and potential restrictions on government services due to staffing shortages and potential public health regulations. The food, Water, Shelter lifeline is impacted through potential challenges created by staffing shortages, which was a significant impact of the COVID-19 pandemic. The food supply chain may be interrupted along with water utility services.

4.3.11.3. Past Occurrence

More than 230 Zika virus cases were reported to the Pennsylvania Department of Health from 2015 to May of 2018. These include 183 virus disease cases (symptomatic individuals who tested positive for Zika virus), 51 virus infection cases (asymptomatic individuals who tested positive for Zika virus), and one presumptive viremic blood donor case (individuals who had no symptoms at the time of donating blood, but whose blood tested positive for Zika virus. No zika virus cases have been reported in Pennsylvania since 2018 (CDC, 2023e).

West Nile virus arrived in the United States in 1999 and was first detected in Pennsylvania in 2000 when mosquito pools, dead birds and/or horses in 19 counties tested positive for the virus. Since then, the number of positive counties, human cases, and West Nile deaths has fluctuated with the temperature and precipitation each year. Pennsylvania's West Nile Control Program tracks reported cases of the West Nile virus (Table 4.3.11-3).

Table 4.3.11-3 Previous West Nile Virus Occurrences in Pennsylvania 2007 to 2017 (PA DEP, 2022e)

YEAR	NUMBER OF COUNTIES WITH VIRUS DETECTED	POSITIVE HUMAN CASES	HUMAN DEATHS*
2007	25	10	0
2008	37	14	1
2009	33	0	0
2010	37	28	0
2011	59	7	0
2012	52	60	4
2013	42	11	1
2014	39	13	1
2015	56	30	1
2016	41	16	0
2017	49	20	0
2018	63	130	-
2019	40	7	-
2020	27	11	-
2021	40	27	-
2022	50	30	-

*Death data not noted after 2018

While West Nile virus occurrences are fairly recent, the United States Department of Health and Human Services estimates that influenza pandemics have occurred for at least 300 years at unpredictable intervals. There have been several pandemic influenza outbreaks over the past 100 years. A list of events worldwide is shown in Table 4.3.11-4.

Table 4.3.11-4 List of Previous Significant Outbreaks of Influenza over the Past Century (CDC 2019b; CDC 2019d; CDC, 2019e; Global Security, 2009).		
DATE	PANDEMIC NAME/SUBTYPE	WORLDWIDE DEATHS (APPROXIMATE)
1918-1920	Spanish Flu / H1N1	50 million
1957-1958	Asian Flu / H2N2	1.5-2 million
1968-1969	Hong Kong Flu / H3N2	1 million
2009 – 2010	Swine Flu / A/H1N1	12,000

Deaths occurred in the United States as a result of the Spanish Flu, Asian flu, and Hong Kong Flu outbreaks. The Spanish Flu claimed 500,000 lives in the United States, and there were 350,000 cases in Pennsylvania – 150,000 in Philadelphia alone. Most deaths resulting from the Asian flu occurred between September 1957 and March 1958; there were about 70,000 deaths in the United States and approximately 15 percent of the population of Pennsylvania was affected. The first cases of the Hong Kong Flu in the U.S. were detected in September of 1968 with deaths peaking between December 1968 and January 1969 (Global Security, 2009).

More recently, the 2014-2015 flu season was marked as severe by the CDC, with approximately 710,000 hospitalizations. The CDC does not track national deaths in adults, but the organization reported 148 pediatric deaths from influenza. The 2017-2018 flu season was another severe season. The CDC reported that the H3N2 flu, along with other strains including H1N1, led to more cases, doctors' visits, hospital visits, and deaths than previous flu seasons. The CDC also noted that the flu became widespread in all states and jurisdictions at the same time. In January 2018, approximately halfway through the flu season, 37 pediatric deaths were reported. The CDC estimated that 34 million Americans were affected by the flu (CDC, 2019c).

The first case of COVID-19 was detected in Pennsylvania during the first week of March, 2020. Between March 1st, 2020, and February 8th, 2023, there were 3.4 million COVID-19 cases with a total of 49,921 deaths. The following table lists COVID-19 case and death data for each county during this time period.

Table 4.3.11-5 Number of COVID-19 Cases and Deaths in Pennsylvania Counties from 3/1/2020 – 2/8/2023 (PA DOH, 2023b; PA DOH, 2023c)					
County	# Cases	# Deaths	County	# Cases	# Deaths
Adams	31,321	420	Lackawanna	58,281	891
Allegheny	336,462	3,790	Lancaster	149,189	2,070
Armstrong	18,214	384	Lawrence	22,972	461
Beaver	48,625	834	Lebanon	45,180	570
Bedford	12,744	288	Lehigh	110,771	1,381
Berks	125,838	1,761	Luzerne	93,474	1,563
Blair	34,816	684	Lycoming	34,500	588
Bradford	20,458	230	McKean	9,723	172
Bucks	154,943	2,150	Mercer	28,047	541
Butler	54,603	833	Mifflin	15,019	304
Cambria	42,941	809	Monroe	47,686	590

Table 4.3.11-5	Number of COVID-19 Cases and Deaths in Pennsylvania Counties from 3/1/2020 – 2/8/2023 (PA DOH, 2023b; PA DOH, 2023c)				
Cameron	1,014	22	Montgomery	198,301	2,631
Carbon	19,964	340	Montour	5,902	96
Centre	43,678	392	Northampton	99,339	1,241
Chester	116,761	1,324	Northumberland	28,354	585
Clarion	9,835	221	Perry	10,356	197
Clearfield	24,127	395	Philadelphia	390,528	5,501
Clinton	11,054	142	Pike	13,244	111
Columbia	19,381	273	Potter	3,851	102
Crawford	24,574	356	Schuylkill	42,154	756
Cumberland	62,494	970	Snyder	9,661	169
Dauphin	72,056	1,074	Somerset	22,083	442
Delaware	140,383	2,064	Sullivan	1,363	38
Elk	8,520	119	Susquehanna	10,004	132
Erie	71292	893	Tioga	10,084	221
Fayette	38,655	750	Union	13,447	159
Forest	2,524	35	Venango	13,680	269
Franklin	51,140	794	Warren	9,589	240
Fulton	5,041	71	Washington	63,097	720
Greene	10,565	119	Wayne	13,202	204
Huntingdon	13,754	279	Westmoreland	98,228	1,540
Indiana	21,672	391	Wyoming	6,474	121
Jefferson	11,098	264	York	146,476	1,652
Juniata	5,693	192	**Total**	**3,490,499**	**49,921**

4.3.11.4. Future Occurrence

Future occurrences of pandemics and infectious diseases are difficult to predict. Occurrences of pandemic influenza are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or “novel” virus to which the population has no immunity. This emergence of a novel virus is the first step toward a pandemic.

This unpredictability makes it increasingly important to develop aggressive planning and eradication measures so that Pennsylvania is prepared for outbreaks. Instances of the West Nile virus have been generally decreasing due to such efforts, and prevention against the Zika virus, like mosquito control and insect repellent, have done the same (PA Department of Health, 2018).

Climate change may be a driving cause in any dramatic changes or shifts in viruses and other diseases by potentially creating favorable conditions for transmission through milder winters, earlier spring seasons, and warmer temperatures. One way this benefits the spread of infectious diseases is through expanding the habitats of mosquitos and allowing them more time to reproduce. In addition, different fungi are now able to survive in new environments, and the narrowing differences between environmental temperatures and human body temperatures

means fungi may become more adapted to survive in humans (CDC, 2022i). Climate change will also force animals into different migration patterns and into new habitats, which will create new interactions and opportunities for pathogens to infect new hosts; this is a concern as most pandemics are driven by diseases that are passed from animals to humans (Baker & Metcalf, 2022). Tick populations may increase as a result of climate changes, especially warmer winters that allow them to be active for longer periods of the year and expand the ranges they can survive in. Since 2019, the Asian long horned tick and the gulf coast tick have been discovered in Pennsylvania possibly due to changing environmental conditions that allow them to survive (Petelin, 2023).

Some health threats that the CDC believes climate change will increase the risk of are:

- Anaplasmosis and Lyme disease
- Dengue
- Fungal diseases
- Hantavirus
- Harmful algae blooms
- Rabies
- Salmonellosis
- Vibriosis
- West Nile virus

It's important to note that even if these changes don't occur in Pennsylvania, the interconnectedness of global commerce and tourism increase the risks of diseases spreading across the world from their origin. Future pandemics and infectious disease outbreaks may emerge from a long list of diseases, and invasive pathogens for which Pennsylvanians lack natural immunity present a significant danger.

4.3.11.5. State Facility Vulnerability Assessment and Loss Estimation

State facilities are no more or less vulnerable to pandemic and infectious disease than the general population. There are some occupation-specific risks that may make some employees more vulnerable, though. For example, those working in direct patient care situations are more likely to be exposed to a pandemic disease. Similarly, state employees working outdoors for extended periods of time in the warm months may be more vulnerable to West Nile or Zika virus.

The physical plant and facilities of the Commonwealth are not likely to be damaged by a pandemic disease outbreak. However, the people that work at these locations will be impacted if they or their loved ones become sick, depending on how serious both the sickness and rate of spread are. Many state employees were deemed essential and therefore were required to work in-person throughout the COVID-19 pandemic to ensure critical state facilities and functions continued throughout the pandemic. Continuing these operations is crucial to state infrastructure and operations yet depending on the situation it could put these employees at greater risk. If a disease outbreak were significantly dangerous and easily spread, these essential employees being infected could lead to serious cascading issues as people able to fill their role may not be

available. High rates of absenteeism and potential deaths associated with a pandemic or an infectious disease will likely lead to significant economic costs in lost productivity and increased medical costs in nearly all state agencies.

COVID-19 saw regulations enacted that required school closures and telework when possible, including many state employees. These regulations were put in place to slow the spread of the virus by allowing certain jobs that could function remotely to do so. Many employees are still on a hybrid schedule, working some days remotely and some in the office. This change has generated some positive impacts, but also has some downsides. A significant downside of the telework environment is the security risks that arise from employees accessing databases or files remotely and potentially using unsafe internet connections.

4.3.11.6. Jurisdictional Vulnerability Assessment and Loss Estimation

In general, jurisdictions that are more densely populated are more vulnerable to disease threats when the disease is directly spread from human to human, but every jurisdiction in the Commonwealth has some vulnerability to pandemic and infectious disease threats.

Jurisdictional losses in a pandemic or infectious disease outbreak are similar to the state, stemming from the health impact of employees and residents. These health impacts, beyond the physical and mental toll on employees and their families, will result in lost wages and productivity. No losses are expected to buildings or land. Losses are difficult to estimate because the exact rates of absenteeism and cost of treating a widespread disease will depend on the virus or bacterium in question, the availability of vaccination or treatment, and the severity of symptoms. With Pennsylvania's economy so integral to the national economy, economic losses from a pandemic or infectious disease threat could be significant.

4.3.12. Radon Exposure

4.3.12.1. Location and Extent

Radioactivity caused by airborne radon has been recognized for many years as an important component in the natural background radioactivity exposure of humans, but it was not until the 1980s that the wide geographic distribution of elevated values in houses and the possibility of extremely high radon values in houses were recognized. In 1984, routine monitoring of employees leaving the Limerick nuclear power plant near Reading, PA, showed that readings on Mr. Stanley Watras frequently exceeded expected radiation levels, yet only natural, non-fission-product radioactivity was detected on him. Radon levels in his home were detected around 2,500 pCi/L (pico Curies per Liter), much higher than the 4 pCi/L guideline of the Environmental Protection Agency (EPA) or even the 67 pCi/L limit for uranium miners (Massachusetts Department of Public Health, 2022). As a result of this event, the Reading Prong section of Pennsylvania where Watras lived became the focus of the first large-scale radon scare in the world.

Radon is a noble gas that originates by the natural radioactive decay of uranium and thorium. Like other noble gases (e.g., helium, neon, and argon), radon forms essentially no chemical compounds and tends to exist as a gas or as a dissolved atomic constituent in groundwater. Two isotopes of radon are significant in nature, 222Rn and 220Rn. The isotope thoron (i.e., 220Rn) has a half-life (time for decay of half of a given group of atoms) of 55 seconds, barely long enough for it to migrate from its source to the air inside a house and pose a health risk. However, radon (i.e., 222Rn), which has a half-life of 3.8 days, is a widespread hazard.

The distribution of radon is correlated with the distribution of radium (i.e., 226Ra), its immediate radioactive parent, and with uranium, its original ancestor. Due to the short half-life of radon, the distance that radon atoms can travel from their parent before decay is generally limited to distances of feet or tens of feet.

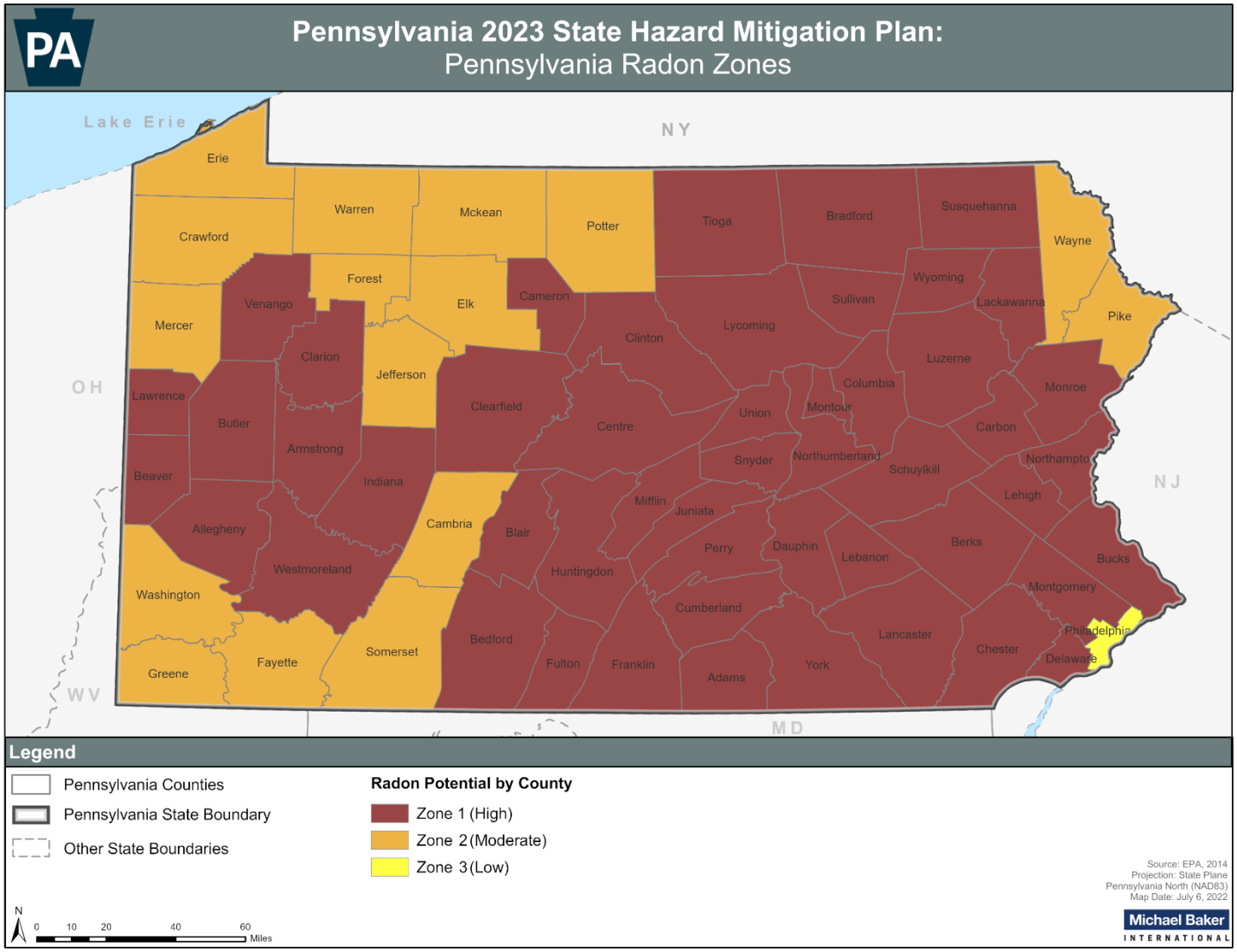
Three sources of radon in houses are now recognized (PA DEP, 2021a):

- Radon in soil air that flows into the house;
- Radon dissolved in water from private wells and exsolved during water usage; this is rarely a problem in Pennsylvania; and
- Radon emanating from uranium-rich building materials (e.g., concrete blocks or gypsum wallboard); this is not known to be a problem in Pennsylvania.

Each county in Pennsylvania is classified as having a *low*, *moderate*, or *high* radon hazard potential (see Figure 4.3.12-1). While this analysis has not been repeated since 2014, it represents the best available comprehensive radon hazard potential information available. A majority of counties across the Commonwealth, particularly counties in eastern Pennsylvania, have a *high* hazard potential. A high hazard potential indicates that the average indoor radon screening level for these counties is greater than 4 pico-curies per liter (pCi/L). Approximately

40% of homes in Pennsylvania have radon levels above this guideline level (PA DEP, 2022b). Counties with a moderate radon potential have an average indoor radon screening level between 2 pCi/L and 4 pCi/L. The City of Philadelphia is the only jurisdiction designated with a *low* radon hazard potential (less than 2 pCi/L) (EPA, 2014).

Figure 4.3.12-1 Radon Hazard Zones in Pennsylvania (EPA, 2014).



High radon levels were initially thought to be exacerbated in houses that are tightly sealed, but it is now recognized that rates of air flow into and out of houses, plus the location of air inflow and the radon content of air in the surrounding soil, are key factors in radon concentrations. Outflows of air from a house, caused by a furnace, fan, thermal “chimney” effect, or wind effects, require that air be drawn into the house to compensate. If the upper part of the house is tight enough to impede influx of outdoor air (radon concentration generally <0.1 pCi/L), then an appreciable fraction of the air may be drawn in from the soil or fractured bedrock through the foundation and slab beneath the house, or through cracks and openings for pipes, sumps, and similar features. Soil gas typically contains from a few hundred to a few thousand pCi/L of radon; therefore, even a small rate of soil gas inflow can lead to elevated radon concentrations in a house.

The radon concentration of soil gas depends upon a number of soil properties, the importance of which is still being evaluated. These properties include the levels of radium and uranium in soil, the depth of the soil, its permeability, the presence of fissure or cracks in underlying bedrock, and moisture content as radon gas moves faster and easier through drier soils (Otton, 1992). For houses built on bedrock, fractured zones may supply air having radon concentrations similar to those in deep soil. In general, ten to fifty percent of newly formed radon atoms escape the host mineral of their parent radium and gain access to the air-filled pore space.

Areas where houses have high levels of radon can be divided into three groups in terms of uranium content in rock and soil:

- Areas of very elevated uranium content (>50 ppm) around uranium deposits and prospects.
    - Although very high levels of radon can occur in such areas, the hazard normally is restricted to within a few hundred feet of the deposit. In Pennsylvania, such localities occupy an insignificant area.
- Areas of common rocks with higher-than-average uranium content (5 to 50 ppm).
    - In Pennsylvania, such rock types include granitic and felsic alkali igneous rocks and black shales. In the Reading Prong, high uranium values in rock or soil and high radon levels in houses are associated with Precambrian granitic gneisses commonly containing 10 to 20 ppm uranium, but locally containing more than 500 ppm uranium. In Pennsylvania, elevated uranium occurs in black shales of the Devonian Marcellus Formation and possibly the Ordovician Martinsburg Formation. High radon values are locally present in areas underlain by these formations.
- Areas of soil or bedrock that have normal uranium content but other properties that promote high radon levels in houses.
    - This group is incompletely understood at present. Relatively high soil permeability can lead to high radon, the clearest example being houses built on glacial eskers. Limestone-dolomite soils also appear to be predisposed for high radon levels in houses, perhaps because of the deep clay-rich residuum in which radium is concentrated by weathering on iron oxide or clay surfaces, coupled

with moderate porosity and permeability. The importance of carbonate soils is indicated by the fact that radon contents in 93 percent of a sample of houses built on limestone-dolomite soils near State College, Centre County, exceeded 4 pCi/L, and 21 percent exceeded 20 pCi/L, even though the uranium values in the underlying bedrock are all in the normal range of 0.5 to 5 ppm uranium.

4.3.12.2. Range of Magnitude

Exposure to radon is the second leading cause of lung cancer after smoking. It is the number one cause of lung cancer among non-smokers. Radon is responsible for about 21,000 lung cancer deaths every year; approximately 2,900 of which occur among people who have never smoked. Lung cancer is the only known effect on human health from exposure to radon in air and thus far, there is no evidence that children are at greater risk of lung cancer than are adults (EPA, 2016b).

According to the EPA, the average radon concentration in the indoor air of America's homes is about 1.3 pCi/L. The EPA recommends homes be fixed if the radon level is 4 pCi/L or more. However, because there is no known safe level of exposure to radon, the EPA also recommends that Americans consider fixing their home for radon levels between 2 pCi/L and 4 pCi/L. Table 4.3.12-1 shows the relationship between various radon levels, probability of lung cancer, comparable risks from other hazards, and action thresholds. Smokers exposed to radon have a much higher risk of lung cancer (EPA, 2016b).

Table 4.3.12-1 Radon Risk for Smokers and Non-Smokers (EPA, 2016b).

RADON LEVEL (PCI/L)	IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME… *	RISK OF CANCER FROM RADON EXPOSURE COMPARES TO… **	ACTION THRESHOLD
SMOKERS			
20	About 260 people could get lung cancer	250 times the risk of drowning	Fix structure
10	About 150 people could get lung cancer	200 times the risk of dying in a home fire	Fix structure
8	About 120 people could get lung cancer	30 times the risk of dying in a fall	Fix structure
4	About 62 people could get lung cancer	5 times the risk of dying in a car crash	Fix structure
2	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3	About 20 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4	About 3 people could get lung cancer	(Average outdoor radon level)	
NON-SMOKERS			
20	About 36 people could get lung cancer	35 times the risk of drowning	Fix structure
10	About 18 people could get lung cancer	20 times the risk of dying in a home fire	Fix structure

Table 4.3.12-1 Radon Risk for Smokers and Non-Smokers (EPA, 2016b).			
RADON LEVEL (PCI/L)	IF 1,000 PEOPLE WERE EXPOSED TO THIS LEVEL OVER A LIFETIME… *	RISK OF CANCER FROM RADON EXPOSURE COMPARES TO… **	ACTION THRESHOLD
8	About 15 people could get lung cancer	4 times the risk of dying in a fall	Fix structure
4	About 7 people could get lung cancer	The risk of dying in a car crash	Fix structure
2	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3	About 2 people could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4		(Average outdoor radon level)	
NOTE: Risk may be lower for former smokers. * Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003). ** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.			

Radon exposure has minimal environmental impacts. Due to the relatively short half-life of radon, it tends to only affect living and breathing organisms such as humans or pets which are routinely in contained areas (i.e., basement or house) where the gas is released.

The worst-case scenario for radon exposure would be that a large area of tightly sealed homes provided residents high levels of exposure over a prolonged period of time without the resident being aware. This worst-case scenario exposure then could lead to a large number of people with cancer attributed to the radon exposure.

Table 4.3.12-2 Most Likely Lifelines Impacted by Radon Exposure		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating causal impacts due to the dangers to community safety from direct exposure to radon. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the dangers and best safety precautions for their homes.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery. Radon exposure may be the result of radon entering the home through cracks in the foundation or through private water supplies. Actions to mitigate the risk of radon exposure are providing access to specialized tests for radon detection, surveys of homes in prone areas, and programs to support home repairs.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline in response and recovery as radon exposure can significantly increase the chances of lung cancer and therefore potentially increase the amount of services and resources if communities develop more instances of cancer.

4.3.12.3. Past Occurrence

Current data on the abundance and distribution of radon in Pennsylvania homes is considered incomplete and potentially biased, but a study was conducted testing the basements and first floors of over 800,000 buildings throughout all 67 counties in Pennsylvania. A total of nearly two million data points were gathered and analyzed to determine radon concentrations in PA. Figure 4.3.12-2 and Figure 4.3.12-3 show maps depicting the unadjusted median concentrations throughout the state and the levels of predicted radon contribution from geologic unit, county, and well water after accounting for variations in the tests, seasons, buildings, year, and average rainfall (Casey et al., 2015).

Figure 4.3.12-2 Unadjusted Median Basement Radon Concentrations in PA by Geologic Unit, 2006-2013. (Casey et al, 2015).

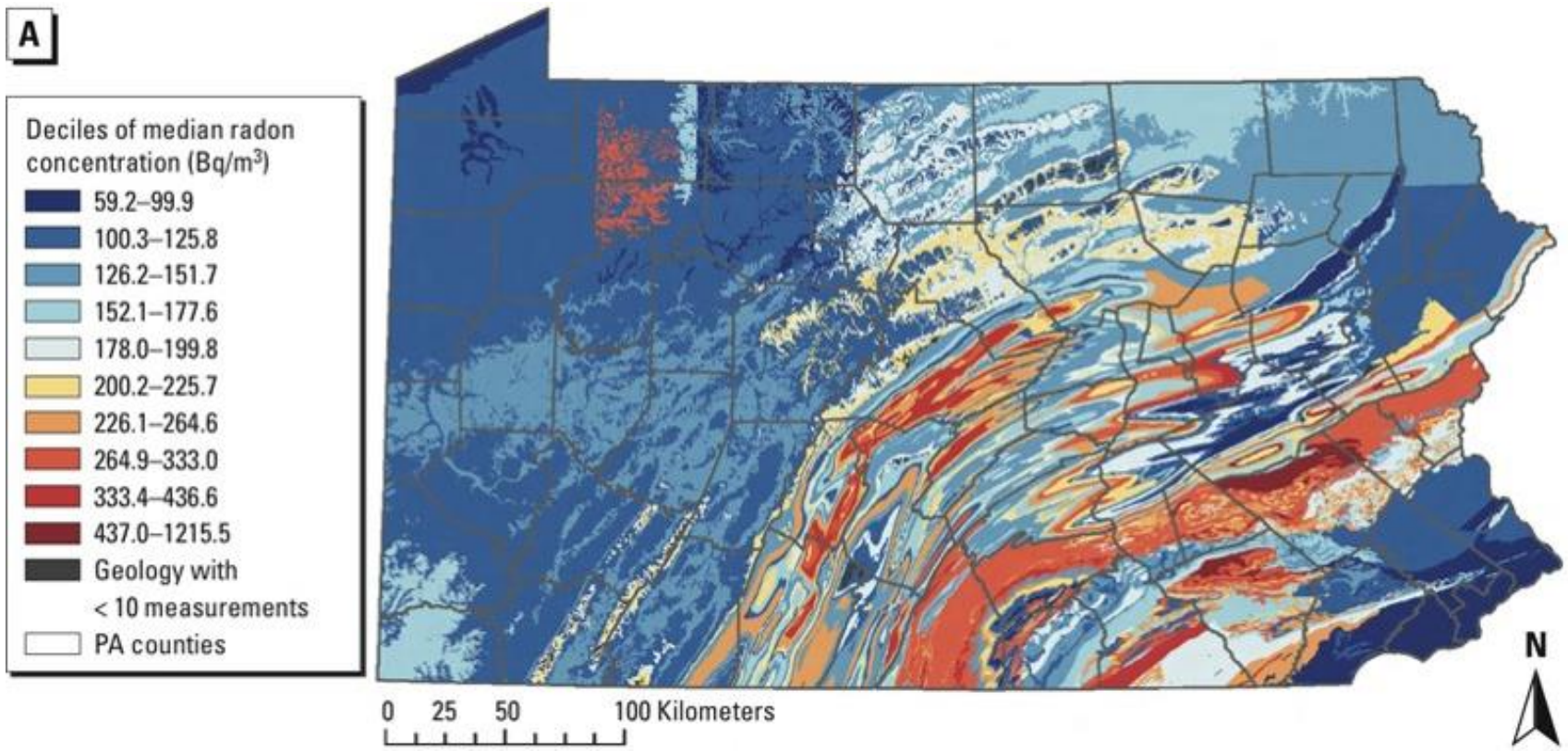
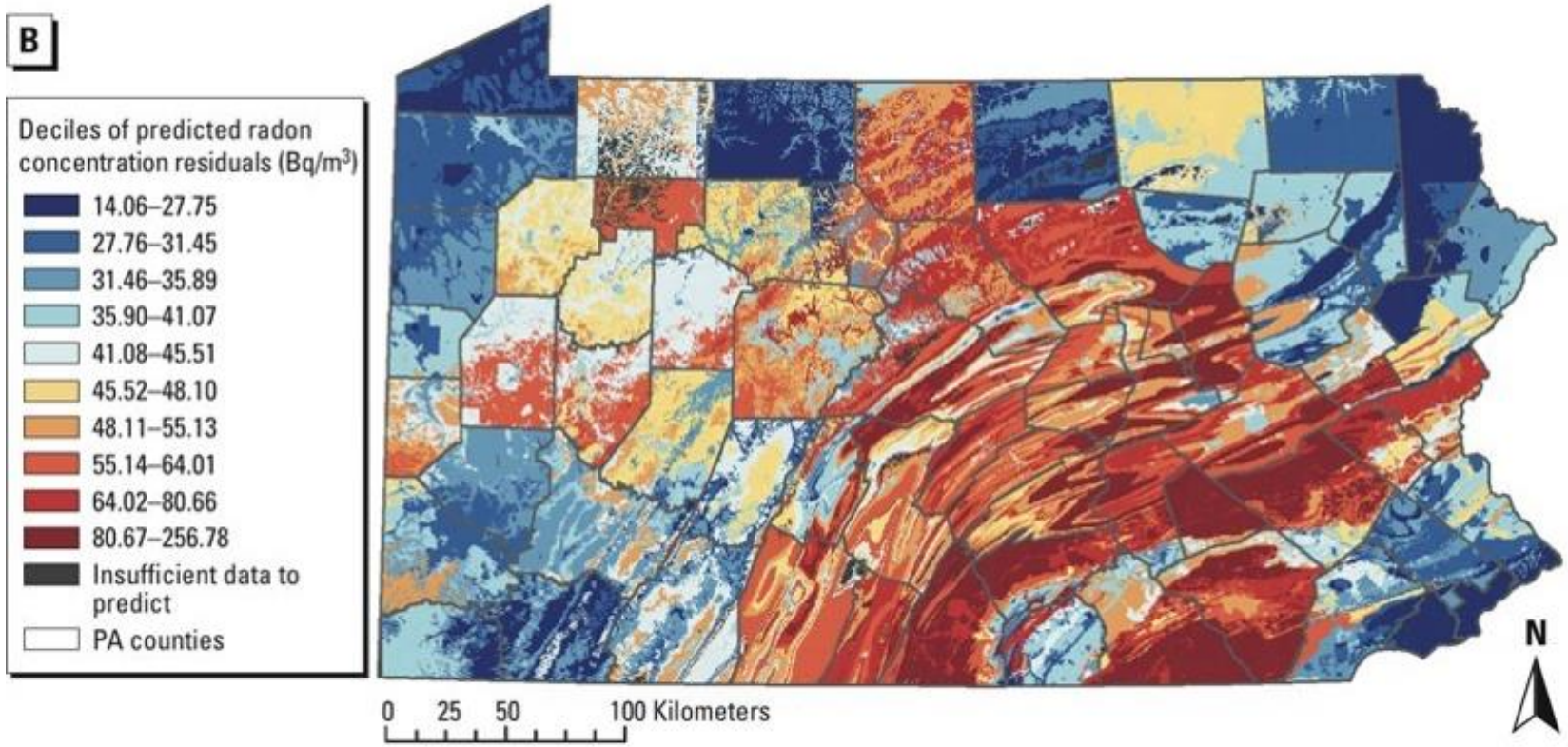
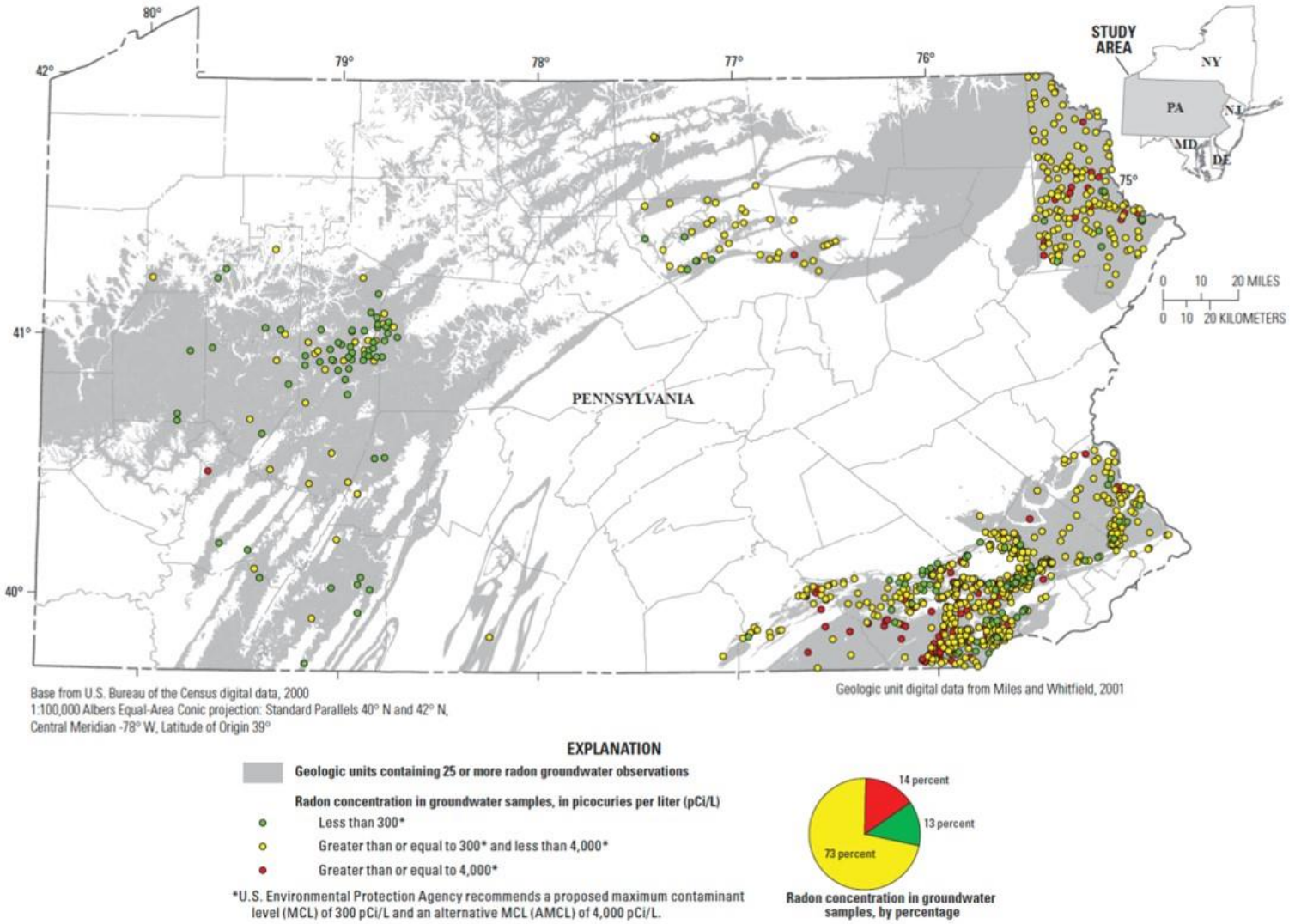


Figure 4.3.12-3 Predicted Contribution to Basement Radon Concentration from Geologic Unit, County, and Well Water After Accounting for Variation due to Year, Building Type, Test Type, Test Duration, Season, Average Temperature, and Average Rainfall (Casey et al, 2015).



The United State Geological Survey conducted a study with the Pennsylvania Department of Health and Environmental Protection to examine radon levels in wells throughout the state. The data for the study was collected from 1986 to 2015 and accounts for approximately 31 percent of the land area of Pennsylvania. The study concluded that more than 14 percent of the tested wells had radon levels “at or above the Environmental Protection Agency’s proposed alternative maximum contaminant level of 4,000 picocuries per liter.” The standard maximum concentration that the EPA suggests is 300 pCi/L, but they also have this alternative maximum for states with an EPA-approved radon indoor air quality program, which Pennsylvania does have. However, the limits are just proposed since the EPA does not currently regulate radon level in drinking water. Figure 4.3.12-4 shows where these wells are located throughout the states and what levels the other wells were tested at (USGS, 2017).

Figure 4.3.12-4 A Map of Pennsylvania Indicating Radon Concentrations of Water Samples Collected During a Multi-Year Groundwater Radon Study. (USGS, 2017).



4.3.12.4. Future Occurrence

Radon exposure is inevitable given present soil, geologic, and geomorphic factors across Pennsylvania. Development in areas where previous radon levels have been significantly high will continue to be more susceptible to exposure. However, new incidents of concentrated exposure may occur with future development or deterioration of older structures. Exposure can be limited with proper testing for both past and future development and appropriate mitigation measures. At this moment, there is no anticipated impacts on the future occurrence of radon exposure due to climate change. Overall, the probability of future radon exposure hazards is considered *likely* as defined by the Risk Factor Methodology (see Section 4.1).

4.3.12.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to radon exposure, data containing individual radon test results with ZIP code information was gathered from the EPA. Using this, all structures located within zip codes where average basement and/or first floor radon readings between 2000 and 2022 were greater than or equal to 4 Pci/L. The results of this assessment represent the potential impacts to state assets based on location, but do not account for other factors. Of the 4,460 geolocated state facilities, 3,258, or 73 percent, are located within these zip codes (Table 4.3.12-3). More than half of the vulnerable facilities are owned by the state. Overall, over 24 million square feet of building space are found within zip codes considered at risk for radon exposure.

Table 4.3.12-3 Vulnerability of State Facilities to Radon Exposure

STATE DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	4	44%	0	72,785
Department of Agriculture	14	88%	11	1,160,353
Department of Banking and Securities	1	50%	0	44,961
Department of Community and Economic Development	1	25%	0	3,521
Department of Conservation and Natural Resources	2	100%	1	37,703
Department of Corrections	387	56%	373	7,077,209
Department of Education		0%		
Department of Environmental Protection	8	62%	1	188,346
Department of General Services	96	73%	89	7,915,420
Department of Health	33	69%	0	83,408
Department of Labor and Industry	45	65%	7	1,172,871
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	57	58%	0	739,588
Department of Revenue	5	50%	0	120,754
Department of Transportation	1,330	79%	1,177	2,941,113
Drug and Alcohol Programs	1	100%	0	17,503
Emergency Management Agency	8	100%	8	109,430
Executive Offices	1	50%	0	27,983
Fish and Boat Commission	135	88%	134	311,458
Governor's Office		0%		

Table 4.3.12-3 Vulnerability of State Facilities to Radon Exposure				
STATE DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Historical and Museum Commission	22	73%	2	7,442
Insurance Department	2	100%	0	42,511
Liquor Control Board	342	63%	0	1,604,678
Public School Employees' Retirement System	4	67%	0	79,074
State Civil Service Commission	1	100%	0	620
State Department	1	100%	0	84,349
State Employees' Retirement System	3	75%	0	57,817
State Police	24	67%	0	268,304
State System of Higher Education	711	83%		
Thaddeus Stevens College of Technology	20	100%	20	2,200
Treasury Department		0%		
Total	**3,258**	**73%**	**1,823**	**24,171,401**

Table 4.3.12-4 lists a breakdown of the types of state critical facilities contained within the zip codes where average basement and/or first floor radon readings between 2000 and 2022 were greater than or equal to 4 Pci/L. Due to the large number of schools, fire departments, and police stations in the Commonwealth, it is unsurprising that those categories of facility have the highest number of critical facilities. Of the 13,448 geolocated critical facilities, 13,331, or 99 percent, are located within zip codes with elevated radon test results. Of course, each facility itself will depend on its own testing.

Table 4.3.12-4 State Critical Facilities in High-Risk Areas by Critical Facility Type.		
STATE CRITICAL FACILITY TYPE	NUMBER OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	275	100%
Banking	4	100%
Commercial	21	100%
Communication	557	100%
Dams	1,480	99%
Education (colleges and universities)	396	99%
Education (public schools)	4,670	100%
Emergency Operation Centers	71	100%
Energy	354	97%
Fire Stations	2,563	98%
Government	25	100%
Hospitals	309	99%
National Monuments or Icons	6	100%
Nuclear	5	100%
Police Stations	1,300	100%

Table 4.3.12-4 State Critical Facilities in High-Risk Areas by Critical Facility Type.		
STATE CRITICAL FACILITY TYPE	NUMBER OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Transportation	669	99%
Water	626	99%
Total	**13,331**	**99%**

4.3.12.6. Jurisdictional Vulnerability Assessment

Vulnerability to radon exposure is primarily being defined as jurisdictions and/or critical facilities located in a zip code whose average first floor and/or basement radon reading is greater than four pCi/L, the threshold for action.

Jurisdictional and state critical facility vulnerability assessments were completed by spatially overlaying hazards with census tracts and state critical facility layers in GIS. When spatial analysis determined that the hazard would impact a census tract within a county or the location of state critical facilities these locations where deemed vulnerable to the hazard. Loss estimates were prepared based on the value of the facilities impacted by census tract and by state critical facility. Each hazard uses a methodology that is specific to the type of risk it may cause; Table 4.2.2-2 includes a complete methodology description for vulnerability assessments and loss estimates for each hazard.

The EPA determines that an average radon mitigation system costs $1,200. The EPA also states that current state surveys show that one home in five has elevated radon levels. Using this methodology, radon loss estimation is factored by assuming that 20% of the buildings within the zip codes with elevated test results have elevated radon values and each would require a radon mitigation system installed at the EPA estimated average of $1,200, as shown in Table 4.3.12-5.

Table 4.3.12-5 Estimated Jurisdictional Losses in Areas with High Radon Test Results.			
COUNTY	TOTAL NUMBER OF BUILDINGS IN AREAS WITH HIGH RADON TEST RESULTS	NUMBER OF IMPACTED BUILDINGS (20% OF TOTAL)	RADON MITIGATION COSTS (SYSTEM COST X IMPACTED BUILDING)
Adams	31,100	6,220	$7,464,000
Allegheny	303,396	60,679	$72,815,040
Armstrong	29,559	5,912	$7,094,160
Beaver	72,994	14,599	$17,518,560
Bedford	24,161	4,832	$5,798,640
Berks	151,697	30,339	$36,407,280
Blair	54,104	10,821	$12,984,960
Bradford	22,365	4,473	$5,367,600
Bucks	108,088	21,618	$25,941,120
Butler	76,976	15,395	$18,474,240
Cambria	60,848	12,170	$14,603,520

Table 4.3.12-5 Estimated Jurisdictional Losses in Areas with High Radon Test Results.			
COUNTY	TOTAL NUMBER OF BUILDINGS IN AREAS WITH HIGH RADON TEST RESULTS	NUMBER OF IMPACTED BUILDINGS (20% OF TOTAL)	RADON MITIGATION COSTS (SYSTEM COST X IMPACTED BUILDING)
Cameron	2,611	522	$626,640
Carbon	22,004	4,401	$5,280,960
Centre	52,069	10,414	$12,496,560
Chester	139,296	27,859	$33,431,040
Clarion	16,876	3,375	$4,050,240
Clearfield	29,734	5,947	$7,136,160
Clinton	16,241	3,248	$3,897,840
Columbia	28,445	5,689	$6,826,800
Crawford	12,582	2,516	$3,019,680
Cumberland	96,168	19,234	$23,080,320
Dauphin	108,527	21,705	$26,046,480
Delaware	10,559	2,112	$2,534,160
Elk	17,366	3,473	$4,167,840
Erie	46,014	9,203	$11,043,360
Fayette	37,248	7,450	$8,939,520
Forest	3,161	632	$758,640
Franklin	66,050	13,210	$15,852,000
Fulton	8,554	1,711	$2,052,960
Greene	3,010	602	$722,400
Huntingdon	17,134	3,427	$4,112,160
Indiana	35,810	7,162	$8,594,400
Jefferson	26,258	5,252	$6,301,920
Juniata	11,181	2,236	$2,683,440
Lackawanna	36,234	7,247	$8,696,160
Lancaster	204,314	40,863	$49,035,360
Lawrence	24,738	4,948	$5,937,120
Lebanon	56,071	11,214	$13,457,040
Lehigh	126,712	25,342	$30,410,880
Luzerne	60,345	12,069	$14,482,800
Lycoming	49,444	9,889	$11,866,560
McKean	17,398	3,480	$4,175,520
Mercer	21,192	4,238	$5,086,080
Mifflin	22,365	4,473	$5,367,600
Monroe	50,783	10,157	$12,187,920
Montgomery	94,943	18,989	$22,786,320
Montour	6,585	1,317	$1,580,400
Northampton	110,844	22,169	$26,602,560
Northumberland	34,106	6,821	$8,185,440

Table 4.3.12-5 Estimated Jurisdictional Losses in Areas with High Radon Test Results.			
COUNTY	TOTAL NUMBER OF BUILDINGS IN AREAS WITH HIGH RADON TEST RESULTS	NUMBER OF IMPACTED BUILDINGS (20% OF TOTAL)	RADON MITIGATION COSTS (SYSTEM COST X IMPACTED BUILDING)
Perry	21,073	4,215	$5,057,520
Philadelphia	22,503	4,501	$5,400,720
Pike	16,372	3,274	$3,929,280
Potter	8,558	1,712	$2,053,920
Schuylkill	59,243	11,849	$14,218,320
Snyder	14,487	2,897	$3,476,880
Somerset	33,237	6,647	$7,976,880
Sullivan	1,366	273	$327,840
Susquehanna	23,674	4,735	$5,681,760
Tioga	18,246	3,649	$4,379,040
Union	12,383	2,477	$2,971,920
Venango	26,935	5,387	$6,464,400
Warren	22,221	4,444	$5,333,040
Washington	71,064	14,213	$17,055,360
Wayne	4,242	848	$1,018,080
Westmoreland	150,649	30,130	$36,155,760
Wyoming	11,944	2,389	$2,866,560
York	159,529	31,906	$38,286,960
Total	**3,335,986**	**667,197**	**$800,636,640**

4.3.13. Subsidence, Sinkhole

4.3.13.1. Location and Extent

Land subsidence is a gradual settling or sudden sinking of the Earth's surface due to removal or displacement of subsurface earth materials (USGS, 2019). Sinkholes are subsidence features resulting from the downward movement of surficial material into a pre-existing subsurface void. 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 the voids collapses, leaving surface depressions resulting in karst topography. Characteristic structures associated with karst topography include sinkholes, linear depressions and caves. Often, sub-surface solution of limestone will not result in the immediate formation of karst features. Collapse sometimes occurs only after a large amount of activity, or when a heavy burden is placed on the overlying material (DCNR, 2022b).

Figure 4.3.13-1 shows the distribution of areas in Pennsylvania having karst or the potential for karst development (USGS, 2014a). The map identifies areas underlain by soluble rocks based primarily on State geologic maps of rock units. These areas are further classified by general climate setting and degree of exposure. In Pennsylvania, thick sequences of structurally deformed carbonates comprise the surface bedrock of a sizable area in central, south-central and southeastern Pennsylvania. Note that Figure 4.3.13-1 provides only a first approximation for delineating the degree of karst hazard across Pennsylvania. While the areas underlain by carbonate rock are known to have karst landforms or karst potential, ground collapse potential within these areas varies greatly.

To better evaluate degrees of karst hazard within areas underlain by soluble rocks, Figure 4.3.13-1 shows the locations of observed sinkholes and surface depressions in Pennsylvania (DCNR, 2021). Common sinkhole locations in Pennsylvania include the Saucon Valley of Lehigh County, the greater Harrisburg metropolitan area in Dauphin and Cumberland Counties, and the Nittany Valley in Blair, Centre, and Clinton Counties.

Figure 4.3.13-1 Areas in Pennsylvania with Karst or Potential for Karst Development (USGS, 2014a).

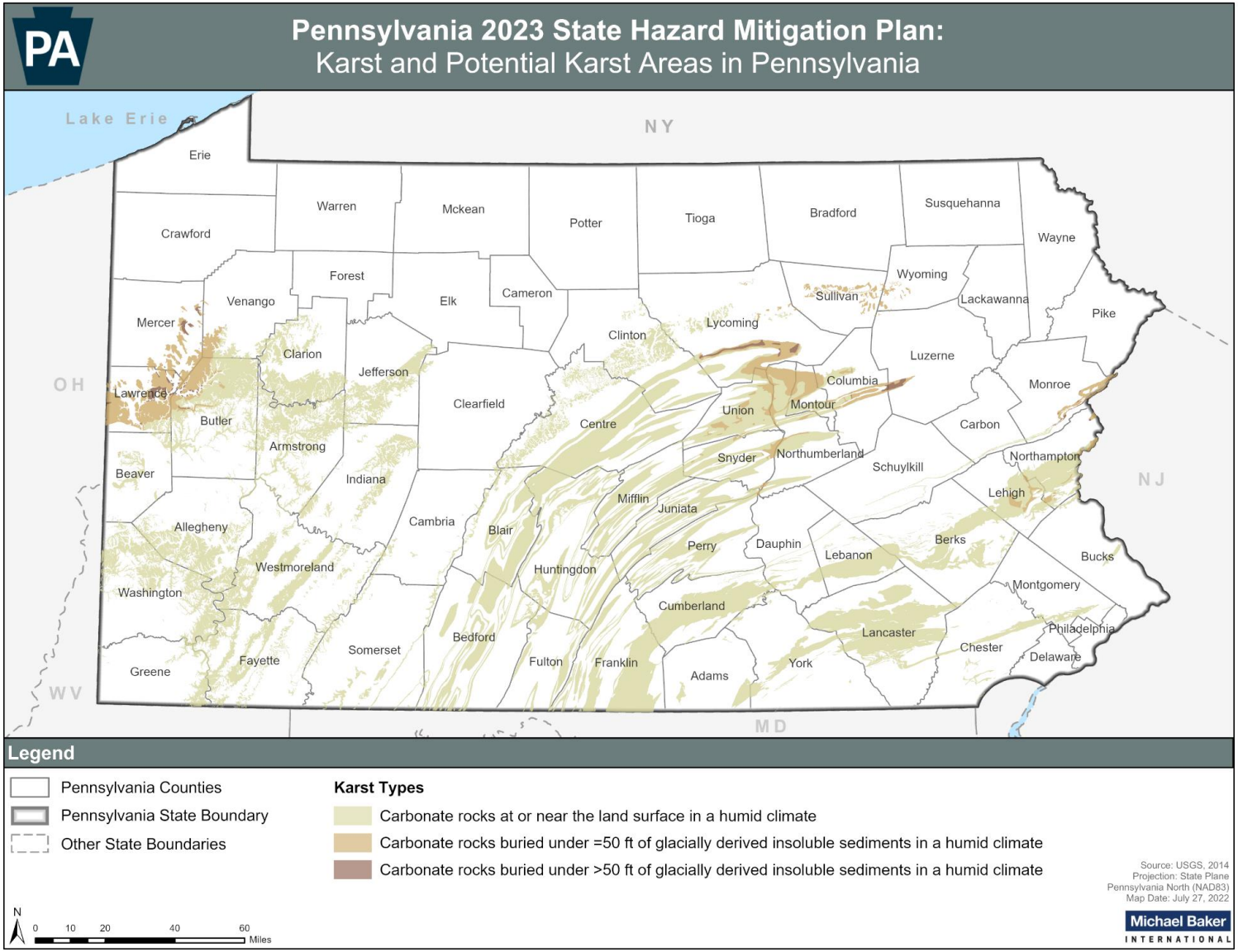
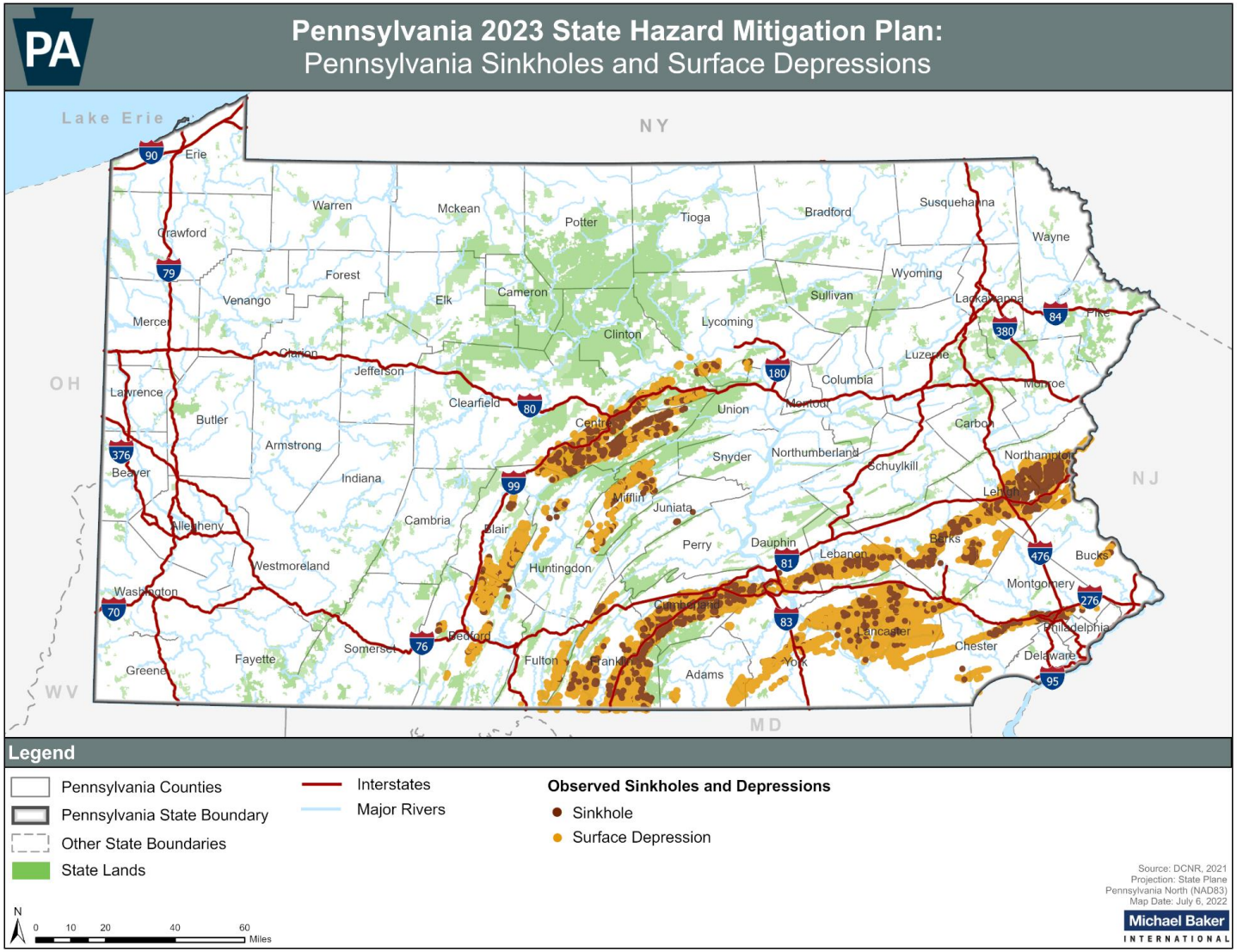
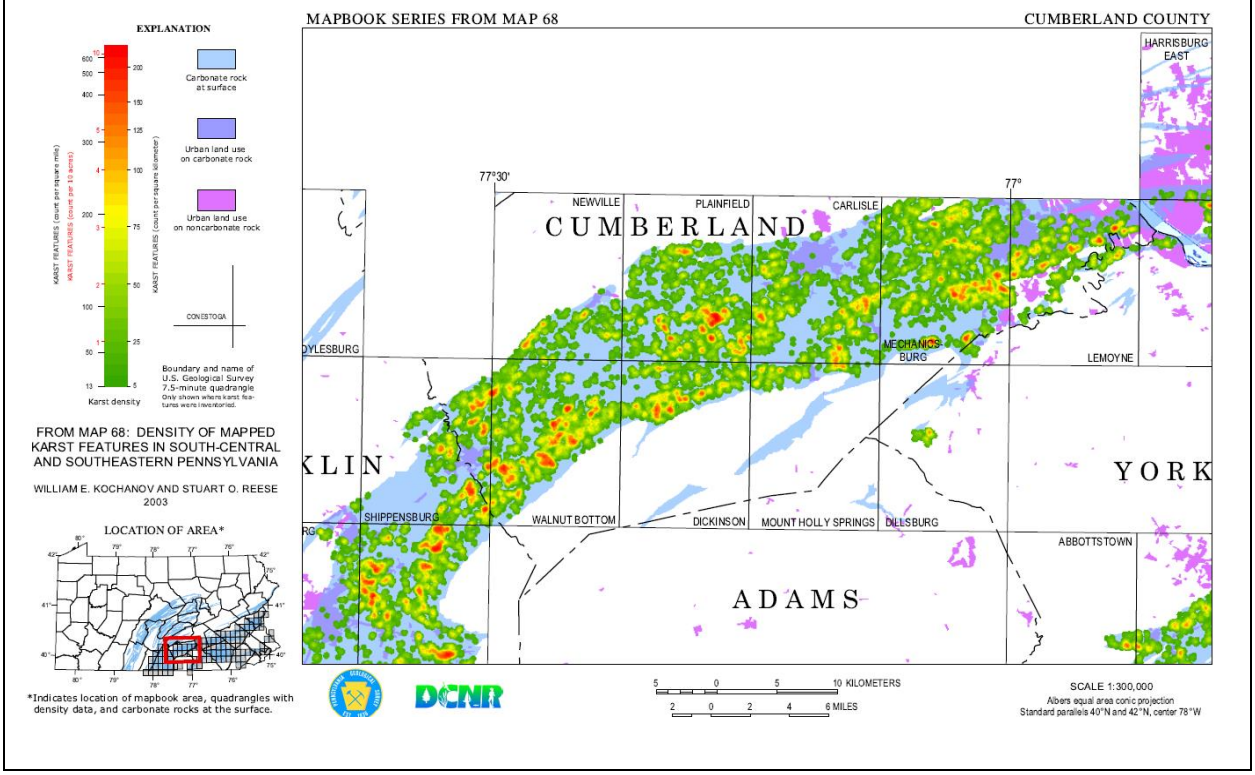


Figure 4.3.13-2 Inventoried Sinkholes and Surface Depressions in Pennsylvania (DCNR, 2021).



DCNR has created a series of maps showing the density of identified karst features across south-central and eastern Pennsylvania (see Figure 4.3.13-3 for example). The density of karst features ranges from 0 to 600 features per square mile with wide variations in size. Fewer karst features have been mapped in existing urban areas; however, this is likely a result of development activities that disguise, cover, or fill existing features rather than an absence of the features themselves (PA DCNR, 2003b).

Figure 4.3.13-3 Example of Map Showing Density of Karst Features in Cumberland County. An Index Map Showing the Coverage of the Inventory is also Provided.



Human activity can also result in subsidence or sinkhole events. Leaking water pipes or structures that convey storm-water runoff may also result in areas of subsidence as the water dissolves substantial amounts of rock over time. Stormwater infrastructure has been an exacerbating factor in subsidence events in Cumberland County, Lebanon County, and Palmyra. In some cases, construction, land grading or earthmoving activities that cause changes in stormwater flow can trigger sinkhole events (DCNR, 2015).

Subsidence or sinkhole events may also occur in the presence of mining activity, even in areas where bedrock is not necessarily conducive to their formation. Mining activity is concentrated in the southwestern region of the state, as well as Schuylkill, Northumberland, and Carbon Counties, see Section 4.3.21 for more information on mining locations across the Commonwealth. Because sub-surface (i.e., underground) extraction of materials such as oil, gas, coal, metal ores (i.e. copper, iron, and zinc), clay, shale, limestone, or water may result in

slow-moving or abrupt shifts in the ground surface, these areas have a higher potential to be impacted by sinkholes and subsidence (DCNR, 2015).

Sinkholes often develop where the cover above a mine is thin. In western Pennsylvania, most sinkholes develop where the soil and rock above a mine are less than fifty feet thick (Bruhn et al., 1978). A study of subsidence in the Pittsburgh area revealed that 95% of all reported subsidence incidents occurred on sites located less than sixty feet above mine level (Bruhn et al., 1981). This profile focuses most on karst-related subsidence and sinkholes; for more information on mine-related subsidence and sinkholes, see Section 4.3.21.

4.3.13.2. Range of Magnitude

No two subsidence areas or sinkholes are exactly alike. Variations in size, shape, time period under which they occur (i.e., gradually or abruptly), and their proximity to development ultimately determines the magnitude of damage incurred (Kochanov, 2015). Events could result in minor elevation changes or deep, gaping holes in the ground surface. Subsidence and sinkhole events can cause severe damage in urban environments, although gradual events can be addressed before significant damage occurs. Primarily, problems related to subsidence include the disruption of utility services and damage to private and public property including buildings, roads, and underground infrastructure (Kochanov, 2015). Figure 4.3.13-4 provides examples of the damage that can occur as a result of these events. If long-term subsidence or sinkhole formation is not recognized and mitigation measures are not implemented, fractures or complete collapse of building foundations and roadways may result. The cost to fill in and stabilize sinkholes can be significant even if the sinkhole itself is limited in extent. The 1994 event in Allentown (see top-left image in table below) is one of the worst-case known events in Pennsylvania. Damage to the Corporate Plaza Building was significant, but dollar information is unknown.

Figure 4.3.13-4 Example of Damage which can Occur as a Result of Abrupt Sinkhole and Long-Term Subsidence Events.

Sinkhole at Corporate Plaza Building in Allentown, Lehigh County, PA in February, 1994 (Photograph by *William E. Kochanov*. PA DCNR, 2009b).

Sinkhole in Philadelphia in private home's front yard (Tan, 2017).

Building damage as a result of subsidence in Pennsylvania. Photo is from a PA DEP Educational Poster for the Mine Subsidence Fund.

In addition to infrastructure and building damage, the presence of sinkholes can result in increased potential for groundwater contamination. Due to their porous nature, sinkholes are sometimes used as instruments for enhancing groundwater recharge. However, if hazardous materials are spilled at a recharge point, groundwater can quickly be contaminated due to the lack of soil substrate which normally would slow migrating contaminants (Kochanov, 2015). Vegetation is usually damaged during abrupt subsidence events. However, re-growth takes place over time. Land subsidence can also result in more frequent and expansive flooding and changes in river canal and drain flow systems.

Table 4.3.13-1 Most Likely Lifelines Impacted by Subsidence, Sinkholes		
Lifelines	Impact Type	Notes
Safety and Security	⚠	Anticipating causal impacts due to the dangers to community safety from subsidence or sinkholes. Mitigation for the lifeline will be focused on increase residents' knowledge of risks in their area.
Food, Water, Shelter	⚠	Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery due to the damage this hazard can cause to homes, disruption of water utility services, and potential groundwater contamination. Mitigation actions for this lifeline may be managing development in high-risk areas, developing design standards for the same areas, and removing the most at-risk structures.
Transportation	⚠	Anticipating a causal relationship for the Transportation lifeline in response and recovery due to direct damage to transportation infrastructure. Mitigation efforts may follow the lifeline above by developing design standards and utilizing increased mapping capabilities.

4.3.13.3. Past Occurrence

DCNR provides an online inventory of sinkholes which lists 3,619 sinkholes that have been identified across Pennsylvania. Note that this inventory has not been updated since the 2013 SHMP. The distribution of these sinkholes by county is provided in Table 4.3.13-2. Note that some of these sinkholes have been filled. This inventory represents best available information at the state-wide level. The fact that no sinkholes are identified does not necessarily mean there are no sinkholes or historical subsidence hazards in a given county. For instance, Westmoreland County has 5 sinkholes identified in their County HMP, even though they do not have any sinkholes identified by DCNR. Additionally, PA DEP staff indicated that small sinkholes occur several times per week and cause limited damage; many of these are related to failing infrastructure like water main breaks or collapsed pipes.

Table 4.3.13-2 Summary of Sinkholes Identified in Pennsylvania (PA DCNR, 2016a)			
COUNTY	NO. OF SINKHOLES	COUNTY	NO. OF SINKHOLES
Adams	31	Lackawanna	none identified
Allegheny	none identified	Lancaster	159
Armstrong	none identified	Lawrence	none identified
Beaver	none identified	Lebanon	129

Table 4.3.13-2 Summary of Sinkholes Identified in Pennsylvania (PA DCNR, 2016a)

COUNTY	NO. OF SINKHOLES	COUNTY	NO. OF SINKHOLES
Bedford	55	Lehigh	470
Berks	211	Luzerne	none identified
Blair	55	Lycoming	70
Bradford	none identified	McKean	none identified
Bucks	9	Mercer	none identified
Butler	none identified	Mifflin	176
Cambria	none identified	Monroe	none identified
Cameron	none identified	Montgomery	131
Carbon	none identified	Montour	*not provided*
Centre	546	Northampton	677
Chester	50	Northumberland	none identified
Clarion	none identified	Perry	none identified
Clearfield	none identified	Philadelphia	none identified
Clinton	75	Pike	none identified
Columbia	none identified	Potter	none identified
Crawford	none identified	Schuylkill	none identified
Cumberland	366	Snyder	none identified
Dauphin	48	Somerset	none identified
Delaware	none identified	Sullivan	none identified
Elk	none identified	Susquehanna	none identified
Erie	none identified	Tioga	none identified
Fayette	none identified	Union	none identified
Forest	*not provided*	Venango	none identified
Franklin	260	Warren	none identified
Fulton	5	Washington	none identified
Greene	none identified	Wayne	none identified
Huntingdon	27	Westmoreland	none identified
Indiana	none identified	Wyoming	none identified
Jefferson	none identified	York	60
Juniata	9	**TOTAL**	**3,619**

Examples of sinkholes caused by various catalysts can be found all over Pennsylvania. In 2018, Sunoco had to fill several sinkholes in Chester County that were caused by drilling for fossil fuel pipelines (Hurdle, 2018). Rain and stormwater systems were thought to be heavy contributors to a sinkhole at the Pittsburgh Botanical Garden in August of 2022 and a February 2022 sinkhole outside a residential home in Easton that expanded into the street as a fire truck responded to the scene (Deluca, 2022; Miller, 2022). In 2018, a 6-to-8-foot sinkhole in Luzerne County was found to be caused by a water main break that eroded the roadway (Hayes, 2018). Palmyra has been plagued by two particularly persistent sinkhole issues in recent times. A series of sinkholes

in the borough led to 6 houses being condemned and over 5 years of construction between 2013 and 2018 to fix (Miller, 2015; Jenkins, 2018). A significant sinkhole, estimated to be 40 to 180 feet deep and 40 feet wide, was discovered in 2019 along Route 422 in Palmyra and was eventually repaired with an 11,400 square foot concrete slab by PennDOT; the area has been known to cause many sinkhole issues for the agency (Drapac, 2019; Schweigert, 2021).

4.3.13.4. Future Occurrence

PA DEP's list of activities that can lead to sinkholes consists of a decline of water levels, disturbances of the soil, water leaks, concentration of water flow in a specific area, water impoundments, and heavy loads on the surface (PA DEP, 2022f). Hydrological changes play a big part in sinkhole formation, whether it is adding more water or taking some away. This change creates opportunities for destabilization as either soil is very saturated, or cracks and voids are no longer being filled by groundwater. A potential concern for the future will be how much projected precipitation and intense rainfall event increases from climate change will contribute, as they can result in at least 3 of the activities listed (soil disturbance, concentrated water flows, heavy loads).

Based on geological conditions and current mining activity in Pennsylvania, the annual occurrence of subsidence and sinkhole events in areas of the Commonwealth underlain by carbonate rock or where mining occurs is considered *likely* as defined by the Risk Factor Methodology (see Section 4.1). The precise location of future occurrences is difficult to predict give the site-specific conditions that contribute to sinkhole development. Several signs, however, can signal potential development. These include slumping or falling fence posts, trees, or foundations, sudden formation of small ponds, wilting vegetation, discolored well water, and structural cracks in walls and floors (University of Florida, 2015).

4.3.13.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to subsidence, all structures located in areas having karst or the potential for karst development were identified (see Figure 4.3.13-1). As discussed above, the degree of karst hazard varies within these areas. However, these areas broadly have the potential for subsidence or sinkhole development, and this analysis was designed to provide a conservative estimate of the facilities vulnerable to ground collapse. As in other profiles, it is important to note that the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 1,418, or 32 percent, are located in areas with karst or the potential for karst development (Table 4.3.13-3). These facilities have a combined replacement value of nearly $2.2 billion, or approximately 56 percent of the known value of geolocated state facilities. About half of the facilities considered vulnerable are owned by the state. Overall, 11.62 million of building square footage is reported within the DGS inventory.

Table 4.3.13-3 Vulnerability of State Facilities to Subsidence or Sinkholes.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	2	22%	0	53,215
Department of Agriculture	2	13%	1	64,253
Department of Banking and Securities		0%		
Department of Community and Economic Development	1	25%	0	3,521
Department of Conservation and Natural Resources		0%		
Department of Corrections	132	19%	123	4,021,451
Department of Education		0%		
Department of Environmental Protection	2	15%	0	51,670
Department of General Services	26	20%	26	3,943,587
Department of Health	16	33%	0	44,073
Department of Labor and Industry	20	29%	0	403,558
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	27	28%	0	453,073
Department of Revenue	4	40%	0	116,584
Department of Transportation	536	32%	473	1,388,286
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices	1	50%	0	11,282
Fish and Boat Commission	70	45%	69	160,496
Governor's Office		0%		
Historical and Museum Commission	7	23%	0	0
Insurance Department	2	100%	0	42,511
Liquor Control Board	156	29%	0	786,679
Public School Employees' Retirement System	1	17%	0	2,086
State Civil Service Commission	1	100%	0	620
State Department		0%		
State Employees' Retirement System	1	25%	0	2,291
State Police	6	17%	0	75,010
State System of Higher Education	385	45%		
Thaddeus Stevens College of Technology	20	100%	20	2,200
Treasury Department		0%		
Total	**1,418**	**32%**	**712**	**11,626,446**

Of the 13,448 geolocated critical facilities, 3,336 or 25 percent, are located within karst areas characterized as high subsidence or sinkhole hazard (Table 4.3.13-4). These facilities have a

combined replacement value of approximately $107 billion, or 27% of the known value of geolocated critical facilities.

Table 4.3.13-4 Vulnerability of Critical Facilities to Subsidence or Sinkholes.

TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	81	29%
Banking		0%
Commercial	4	19%
Communication	123	22%
Dam	199	13%
Education (colleges and universities)	117	29%
Education (public schools)	1341	29%
Emergency Operation Center	19	27%
Energy	76	21%
Fire Station	626	24%
Government	8	32%
Hospital	75	24%
National Monument or Icon	1	17%
Nuclear	2	40%
Police Station	327	25%
Transportation	164	24%
Water	173	27%
Total	**3,336**	**25%**

4.3.13.6. Jurisdictional Vulnerability Assessment and Loss Estimation

The northeast-trending valleys of the Ridge and Valley province are more desirable than adjacent ridges as sites for homes, farms, industry, and transportation routes. The residual soil in these valleys is excellent for agriculture, and, in many places, the carbonate rock is a valuable mineral resource and is a host rock for some metallic ore deposits. However, these areas are where most subsidence events occur.

Municipal governments determine guidelines for construction in high-subsidence areas. A community can reduce its vulnerability to subsidence or sinkholes by implementing solutions such as land use controls, insurance programs, subsidence-resistant designs, or in the case of mine-related subsidence, conduct selective support or mine filling. If a sinkhole occurs on private property, it is normally the responsibility of the property owner to initiate repairs. Homeowners' insurance often does not cover damages attributed to sinkholes. Since 1987, sinkhole insurance has been available within Pennsylvania and may serve to eliminate the financial burdens placed on the homeowner.

Careful planning is the least-costly and most effective method for reducing vulnerability to subsidence hazards. Municipalities could minimize the potential for sinkhole development

through proper maintenance and updating of water utility lines. Zoning laws can also be enacted to regulate development within highly karst areas.

The Surface Mining Control and Reclamation Act of 1977 imposes land use controls on active mines. This law requires an evaluation of whether subsidence could occur and cause material damage or diminution of use of structures or renewable resource lands. If there is potential for damage, a plan to prevent or mitigate the damage is required.

To assess the relative vulnerability of each county to subsidence or sinkhole development, all census blocks with centers located in areas with karst or karst potential were identified. These census blocks were considered to have a moderate to high hazard of subsidence and sinkhole development. The population, building counts, and building value of these moderate-to-high hazard census blocks were then aggregated to the county scale. The results of this analysis are shown in Table 4.3.13-5.

Table 4.3.13-5 Vulnerability of People and Buildings to Subsidence or Sinkhole Development.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Adams	16,773	6,827	$3,113,779	15%
Allegheny	383,593	161,412	$68,273,964	26%
Armstrong	23,231	11,870	$4,454,703	36%
Beaver	25,006	11,039	$7,380,040	22%
Bedford	19,351	10,934	$4,788,183	39%
Berks	253,329	86,248	$49,084,507	57%
Blair	52,462	23,886	$12,124,975	44%
Bradford				0%
Bucks	4,151	1,971	$1,600,143	1%
Butler	43,489	18,435	$9,856,277	22%
Cambria	434	239	$151,824	0%
Cameron				0%
Carbon	3,244	1,400	$413,317	4%
Centre	134,713	40,300	$26,449,550	86%
Chester	66,449	23,196	$21,486,469	15%
Clarion	12,058	6,652	$2,408,644	29%
Clearfield	787	324	$226,606	1%
Clinton	20,264	8,144	$3,315,765	53%
Columbia	28,297	10,967	$6,197,502	49%
Crawford				0%
Cumberland	161,112	58,581	$37,207,413	68%
Dauphin	61,321	22,542	$15,184,224	24%
Delaware				0%
Elk	35	9	$3,497	0%

Table 4.3.13-5 Vulnerability of People and Buildings to Subsidence or Sinkhole Development.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Erie				0%
Fayette	49,361	24,148	$9,715,991	39%
Forest				0%
Franklin	107,681	45,448	$23,027,544	73%
Fulton	4,240	2,483	$1,308,301	29%
Greene	5,368	2,790	$1,332,782	14%
Huntingdon	11,379	5,449	$2,169,324	27%
Indiana	6,321	3,426	$1,233,147	7%
Jefferson	9,432	6,101	$1,518,415	19%
Juniata	15,116	7,606	$2,986,969	69%
Lackawanna				0%
Lancaster	371,484	134,889	$74,749,263	71%
Lawrence	37,367	16,988	$5,943,012	41%
Lebanon	94,643	36,066	$19,598,383	67%
Lehigh	289,887	94,197	$58,131,128	77%
Luzerne	4,766	2,317	$1,001,263	2%
Lycoming	66,800	25,806	$12,142,014	56%
McKean				0%
Mercer	8,919	3,592	$2,198,119	8%
Mifflin	28,381	13,634	$5,387,924	58%
Monroe	12,459	5,195	$2,793,573	7%
Montgomery	58,962	20,981	$14,715,008	7%
Montour	11,905	4,524	$2,250,193	68%
Northampton	226,131	76,063	$43,460,895	74%
Northumberland	36,422	14,547	$8,399,622	41%
Perry	10,734	5,557	$2,006,269	24%
Philadelphia	258	79	$28,270	0%
Pike				0%
Potter				0%
Schuylkill	3,628	1,668	$735,366	2%
Snyder	22,704	8,776	$5,271,671	61%
Somerset	2,688	1,931	$1,330,738	6%
Sullivan	543	375	$167,344	8%
Susquehanna				0%
Tioga				0%
Union	40,787	12,595	$6,567,497	96%
Venango	2,905	1,696	$565,269	6%

Table 4.3.13-5 Vulnerability of People and Buildings to Subsidence or Sinkhole Development.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Warren				0%
Washington	82,287	38,944	$17,529,062	38%
Wayne				0%
Westmoreland	143,320	65,510	$30,939,427	39%
Wyoming	11	16	$5,231	0%
York	133,744	46,816	$28,174,855	34%
Total	**3,210,732**	**1,235,189**	**$661,105,251**	**24%**

Using the methodology defined above, 53 counties were identified as having population and buildings vulnerable to subsidence or sinkhole development. Throughout the Commonwealth, 3,210,732 people have been identified as vulnerable to this hazard. The counties with the largest vulnerable populations include Allegheny, Lancaster, Lehigh, and Northampton Counties. In contrast, the counties with the highest percentage of exposed building value are Union, Juniata, Centre, Lehigh, and Northampton Counties.

Subsidence repair or preemptive mitigation can be quite costly for local communities. Areas that have already undergone development have special problems in re-design and re-construction. After-the-fact methods of subsidence repair are often expensive and offer no guarantee that the problem will not re-occur. Sinkhole repair for Vera Cruz Road in Lehigh County cost nearly $80,000, and a new sinkhole opened, just outside the repair area, within six months. Bruhn et al. (1978) reported in a study of the Pittsburgh coal, that annual costs for remedial measures and repairs were $438,000. This estimate does not include the cost of damage to commercial structures, utilities, or transportation rights-of-way, and the cost of engineering and construction measures undertaken to prevent or minimize subsidence damage. In a study of damage from active mining in western Pennsylvania, Bruhn et al. (1982) reported that home repair costs (measured in 1981-dollar values) ranged from a few hundred dollars to more than $100,000. The median repair cost was $6,000 to $10,000 per home.

4.3.14. Tornado, Windstorm

4.3.14.1. Location and Extent

Both tornado and windstorm events can occur throughout Pennsylvania. A tornado is a narrow, violently rotating column of air that extends from a thunderstorm to the ground (NOAA NSSL, 2022b). Windstorms are generally defined with sustained wind speeds of 40 mph or greater lasting for one hour or longer, or winds of 58 mph or greater for any duration (NOAA NWS, 2022d).

Tornado events are usually localized. However, severe thunderstorms may result in conditions favorable to the formation of numerous or long-lived tornadoes. While tornadoes nationally can occur at any time during the day or night or any month of the year but are most frequent during late afternoon into early evening, the warmest hours of the day, and most likely to occur during the spring and early summer months of March through June (NOAA NSSL, 2022b), they are most frequent (and most violent) in May, June, and July for Pennsylvania. Tornadoes can and have occurred during any month of the year in Pennsylvania. Figure 4.3.14-1 and Figure 4.3.14-2 show showcase this data. Tornado movement is characterized in two ways: direction and speed of spinning winds and forward movement of the tornado, also known as the storm track. Most tornadoes have a damage path of around 50 yards, are on the ground for five to ten minutes, and travel 10 to 20 mph (NOAA NSSL, 2022b; NOAA NWS, n.d.d) Some attain wind speeds of more than 300 mph (480 km/h), stretch more than a mile (1.6 km) across, and stay on the ground for dozens of miles (more than 100 km) (Hirschlag, 2022).

Figure 4.3.14-1 Tornadoes by Month in Pennsylvania 1950-2022 (PEMA, 2022)

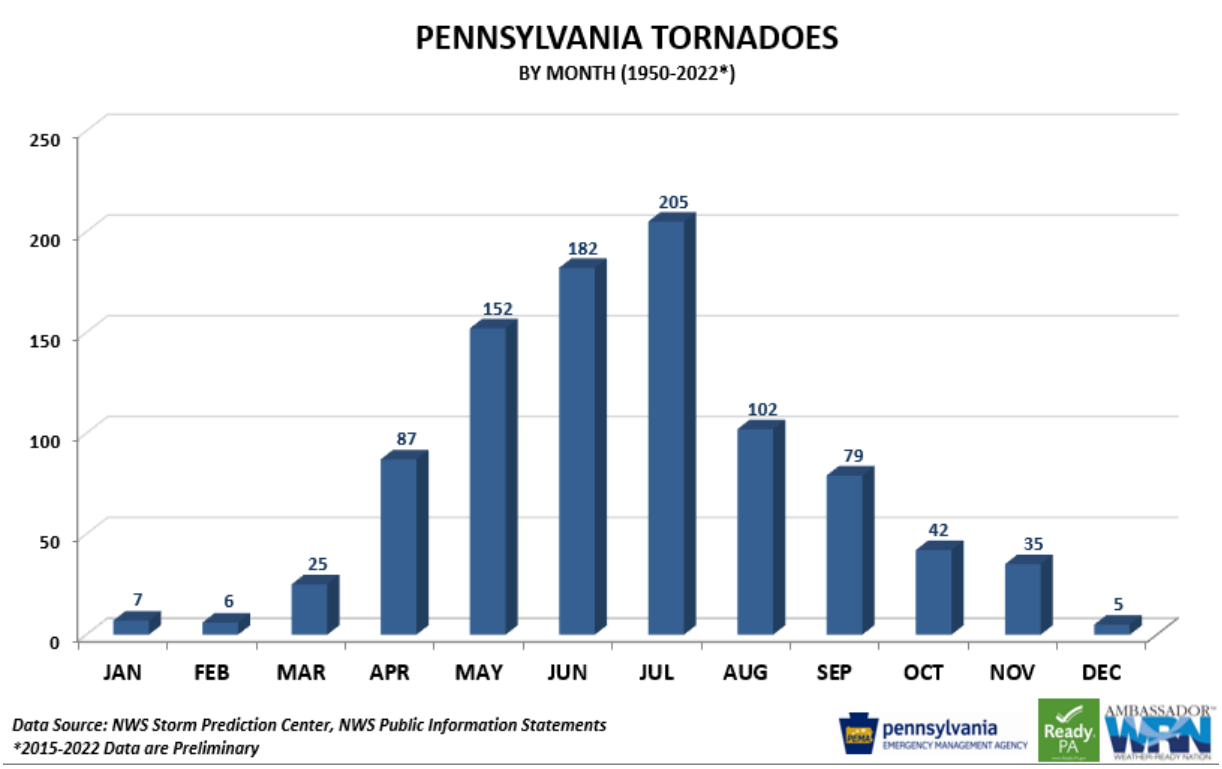
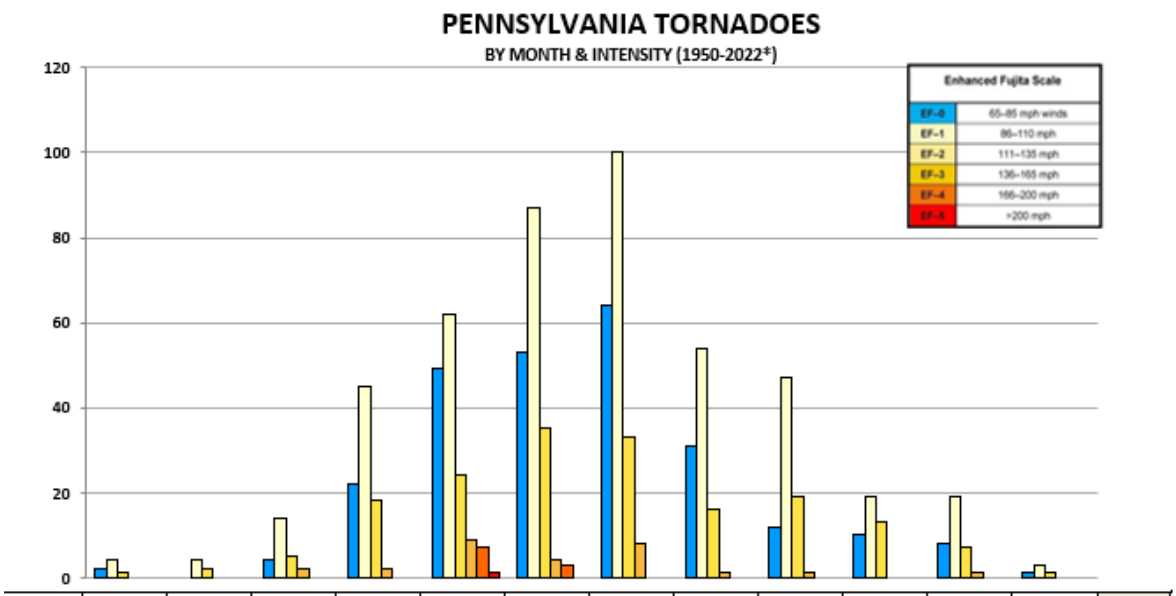


Figure 4.3.14-2 Intensity of Tornadoes by Month in Pennsylvania 1950-2022 (PEMA, 2022)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
EF-0	2	0	4	22	49	53	64	31	12	10	8	1	256
EF-1	4	4	14	45	62	87	100	54	47	19	19	3	458
EF-2	1	2	5	18	24	35	33	16	19	13	7	1	174
EF-3	0	0	2	2	9	4	8	1	1	0	1	0	28
EF-4	0	0	0	0	7	3	0	0	0	0	0	0	10
EF-5	0	0	0	0	1	0	0	0	0	0	0	0	1

Data Source: NWS Storm Prediction Center, NWS Public Information Statements
Note: Note Fujita (F) Scale upgraded to Enhanced Fujita (EF) Scale in 2007
**2015-2022 Data are Preliminary*

Straight-line winds and windstorms are different from tornadoes in that they don't involve any rotation. They are experienced on a region-wide scale. They may accompany tornadoes and thunderstorms as straight-lined winds are caused by the movement of air from areas of higher pressure to areas of lower pressure (NOAA NSSL, 2022e). Stronger winds are the result of greater differences in pressure. Wind events can vary in spatial size from small microscale events which take place over only a few hundred feet to large-scale synoptic wind events often associated with warm or cold fronts (NOAA NSSL, 2022e).

4.3.14.2. Range of Magnitude

On average, 60 people are killed each year from tornadoes in the United States (Edwards, 2021). From 2010 to 2021, tornadoes caused $14.1 billion in damages, an average of $2.5 million per storm (Hurst, 2021). 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 wind-blown debris, also accompanied by lightning or large hail. The most violent tornadoes have

rotating winds of 300 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles (NOAA NSSL, 2022a).

Most years there are far more damage reports from thunderstorm straight line winds than from tornadoes (NOAA NWS, 2022e). In damaging high wind conditions, wind damage occurs to unanchored mobile homes, porches, carports, awnings, pool enclosures, and with some shingles blown from roofs. Large branches break off trees with weak or diseased trees blown down. Loose objects are easily blown about and can become dangerous projectiles. Widely scattered power outages may occur. Winds are considered extremely dangerous for high profile vehicles and for boaters on area lakes (NOAA NWS, 2022d).

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 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," which was published in 1971. The EF-Scale provides engineered wind estimates and better damage descriptions. It classifies United States tornadoes into six intensity categories, as shown in Table 4.3.14-1, based upon the estimated maximum winds occurring within the wind vortex. 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. F-Scale categories with corresponding EF-Scale wind speeds are also provided since previous tornado occurrences are described based on the F-Scale (NOAA NWS, 2022f).

Table 4.3.14-1 Enhanced Fujita Scale (EF-Scale) Categories with Associated Wind Speeds and Description of Damages (NOAA NWS, 2022f).

EF-SCALE NUMBER	WIND SPEED (MPH)	F-SCALE NUMBER	TYPE OF DAMAGE POSSIBLE
EF0	65–85	F0-F1	**Light damage**: Chimneys are damaged, tree branches are broken, shallow-rooted trees are toppled.
EF1	86-110	F1	**Moderate damage**: Roof surfaces are peeled off, windows are broken, some tree trunks are snapped, unanchored mobile homes are overturned, attached garages may be destroyed.
EF2	111–135	F1-F2	**Considerable damage**: Roof structures are damaged, mobile homes are destroyed, debris becomes airborne, (missiles are generated), large trees are snapped or uprooted.
EF3	136–165	F2-F3	**Severe damage**: Roofs and some walls are torn from structures, some small buildings are destroyed, nonreinforced masonry buildings are destroyed, most trees in forest are uprooted.

Table 4.3.14-1 Enhanced Fujita Scale (EF-Scale) Categories with Associated Wind Speeds and Description of Damages (NOAA NWS, 2022f).			
EF-SCALE NUMBER	WIND SPEED (MPH)	F-SCALE NUMBER	TYPE OF DAMAGE POSSIBLE
EF4	166–200	F3	**Devastating damage**: Well-constructed houses are destroyed, some structures are lifted from foundations and blown some distance, cars are blown some distance, large debris becomes airborne.
EF5	>200	F3-F6	**Extreme damage**: Strong frame houses are lifted from foundations, reinforced concrete structures are damaged, automobile-sized missiles become airborne, trees are completely debarked.

The impact of tornado hazards is ultimately dependent on the population or amount of property (i.e., buildings, infrastructure, agricultural land, etc.) present in the area in which the tornado occurs. Tornado events are often so severe that property loss or human fatality is typically inevitable if evacuation or proper construction standards are not implemented.

Since tornado events are typically localized, environmental impacts are rarely widespread. The impacts of windstorms on the environment typically take place over a larger area. In either case, where these events occur, severe damage to plant species is likely. This includes uprooting or total destruction of trees and an increased threat of wildfire in areas where dead trees are not removed. Hazardous material facilities should meet design requirements for the wind zones identified in Figure 4.3.14-3 in order to prevent release of hazardous materials into the environment.

Figure 4.3.14-3 shows wind speed zones developed for the design of tornado shelters. It identifies worst-case wind speeds that could occur across the United States to be used as the basis for design and evaluation of the structural integrity of shelters and critical facilities. Eastern Pennsylvania falls within Zone II, meaning design wind speeds for shelters and critical facilities should be able to withstand a 3-second gust of up to 160 mph, regardless of whether the gust is the result of a tornado, hurricane, tropical storm, or windstorm event. Central and parts of western Pennsylvania fall within Zone III, meaning design wind speeds for shelters and critical facilities should be able to withstand a 3-second gust of up to 200 mph. Western and northwestern Pennsylvania are located in Zone IV; design wind speeds for shelters and critical facilities should be able to withstand a 3-second gust of up to 250 mph. Also, it is important to note that eastern and south-central Pennsylvania is within a hurricane-susceptible wind zone. For more information on hurricanes in Pennsylvania, see Section 4.3.7. The wind zones identified in Figure 4.3.14-3 represent the strongest wind speeds anticipated throughout Pennsylvania, not the normal or routine wind speeds expected statewide.

Figure 4.3.14-3 Design Wind Speeds for Tornado Shelters (ICC 500, 2020).

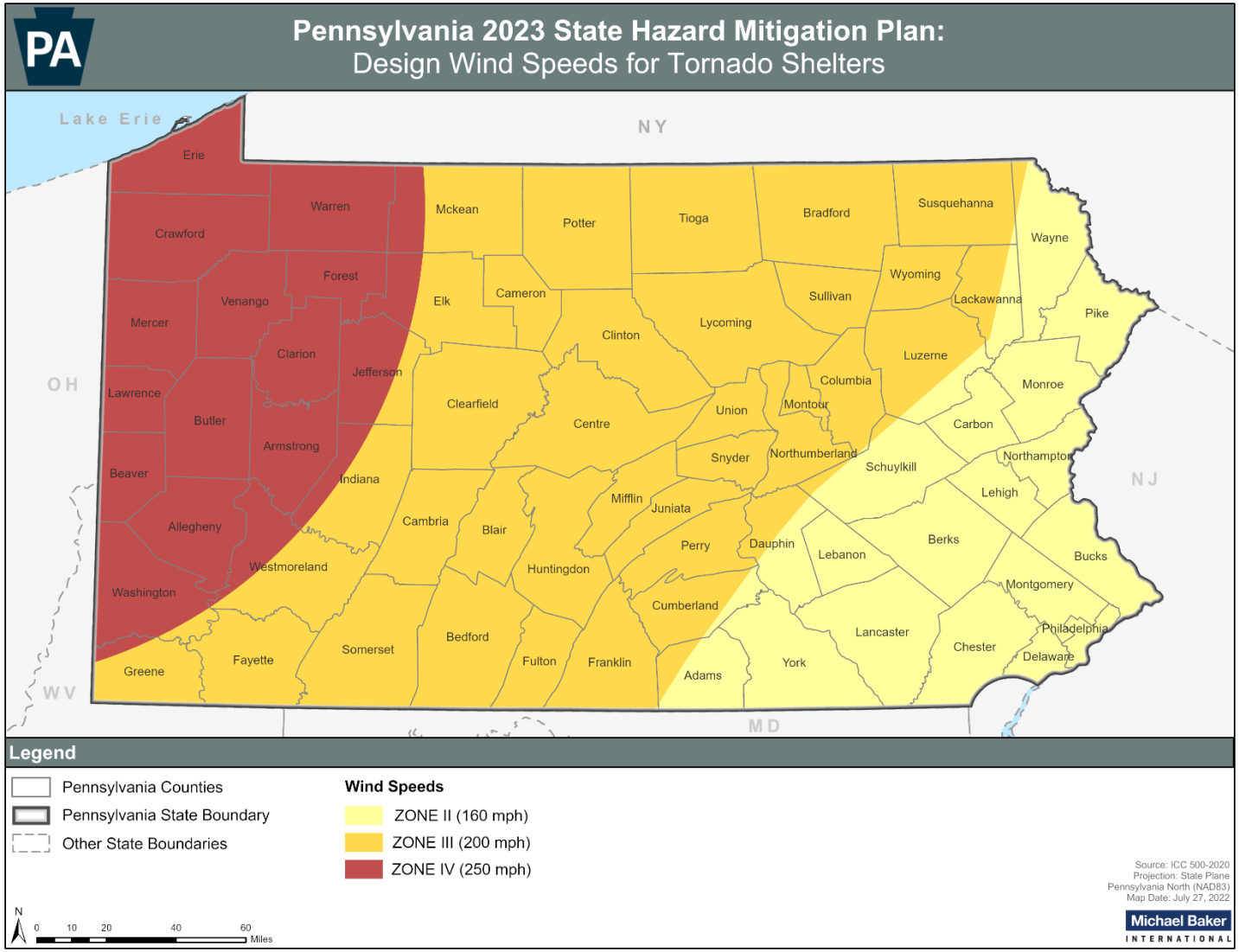
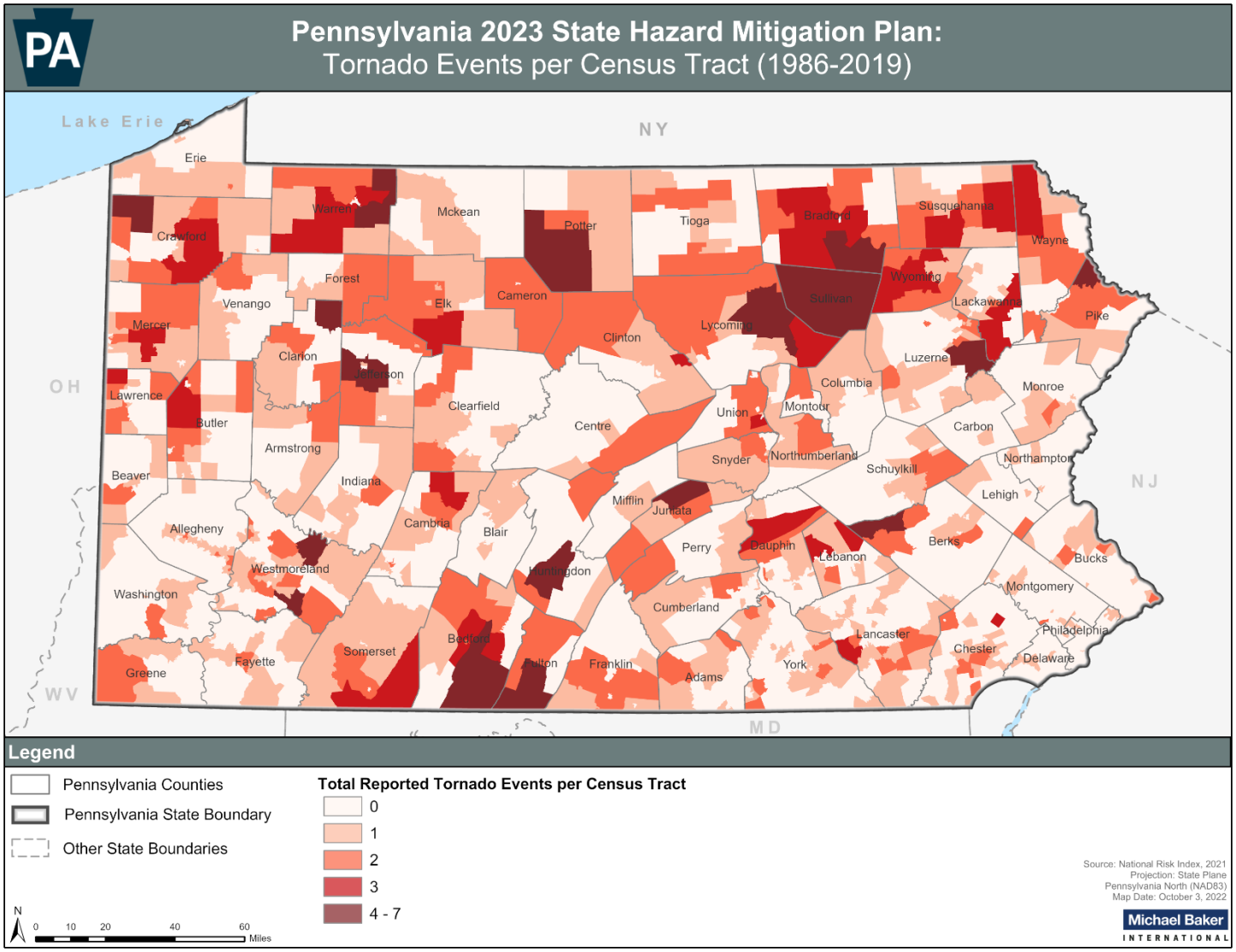


Table 4.3.14-2 Most Likely Lifelines Impacted by Tornadoes and Windstorms		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and compounding impacts where community safety may be threatened due to potential harm from tornadoes, high winds, and associated weather conditions. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the dangers and best safety precautions or encouraging the construction of safe rooms in certain facilities or homes.
Food, Water, Shelter		Anticipating a causal and compounding relationship for the Food, Water, Shelter lifeline in response and recovery. Tornadoes and windstorms cause significant damage to agricultural operations and structures. Mitigation actions for this lifeline should be focused on protecting buildings from damage through requiring wind-resistant building techniques.
Energy		Anticipating a causal and compounding relationship for the Energy lifeline in response and recovery due to potential direct damage from tornadoes and windstorms and compounding issues from associated weather such as lightning. Mitigation should be focused on increasing grid resilience.
Hazardous Materials		Anticipating a causal relationship to the Hazardous Materials lifeline in both response and recovery due to the significant damage tornadoes and windstorms can cause to storage facilities and operations. Mitigation actions may be similar to the Food, Water, Shelter lifeline and focused on increasing structure resilience.

4.3.14.3. Past Occurrence

Tornadoes have occurred throughout Pennsylvania. Between the years 1986 and 2019, There are some clusters where tornado events have occurred more frequently, such as in the south near Bedford County, and Northeast towards Sullivan County. Figure 4.3.14-4 provides a map the maximum number of tornado touchdowns per census tract across the state from 1986 to 2019.

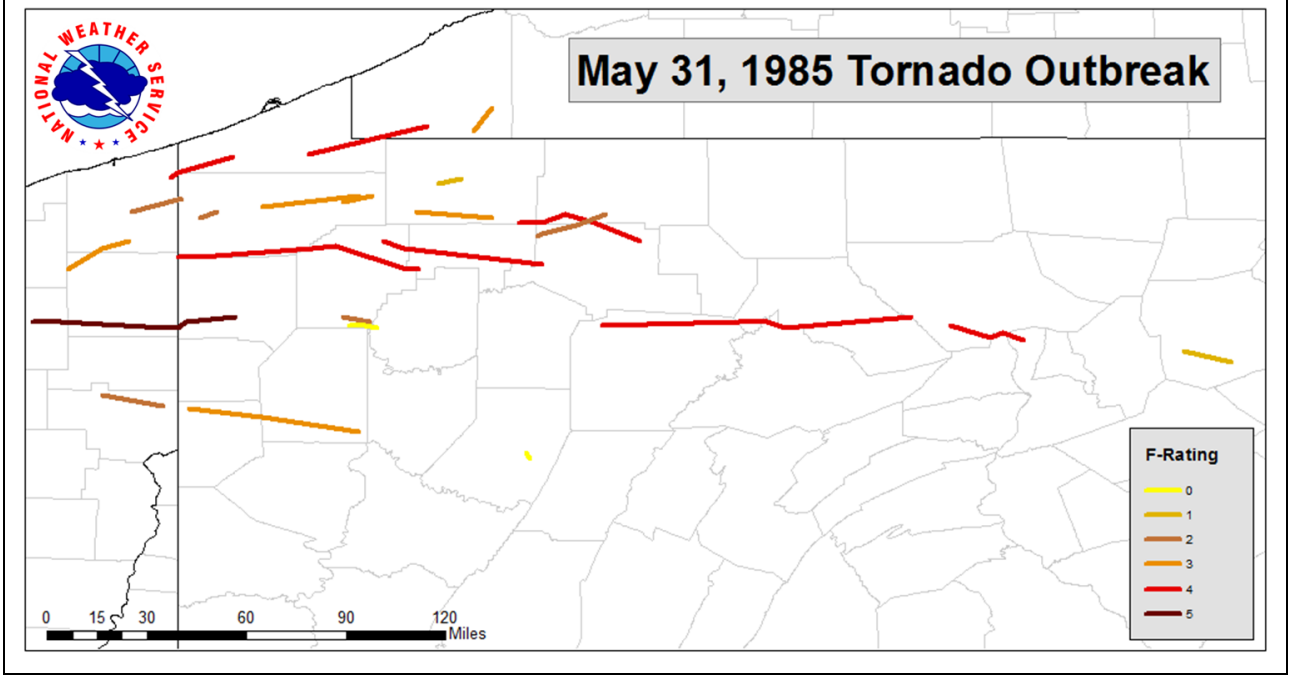
Figure 4.3.14-4 Tornado Events per Census Tract (FEMA NRI 2021).



The worst-case single tornado event on record occurred on June 3, 1980, across Allegheny, Armstrong, and Westmoreland Counties. This F4 tornado injured about 140 people and caused $250 million in property damage through its nearly 12-mile track across the three counties (NCEI, 2018).

On May 31, 1985, a very rare outbreak of 43 tornadoes tracked across northwest Pennsylvania, northeast Ohio, southwest New York, and even parts of southern Ontario, Canada. Pennsylvania was the hardest hit with tornadoes impacting Erie, Warren, Crawford, Forest, Mercer, Venango, Mercer, and Butler counties (Figure 4.3.14-5). One of these tornadoes was rated an F5 while seven were rated F4s on the old Fujita Scale. The deadliest tornado touched down in Wheatland, PA as an F5 on the old Fujita Scale, killing 18 people and injuring 310 as it traversed 47 miles in a little over an hour (NOAA NWS, 2020). According to the National Center for Environmental Information, 65 people died and 526 were injured in Pennsylvania and over $378 million worth of property damage was incurred from these tornadoes (NCEI, 2018).

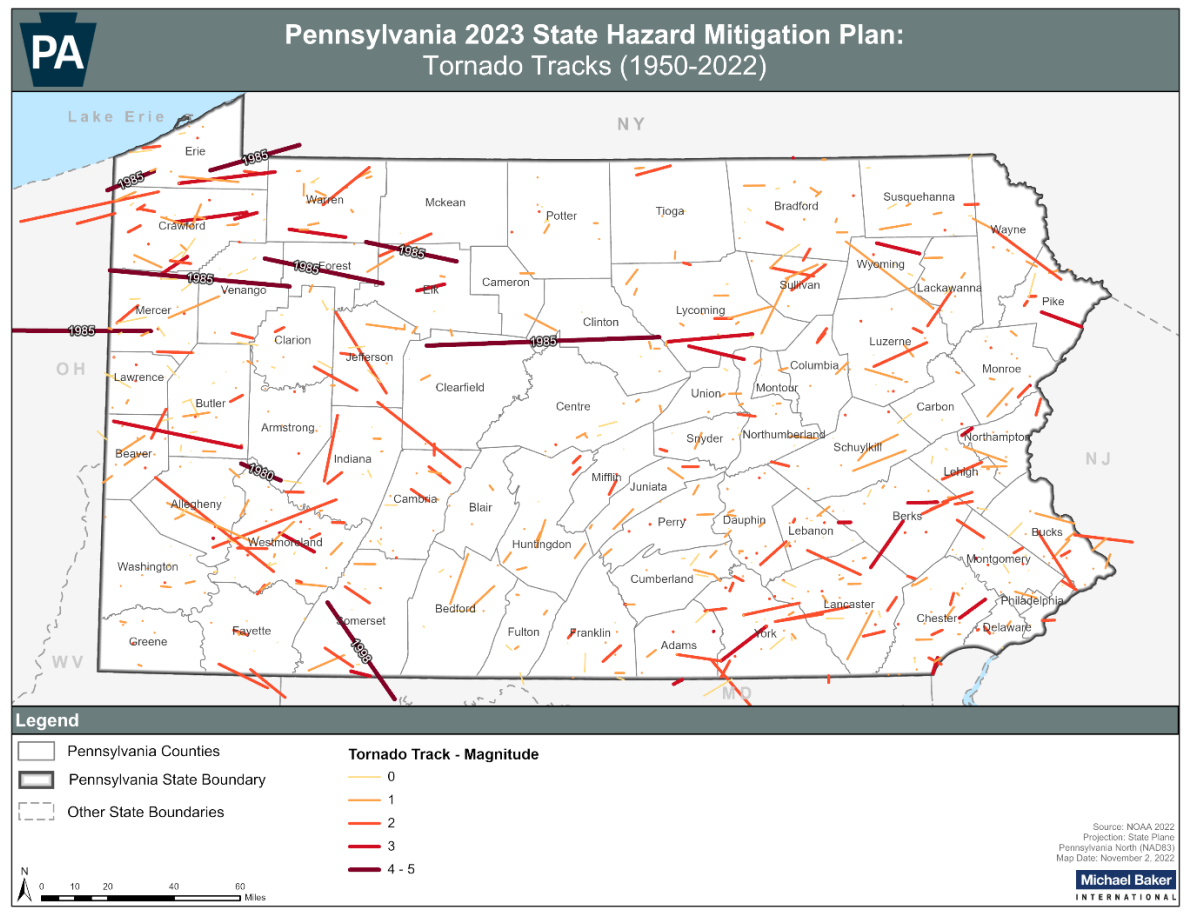
Figure 4.3.14-5 Map Showing Tornado Tracks During the May 31, 1985, Tornado Outbreak (NOAA NWS, 2015b).



According to the NCEI Storm Events Database, there has been an increase in the total amount of tornadoes recorded in recent decades. From 1950-1995 (46 years) there were 493 tornadoes recorded, while 497 were recorded from 1996-2021 (26 years). This seems to be a regional trend and potentially a product of reporting methods, as the National Weather Service reports that tornado frequency across the country has remained relatively consistent since 1950 while reporting procedures have evolved (NOAA NWS, 2018b). The 44-50 tornadoes in 2021 (SPC and NCEI reported numbers, respectively) were the most since 1998 (62), with the years in between having fluctuating totals between 5 (2008) and 37 (2019). A few notable events from 2021 are the first EF-3 tornado in the state since 2004 recorded in the Philadelphia suburbs, a handful of tornadoes as a result of Hurricane Ida in the southeast that resulted in one death, and

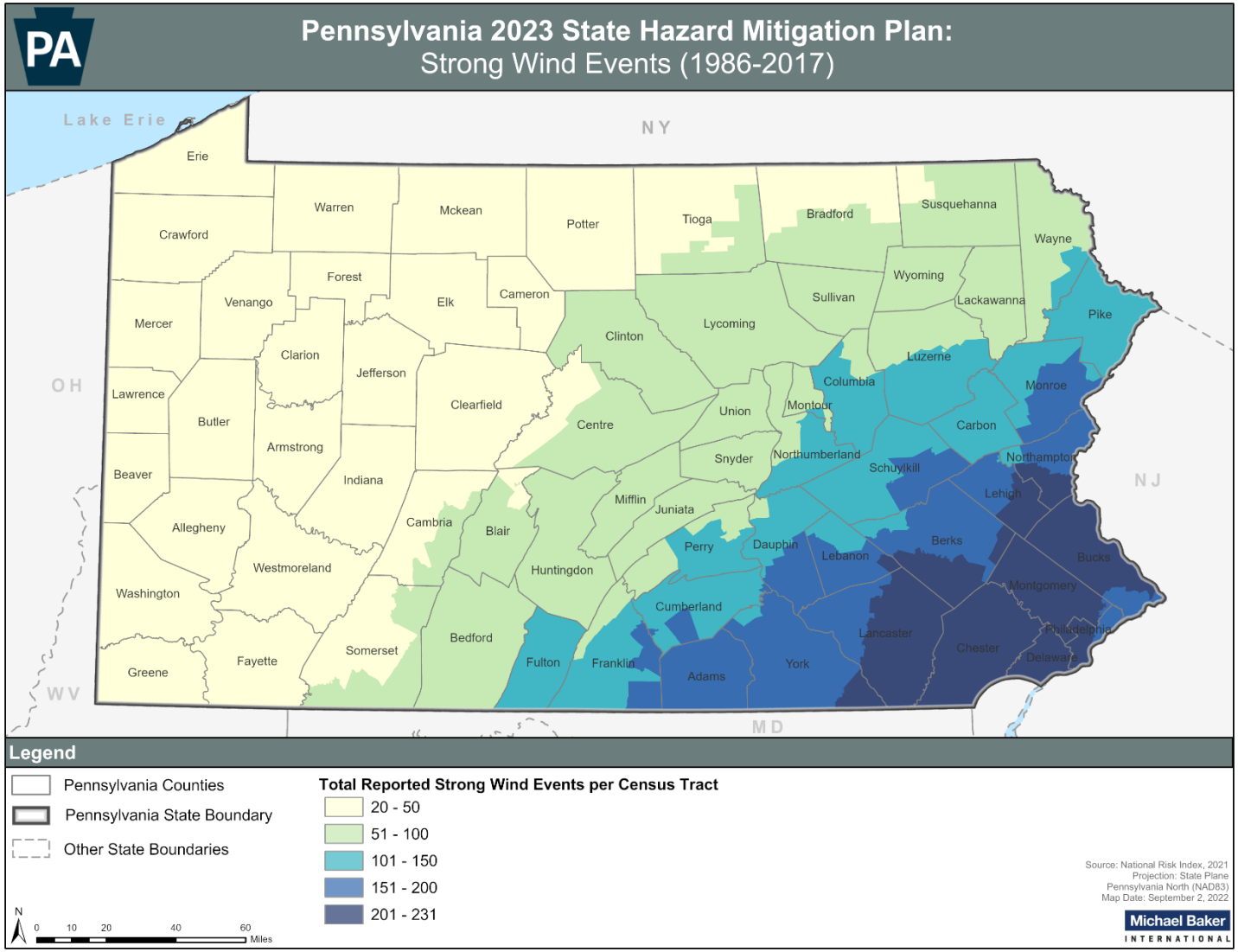
an EF-2 tornado in late October that caused significant damage in Buffalo Township, which headlined a day with 18 tornadoes across eastern Ohio and western Pennsylvania (NOAA NCEI, 2022b). Figure 4.3.14-6 below represents the paths of historical tornadoes in Pennsylvania between the years 1950 and 2022. Paths also display the reported magnitude of the event, with the strongest tornadoes being labeled with their corresponding year. The map shows the rare strong events of 1985 in the northeast, and many smaller tornadoes in the eastern part of the state. It can be seen that the center of the state has had far fewer tornadoes than the east and west.

Figure 4.3.14-6 Map of Historical Tornado Tracks (1950-2022).



Maximum number of strong wind events per census tract in Pennsylvania between 1986 and 2017 are provided in Figure 4.3.14-7. Events may be the result of thunderstorms, hurricanes, tropical storms, winter storms, or nor'easters. The most activity is recorded in the southeastern region of the state, with occurrences decreasing steadily as you move both west and north.

Figure 4.3.14-7 Map Showing Maximum Number of Strong Wind Events per Census Tract in Pennsylvania from 1986-2017 (FEMA NRI, 2021).



4.3.14.4. Future Occurrence

In the United States, variability in tornado activity has increased, with fewer days of year of activity but more activity on those days (Brooks et al., 2014). Climate models project atmospheric conditions conducive to severe thunderstorms, tornadoes, and hail and wind will become more likely, but those events may not actually become more frequent themselves (Kossin et al. 2017). Projecting tornado activity based on more conducive conditions is difficult, as less than 10% of severe thunderstorms even produce tornadoes (Treisman, 2021). This unpredictable nature, combined with the inconsistent observational record on tornadoes, makes developing models and creating projections very difficult (Lindsey, 2016). Therefore, confidence in any projections for future activity is generally low.

4.3.14.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to tornadoes and windstorms, all structures located within census tracts where there have been 3 or more tornado events between 1986 and 2019, or census tracts that have more than 200 strong wind events between 1986 and 2017, as shown in Table 4.3.14-3. Of the 4,460 geolocated state facilities, 876, or 20 percent, are located within these vulnerable census tracts. These facilities have a combined replacement value of more than $364 million, or approximately 9% of the known value of geolocated state facilities. Of the 876 vulnerable facilities, 376 are reported to be owned by the state. Overall, 6.48 million square feet of building space is found to exist in areas vulnerable to tornado or strong wind events.

Table 4.3.14-3 State Facilities Vulnerable to Tornadoes or Windstorms for Each Department.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	3	33%	0	77,511
Department of Agriculture	1	6%	0	3,398
Department of Banking and Securities	1	50%	0	4,859
Department of Community and		0%		
Department of Conservation and		0%		
Department of Corrections	20	3%	10	589,441
Department of Education	1	100%	1	0
Department of Environmental	1	8%	0	85,000
Department of General Services	45	34%	43	2,886,297
Department of Health	5	10%	0	59,853
Department of Labor and Industry	14	20%	0	191,825
Department of Military and	1	100%	0	2,500
Department of Public Welfare	26	27%	0	520,622
Department of Revenue	3	30%	0	27,043
Department of Transportation	309	18%	288	591,198
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		

Table 4.3.14-3 State Facilities Vulnerable to Tornadoes or Windstorms for Each Department.				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Executive Offices		0%		
Fish and Boat Commission	12	8%	12	24,075
Governor's Office		0%		
Historical and Museum	12	40%	1	2,730
Insurance Department		0%		
Liquor Control Board	167	31%	1	1,311,290
Public School Employees'	1	17%	0	4,025
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement		0%		
State Police	8	22%	0	97,946
State System of Higher Education	226	26%		
Thaddeus Stevens College of	20	100%	20	2,200
Treasury Department		0%		
Total	**876**	**20%**	**376**	**6,481,813**

Of the 13,448 geolocated critical facilities 3,776, or 28 percent, located within census tracts where the maximum number of tornado events between 1986 and 2019 is 3 or more, or census tracts that have more than 200 strong wind events between 1986 and 2017 (Table 4.3.14-4). These facilities have a combined replacement value of more than $112 billion, or nearly 29% of the known value of geolocated critical facilities.

Table 4.3.14-4 State Critical Facilities Vulnerable to Tornadoes and Windstorms by Critical Facility Type		
STATE CRITICAL FACILITY TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	95	35%
Banking	2	50%
Commercial	11	52%
Communication	115	21%
Dam	293	20%
Education (colleges and universities)	146	37%
Education (public schools)	1741	37%
Emergency Operation Center	14	20%
Energy	80	22%
Fire Station	574	22%
Government	3	12%
Hospital	97	31%
National Monument or Icon	4	67%

Table 4.3.14-4 State Critical Facilities Vulnerable to Tornadoes and Windstorms by Critical Facility Type		
STATE CRITICAL FACILITY TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Nuclear	2	40%
Police Station	311	24%
Transportation	166	24%
Water	122	19%
Total	**3,776**	**28%**

4.3.14.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to tornadoes, all census tracts where the maximum number of tornado events between 1986 and 2019 is 3 or more, or census tracts that have more than 200 strong wind events between 1986 and 2017 were identified. The population, building counts, and building value of all vulnerable census blocks were then aggregated to the county scale and compiled in Table 4.3.14-5. Across the state, about 4.77 million people are located in census tracts vulnerable to tornadoes or windstorms. There are also over 1.7 million buildings that are vulnerable to tornadoes or windstorms. The total replacement value for which is just over $1 trillion, or about 38 percent of the total value for all buildings in the state.

Table 4.3.14-5 Estimated Jurisdictional Losses due to Tornadoes and Windstorms.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Adams				0%
Allegheny				0%
Armstrong				0%
Beaver				0%
Bedford	15,798	9,966	$4,534,423	37%
Berks	274,283	95,489	$51,834,128	61%
Blair				0%
Bradford	17,880	11,098	$4,695,945	33%
Bucks	396,211	153,115	$108,354,804	68%
Butler	10,330	5,568	$2,705,028	6%
Cambria	6,046	3,282	$1,584,082	5%
Cameron				0%
Carbon				0%
Centre				0%
Chester	534,152	189,944	$145,853,432	100%
Clarion	1,781	1,933	$666,366	8%
Clearfield				0%
Clinton	4,889	1,882	$647,378	10%

Table 4.3.14-5 Estimated Jurisdictional Losses due to Tornadoes and Windstorms.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Columbia				0%
Crawford	18,198	11,308	$5,557,440	23%
Cumberland				0%
Dauphin	7,818	4,031	$1,903,369	3%
Delaware	576,352	190,740	$118,654,633	100%
Elk	4,937	3,287	$1,389,981	17%
Erie				0%
Fayette	54	63	$35,077	0%
Forest				0%
Franklin				0%
Fulton	4,692	3,441	$1,642,852	36%
Greene				0%
Huntingdon	3,416	2,168	$599,516	8%
Indiana				0%
Jefferson	5,589	3,773	$1,218,326	15%
Juniata	7,063	3,422	$1,392,490	32%
Lackawanna	13,010	5,505	$3,384,175	7%
Lancaster	388,685	143,037	$73,897,071	70%
Lawrence	3,102	1,690	$527,671	4%
Lebanon	13,641	6,578	$3,604,612	12%
Lehigh	300,360	98,712	$54,201,431	72%
Luzerne	3,982	2,137	$743,855	1%
Lycoming	16,157	8,924	$3,467,051	16%
McKean				0%
Mercer	5,834	3,107	$1,832,100	7%
Mifflin				0%
Monroe				0%
Montgomery	837,765	289,187	$202,628,739	98%
Montour				0%
Northampton	166,030	56,438	$31,208,481	53%
Northumberland				0%
Perry	5	8	$14,361	0%
Philadelphia	1,051,119	351,475	$183,217,702	71%
Pike	3,510	4,139	$1,922,710	11%
Potter	2,793	2,476	$530,903	19%
Schuylkill				0%

Table 4.3.14-5 Estimated Jurisdictional Losses due to Tornadoes and Windstorms.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Snyder				0%
Somerset	6,297	4,645	$2,407,693	10%
Sullivan	5,840	6,562	$2,049,204	100%
Susquehanna	8,560	7,131	$3,410,860	25%
Tioga				0%
Union	5,920	2,266	$1,149,641	17%
Venango				0%
Warren	12,071	9,218	$2,356,934	32%
Washington				0%
Wayne	3,077	2,912	$880,629	7%
Westmoreland	9,341	5,199	$2,362,032	3%
Wyoming	7,105	3,624	$1,772,788	31%
York	12,179	4,976	$1,969,205	2%
Total	**4,765,872**	**1,714,456**	**$1,032,809,118**	**38%**

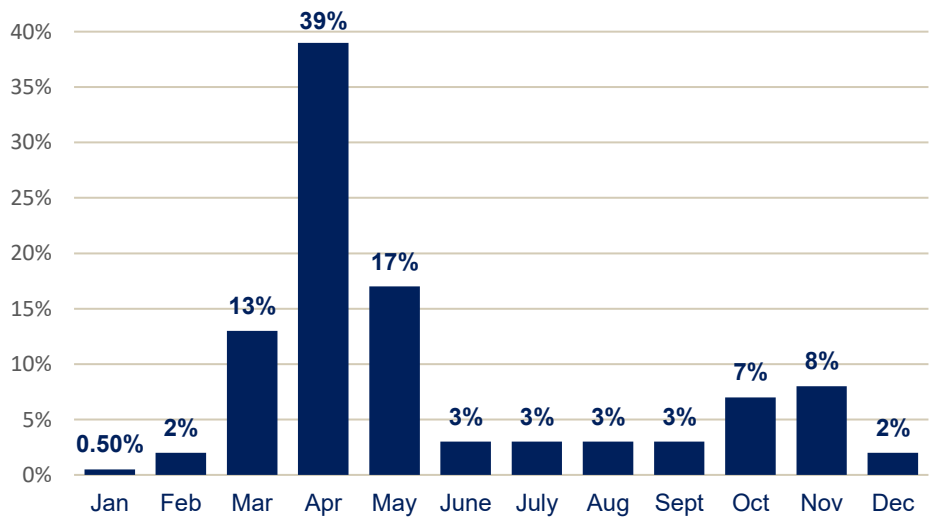
4.3.15. Wildfire

4.3.15.1. Location and Extent

Wildfires occur throughout wooded and open vegetation areas of Pennsylvania. Open fields, grass, dense brush, and forest-covered areas are typical sites for wildfire events. Under dry conditions or droughts, wildfires have the potential to burn forests as well as croplands. Any small fire, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness or negligence. However, some are precipitated by lightning (DCNR, 2022c). According to DCNR's Bureau of Forestry, on average there is one fatality and four residences destroyed each year due to wildfire, with fires that cause the greatest damage to life and property being less than five acres on average.

Wildfires can occur any time of the year, but mostly occur during long, dry hot spells. The greatest potential for wildfires is in the spring months of March, April, and May, and, to a lesser extent, the autumn months of October and November. In the spring, bare trees allow sunlight to reach the forest floor, drying fallen leaves and other ground debris. In the fall, dried leaves are also fuel for fires (DCNR, 2022c). The percentage of wildfires occurring each month is shown in Figure 4.3.15-1.

Figure 4.3.15-1 Percentage of Wildfires Occurring Each Month in Pennsylvania (1940-2021) (PA DCNR, 2022c)



Most wildfires in Pennsylvania are caused by people, often by debris burns (DCNR, 2021). Table 4.3.15-1 displays the primary causes of wildfires throughout Pennsylvania in 2021. Debris burning accounted for the largest number of wildfires (746) and the largest number of acres

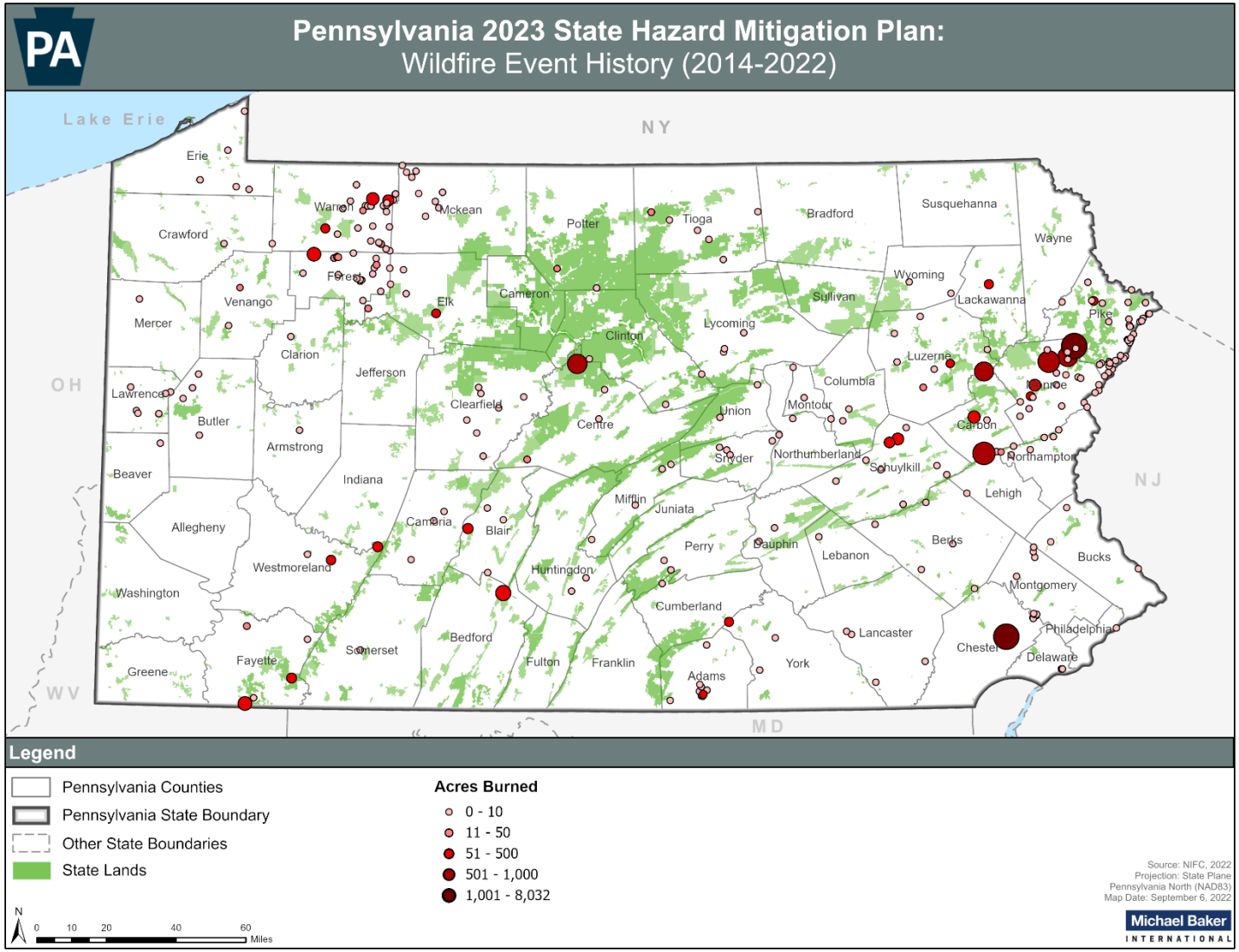
burned (1,181) (DCNR, 2021). Several fires have started in a person's backyard and traveled through dead grasses and weeds into bordering woodlands. Ninety-two percent of Pennsylvania wildfires burn less than ten acres and are suppressed within the first burning period.

Table 4.3.15-1 Pennsylvania Wildfire Causes in 2021 (DCNR, 2021).

CAUSE	NUMBER OF FIRES	NUMBER OF ACRES BURNED	PERCENT OF TOTAL FIRES	PERCENT OF ACRES BURNED
Campfire	47	179.2	3.4%	6.0%
Children	11	12.3	0.8%	0.4%
Debris Burning	746	1,181.7	54.4%	39.6%
Equipment Use	112	163.8	8.2%	5.5%
Fireworks	9	2.6	0.7%	0.1%
Incendiary	130	679.7	9.5%	22.8%
Lightning	3	0.3	0.2%	0.0%
Miscellaneous	91	169.1	6.6%	5.7%
Power Line	141	465.0	10.3%	15.6%
Railroad	61	74.7	4.4%	2.5%
Smoking	8	2.0	0.6%	0.1%
Structure	12	51.0	0.9%	1.7%
TOTAL	**1,371**	**2,981**	***100%***	***100%***

Figure 4.3.15-2 shows the location and size of wildfires that occurred in Pennsylvania between 2014 and 2022 as compiled by the National Interagency Fire Center (NIFC, 2022). The NIFC is the nation's logistical and support center for wildland fires, coordinating and support efforts amongst many local, state, and federal agencies. The wildfire records were acquired from the reporting systems of federal, state, and local fire organizations. This data, and all the wildfire data in this section, represents the best available data for wildfire hazards. Wildfire are relatively frequent hazard events that involve emergency response from thousands of different jurisdictions at all levels of government. A 2017 study using data from the National Fire Incident Reporting System (NFIRS) found that it had failed to record a significant number of fires in California; they believe the same underreporting has been happening across the country (Butry and Thomas, 2017). It is estimated that five to ten thousand wildfires occur annually in Pennsylvania. As shown in Figure 4.3.15-2, Monroe County and the state's eastern counties have experienced the largest number of wildfires in the period of record.

Figure 4.3.15-2 Map Showing Location and Size of Wildfires (National Interagency Fire Center, 2022).



Areas of the Commonwealth that have large home developments built in volatile fuel types are at risk for catastrophic wildfires. Many areas of the state are at risk for large wildfires, but Northeastern Pennsylvania is the most at risk for loss of life and/or property due to the number of homes at risk for wildfires. This area has large home developments built in volatile fuel types including scrub oak, mountain laurel, blueberry, and huckleberry. If spring weather conditions were perfect for a fire (i.e., clear sky, high winds, low relative humidity, and a prolonged period of dry weather), it is possible that 10,000 acres or more could burn in areas of Monroe or Pike Counties, as they nearly did in 2016 (DCNR, 2016b)

In locations where homes are at risk for wildfires, the BOF's Wildland/Urban Interface Guidance Document is available to assist homeowners, community associations, local government, and developers to assess and mitigation the potential dangers of a wildfire. The guidance also provides information for developing an action plan in coordination with local emergency managers. Communities at risk for wildfires can adopt by local ordinance the ''International Wildland-Urban Interface Code" of the Uniform Construction Code. The actions under Objective 1-9 address Wildland-Urban Interface related mitigation.

4.3.15.2. 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. They often destroy property, valuable timber, forage, and recreational and scenic values. In 2016, the state experienced its largest fire since 1990 when two fires joined to burn almost 9,000 acres along the Monroe-Pike County line across a two-week period (DCNR, 2016b).

In addition to the risk wildfires pose to the 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.

A potential worst-case scenario for a wildfire in Pennsylvania would be if a large fire ignited in/around a secluded but populated area of the Pocono Mountains. This kind of an event could cause damage to homes, threaten lives, and destroy stands of trees with both agricultural and tourism economic value. The seclusion of housing developments along with the strong availability of wildfire fuel could also complicate emergency response and home defense.

Environmentally, vegetation loss is a concern but typically not a serious impact as fires burn dead trees, leaves, and grasses that add nutrients to soil and can both stimulate and help create space for new growth (USDA-FS, nd.). However, vegetation loss also creates the opportunity for non-native grasses to invade, which has been demonstrated to suppress native vegetation regrowth and result in hotter and longer-lasting fires in the deciduous forests that populate most of the Eastern United States, including Pennsylvania (Flory et al. 2015). The most significant environmental impact is the potential for severe erosion, silting of stream beds

and reservoirs from landslides and debris flow, and flooding due to ground-cover loss following a fire event (Ryan-Burkett, 2014).

Table 4.3.15-2 Most Likely Lifelines Impacted by Wildfire

Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and cascading impacts where community safety is threatened, and fire departments are called into action for both response and recovery. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the dangers and best safety precautions.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery as wildfire directly threatens homes and potentially agricultural operations. Mitigation actions for this lifeline should be focused on protecting buildings through building codes and regulating development in at-risk areas.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline in response and recovery due to potential serious injuries and fatalities because of wildfires.

4.3.15.3. Past Occurrence

The DCNR Bureau of Forestry (BOF) maintains an inventory of wildfire events dating back to 1913 and publishes annual reports. The inventory shows that the annual number of wildfires peaked in the early 1930s, while the annual number of acres burned had its peak in the 1910s and has declined steadily since the 1930s. The following figures display wildfire history from 1913 to 2022, binned by decade. Over the entire period of record, the average annual number of wildfires was 1,563, and the average size of wildfires was 35.05 acres. The most recent three years, 2020-22, saw an uptick in the number of wildfires, with each year crossing 1,000 fires for the first time since 1999. The 1,507 fires recorded in 2020 was the most since 1988, when 1,761 occurred. However, these fires resulted in less acres burned than most years, making the average size of fires for both years relatively small compared to the state's history.

Table 4.3.15-3 Wildfire Data from 2000-2022 (DCNR, 2023)				
YEAR	NUMBER OF FIRES	ACRES BURNED	AVERAGE SIZE	COST OF EXTINCTION
2000	744	4,702	6.32	$ 598,394.00
2001	974	7,244	7.47	$ 941,452.00
2002	636	2903	4.56	$ 540,454.00
2003	407	2024	4.97	$ 262,736.52
2004	211	2,780	13.70	$ 169,065.00
2005	804	4,268	5.30	$ 599,910.00
2006	912	7,920	8.03	$ 942,544.00
2007	540	1,140	2.10	$ 299,971.00
2008	689	7,670	11.10	$ 711,229.19
2009	619	6,605	9.80	$ 613,838.48
2010	569	3,399	6.00	$ 638,248.84
2011	202	579	2.90	$ 83,654.69
2012	717	3,186	4.44	$ 677,708.70
2013	632	1,790	2.83	$ 180,825.65
2014	871	4,514	5.18	$ 595,389.29
2015	817	4,165	5.10	$ 756,092.67
2016	853	12,190	14.3	$2,722,738.29
2017	534	1,649	3.09	$ 244,765.77
2018	690	1,843	2.67	$ 320,141.08
2019	536	693	0.69	$ 94,280.78
2020	1,507	3,033	2.01	$ 466,544.68
2021	1,371	2,981	2.17	$ 497,086.49
2022	1,036	2,700	2.61	$522,354.76
TOTAL	**16,871**	**89,978**	**5.33**	**$13,479,425.90**

Figure 4.3.15-3 Total Fires by Decade in Pennsylvania (1913-2022) (DCNR, 2023)

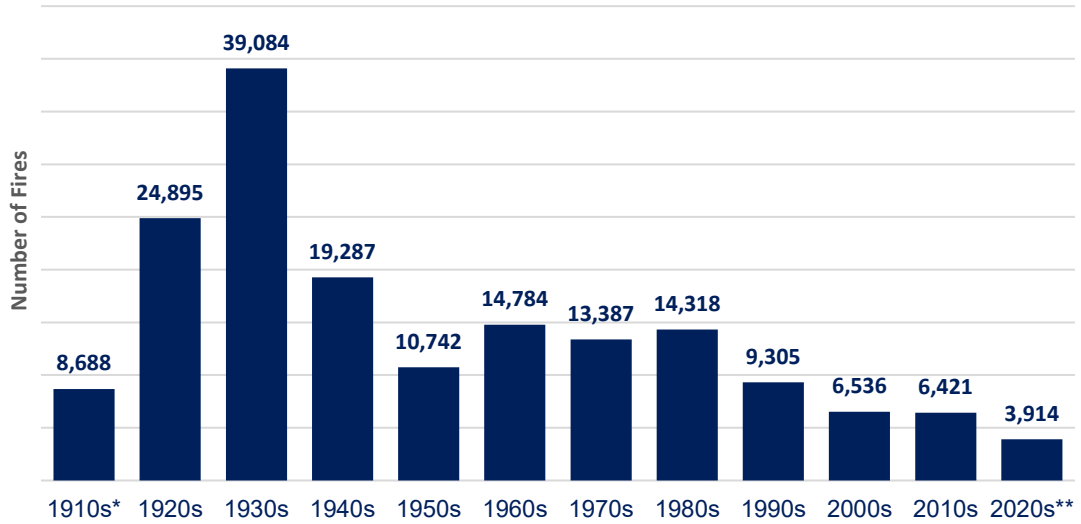


Figure 4.3.15-4 Total Acres Burned by Decade (1913-2022) (DCNR, 2023)

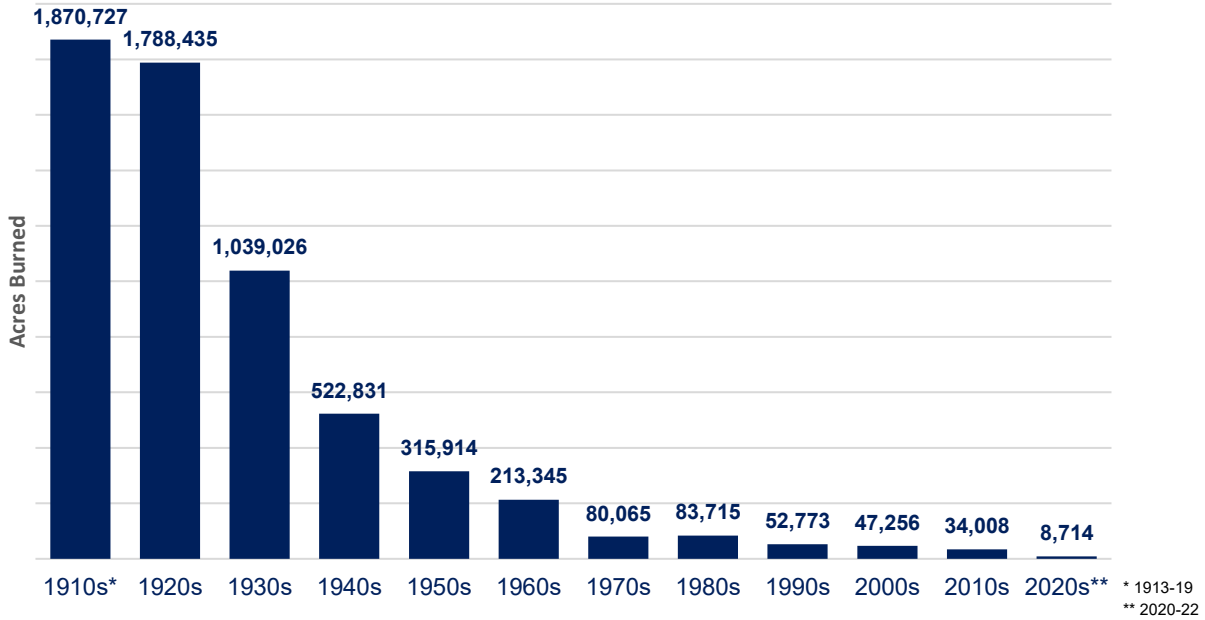


Figure 4.3.15-5 Average Size of Fires by Decade (1913-2022) (DCNR, 2023)

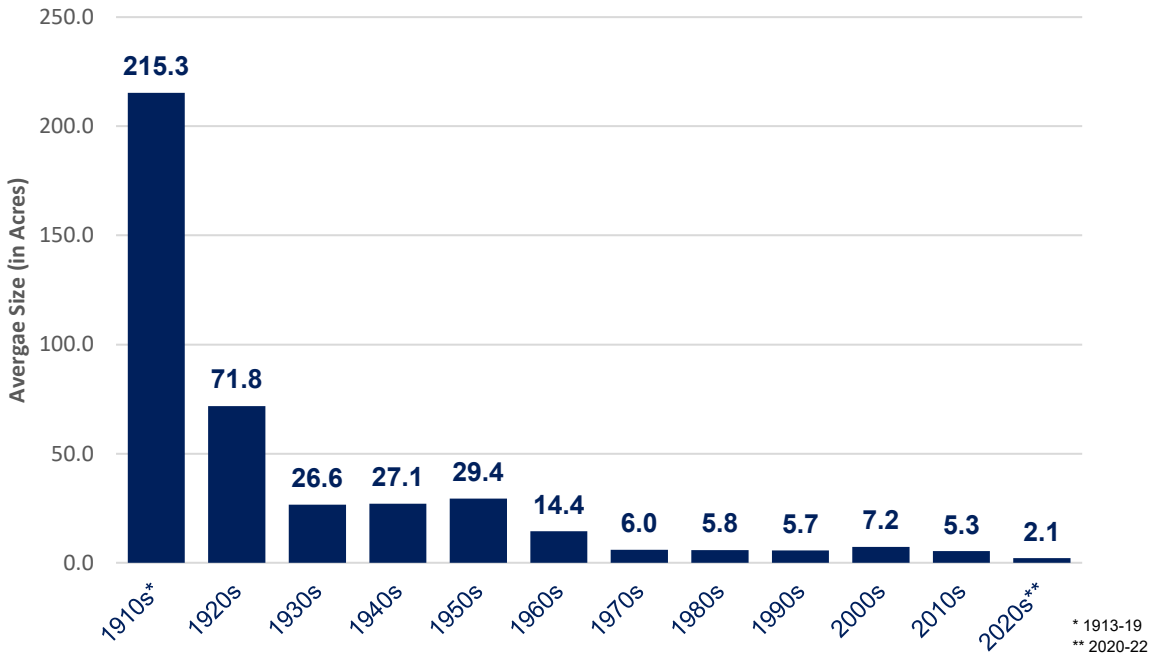
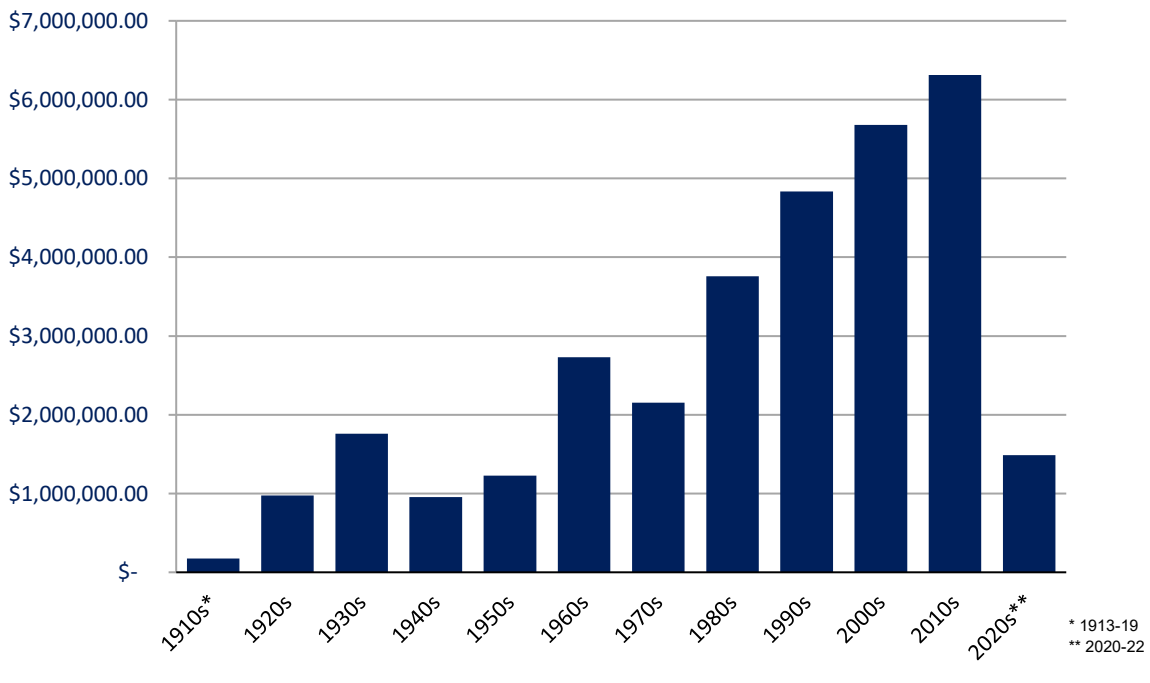


Figure 4.3.15-6 Total Cost of Fire Extinction by Decade (1913-2022) (DCNR, 2023)



4.3.15.4. Future Occurrence

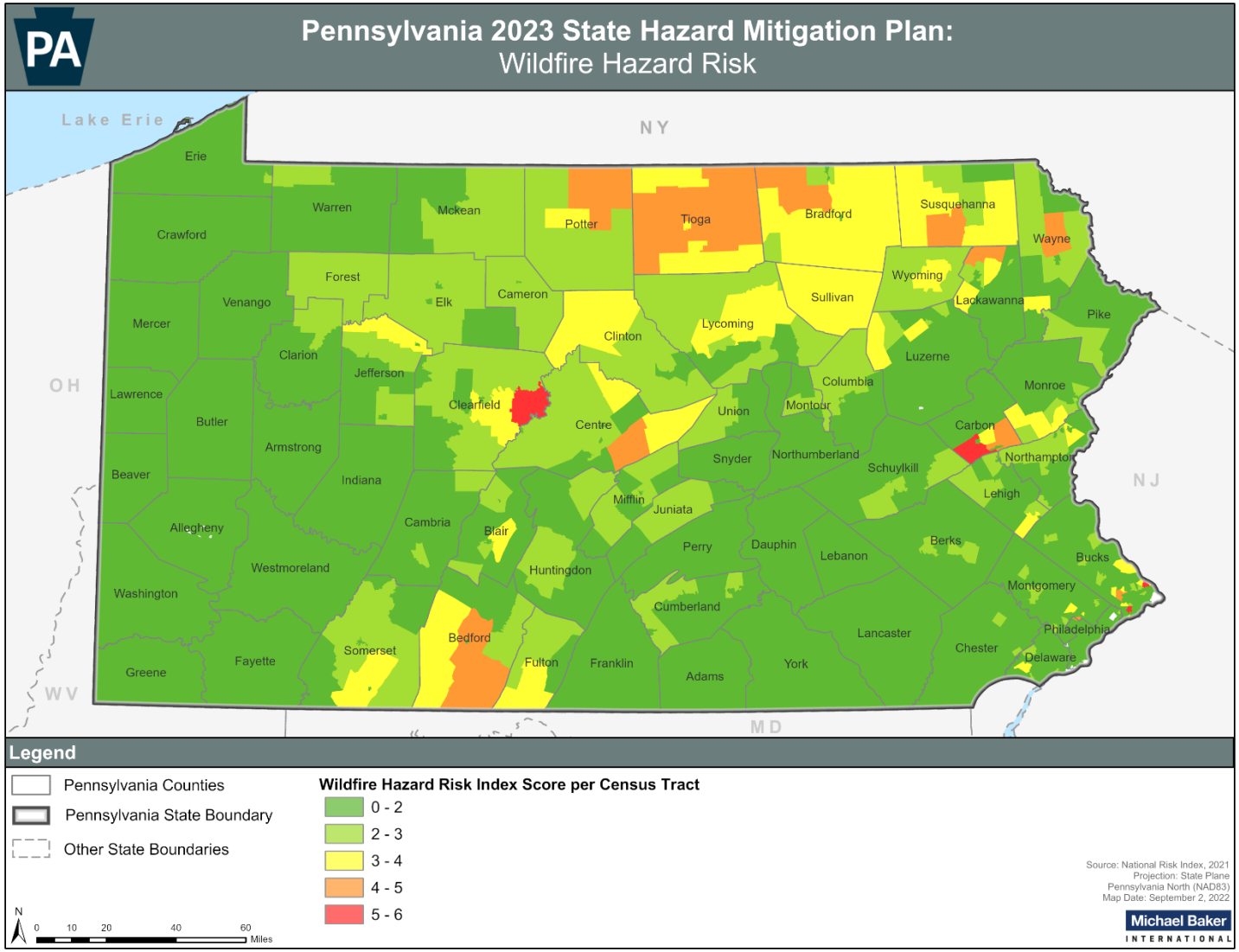
One guide to the future occurrence of wildfires is the U.S. Forest Service Wildfire Hazard Potential (WHP) map. The latest available WHP map is based on 2014 landscape conditions and evaluates wildfire hazard based on the types of fuels present. Areas with fuels having a higher probability of experiencing torching, crowning, or other forms of extreme fire behavior under conducive weather conditions are assigned higher hazard values. Figure 4.3.15-7 summarizes WHP values at the census tract scale by showing the percent of each census tract with moderate or high wildfire hazard potential. The percentage values were taken from FEMA's National Risk Index (FEMA, 2021c). In Pennsylvania, the census tracts with the highest wildfire hazard are in the state's easternmost and northernmost counties, with some high-hazard areas in the southernmost counties as well.

Based on experience, wildfire events will occur in Pennsylvania every year; therefore, annual occurrence should be considered *highly likely* according to the Risk Factor Methodology (see Section 4.1). However, the likelihood of one of those fires attaining significant size and intensity is unpredictable and highly dependent on environmental conditions and firefighting response. As stated above, smaller fires still pose a significant danger to life and property. Key factors in the occurrence and spread of wildfires are temperature, soil moisture, humidity, precipitation, topography, wind speed, and both the size and amount of fuel or vegetation (Moore, 2021). In Pennsylvania, conditions are currently most conducive to wildfires in the spring and autumn, as trees are bare, temperatures are warm, and humidity is low (DCNR, 2022c). Invasive forest insects can increase the likelihood and severity of wildfires by killing existing plants and providing more fuel (Jenkins et al. 2014). One species that could impact Pennsylvania in this way is the spotted lanternfly. For more on invasive species, see Section 4.3.8.

Climate changes have the potential to increase the frequency, extent, and severity of wildfires by lengthening the wildfire seasons through warmer temperatures throughout the year, longer dry seasons, and increases in drought events (EPA, 2022c). Decreases in the surface soil moisture due to enhanced evaporation under a warmer climate is likely and could contribute to wildfire conditions, especially in the summer and fall (Wehner et al. 2017). While total rainfall is projected to increase across the state, the nature of it being from less frequent but more intense events combined with rising temperatures means that drought conditions are expected to increase as well (PA Climate Impacts Assessment, 2021).

It is important to note that 98% of wildfires in Pennsylvania are human-caused (PA DCNR-BOF, 2010). Thus, there is rationale for including this hazard under the summary of *human-made hazards*. Nonetheless, the critical inference to draw from this statistic is the fact that the occurrence of future wildfire events will strongly depend on patterns of human activity. Events are more likely to occur in wildfire-prone areas experiencing new or additional development.

Figure 4.3.15-7 Wildfire Hazard Potential for Pennsylvania (FEMA National Risk Index, 2021).



4.3.15.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to wildfires, all structures located in high hazard census tracts were identified. Wildfire hazard was characterized based on the National Risk Index. As described in Section 4.3.15.4, the National Risk Index determined an index score of wildfire hazard potential. A wildfire index score of 4 or more in a census tract is considered high risk for this analysis. Note that the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 104, or 2 percent, are located within census tracts characterized by high wildfire hazard, based on NRI wildfire risk index score (Table 4.3.15-3). These facilities have a combined replacement value of approximately $7.9 million, or approximately 0.2% of the known value of geolocated state facilities. Overall, nearly 95,000 square feet of building space is found to be vulnerable, with 48 owned buildings out of the 104 vulnerable facilities.

Table 4.3.15-4 Vulnerability of State Facilities to Wildfire.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General		0%		
Department of Agriculture		0%		
Department of Banking and Securities		0%		
Department of Community and Economic Development		0%		
Department of Conservation and Natural		0%		
Department of Corrections		0%		
Department of Education		0%		
Department of Environmental Protection	1	8%	0	2,757
Department of General Services		0%		
Department of Health		0%		
Department of Labor and Industry		0%		
Department of Military and Veterans		0%		
Department of Public Welfare		0%		
Department of Revenue		0%		
Department of Transportation	62	4%	48	72,353
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission		0%		
Governor's Office		0%		
Historical and Museum Commission		0%		

Table 4.3.15-4 Vulnerability of State Facilities to Wildfire.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Insurance Department		0%		
Liquor Control Board	2	0.4%	0	9,276
Public School Employees' Retirement		0%		
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System		0%		
State Police	1	3%	0	9,890
State System of Higher Education	38	4%		
Thaddeus Stevens College of Technology		0%		
Treasury Department		0%		
Total	**104**	**2%**	**48**	**94,276**

Of the 13,448 geolocated critical facilities, 229 or 2 percent, are located within census tracts characterized by high wildfire hazard (Table 4.3.15-4). These facilities have a combined replacement value of approximately $4.4 billion, or 1.1% of the known value of geolocated critical facilities.

Table 4.3.15-5 Vulnerability of Critical Facilities to Wildfire.

TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	7	3%
Banking		0%
Commercial		0%
Communication	14	3%
Dam	64	4%
Education (colleges and universities)	3	1%
Education (public schools)	50	1%
Emergency Operation Center	0	0%
Energy	16	4%
Fire Station	37	1%
Government		0%
Hospital	3	1%
National Monument or Icon		0%
Nuclear		0%
Police Station	13	1%
Transportation	5	1%
Water	17	3%
Total	**229**	**2%**

4.3.15.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to wildfire hazards, the population, building counts, and building value of all high-hazard census tracts were aggregated to the county scale and compiled in Table 4.3.14-5. Based on the FEMA's NRI wildfire risk index, 13 counties in Pennsylvania contain census tracts that could be significantly impacted by wildfire hazards. Across these counties, about 124,000 people are located in census tracts vulnerable to wildfires. There are also over 64,000 buildings that are vulnerable to wildfires, the total replacement value for which is $27billion, or about 1 percent of the total value for all buildings in the state.

Table 4.3.15-6 Estimated Jurisdictional Losses Due to Wildfires.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Bedford	10,955	7,248	3,337,472	28%
Bradford	8,069	4,569	1,769,125	12%
Bucks	26,618	9,927	5,756,316	4%
Carbon	15,361	7,500	2,705,650	24%
Centre	7,120	3,728	1,379,348	5%
Clearfield	6,713	3,074	1,166,336	7%
Lackawanna	3,986	2,159	1,019,438	2%
Montgomery	4,580	1,693	1,136,947	1%
Philadelphia	2,249	788	887,106	0%
Potter	4,349	2,377	636,273	23%
Susquehanna	4,553	3,261	1,683,130	12%
Tioga	27,194	16,070	5,498,777	64%
Wayne	3,157	1,952	648,785	5%
Total	**124,904**	**64,346**	**27,624,703**	**1%**

Another component of jurisdictional vulnerability involves examining the number of past wildfire occurrences and the respective acres burned. Table 4.3.15-7 displays the number of reported wildfires and acres burned per county. In terms of number of past wildfires, Clearfield County is the most vulnerable with 726 wildfire events. Clinton County is most vulnerable to large-scale wildfires; from 1992-2015 the average fire size in this county was more than 36 acres..

Table 4.3.15-7 Number of Reported Wildfires and Acres Burned per County from 1992-2015 (USFS, 2017)

COUNTY	WILDFIRES	ACRES BURNED	COUNTY	WILDFIRES	ACRES BURNED
Adams	42	49.3	Lackawanna	141	1,299.2
Allegheny	54	44.2	Lancaster	106	176.7
Armstrong	83	274.7	Lawrence	76	301.4
Beaver	19	107.5	Lebanon	33	1,076.0

Table 4.3.15-7 Number of Reported Wildfires and Acres Burned per County from 1992-2015 (USFS, 2017)					
COUNTY	WILDFIRES	ACRES BURNED	COUNTY	WILDFIRES	ACRES BURNED
Bedford	104	1,295.2	Lehigh	122	313.6
Berks	251	275.6	Luzerne	586	9,783.6
Blair	113	771.1	Lycoming	52	1,350.3
Bradford	210	416.0	McKean	62	346.0
Bucks	62	124.0	Mercer	21	60.2
Butler	36	192.8	Mifflin	49	133.6
Cambria	104	416.0	Monroe	234	880.5
Cameron	32	1,039.0	Montgomery	61	57.8
Carbon	350	2,178.9	Montour	24	25.1
Centre	233	1,744.2	Northampton	87	168.0
Chester	87	155.9	Northumberland	217	357.4
Clarion	68	676.9	Perry	103	190.4
Clearfield	726	1,147.9	Pike	276	972.2
Clinton	88	3,245.8	Potter	56	493.9
Columbia	58	200.9	Schuylkill	555	1,890.7
Crawford	6	12.0	Snyder	59	78.7
Cumberland	40	239.8	Somerset	98	1,066.4
Dauphin	98	413.1	Steuben	1	2.0
Delaware	10	9.2	Sullivan	44	254.2
Elk	70	329.6	Susquehanna	39	102.6
Erie	9	10.5	Tioga	109	1,476.3
Fayette	187	614.9	Union	35	139.1
Forest	37	320.7	Venango	76	589.1
Franklin	95	241.9	Warren	92	412.6
Fulton	39	65.9	Washington	3	12.0
Greene	5	6.4	Wayne	11	150.5
Hunterdon	2	1.3	Westmoreland	142	314.5
Huntingdon	131	535.5	Wyoming	57	170.2
Indiana	76	622.1	York	54	90.4
Jefferson	63	210.1	**Grand Total**	**7,306**	**54,732.5**
Juniata	37	130.9			

As discussed in Section 4.1.3, the 2023 SHMP recognized the importance of protecting not just lives and property, but sense of place as well. To this end, historic assets were also included in the assessment of jurisdictional vulnerability to wildfires. The data source and definition of historic assets is described further in Section 4.1.3. Table 4.3.15-8 shows the number and percent of historic assets in each county located in census tracts characterized by high wildfire

risk. As in the state vulnerability assessment, high risk census tracts were identified based on the hazard values available through FEMA's National Risk Index (FEMA NRI, 2021). A total of 3,031 historic assets are located in high hazard census tracts. By far the counties with the largest share of vulnerable historic assets are Bedford and Centre counties, with 18.5 percent and 9.6 percent of their historic buildings located in census tracts vulnerable to wildfires, respectively.

Table 4.3.15-8 Vulnerability of Historic Buildings to Wildfires (PHMC, as of December, 2022).

COUNTY	AT-RISK HISTORIC BUILDINGS	% OF COUNTY HISTORIC BUILDINGS
Bedford	887	18.5%
Blair	2	0.2%
Bradford	53	6.1%
Bucks	39	1.0%
Carbon	81	35.8%
Centre	772	9.6%
Clearfield	105	8.4%
Clinton	1	0.1%
Huntingdon	1	0.0%
Lackawanna	62	2.9%
Lehigh	1	0.1%
Luzerne	1	0.0%
Lycoming	2	0.0%
Mckean	1	0.3%
Mifflin	1	0.2%
Montgomery	5	0.1%
Philadelphia	10	0.2%
Potter	368	31.8%
Snyder	1	0.1%
Susquehanna	229	15.5%
Tioga	390	58.6%
Union	1	0.2%
Wayne	17	3.1%
Wyoming	1	0.1%
Total	**3,031**	**0.01%**

4.3.16. Winter Storm

4.3.16.1. Location and Extent

Winter storms are regional events and most often impact a large portion or all of Pennsylvania. In many cases, surrounding states and even the larger northeastern U.S. region are affected (NOAA NSSL, 2022c).

Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. They begin as low-pressure systems that move through Pennsylvania usually following the jet stream (NOAA NSSL, 2022c). describe the types of winter storms that can occur and the kinds of precipitation that may be involved.

Table 4.3.16-1 Types of Winter Storms (NOAA NSSL, 2022f)

TYPE	DESCRIPTION
Blizzards	Storms consisting of snow, winds of at least 35mph, and visibility frequently reduced to less than a ¼ mile. These conditions must last for at least 3 hours.
Ice Storms	Storms where at least ¼" of ice accumulates on exposed surfaces.
Lake Effect Storms	Storms that are created by cold, dry air moving through warm, moist air over lakes, adding moisture that is then deposited in the form of snow. They affect areas to the south and east of lakes.
Snow Squalls	Brief, intense snow events where strong and gusty winds can lead to large snow deposits and low visibility conditions.

Table 4.3.16-2 Types of Winter Precipitation (NOAA NSSL, 2022f)

TYPE	DESCRIPTION
Snow	Ice crystals that form in wintertime clouds that cling to each other as they fall forming snowflakes; they will remain in this form if the temperature from cloud to ground is at or below 0°C/32°F. Accumulation can range from none to significant. Wind conditions will impact visibility.
Sleet	Partially melted snowflakes that have passed through a small layer of warm air on their descent, only to refreeze as they approach the ground and form frozen rain drops.
Freezing Rain	Completely melted snowflakes that have passed through a large layer of warm air on their descent; they are then “supercooled” but not frozen by a small layer of cold air directly above the ground. The water drops will refreeze when contacting with anything that is 0°C/32°F or below, creating a layer of ice on exposed surfaces.

4.3.16.2. Range of Magnitude

Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific structures or cause disruption to traffic, communications, electric power, or other utilities. A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of oil heating supplies (FEMA, 2022d). Winter storms can also cause building or structure collapses, most commonly with warehouses and other commercial buildings, if snowfall and accumulation is significant enough (Geis et al. 2012). During a particularly rough winter in 1993-94, Philadelphia spent $1 million to demolish 209 buildings that become safety hazards after repeated damage from storms (Dunn, 1994).

Average annual snowfall across Pennsylvania ranges from 10 inches in the southeast to over 100 inches in the northwest (see Figure 4.3.16-1). Storms tracking up the east coast tap into Atlantic moisture, whereas the Great Lakes supply the moisture and instability for heavy snow squalls in the northwest (NOAA NWS, 2022b). Orographic lift enhances snowfall over higher elevations (note particularly higher average snowfall in Somerset County in the Allegheny Mountains) (NOAA NWS, 2022b). The snowfall season is November through April, and amounts are generally below one inch during October and May. The greatest monthly snowfalls occur in January and February across most of the commonwealth (Erdman, 2020).

Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. An indirect effect of winter storms is the treatment of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surfaces through corrosion and impair local water bodies and water supply (Hinsdale, 2018). Winter storms have a positive environmental impact as well, as gradual melting of snow and ice provides excellent groundwater recharge. However, quickly rising temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

Figure 4.3.16-1 Pennsylvania Average Annual Snowfall (NOAA, 2021).

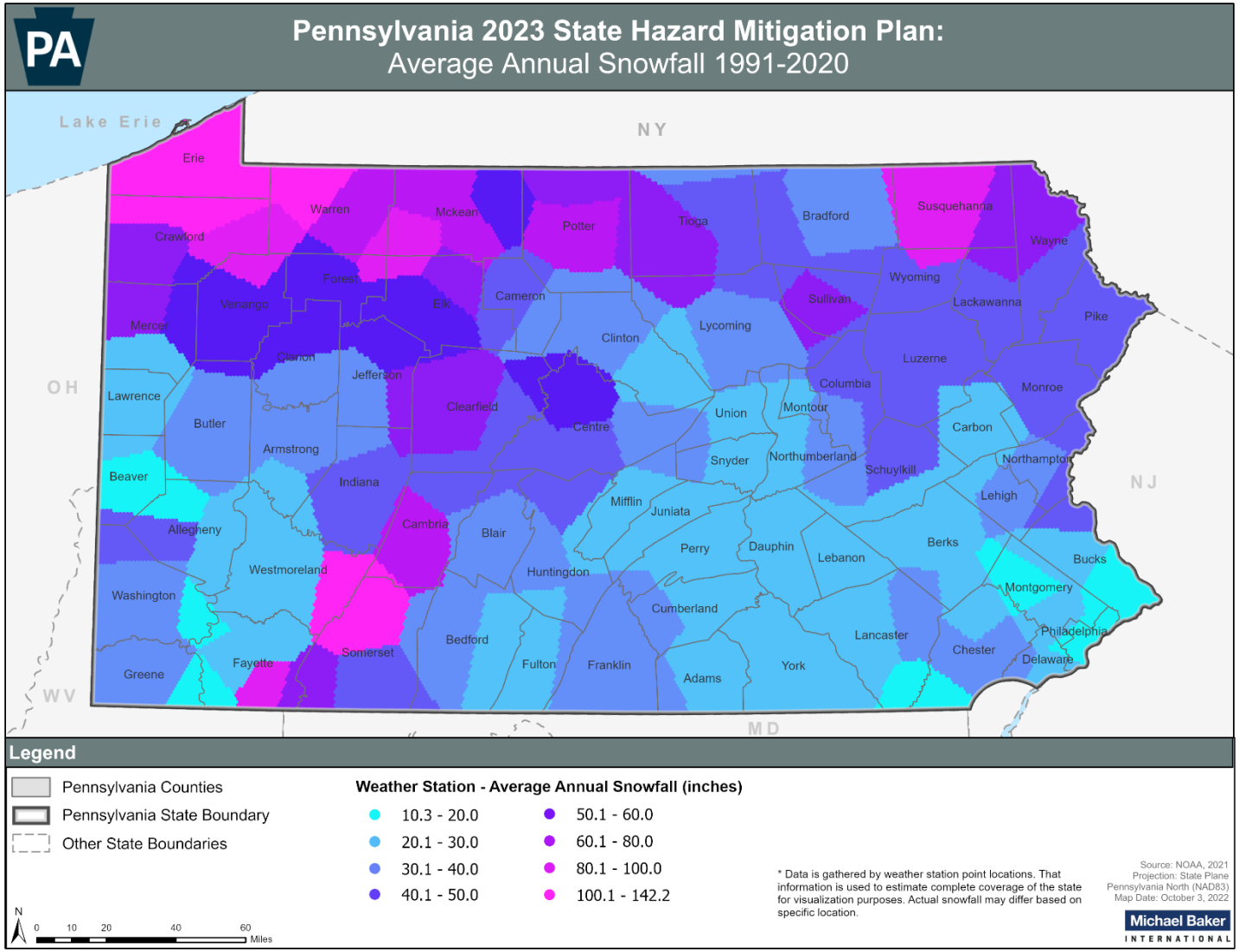


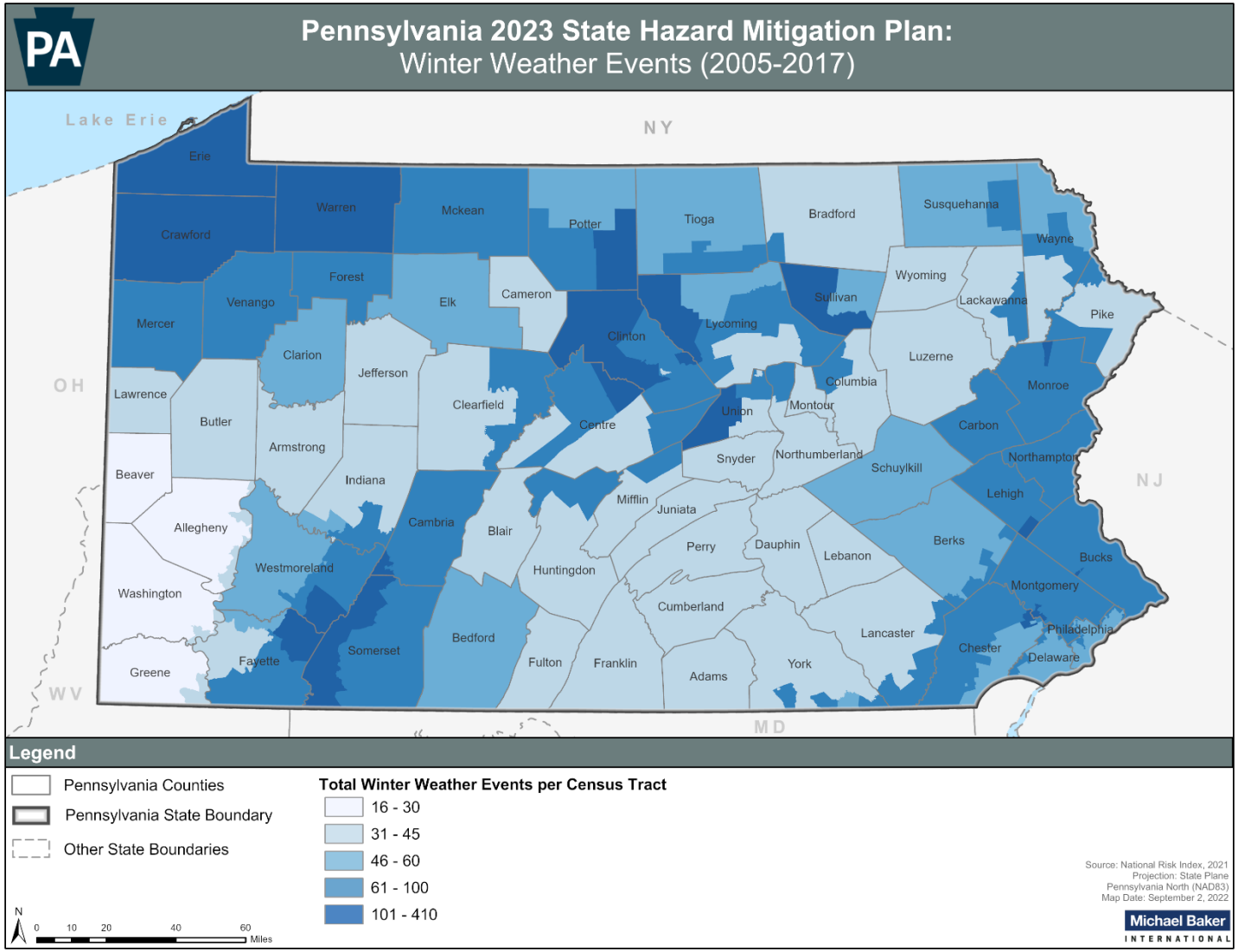
Table 4.3.16-3 Most Likely Lifelines Impacted by Winter Storms		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and compounding impacts where community safety may be threatened due to potential harm from storm impacts and how the administration of services may be impacted through transportation infrastructure issues. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the dangers and best safety precaution and directly assisting vulnerable populations.
Food, Water, Shelter		Anticipating a causal and cascading relationship for the Food, Water, Shelter lifeline in response and recovery. Winter storms can cause damage to structures and water utility infrastructure, while the food supply chain may be disrupted due to impacts on transportation infrastructure. Mitigation actions for this lifeline should be focused on protecting buildings through building codes and retrofitting.
Energy		Anticipating both causal and cascading impacts to the Energy lifeline due to potential direct damage to infrastructure and then potential increases fuel usage for those who lost access to electrical heating. Mitigation actions should be focused on grid resilience and reducing direct damage to infrastructure.
Transportation		Anticipating a causal relationship for the Transportation lifeline in response and recovery due to direct damage to infrastructure and dangerous road conditions. Mitigation actions should be focused on developing plans for pre-storm maintenance to reduce impacts and keep road conditions as clear as possible.

4.3.16.3. Past Occurrence

Pennsylvania has a long history of severe winter weather. Six of the 59 Presidential Disaster and Emergency Declarations issued in Pennsylvania have been in response to winter storm events (see Table 4.2.1-1). Figure 4.3.16-2 shows the number of winter weather events by census tract across Pennsylvania between 2005 and 2017. Several patterns can be seen in the map. The northwest has a large cluster of winter weather events between the given time period, with counties Erie, Crawford, and Warren having a large number of events existing off the coast

of Lake Erie. Also showing a high number of events are clusters in the north central region around Clinton County, and in the southwest towards Somerset County. Allegheny, Beaver, Greene, and Washington Counties represent a cluster of counties that contain a smaller number of winter events compared to the rest of the state.

Figure 4.3.16-2 Map Showing the Number of Winter Weather Events by Census Tracts across Pennsylvania (FEMA NRI, 2021).



The worst winter storm in the country on record occurred on March 11-14, 1993. This blizzard, often called the *Storm of the Century*, stretched from Canada to the Gulf of Mexico but was worst in the Eastern United States, including all of Pennsylvania. This storm caused widespread blackout conditions and registered snowfall totals of 12" in Philadelphia, 20” in Harrisburg and Scranton, 25” in the Pittsburgh area, and a state-high 36” of snow (with 10’ drifts) in Latrobe, Westmoreland County (NOAA NWS, n.d.e). This event garnered a Presidential Emergency Declaration and the overall damage estimate for all states was $5.5 billion (NOAA NCEI, 2017).

The following winter (1993-94), the Commonwealth 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.

The first of these devastating winter storms occurred in early January 1994 with record snowfall depths of more than 33 inches across southwest and south-central portions of the Commonwealth, strong winds and sleet/freezing rains. A ravaging ice storm followed, closing major arterial roads and downing trees and power lines which left almost 600,000 residents without power in the southeast, many for several days (NOAA NWS, n.d.f). Utility crews from a five-state area were called to assist in power restoration repairs. Officials from PP&L stated that this was the worst winter storm in the history of the company; related damage-repair costs exceeded $5,000,000.

The record cold conditions resulted in numerous water-main breaks and interruptions of service to thousands of municipal and city water customers throughout the Commonwealth. Additionally, 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 (Russakoff, 1994).

During January and February 1994, Pennsylvania experienced at least seventeen regional or statewide winter storms (Dunn, 1994). In January 1996, another series of severe winter storms with 27- and 24-inch accumulated snow depths was followed by 50- to 60-degree temperatures resulting in rapid melting and flooding.

Pennsylvania experienced several significant snowstorms in the winter of 2009-2010 resulting in record season-total snowfalls in many areas. Two of the top snowfall events were recorded in Philadelphia, including a snowfall of 23.2” on December 19-20, 2009 and a snowfall of 28.5” on February 5-6, 2010 (NOAA NWS, 2009; Wood, 2020). After the initial February storm, another occurred 3 days later, bringing the 5-day total to 44.3” in Philadelphia (Wood, 2020). These storms crippled many areas of Pennsylvania, prompting the federal government to declare a major disaster and make over $34 million available for recovery (FEMA, 2010).

January 2016 brought another significant winter storm to Pennsylvania. Harrisburg, Allentown and Philadelphia all set single-day snowfall records with 26.4, 30.2, and 19.4” respectively (NOAA NWS, 2016a). Over the course of the three-day storm, Allentown also recorded its

greatest-ever snowfall event with 31.9" (NOAA NWS, 2016a). A Declaration of Disaster Emergency was made, airports were closed, and the Pennsylvania Turnpike was so heavily impacted through adverse road conditions and roadway incidents that more than 500 vehicles were stranded for more than 24 hours; over 300 personnel were involved in response and recovery operations (NOAA NWS, 2016a). Two winters later (2017-18), Erie would set its 24-hour, monthly, and seasonal snowfall records with 32.6" on Christmas 2017, 93.8" in December 2017, and 166.3" throughout the winter (NOAA NWS, 2018c).

A summary of the most extreme snowfall events as well as the greatest snowfall depth recorded in Pennsylvania is provided in Table 4.3.16-4

Table 4.3.16-4 Summary of Pennsylvania Snowfall and Snow Depth Extremes (NOAA, 2018)

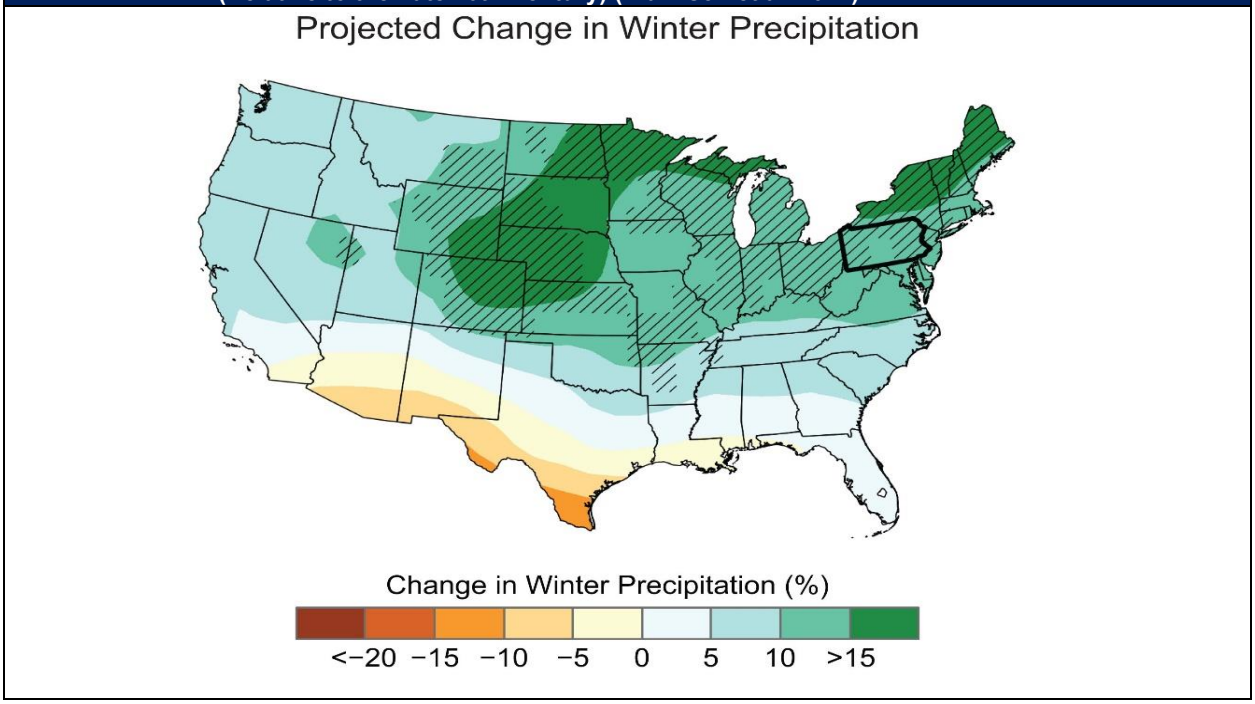
CATEGORY	SNOW AMOUNT (INCHES)	STATION LOCATION	COUNTY	ENDING DATE
Greatest daily snowfall	41	Lakeville 2 NNE	Wayne	2/16/1958
Greatest 2-day snowfall	46	Seven Springs	Somerset	3/14/1993
Greatest 3-day snowfall	52.4	Coatesville 1 SW	Chester	2/14/1899

4.3.16.4. Future Occurrence

Winter storms are a regular, annual occurrence in Pennsylvania and should be considered *highly likely* according to the Risk Factor Methodology (see Section 4.1). Extreme snowfall totals for 10%-, 4%-, 2%-, and 1%-annual probabilities vary by location and can be obtained by weather station or county from the NOAA National Climatic Data Center at: https://www.ncei.noaa.gov/access/monitoring/snowfall-extremes/. The northwestern part of the state receives lake effect snows and can have more than 100 inches of snow annually due to the moist arctic air passing over the Great Lakes.

Winter storm tracks in North America have shifted northward by 0.4 degrees latitude and there has been an increase in frequency and intensity of storms since 1950. The most recent decades have brought some of the highest single-day and seasonal snowfall totals to many different parts of the Commonwealth. This trend may change in the future as the nature of winter precipitation changes. Projections show increases in winter precipitation, as shown in Figure 4.3.16-3, but less of it will fall as snow (Zarzycki, 2018). This change will lead to fewer snowstorms, but data shows the decrease is more likely with smaller-scale storms than large-scale ones (Zarzycki, 2018). One of the primary causes of this increased precipitation is the warming of sea surface temperatures in the Atlantic Ocean; higher temperatures lead to an increased amount of water vapor in the air, providing more fuel for storms (Huang et. al. 2021).

Figure 4.3.16-3 The Percent Change in Winter Precipitation Projected for the Middle of the 21st Century (Relative to the Late 20th Century) (Frankson et al. 2017).



In addition to this increase in fuel from the Atlantic, the polar jet stream and arctic warming may play a part in large-scale storms still being a potential hazard. Cohen, Pfeiffer, and Francis (2018) posited that warming Artic temperatures have led to a weakening of the polar jet stream, which has allowed warmer, yet still very cold, artic air to travel southward and provide the other half of the equation for the intense winter storms seen in the Northeast United States. There is a possibility these storms continue to occur and may even occur more frequently, with the warming Atlantic Ocean generating more and more fuel and the potential for more intense hot air-cold air clashes that strengthen storms (Feuerstein, 2022). However, this study has been criticized due to the small size of the 35-year sample and the potential for compounding factors impacting the data, as various climate modeling techniques have so-far been unable to reproduce the effect and confirm the linkage (Blackport and Screen, 2021). More studies are ongoing.

The projections of less snow and a higher percentage of winter precipitation as rainfall are already playing out in some parts of the state, but not so in others. The number of snow-covered days declined by 1.5 days per decade for January and by 1 day per decade for February in the Northeast; snowfall totals are expected to decline 20-30% in the northern part of the state and 50-60% in southern parts (PA DCNR 2015). There has also been a trend toward earlier snowmelt and total snowfall has decreased in Bradford and York counties, but its increased in Centre, Franklin and Elk counties (Figure 4.3.16-4). As shown in Figure 4.3.16-5 there is a lower percentage of precipitation as snow for the majority of Pennsylvania, especially in the northern parts of the state. Erie is an exception to this, as the potential for lake effect snow increases due to warmer lake water allowing for more moist air.

Figure 4.3.16-4 Change in Total Snowfall from 1930 to 2007. (Kunkel et al., 2009).

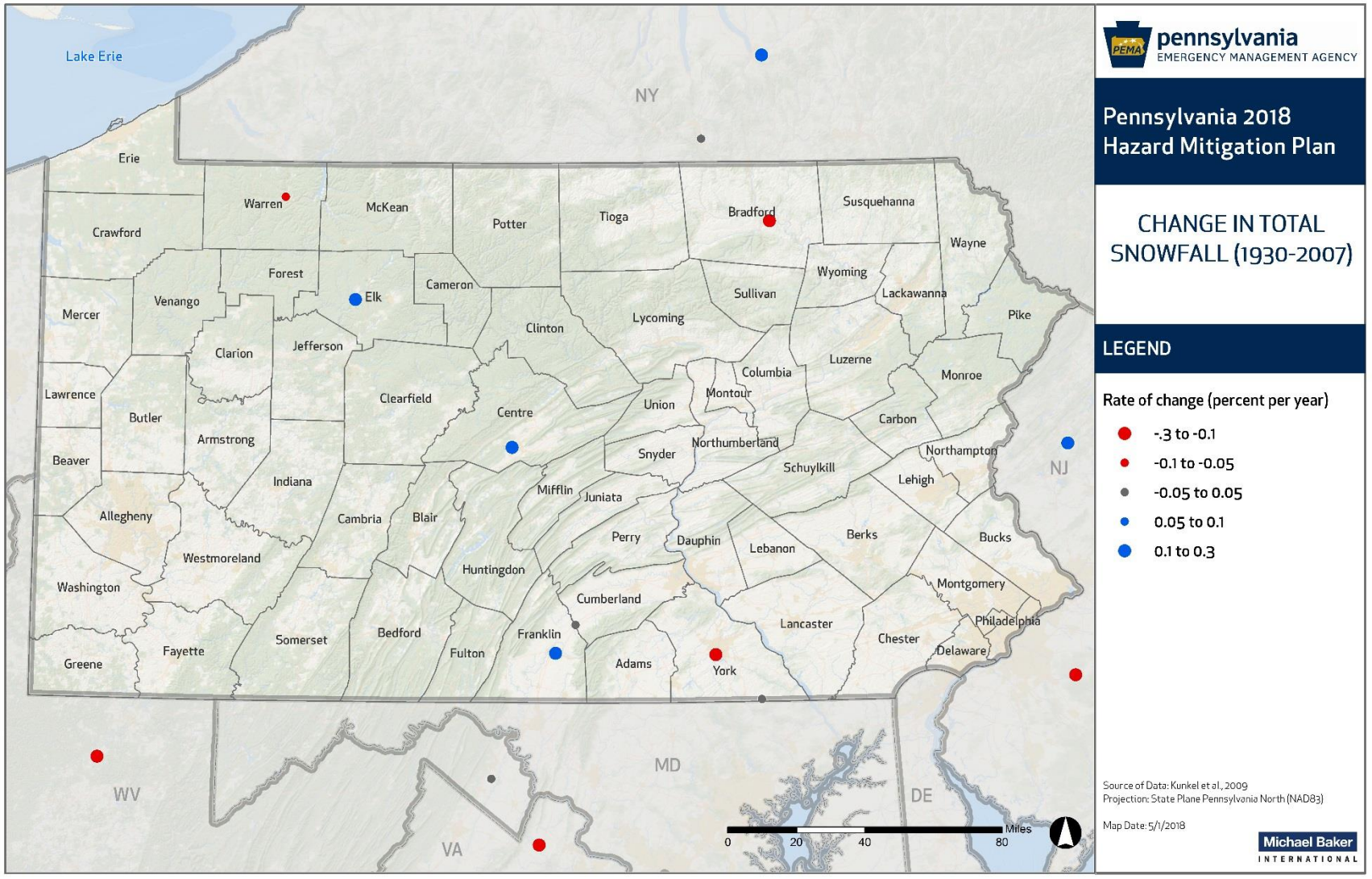
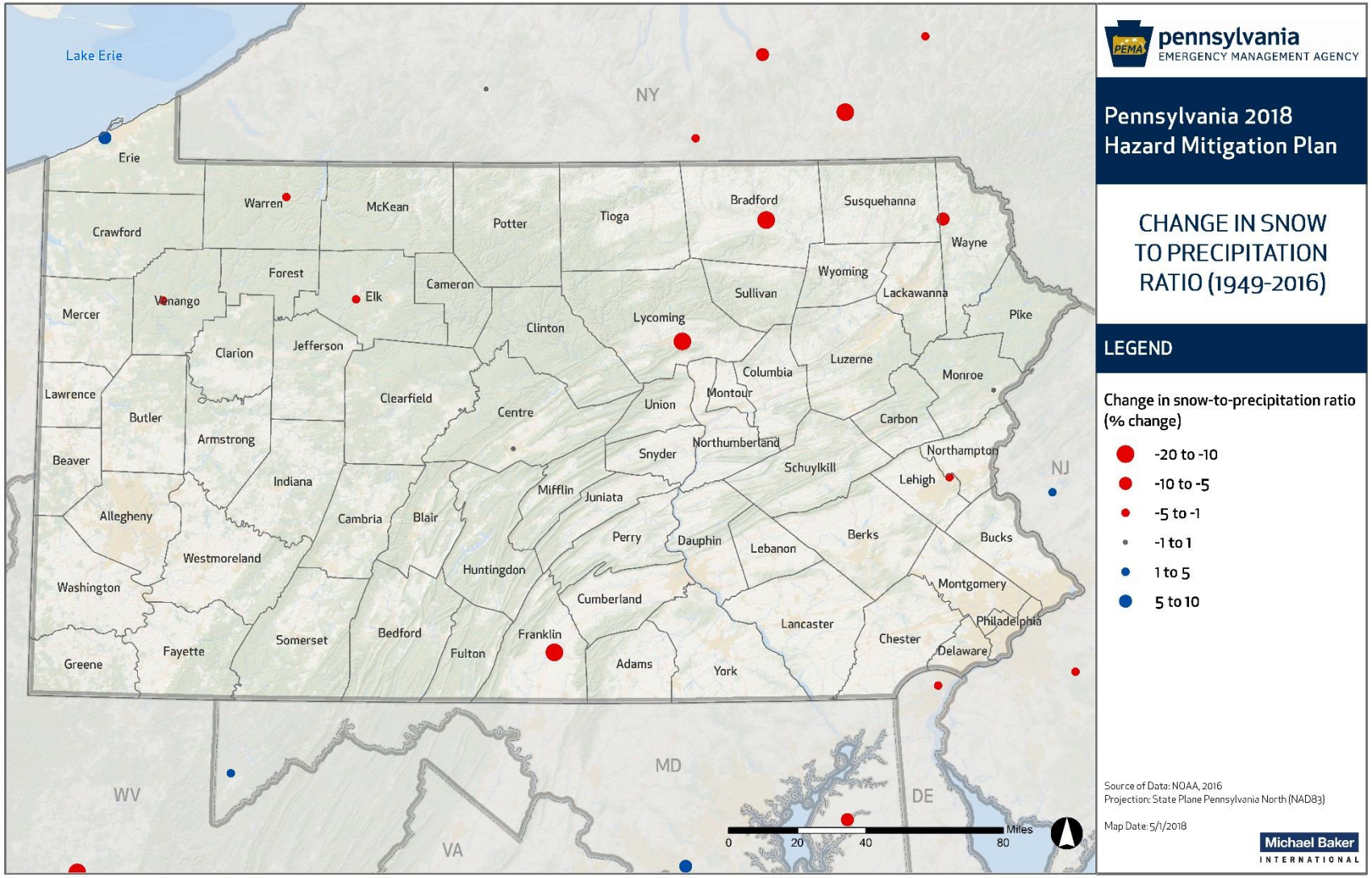


Figure 4.3.16-5 Change in Winter Snow-To-Precipitation Ratio from 1949 to 2016. Decreases Mean More Precipitation is Falling as Rain Instead of Snow. (NOAA, 2016).



To sum up the myriad of projections, it is expected that there will be an increase in winter precipitation in the state, and it is very likely that an increasing amount of it will fall as rain instead of snow. There will be a decrease in the amount of days where conditions allow for snow at all, but when they are cold enough, the result could be a significant amount of snowfall (Zarzycki, 2018).

4.3.16.5. State Facility Vulnerability Assessment and Loss Estimation

In winter storm events, state critical facility buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as building collapse or damage from downed trees. Structure vulnerability frequently depends on the age of the structure in question and its roof pitch; the older the structure, especially the roof, the less snow load it can handle. Similarly, roofs with a more gradual pitch are less able to have snow and ice slide off of them, increasing the weight of snow and ice sitting on top and thus the potential for damage.

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to winter storms, all structures located within census tracts where the number of winter weather events between 2005 and 2017 exceeded 100, as shown in Figure 4.3.16-2. Of the 4,460 geolocated state facilities, 345, or 8 percent, are located within these vulnerable census tracts (Table 4.3.16-5). These facilities have a combined replacement value of more than $189 million, or approximately 5% of the known value of geolocated state facilities. Owned facilities account for 211 of the 345 vulnerable state facilities. A total of nearly 2.16 million square feet of building space exists in areas considered to be vulnerable to winter storms.

Table 4.3.16-5 Vulnerability of State Facilities to Winter Storms.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	1	11%	0	10,509
Department of Agriculture	1	6%	0	5,053
Department of Banking and Securities		0%		
Department of Community and	1	25%	0	3,015
Department of Conservation and Natural		0%		
Department of Corrections	52	7%	51	966,920
Department of Education		0%		
Department of Environmental Protection	1	8%	0	51,376
Department of General Services		0%		
Department of Health	3	6%	0	7,086
Department of Labor and Industry	9	13%	7	588,640
Department of Military and Veterans		0%		
Department of Public Welfare	5	5%	0	69,743
Department of Revenue	1	10%	0	4,147
Department of Transportation	117	7%	101	231,949
Drug and Alcohol Programs		0%		

Table 4.3.16-5 Vulnerability of State Facilities to Winter Storms.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	51	33%	51	82,408
Governor's Office		0%		
Historical and Museum Commission	7	23%	1	4,712
Insurance Department		0%		
Liquor Control Board	28	5%	0	100,210
Public School Employees' Retirement		0%		
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System		0%		
State Police	5	14%	0	31,536
State System of Higher Education	63	7%		
Thaddeus Stevens College of		0%		
Treasury Department		0%		
Total	**345**	**8%**	**211**	**2,157,304**

Winter storms can potentially affect all critical facilities, but of the 13,448 geolocated critical facilities, 641, or 5 percent, are located within a census tract that had more than 100 winter weather events between 2005 and 2017 (Table 4.3.16-6). These facilities have a combined replacement value of more than 127 billion, or just over 3% of the known value of geolocated critical facilities.

Table 4.3.16-6 Vulnerability of Critical Facilities to Winter Storms.

STATE CRITICAL FACILITY TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	10	4%
Banking		0%
Commercial	2	10%
Communication	48	9%
Dam	80	5%
Education (colleges and universities)	15	4%
Education (public schools)	210	4%
Emergency Operation Center	3	4%
Energy	20	5%
Fire Station	146	6%
Government		0%
Hospital	17	5%
National Monument or Icon	1	17%

Table 4.3.16-6 Vulnerability of Critical Facilities to Winter Storms.		
STATE CRITICAL FACILITY TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Nuclear		0%
Police Station	49	4%
Transportation	14	2%
Water	26	4%
Total	**641**	**5%**

4.3.16.6. Jurisdictional Vulnerability Assessment

Areas considered to be at high risk to winter storms were defined as census tracts where the number of winter weather events between 2005 and 2017 exceeded 100, as shown in Figure 4.3.16-2. In these areas, just over 500,000 people and 230,000 buildings may be impacted by winter storms. These buildings have a combined loss estimate of $109.3 billion, which is about 4% of the estimated total building value in the commonwealth (Table 4.3.16-7). Of the vulnerable jurisdictions, Erie County is the most threatened with more than 270,000 vulnerable people, and nearly 100,000 potentially impacted buildings worth almost $49 billion.

Table 4.3.16-7 Estimated Jurisdictional Losses due to Winter Storms.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Adams				0%
Allegheny				0%
Armstrong				0%
Beaver				0%
Bedford				0%
Berks				0%
Blair				0%
Bradford				0%
Bucks	4,971	1,858	$1,104,322	1%
Butler				0%
Cambria	8,239	4,155	$1,606,246	5%
Cameron				0%
Carbon				0%
Centre	3,815	2,057	$546,782	2%
Chester	9,616	3,575	$4,017,582	3%
Clarion				0%
Clearfield				0%
Clinton	12,989	6,821	$2,390,459	38%
Columbia				0%
Crawford	83,927	49,842	$24,415,962	100%
Cumberland				0%
Dauphin				0%

Table 4.3.16-7 Estimated Jurisdictional Losses due to Winter Storms.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Delaware				0%
Elk				0%
Erie	270,634	98,178	$48,825,274	100%
Fayette	10,154	6,464	$2,223,797	9%
Forest				0%
Franklin				0%
Fulton				0%
Greene				0%
Huntingdon				0%
Indiana				0%
Jefferson				0%
Juniata				0%
Lackawanna				0%
Lancaster				0%
Lawrence				0%
Lebanon				0%
Lehigh	3,861	1,730	$1,021,768	1%
Luzerne				0%
Lycoming	6,738	3,741	$1,378,880	6%
McKean				0%
Mercer				0%
Mifflin				0%
Monroe	5,681	2,513	$653,895	2%
Montgomery	12,809	2,563	$4,142,466	2%
Montour				0%
Northampton				0%
Northumberland				0%
Perry				0%
Philadelphia				0%
Pike				0%
Potter	2,006	1,984	$414,577	15%
Schuylkill				0%
Snyder				0%
Somerset	14,872	11,441	$5,881,667	25%
Sullivan	2,574	3,417	$965,646	47%
Susquehanna				0%
Tioga				0%
Union	6,263	2,220	$835,142	12%
Venango	27	17	$3,329	0%
Warren	38,587	24,810	$7,440,243	100%

Table 4.3.16-7 Estimated Jurisdictional Losses due to Winter Storms.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Washington				0%
Wayne				0%
Westmoreland	4,185	3,209	$1,528,845	2%
Wyoming				0%
York				0%
Total	**501,948**	**230,595**	**$109,396,882**	**4%**

HUMAN-MADE HAZARDS

4.3.17. Building and Structure Collapse

4.3.17.1. Location and Extent

Buildings and other engineered structures, including bridges, may collapse if their structural integrity is compromised, especially due to effects from other natural or human-made hazards. Older buildings or structures, structures that are not built to standard codes, or structures that have been weakened are more susceptible to be affected by these hazards.

Adherence to modern building codes can lower a building's risk to collapse. Building codes – developed by the International Code Council in partnership with FEMA and other federal, state, local, and private authorities – specify the minimum legal design and construction requirements for structural integrity, construction materials, and fire protection (FEMA, 2014). Most buildings constructed after 1961 in the Commonwealth were built under modern building codes as adopted in the Pennsylvania Uniform Construction Code. However, 46.6% of occupied housing units were built before 1960 in Pennsylvania. Figure 4.3.17-1 shows which counties have higher percentages of buildings constructed prior to 1960 in the Commonwealth. As illustrated on the map, Philadelphia County has the highest percentage (68.4%) of housing units built prior to 1960, while Monroe and Pike Counties have the lowest percentages at 17.5% and 15.4%, respectively. More than half of all housing units in 18 counties were built prior to 1960.

In addition, the vast majority of historic resources (which are typically considered eligible for listing in the National Register of Historical Places once they past 50 years in age) were constructed prior to 1960. Historic resources are addressed in association with other hazards, but the hazard of building collapse poses a distinct, heightened risk. Based on the historical assets inventory provided to the SPT from PA-SHARE, there are nearly 130,000 historical buildings in Pennsylvania. For analysis here, all historic buildings with all historic classifications are considered for the hazard of building collapse. Table 4.3.17-1 shows the distribution of all historical buildings in the Commonwealth by county. The counties with the largest numbers of historic buildings include those in the greater Philadelphia and greater Pittsburgh regions, Centre, Lancaster County, and York County.

Figure 4.3.17-1 Percent of Housing Units Built Prior to 1960 by County (ACS, 2020).

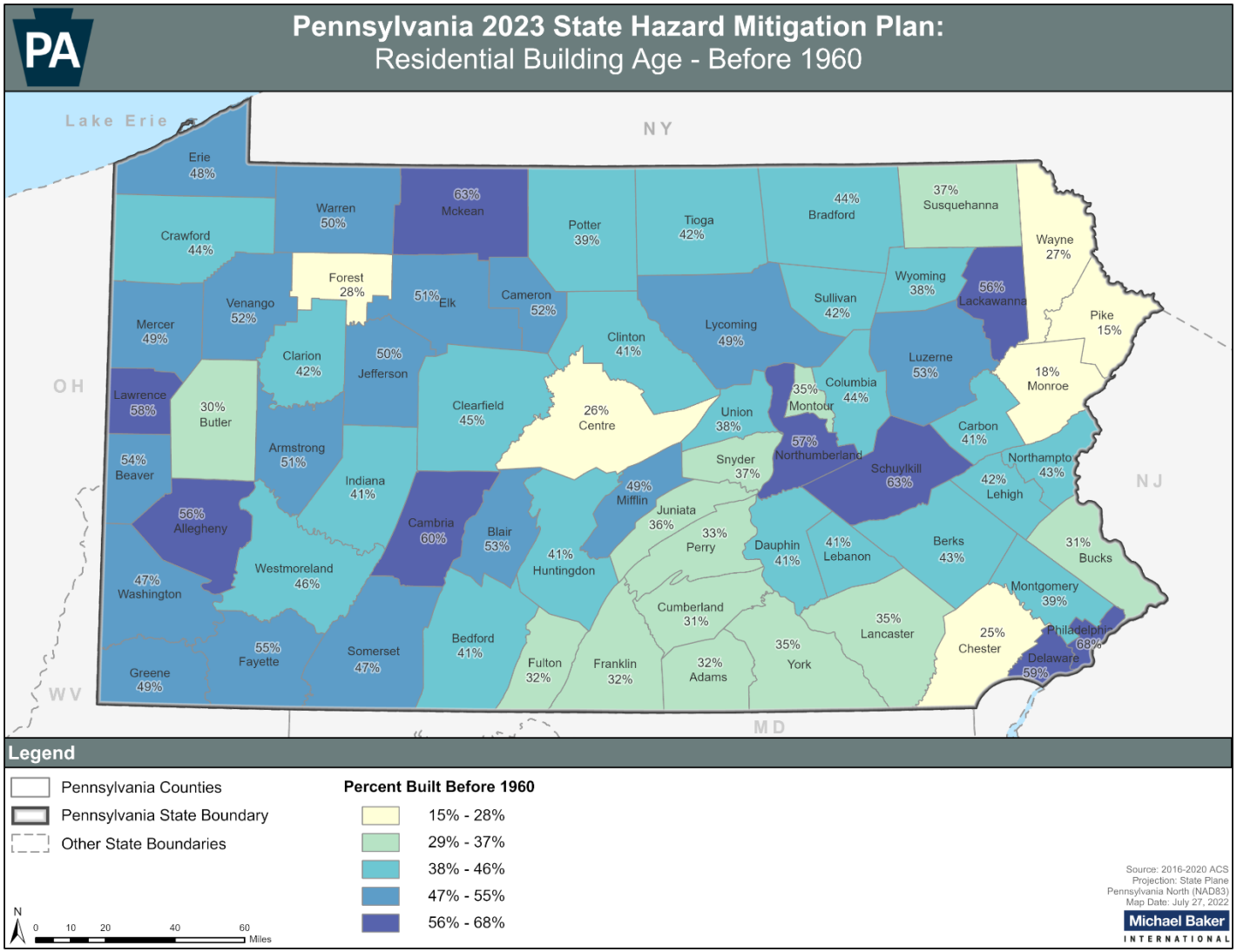


Table 4.3.17-1 Historic Buildings in Pennsylvania by County (PHMC, as of December 2022)		
COUNTY	ALL HISTORIC BUILDINGS	% OF STATE TOTAL
Adams	3,543	2.7%
Allegheny	11,226	8.6%
Armstrong	421	0.3%
Beaver	485	0.4%
Bedford	4,460	3.4%
Berks	4,006	3.1%
Blair	845	0.7%
Bradford	566	0.4%
Bucks	3,257	2.5%
Butler	613	0.5%
Cambria	2,544	2.0%
Cameron	215	0.2%
Carbon	131	0.1%
Centre	7,779	6.0%
Chester	9,194	7.1%
Clarion	1,211	0.9%
Clearfield	965	0.7%
Clinton	651	0.5%
Columbia	1,957	1.5%
Crawford	1,425	1.1%
Cumberland	1,574	1.2%
Dauphin	1,777	1.4%
Delaware	1,819	1.4%
Elk	511	0.4%
Erie	2,514	1.9%
Fayette	1,465	1.1%
Forest	270	0.2%
Franklin	1,018	0.8%
Fulton	749	0.6%
Greene	799	0.6%
Huntingdon	2,468	1.9%
Indiana	1,269	1.0%
Jefferson	554	0.4%
Juniata	509	0.4%
Lackawanna	1,685	1.3%
Lancaster	4,986	3.8%
Lawrence	192	0.1%
Lebanon	2,913	2.2%
Lehigh	1,483	1.1%

Table 4.3.17-1 Historic Buildings in Pennsylvania by County (PHMC, as of December 2022)		
COUNTY	ALL HISTORIC BUILDINGS	% OF STATE TOTAL
Luzerne	2,351	1.8%
Lycoming	6,664	5.1%
McKean	116	0.1%
Mercer	597	0.5%
Mifflin	418	0.3%
Monroe	1,510	1.2%
Montgomery	4,634	3.6%
Montour	134	0.1%
Northampton	1,546	1.2%
Northumberland	900	0.7%
Perry	854	0.7%
Philadelphia	5,702	4.4%
Pike	214	0.2%
Potter	981	0.8%
Schuylkill	387	0.3%
Snyder	665	0.5%
Somerset	1,046	0.8%
Sullivan	251	0.2%
Susquehanna	1,244	1.0%
Tioga	388	0.3%
Union	402	0.3%
Venango	235	0.2%
Warren	43	0.0%
Washington	2,182	1.7%
Wayne	339	0.3%
Westmoreland	5,205	4.0%
Wyoming	745	0.6%
York	5,991	4.6%
Total	**129,676**	**100%**

Bridges serve to connect both large and small roadways and communities throughout the Commonwealth. Whether they span another roadway or a body of water, bridges are a crucial part of every transportation system. However, many of Pennsylvania's bridge structures are aging and in great need of repair. Pennsylvania has more than 25,400 state-owned bridges 8 feet or longer, the third-largest number of bridges in the nation, with an average age of over 50 years old (PennDOT, 2022b). Inspection and maintenance are necessary to observe and mitigate the extent of the disrepair, especially on older structures.

4.3.17.2. Range of Magnitude

There are different effects of a collapse, depending on the type and cause of the collapse and the type of structure that collapses. A building collapsing in on itself will likely result in a debris field which is dense but has a small footprint. However, if a building collapses in an outward direction, the debris field will be more widely scattered (University of Michigan, 2011). Both types of collapses can cause injury to and endanger the lives of those inside or near to the structure and can result in damages to nearby property, especially if the collapse causes a large amount of debris near a populated area. Though occupied buildings are less likely to collapse since they would generally be maintained, more risk of death or injury would be likely with the sudden collapse of an occupied building.

A worst-case scenario for a building collapse would be for a building with multiple people in it to collapse in a denser area causing injuries and possible death to those in the building as well as around the area.

Disrepair can critically affect the integrity of bridge structures as well. The level of disrepair depends on how much of the structure is damaged and how critical that portion of the structure is to the safety of drivers. Some structures only need deck replacement or a new superstructure, while others have substructure problems and should be entirely replaced. As of April 2018, 3,098 of the 25,396 bridges on state roads and 1,909 of the 6,423 bridges on locally-owned roads were classified as structurally deficient. However, a structurally-deficient rating does not indicate that a bridge is unsafe, only that there is deterioration to one or more of the major components. Should a bride be determined to be unsafe, it would be closed (PennDOT, 2018). As of April 2018, 30 bridges on state roads and 190 bridges on locally-owned roads were closed. Table 4.3.17-1 shows the number of closed and structurally-deficient bridges by county as reported by PennDOT.

Table 4.3.17-2 Total, Closed, and Structurally-Deficient Bridges on State- and Locally-Owned Roads by County (PennDOT, 2018)

COUNTY	BRIDGES ON STATE ROUTE SYSTEM, LENGTH 8' OR GREATER			BRIDGES ON LOCAL ROUTE SYSTEM, LENGTH 20' OR GREATER		
	TOTAL COUNT	CLOSED BRIDGES	STRUCT. DEFICIENT COUNT	TOTAL COUNT	CLOSED BRIDGES	STRUCT. DEFICIENT COUNT
Adams	380	0	49	67	0	4
Allegheny	1,182	0	139	391	11	91
Armstrong	370	0	57	65	0	9
Beaver	336	1	42	58	2	10
Bedford	458	0	52	86	0	30
Berks	640	3	77	241	6	83
Blair	321	0	17	112	1	38
Bradford	509	0	23	117	5	46
Bucks	660	1	114	174	2	61
Butler	354	0	56	146	0	37
Cambria	332	0	13	87	2	32

Table 4.3.17-2	Total, Closed, and Structurally-Deficient Bridges on State- and Locally-Owned Roads by County (PennDOT, 2018)					
COUNTY	BRIDGES ON STATE ROUTE SYSTEM, LENGTH 8' OR GREATER			BRIDGES ON LOCAL ROUTE SYSTEM, LENGTH 20' OR GREATER		
	TOTAL COUNT	CLOSED BRIDGES	STRUCT. DEFICIENT COUNT	TOTAL COUNT	CLOSED BRIDGES	STRUCT. DEFICIENT COUNT
Cameron	66	0	12	16	1	7
Carbon	135	0	27	30	1	11
Centre	432	0	30	57	1	12
Chester	665	3	102	223	4	61
Clarion	210	0	20	49	2	12
Clearfield	385	1	56	70	4	31
Clinton	249	0	19	19	1	9
Columbia	304	0	9	78	2	31
Crawford	500	0	50	124	5	51
Cumberland	372	0	28	67	2	12
Dauphin	440	0	27	119	3	17
Delaware	374	0	51	96	2	27
Elk	124	0	10	35	0	10
Erie	575	2	25	111	5	38
Fayette	433	0	79	113	7	47
Forest	76	0	6	13	1	7
Franklin	324	0	34	95	1	14
Fulton	181	0	25	25	0	9
Greene	395	1	69	91	6	29
Huntingdon	318	0	30	57	1	16
Indiana	431	0	121	79	4	12
Jefferson	264	0	30	44	2	12
Juniata	254	0	47	36	0	14
Lackawanna	415	2	46	64	2	34
Lancaster	724	4	101	266	8	62
Lawrence	279	0	30	80	5	28
Lebanon	223	0	18	89	2	16
Lehigh	350	0	34	122	2	32
Luzerne	571	1	124	103	8	37
Lycoming	513	0	12	103	0	22
McKean	245	0	53	79	1	34
Mercer	423	0	25	168	5	37
Mifflin	184	0	13	50	3	13
Monroe	368	3	65	61	1	22
Montgomery	640	0	111	261	15	86
Montour	133	0	1	25	2	6

Table 4.3.17-2 Total, Closed, and Structurally-Deficient Bridges on State- and Locally-Owned Roads by County (PennDOT, 2018)						
COUNTY	BRIDGES ON STATE ROUTE SYSTEM, LENGTH 8' OR GREATER			BRIDGES ON LOCAL ROUTE SYSTEM, LENGTH 20' OR GREATER		
	TOTAL COUNT	CLOSED BRIDGES	STRUCT. DEFICIENT COUNT	TOTAL COUNT	CLOSED BRIDGES	STRUCT. DEFICIENT COUNT
Northampton	308	1	45	137	2	20
Northumberla	342	1	11	86	3	17
Perry	275	0	44	44	3	11
Philadelphia	420	0	50	167	1	45
Pike	178	0	29	36	1	22
Potter	246	0	40	44	3	18
Schuylkill	343	0	48	156	6	74
Snyder	240	0	3	32	0	7
Somerset	474	0	56	94	4	46
Sullivan	139	0	4	34	6	11
Susquehanna	414	1	106	59	1	12
Tioga	521	0	10	84	3	20
Union	198	0	3	38	2	11
Venango	223	0	18	66	2	26
Warren	267	1	20	63	2	25
Washington	780	1	123	161	3	47
Wayne	316	2	82	64	1	23
Westmorelan	735	1	109	168	4	62
Wyoming	203	0	38	25	1	9
York	657	0	80	203	4	44
TOTAL	**25,396**	**30**	**3098**	**6423**	**190**	**1909**

A total of 17 counties have more than 100 structurally-deficient bridges on both state- and locally-owned roads combined, with Allegheny County having the most at 230. The jurisdiction with the greatest number of closed bridges is Montgomery County, which has 15 closed bridges.

A worst-case scenario for a bridge structure collapse is for a high traffic bridge to collapse during rush hour causing many injuries and several deaths.

The environmental impacts of building and structure collapse can vary depending on the scale of the event and the type of collapse. A building that collapses within itself results in a smaller debris field than a collapse in an outward direction. As a result of the debris, a building or structure collapse may have an impact air quality. A 2003 study in the *Journal of the Air & Waste Management Association* found that the impact of a 22-story building implosion on air quality was potentially severe, but short-lived and that effective protection includes staying indoors or upwind (Beck et al, 2003). Potential impacts on air quality may also have associated

health risks depending on the type of pollutants and particulate matter released in the collapse. With respect to bridge collapses over water bodies, rivers, or streams, environmental impacts can include water flow and habitat disruption and water contamination.

Table 4.3.17-3 Most Likely Lifelines Impacted by Building and Structure Collapse

Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and cascading impacts where community safety may be threatened due to structure collapse and services such as search and rescue may need to be deployed. Government structures collapsing may cascade into service disruptions.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery due to the direct impacts to buildings from collapse Mitigation actions for this lifeline should be focused on developing procedures for inspections and enforcing building codes to ensure buildings are not at-risk of collapse
Transportation		Anticipating a causal relationship for the Transportation lifeline in response and recovery due to direct collapse of structures such as bridges. Mitigation efforts should be focused on inspections to identify at-risk structures and maintenance programs to ensure risks are mitigated.

4.3.17.3. Past Occurrence

There is no comprehensive list of building or structure collapses in Pennsylvania. However, two recent events with respect to building collapse and structurally-deficient bridges have been widely reported.

In June 2013, a blighted four-story building in Center City Philadelphia that was undergoing demolition collapsed on a neighboring building, which was the location of a thrift store. At the time of the collapse, the store was open. The incident resulted in seven casualties and 12 injuries; more than a dozen were trapped under the rubble. Prior to the collapse, there were no known violations at the site and the building inspector found that proper permits were on file (CNN, 2013). During the subsequent investigation, it was determined that the collapse was the result of improper demolition. This event highlights the significance of the role of building codes and enforcement.

In January 2017, the Delaware River Turnpike Bridge in Bucks County was determined to be unsafe for travel after inspectors found a crack in the steel support of the bridge. The bride, which reportedly services 42,000 vehicles daily, was initially opened in 1956 and was more than

60 years old. Emergency repairs commenced and the bridge reopened in March 2017. The total cost of repairs was estimated to be $12 million (NJ.com, 2017).

In January 2022, the Fern Hollow Bridge in Pittsburgh's Frick Park collapsed while a bus and five cars were traveling along it. Rescuers had to rappel down into the ravine that the bridge traversed to rescue occupants from the bus, with a total of ten people injured, four people requiring hospitalization, and no fatalities. In addition to the structure collapsing, a gas line was ruptured, and local residents were briefly evacuated before the gas supply could be cut off (Puskar and Scolforo, 2022). The bridge had a documented history of issues, had been given a "poor" rating since 2011, and an inspection a few months before the collapse raised concerns about its integrity. Federal investigators from the National Transportation Safety Board stated that sections of the bridge were "fractural critical", but no definite cause of collapse has been reported. The construction of a new bridge cost an estimated $25 million and was opened in December of 2022 (Silver, 2023).

The year 2022 also included other structure collapses that demonstrate the variability of the hazard. In June, a building in Philadelphia collapsed after a fire, killing one firefighter and injuring five other people after they were trapped in the rubble for hours (Associated Press, 2022). In July, the front of a 6-unit brick apartment building in Cumberland County collapsed, severely damaging a front porch but no injuries to the twelve residents were reported (Stockburger and Bhargaw, 2022). Also in July, a chicken house in Adams County was undergoing demolition when it collapsed, killing one and trapping seven others (Boeckel and Jones, 2022). In August, an ironworker was fatally injured when several walls of a structure collapsed inward at a construction site in Franklin County (Ahearn, 2022). In September, a building in the Fishtown neighborhood of Philadelphia that contained a pizza ship and apartments collapsed (Payoute and Wright, 2022). Twenty-four hours before that event another building did the same in an adjacent neighborhood. In October, an exterior wall of a brick building collapsed and sent bricks cascading into the street in Bethlehem, no injuries were reported but a car parked nearby was damaged (Cassi, 2022).

4.3.17.4. Future Occurrence

Structures and buildings can collapse due to deterioration of bridge critical load bearing members and building structural integrity, but external occurrences can also impact bridges and buildings. As discussed, Pennsylvania has the third highest number of bridges in the country with more than 5,000, or 16%, rated as structurally deficient. Consequently, the entire Commonwealth will see an increased focus on prevention of structure collapse. According to PennDOT, within the past five years, the department has spent approximately $370 million to preserve over 1,050 bridges.

As discussed, there is no comprehensive list of building collapse events for the Commonwealth. However, the risk of issues with building structural integrity in the Commonwealth can grow without proper maintenance and code enforcement. Nearly half of all occupied housing in Pennsylvania were constructed prior to 1960 and approximately 250,000 vacant housing units are not for sale, for rent, or seasonally occupied, an indication that these units are not receiving routine maintenance and inspection (U.S. Census, 2012-2016). These structures may be at an

increased risk of building collapse. Additionally, other hazard events such as fires, winter storms, and tropical storms could create conditions that would cause buildings or structures to collapse.

4.3.17.5. State Facility Vulnerability Assessment and Loss Estimation

The vulnerability of state-owned or leased facilities and critical facilities to building or structure collapse is dependent on a wide variety of factors that can include age, condition, or vulnerability to other natural hazards such as fires, flooding, or severe and winter storms. State and critical facility data used to conduct the vulnerability assessments do not include detailed information on building characteristics. Therefore, an analysis of the vulnerability of these facilities based on structure age or condition was not possible. For more information on the vulnerability of state and critical facilities to other hazards that may impact building or structure collapse, please see Sections 4.3.5, 4.3.7, 4.3.16, and 4.3.33 profiling flooding, hurricanes, winter storms, and urban fires, respectively.

4.3.17.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To determine jurisdictional vulnerability to building and structure collapse, GIS analysis was conducted to identify all census tracts characterized by high risk of building and structure collapse. Census tracts in which more than 75 percent of all occupied housing units were built prior to 1960 were defined as high risk areas. A threshold of 75 percent was identified based on the range of the percent of units built prior to 1960 as identified in Figure 4.3.17-1. It should be noted that this analysis of jurisdictional vulnerability only accounts for the age of housing units, not all buildings and structures within a census tract. For example, counties with high percentages of structurally-deficient bridges may also be considered vulnerable to structure collapse. In Pennsylvania, 17 counties have more than 20 percent of their bridges classified as deficient. Further, it does not account for other factors that may lead to building collapse such as condition, vacancy status, or vulnerability to fires. The total population, building count, and building value within these census tracts were aggregated by county to determine the relative vulnerability of each county (Table 4.3.17-2).

Table 4.3.17-4 Vulnerability of People and Buildings to Structure Collapse.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Adams	11,216	3,616	$2,363,903	12%
Allegheny	309,173	132,869	$55,860,575	21%
Armstrong	2,797	1,414	$528,947	4%
Beaver	30,023	13,126	$6,975,301	20%
Bedford				0%
Berks	70,834	21,033	$10,145,572	12%
Blair	34,891	14,916	$6,258,290	23%
Bradford				0%
Bucks	95,960	33,737	$18,351,796	12%
Butler	7,616	2,930	$1,173,671	3%

Table 4.3.17-4 Vulnerability of People and Buildings to Structure Collapse.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Cambria	19,564	9,453	$3,810,467	11%
Cameron				0%
Carbon	7,181	3,475	$1,110,829	10%
Centre	5,419	2,097	$1,044,789	3%
Chester	19,203	6,645	$3,819,845	3%
Clarion				0%
Clearfield	2,789	1,308	$590,623	4%
Clinton				0%
Columbia				0%
Crawford	2,417	1,004	$516,663	2%
Cumberland	12,960	4,471	$2,603,521	5%
Dauphin	45,119	17,769	$7,836,199	13%
Delaware	148,153	50,360	$26,697,922	22%
Elk	4,157	2,079	$999,463	12%
Erie	36,131	13,353	$6,362,406	13%
Fayette	11,481	5,546	$1,914,536	8%
Forest				0%
Franklin	4,703	2,321	$754,659	2%
Fulton				0%
Greene				0%
Huntingdon	3,312	34	$181,037	2%
Indiana				0%
Jefferson				0%
Juniata				0%
Lackawanna	49,250	16,628	$6,877,550	15%
Lancaster	66,547	22,455	$10,986,989	10%
Lawrence	18,591	8,477	$2,542,422	17%
Lebanon	12,909	4,761	$2,630,356	9%
Lehigh	60,945	18,301	$7,942,155	11%
Luzerne	48,034	16,432	$6,360,390	11%
Lycoming	6,915	2,479	$1,367,099	6%
McKean	5,237	2,097	$886,492	10%
Mercer	12,990	6,192	$2,038,744	7%
Mifflin	3,865	1,623	$629,760	7%
Monroe	4,258	1,900	$674,647	2%
Montgomery	94,550	32,553	$19,491,058	9%
Montour				0%

Table 4.3.17-4 Vulnerability of People and Buildings to Structure Collapse.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Northampton	49,152	14,810	$7,985,211	14%
Northumberland	11,558	5,664	$2,559,714	12%
Perry				0%
Philadelphia	852,760	315,027	$117,340,285	45%
Pike	7,542	4,132	$1,919,703	11%
Potter				0%
Schuylkill	36,980	18,195	$6,626,389	22%
Snyder				0%
Somerset				0%
Sullivan				0%
Susquehanna				0%
Tioga				0%
Union				0%
Venango	6,701	2,988	$970,083	10%
Warren	9,411	4,395	$1,806,218	24%
Washington	16,677	8,458	$3,163,983	7%
Wayne	1,818	2,307	$658,514	6%
Westmoreland	26,613	13,011	$4,819,623	6%
Wyoming				0%
York	32,090	11,255	$5,671,657	7%
Total	**2,320,492**	**877,696**	**$375,850,056**	**14%**

A total of 45 counties were identified as having areas at high risk to building and structure collapse. The assessment found that more than 2.3 million people and approximately 877 thousand buildings are located within census tracts in which more than 75 percent of housing units were built prior to 1960. The largest concentrations of vulnerable people and buildings are in Philadelphia County, which includes dense urban areas with older housing stocks. In Philadelphia, 43 percent of the total building value is located in high risk census tracts. The total estimated value of all vulnerable buildings in high risk census tracts is $375.85 billion, which is 14 percent of the total value of all buildings in the Commonwealth.

4.3.18. Civil Disturbance

4.3.18.1. Location and Extent

Civil disturbance is a broad term that is typically used by law enforcement to describe one or more forms of disturbance caused by a group of people. FEMA defines civil disturbance as civil unrest activity, such as demonstration, riot, or strike, that disrupts a community and requires intervention to maintain public safety (FEMA, 2022j). Civil disturbances are typically a symptom of and a form of protest against major socio-political problems. Civil disturbance hazards include the following:

- ***Famine:*** Involves a widespread scarcity of food leading to malnutrition, increased mortality, and a period of psychosocial instability associated with the scarcity of food, such as riots, theft of food, and the fall of governments caused by political instability borne of an inability to deal with the crisis caused by famine (Tilly, 1971).
- ***Economic Collapse or Recession:*** Very slow or negative growth (Barrett & Chen, 2021).
- ***Misinformation:*** Erroneous information spread unintentionally (Makkai, 1970).
- ***Civil Disturbance, Public Unrest, Mass Hysteria, and Riot:*** Group acts of violence against property and individuals, for example (18 U.S.C. § 232, 2008).
- ***Strike or Labor Dispute:*** Controversies related to the terms and conditions of employment, for example (29 U.S.C. § 113, 2008).

Typically, the severity of the action coincides with the level of public outrage. In addition to a form of protest against major socio-political problems, civil disturbances can also arise out of union protest, institutional population uprising, or from large celebrations that become disorderly.

The scale and scope of civil disturbance events varies widely. However, government facilities, landmarks, prisons, and universities are common sites where crowds and mobs may gather. The concentration of federal buildings in Philadelphia and state government buildings in Harrisburg may be targets of civil disturbance. Furthermore, Pennsylvania has 23 state correctional facilities, one motivational boot camp, 14 community corrections centers, 40 contract facilities, and a training academy. In addition, Pennsylvania is home to ten federal prisons, five federal prison camps, and local and private facilities that may be targets for civil unrest.

4.3.18.2. 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. Often that which was intended to be a peaceful demonstration to the public and the government can escalate into general chaos. 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 (UMN, 2010):

- ***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 or Conventional Crowd:*** A cohesive or conventional 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 such as excitement 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. Note that a conventional crowd may sometimes become an expressive crowd; because excitement and emotional expression are defining features of expressive crowds, individuals in such crowds are engaging in collective behavior as described above.
- ***Aggressive or Acting Crowd:*** An aggressive or acting crowd goes one step beyond an expressive crowd by behaving in violent or other destructive behavior, such as looting. A mob, an intensely emotional crowd that commits or is ready to commit violence is a primary example of an acting crowd. Panic is another example, a sudden reaction by a crowd that involves self-destructive behavior, such as accidental trampling when fleeing an emergency. Crowds that become aggressive are usually assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. The crowd may be more impulsive and emotional and require only minimal stimulation to arouse violence.

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 (Alvarez and Bachman, 2008):

- **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 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.

The impacts of civil disturbance events are contingent upon numerous factors including issues, politics, and method of response. Generally, the impact of civil disturbance events is nominal and short-lived unless acts of sabotage are performed. There may be minor injuries to first responders or participants from physical confrontations, and vandalism may cause minimal damage to property, facilities, infrastructure, and the environment. Adequate law enforcement at planned civil disturbance events and around likely target locations like the offices of state agencies minimizes the chances of a small assembly of individuals turning into a significant disturbance.

The worst-case scenario for a civil disturbance event would be riots akin to the 1967 Newark Riots, an event fueled by police brutality, political exclusion of African Americans, urban renewal, inadequate housing, unemployment, and poverty. In this event, the arrest and subsequent treatment of a cab driver sparked violence and looting in downtown Newark, NJ. The National Guard was called in, but their presence only served to intensify the violence. The riots lasted six days, after which 26 people were dead, more than 700 were injured, and nearly 1,500 were arrested (Rojas and Atkinson, 2017). A similar event could occur in one of Pennsylvania's major cities and have a comparable impact.

Table 4.3.18-1 Most Likely Lifelines Impacted by Civil Disturbance

Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and cascading impacts where community safety may be at risk and police are directly involved, which could potentially reduce the capacity for departments to respond to other issues. Mitigation should be focused on developing plans and procedures to respond to disturbance events.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline in both response and recovery. Participants in disturbance events may be injured or injury others, and large demonstrations may impede emergency service operations.
Transportation		Anticipating a direct relationship for the Transportation lifeline in response and recovery due to disturbance events potentially aiming to disrupt the movement of vehicles or freight as a form of protest.

4.3.18.3. Past Occurrence

Over the past 265 years, Pennsylvania has had about dozen civil disorders take place which were notable enough to be recorded in the state's history (Klein, 1973). The following list includes these events as well as more recent civil disturbance events that received widespread media coverage across the state:

- 1742 – Philadelphia Election Riot
- 1764 – Paxton Riots
- 1775 – Philadelphia Anti-Loyalist Riot
- 1794 – Whiskey Rebellion
- 1844 – Philadelphia Nativist Riots
- 1851 – Christiana Riot
- 1877 – Pennsylvania Railroad Strike
- 1892 – Homestead Steel Riot
- 1919 – Pennsylvania Steel Strike
- 1964 – Philadelphia race riot (August 28-30)
- 1969 – York Race Riot
- 1998 – State College
- 2011 – State College Paterno Riots
- 2011 – Occupy Philadelphia protests
- 2012 – Fans riot in Bethel Park after a win at home against Upper St. Clair
- 2018 – Philadelphia Eagles win the Super Bowl
- 2020 – George Floyd Protests

The George Floyd protests in late May and early June of 2020 were spread across Pennsylvania, with many cities and towns having marches and rallies. The protests turned dangerous in Philadelphia and Pittsburgh, with arrests, looting, property destruction, and violent confrontations with law enforcement. In Pittsburgh, a curfew was enforced on May 30th after protests and marches devolved into violence where tear gas was dispersed, a police car was burned, businesses were vandalized, and more (WPXI, 2020). In Philadelphia, protests and unrest continued for days across the city, with marches and demonstrations devolving into looting in Center City and law enforcement deploying tear gas and rubber bullets against protestors in West Philadelphia and along I-676. From May 30th-June 2nd, 692 people were arrested, 72 police vehicles were vandalized, 104 officers were injured or assaulted, and around $21 million in damages (Concordia, 2021). An independent investigation found that the city had failed to properly plan for the situation, which led to cascading effects that worsened the outcome (Rhynhart, 2021). Any issues with both cities' responses may have been impacted with the ongoing and intensifying COVID-19 pandemic, as city departments and personnel were struggling with day-to-day operations as a result of staffing shortages and operational fatigue in managing the health emergency (Carleton, et al., 2020).

While this situation left a heavy imprint on Philadelphia especially, most civil disturbances have not been catastrophic or widespread. Civil disturbance events of some kind occur every day with minimal impact on the Commonwealth, often in relation to politics, elections, economic stagnation, inflation, unemployment, oppression, disruption of services, or political scandal. From 2001 to 2009, events of this kind reported to the Pennsylvania Emergency Incident Reporting System (PEIRS). Between January 2001 and June 2009, there was an average of 19 civil disturbance events reported to PEIRS, as shown in Table 4.3.18-1 below. After 2012, PEMA migrated to a new incident management system, PEMA-Knowledge Center (PEMA-KC). Between 2012 and April 2018, a total of 463 civil disorder events were recorded in PEMA-KC. From 2012 to 2017, the Commonwealth experienced an average of 74 civil disturbance events each year (Table 4.3.18-2).

From 2018 to 2022, that number jumped to 97 events per year (Table 4.3.18-3). This average number does not include 2023 as data on events was only compiled through April. The main cause of this spike is from large number of protests and large gatherings that occurred in 2020, some of which were highlighted in the paragraph above. In addition to policing, events focused on the pandemic response, the 2020 Presidential Election, and affordable housing development. The subject of pandemic-related protests, gatherings, and demonstrations varied. Some were focused on the regulations that were put in place in the beginning stages of the pandemic, including mask mandates, quarantines, and changes to business operations, while later events focused on the vaccine and mandates such as those that required federal employees and Commonwealth employees in state health care facilities to receive it in order to work (Jansen, 2020; Woodall, 2021). In addition to these anti-regulation events, some events called for greater protections for front-line workers and better oversight into how prisons were handling the public health emergency (Hardison, 2020). Affordable housing protests were closely linked to the pandemic, as regulations, working conditions, and some supply chain disruptions made it difficult for some residents to pay utilities, rent, mortgages, and other bills. These challenges led to some taking to the streets to demand eviction moratoria and both rent and mortgage freezes (Deto, 2020; Lauer, 2020).

The financial impact of the pandemic is still being felt, and events surrounding the issue of affordable housing persist. In the Summer of 2022, protesters gathered and set up an encampment outside a federally-assisted housing complex in the University City neighborhood of Philadelphia, which was being sold for redevelopment despite the complex being one of the last affordable housing options left in the area (Flynn and Kadhim, 2022). Residents of a 55 and older apartment community in Meadville began protesting and writing letters in response to rent increases of 30-40% in the Fall of 2022 (Malone, 2022). Housing struggles also resulted in movements on university campuses, as groups from both the University of Penn and West Chester University held protest events concerning their university's ability to provide affordable housing options to students (Bunch, 2022).

Table 4.3.18-2 Civil Disturbance Events Reported to PEIRS, 2001-2009 (PEMA, 2010).									
EVENT TYPE	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Demonstration	6	1	4	0	0	1	8	3	1
Juvenile Detention Center	0	0	0	1	0	2	3	0	1
Prison Disturbance	1	4	2	0	3	2	3	1	1
Prison Escape	6	1	9	8	4	8	4	1	5
Protest	0	4	3	6	7	9	8	4	3
Riot	6	2	4	2	0	3	6	6	1
Civil Disorder - totals	***19***	***12***	***22***	***17***	***14***	***25***	***32***	***15***	***12***
**Events totaled through June 2009*									

Table 4.3.18-3 Civil Disturbance Events Reported to PEMA-KC, 2012-2017 (PEMA, 2018).						
EVENT TYPE	2012	2013	2014	2015	2016	2017
Demonstration	1	3	9	3	3	3
Juvenile Detention Center	0	0	0	0	0	0
Prison Disturbance	0	2	0	0	0	1
Detainee Escape	2	4	3	4	0	2
Protest	4	24	49	35	64	78
Large Crowd Gathering	0	1	0	4	2	3
Riot	0	0	0	1	0	0
School Threat	1	2	0	2	0	2
Assault	2	8	2	2	3	4
Gun/Bomb Incident	3	15	3	7	2	3
Civil Disorder - totals	***13***	***59***	***66***	***58***	***74***	***96***

Table 4.3.18-4 Civil Disturbance Events Reported to PEMA-KC, 2018- 2023 (PEMA, 2023).						
EVENT TYPE	2018	2019	2020	2021	2022	2023*
Demonstration	4	2	35	14	10	1
Juvenile Detention Center	7	0	0	0	0	0
Prison Disturbance	0	1	5	3	2	0
Detainee Escape	0	0	0	0	0	0
Protest	8	17	172	42	16	7
Large gathering	8	4	16	3	7	1
Riot	0	0	4	0	1	0
School Threat	0	0	0	0	0	0
Assault	0	0	0	0	0	0
Gun/Bomb Incident	0	0	0	0	0	0

Table 4.3.18-4 Civil Disturbance Events Reported to PEMA-KC, 2018- 2023 (PEMA, 2023).						
EVENT TYPE	2018	2019	2020	2021	2022	2023*
Work Stoppage	0	0	0	0	2	0
Other	1	13	28	29	13	1
Civil Disorder - totals	***28***	***37***	***260***	***101***	***51***	***10***
**Events totaled through April 2023*						

4.3.18.4. Future Occurrence

Minor civil disturbances will continue to occur throughout the state, but it is not possible to accurately predict the probability and triggers for a large-scale civil disturbance event over the long-term. Civil disturbance is always a possibility as long as there is discrimination or other perceived social or economic injustices.

The location of civil disturbance events is unpredictable, yet spatial distribution patterns of riots in the past suggest that cities, universities, sporting events, and where large crowds gather are probable areas for a civil disturbance event to ensue. Local law enforcement should continue to anticipate these types of events and be prepared to handle a crowd so that peaceful gatherings are prevented from turning into unruly public disturbances.

4.3.18.5. State Facility Vulnerability Assessment and Loss Estimation

The vulnerability of state facilities depends on the type and function of each individual entity as well as the greater geographic context of the facility. As visible symbols of government, government facilities and national monuments are more vulnerable to civil disturbance events, but the vulnerability of each facility may change based on hot-button issues. Table 4.3.18-3 illustrates the number of critical facilities in Pennsylvania that fall into these more vulnerable types. To a certain extent, though, any facility deemed critical may be a target for civil disturbance.

The maximum threat of civil disturbance is hard to project. It has the potential (in terms of injuries, loss of life, and economic, property, and infrastructure damage) to inflict tremendous loss. Replacement values were not provided for government and national monument facilities, so a true replacement estimation could not be provided. More broadly, in the case of large civil disturbance events, the Commonwealth may incur losses related to work stoppages in addition to any acts of vandalism that might occur. Failure to pursue a program of civil disturbance awareness may result in increased loss of lives and property. Table 4.3.18-3 below shows the total state-owned or leased critical facilities susceptible to civil disturbance events.

Table 4.3.18-5 Vulnerability of Critical Facilities to Civil Disturbance Events (NPS, 2018)	
STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Government Facilities	25
National Monuments & Icons	6
Total	**31**

4.3.18.6. Jurisdictional Vulnerability Assessment

The vulnerability of individual jurisdictions is difficult to determine because civil disturbance hazards are tied to the current political and economic climate. A jurisdiction that is very vulnerable one month may be less vulnerable the next. However, in general, Philadelphia, Dauphin, and Allegheny Counties and individual county seats may have higher vulnerabilities due to higher concentrations of local, state, and federal facilities.

Losses for civil disturbance events are difficult to predict and can vary significantly in range. For example, the State College Riot in July 1998, fueled by alcohol consumption, resulted in approximately $150,000 in damages. Because of its national, state, and regional importance, Philadelphia is the most threatened jurisdiction for civil disturbances. Philadelphia, Allegheny, and Dauphin Counties, the most vulnerable jurisdictions, have total estimated losses of approximately $584 billion, as shown below. This total includes only building value, and not content or inventory value.

Table 4.3.18-6 Vulnerability of People and Buildings to Civil Disturbance Events

COUNTY	NUMBER OF IMPACTED BUILDINGS	NUMBER OF BUILDINGS	BUILDING REPLACEMENT VALUE (THOUSANDS)
Allegheny	1,249,907	517,299	$262,225,147
Dauphin	286,115	110,224	$62,272,979
Philadelphia	1,602,305	527,787	$259,829,378
Total	**3,138,327**	**1,155,310**	**$584,327,504**

4.3.19. Cyber-Terrorism

4.3.19.1. Location and Extent

Cyberterrorism is a broad term that refers to acts associated with the convergence of terrorism and cyberspace. Generally, cyberterrorism involves unlawful attacks or threats against computers, networks, and the information stored therein to intimidate or coerce a government or its people to achieve political or social objectives (Denning, 2000). These acts can range from taking control of a host website, to using networked resources to directly cause destruction and harm. The Pennsylvania Governor's Office of Homeland Security defines the following types and methods of cyberattacks:

Table 4.3.19-1 Methods of Cyberattacks (PA Governor's Office of Homeland Security, 2022)

THREAT	DESCRIPTION
Botnet (also zombies)	A collection of computers subject to control by an outside party, usually without the knowledge of the owners, using secretly installed software robots. The robots are spread by trojan horses and viruses. The botnets can be used to launch denial-of-service attacks and transmit spam.
Card Skimming	The act of using a skimmer to illegally collect data from the magnetic stripe of a credit, debit or ATM card. This information, copied onto another blank card's magnetic stripe, is then used by an identity thief to make purchases or withdraw cash in the name of the actual account holder. Skimming can take place at an ATM and can occur at restaurants, taxis, or other places where a user surrenders his or her card to an employee.
Denial-of-service attack	Flooding the networks or servers of individuals or organizations with false data requests so they are unable to respond to requests from legitimate users.
Malicious code (also malware)	Any code that can be used to attack a computer by spreading viruses, crashing networks, gathering intelligence, corrupting data, distributing misinformation and interfering with normal operations.
Pharming	The act of sending an e-mail to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for identity theft. The e-mail directs the user to visit a website where they are asked to update personal information, such as passwords and credit card, social security, and bank account numbers that the legitimate organization already has. The website, however, is bogus and set up only to steal the user's information.
Phishing	Using fake e-mail to trick individuals into revealing personal information, such as Social Security numbers, debit and credit card account numbers and passwords, for nefarious uses.

Table 4.3.19-1 Methods of Cyberattacks (PA Governor's Office of Homeland Security, 2022)	
THREAT	DESCRIPTION
Spam	Unsolicited bulk e-mail that may contain malicious software. Spam is now said to account for around 81 percent of all e-mail traffic.
Spear Phishing	A type of phishing attack that focuses on a single user or department within an organization, addressed from someone within the company in a position of trust and requesting information such as login IDs and passwords. Spear phishing scams will often appear to be from a company's own human resources or technical support divisions and may ask employees to update their username and passwords. Once hackers get this data, they can gain entry into secured networks. Another type of spear phishing attack will ask users to click on a link, which deploys spyware that can thieve data.
Spoofing	Making a message or transaction appear to come from a source other than the originator.
Spyware	Software that collects information without a user`s knowledge and transfers it to a third party.
Trojan horse	A destructive program that masquerades as a benign application. Unlike viruses, Trojan horses do not replicate themselves but they can be just as destructive. One of the most insidious types of Trojan horse is a program that claims to rid your computer of viruses but instead introduces viruses onto your computer.
Virus	A program designed to degrade service, cause inexplicable symptoms or damage networks.
Worm	Program or algorithm that replicates itself over a computer network and usually performs malicious actions, such as using up the computer's resources and possibly shutting the system down. A worm, unlike a virus, has the capability to travel without human action and does not need to be attached to another file or program.

Cyberattacks may not always constitute acts of cyberterrorism because some acts may have relatively small impacts and only produce annoyances. A cyberattack is generally considered an act of cyberterrorism when the following motivations are present:

- **Effects-based:** When computer attacks result in effects that are disruptive enough to generate fear comparable to a traditional act of terrorism.
- **Intent-based:** When unlawful or politically motivated computer attacks are done to intimidate or coerce a government or people to further a political objective, or to cause grave harm or severe economic damage (Rollins and Wilson, 2007).

Cyberattacks can be further divided into the following categories based on the complexity of the attack (Denning, 2000):

- **Simple-Unstructured:** Simple-unstructured attacks are the most common. These are amateurish attacks with relatively minimal consequences.

- **Advanced-Structured:** Advanced-structured attacks are more sophisticated and consequential, and have a greater emphasis on targeting victims prior to an attack, resulting in a more debilitating effect.
- **Complex-Coordinated:** Complex-coordinated attacks are the most advanced and most troublesome type of attack where success could mean a network shutdown.

Cyberterrorism can cause severe disruptions to transportation, public safety, and utility services, all of which are critical infrastructure that are highly dependent on information technology. The healthcare industry may also be targeted. Cyberterrorism can take many forms, including attacks through physical means, electronic means, and use of malicious code. Cyberterrorists can also have a wide range of personal, political, or cultural agendas. All state agencies, as well as individuals, businesses, and other institutions in the Commonwealth, are potential targets for cyberterrorism. Potential threats include identify theft, loss of sensitive information, disruption of services, and other malicious activity.

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. Cyber-attacks are also unpredictable and typically occur without warning.

4.3.19.2. Range of Magnitude

In recent years, cyberterrorism has become a significant threat and can impact people, businesses, institutions, local governments, and state agencies to varying degrees. Impacts from a large-scale cyberterrorism event could disrupt the state's economy and potentially threaten its economic stability. The magnitude of a cyberterrorism attack will vary greatly based on the extent of systems affected and duration of the impact. Additionally, the magnitude will vary based upon which specific system is affected by an attack, the ability to preempt an attack, and an attack's effect on continuity of operations. The largest threat to institutions from cyberterrorism comes from any processes that are networked and controlled via computer. The state should address and take measures to reduce any vulnerabilities that could allow access to sensitive data or processes. Not only is the attack itself an issue, but the resulting investigation, need to develop new security systems, and rebuilding public trust in the aftermath are consequences that should be considered (Deloitte, n.d.).

Generally, cyberterrorism has no direct effect on the environment; however, the environment may be affected if a hazardous materials release occurred because of critical infrastructure failure because of cyberterrorism. Similarly, an act of cyberterrorism on a nuclear power plant could have devastating environmental consequences if the plant suffered an intentional catastrophic failure.

Table 4.3.19-2 Most Likely Lifelines Impacted by Cyber-Terrorism		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and cascading impacts where community safety may be threatened and government services targeted by cyber-terrorism activities. Mitigation actions should be focused on implementing security procedures and response plans to deter attempts and reduce impacts.
Energy		Anticipating a causal relationship for the Energy lifeline in response and recovery as energy infrastructure may be a target for cyberterrorism activities. Mitigation actions the same as above.
Hazardous Materials		Anticipating a causal relationship for the Transportation lifeline in response and recovery due to hazardous materials facilities and operations may be targets for cyber terrorists. Mitigation actions the same as above.

4.3.19.3. Past Occurrence

Since 2012, the following four cyberterrorism related incidents have been reported to PEMA-KC.

Table 4.3.19-3 Past Occurrences Of Cyber-Attacks, 2012-2023 (PEMA-KC, 2023)		
INCIDENT	YEAR	LOCATION
Cyber threat	2016	York
International cyber attack	2017	Statewide
Cyber attack	2017	Northampton, Bethlehem City
Cyber Incident	2018	Statewide
Cyber Security Event	2019	Chester County
Cyber Attack	2019	Lebanon County
Phishing Email	2020	Somerset County
Cyber Security Issue	2020	Elk County
Cyber Attack	2020	Clearfield County
Cyber Attack - Police Incident	2020	Dauphin County
Ransomware Attack	2020	Somerset County
Ransomware Attack	2020	Washington County
Cyber Attack	2020	Delaware County
9-1-1 Dispatch Outage	2021	Somerset County
Ransomware Attack	2021	Clearfield County

Table 4.3.19-3 Past Occurrences Of Cyber-Attacks, 2012-2023 (PEMA-KC, 2023)		
INCIDENT	YEAR	LOCATION
Telephone DoS Attempt	2021	Dauphin County
Cyber Attack	2021	Montgomery County
Cyber Attack	2021	Philadelphia County
Cyber Attack	2021	Statewide
Malware	2022	Delaware County
Cyber Attack	2022	Union County
Cyber Attack	2022	Bucks County
Cyber Threat/Activity	2022	Statewide
Cyber Attack	2022	Statewide
School District Cyber Attack	2022	Bucks County
Cyber Attack - School Learning App	2022	Cumberland County
Cyber Attack	2023	Lackawanna County
Ransomware Attack	2023	Lancaster County
Ransomware Attack	2023	Dauphin County

Additionally, in 2014 the largest data breach in history impacted over 3 billion Yahoo user accounts, including the names, email address, date of birth, and telephone numbers of over 500 million users (CSO, 2018). In terms of a data breach cyber attack, this could be considered a worst-case scenario event. Another large-scale attack was the Equifax data breach in 2017, which was estimated to potentially impact over 5.5 million residents of Pennsylvania and over 145.5 million nationally. The information accessed included names, Social Security numbers, birthdates, addresses, and driver's license numbers (PA Office of the Attorney General, 2017). In 2021, a ransomware gang shut down the Colonial Pipeline, one of the largest pipelines on the East Coast, which led to fuel issues at Philadelphia International Airport (Carrol et al., 2021). Other large-scale data breach events have also occurred in recent years and are becoming more common.

In addition to large-scale acts of cyberterrorism, smaller cyberattacks occur on a daily basis. Billions of emails are sent each day, and spam and phishing emails account for a significant share of all email traffic. Additionally, brute force attacks, which area trial and error attempts to obtain user passwords and pins, are frequently used by criminals to attempt to crack encrypted data or gain access to private accounts. Firewalls can be effective at keeping security threats such as these out, but once a cybercriminal gains access to a system, they can attack from within.

4.3.19.4. Future Occurrence

Cyberterrorism is an emerging hazard that has the potential to impact the state's computer infrastructure and the systems and services that are provided to the public. Concerns about cyberterrorism throughout the United States is growing as its impacted could have potentially crippling effects. Security experts describe the threat of cyberterrorism as eminent and *highly likely* to occur in any given year in Pennsylvania.

The Commonwealth of Pennsylvania is a leader among states in cybersecurity and takes many steps to prevent and defend against cyberattacks, reduce vulnerability, minimize damage, reduce recovery time, and promote education and awareness. This includes employing multiple layers of security, advanced monitoring, vulnerability testing, data protection, antivirus, spam blocking, mobile device encryption, and other means to protect state systems and data. The Commonwealth also promotes a cultural of cyber awareness throughout its workforce by providing training, assessments, benchmarking, and exercises. One method that the Commonwealth uses to reduce the success rate of future phishing attacks is utilizing PhishMe software, which distributes simulated phishing scenarios to help state employees better identify and know when to report phishing attacks. When a user successfully reports a fake phishing email sent from PhishMe, they are notified. The Office of Administration also provides cybersecurity information for people, businesses, Commonwealth agencies and employees, and local governments on its website (PA Office of Administration, 2018). Pennsylvania also participates in IT strategic planning and has a cyber incident annex as part of its emergency operations plan. The level of success of an attack and the subsequent damage it can create will vary greatly, but these initiatives help reduce the Commonwealth's vulnerability to cyberterrorism.

4.3.19.5. State Vulnerability Assessment and Loss Estimation

All state-owned and leased facilities are vulnerable to cyberterrorism. While the physical structures of these buildings are generally not at risk, information systems and data stored within them are vulnerable. State computer networks contain sensitive information that is integral to the security of the Commonwealth and could be the target of a cyber attack. The state is also entrusted with many forms of personal and financial information, including tax filings, birth and death records, Social Security numbers, medical information, and more. Additionally, many critical facilities that are essential to state operations are reliant upon computer networks to monitor and control critical functions. For example, an attack on a nuclear power plant or the power grid could have detrimental impacts on state services and functions. Additionally, a large-scale computer breach would likely lead to significant economic costs in lost productivity to the impacted state agencies and potentially related businesses and industries. However, lost revenues and productivity would depend on the type and magnitude of the cyberterrorism event.

4.3.19.6. Jurisdictional Vulnerability Assessment

All communities in the Commonwealth are vulnerable on some level, directly or indirectly, to a cyberterrorism attack. However, in general, Philadelphia, Harrisburg, Dauphin County, Pittsburgh, Allegheny County, and individual county seats may have higher vulnerabilities due to higher concentrations of local, state, and federal facilities. Larger cities like Philadelphia and Pittsburgh are also more vulnerable to terrorist attacks because of the higher concentrations of people, businesses, and critical infrastructure.

4.3.20. Dam Failure

The Dam Failure profile can be found in *Appendix H*.

4.3.21. Environmental Hazard – Coal Mining

4.3.21.1. Location and Extent

Mining, including surface, underground, and open-pit operations, has been an important economic activity in Pennsylvania since before the 1860s and was instrumental in the Commonwealth's development. Coal mining is the most prominent of Pennsylvania's mining activities and continues to be a major industry. Pennsylvania produces two types of coal: bituminous and anthracite. Bituminous coal is typically used for electricity generation and metal production. Anthracite coal, which is rarer than bituminous coal and can reach a high heating point that burns blue flame, is typically used for heating and metal production (PA DEP, 2022g).

While resources other than coal are also mined in Pennsylvania - including metal ores, clay and shale, and limestone - most of these deposits are of limited extent. Coal, in contrast, has been mined under large areas of the state. Counties underlain by coal deposits are at highest risk of environmental hazards resulting from coal mining activities. This area includes the majority of southwest Pennsylvania, situated over the Commonwealth's main bituminous field, as well as the jurisdictions in northeast Pennsylvania located over the anthracite fields, particularly in Lackawanna, Luzerne, Northumberland, and Schuylkill Counties (Figure 4.3.21-1).

Figure 4.3.21-2 shows the location of active, inactive, proposed, and abandoned coal mining operations in Pennsylvania. Note that the active and abandoned coal mines are primarily located on the coal fields shown in Figure 4.3.21-1, however there are mines located outside the field areas. Table 4.3.21-1 lists the number of coal mines in each county that are listed as active or abandoned. Statewide, 46 counties contain at least one active or abandoned coal mine. However, the highest concentration of mines is in western Pennsylvania which is underlain by coal seams. Two western Pennsylvania counties, Clearfield County and Somerset County, contain the highest number of active or abandoned coal mines in the state with 1,339 and 1,028 mines respectively. About 46% of mines across the site are active, 23% are inactive, reclamation was completed at 23%, and 8% are abandoned.

Figure 4.3.21-1 Distribution of Pennsylvania Coals (PA DMCR, 2022).

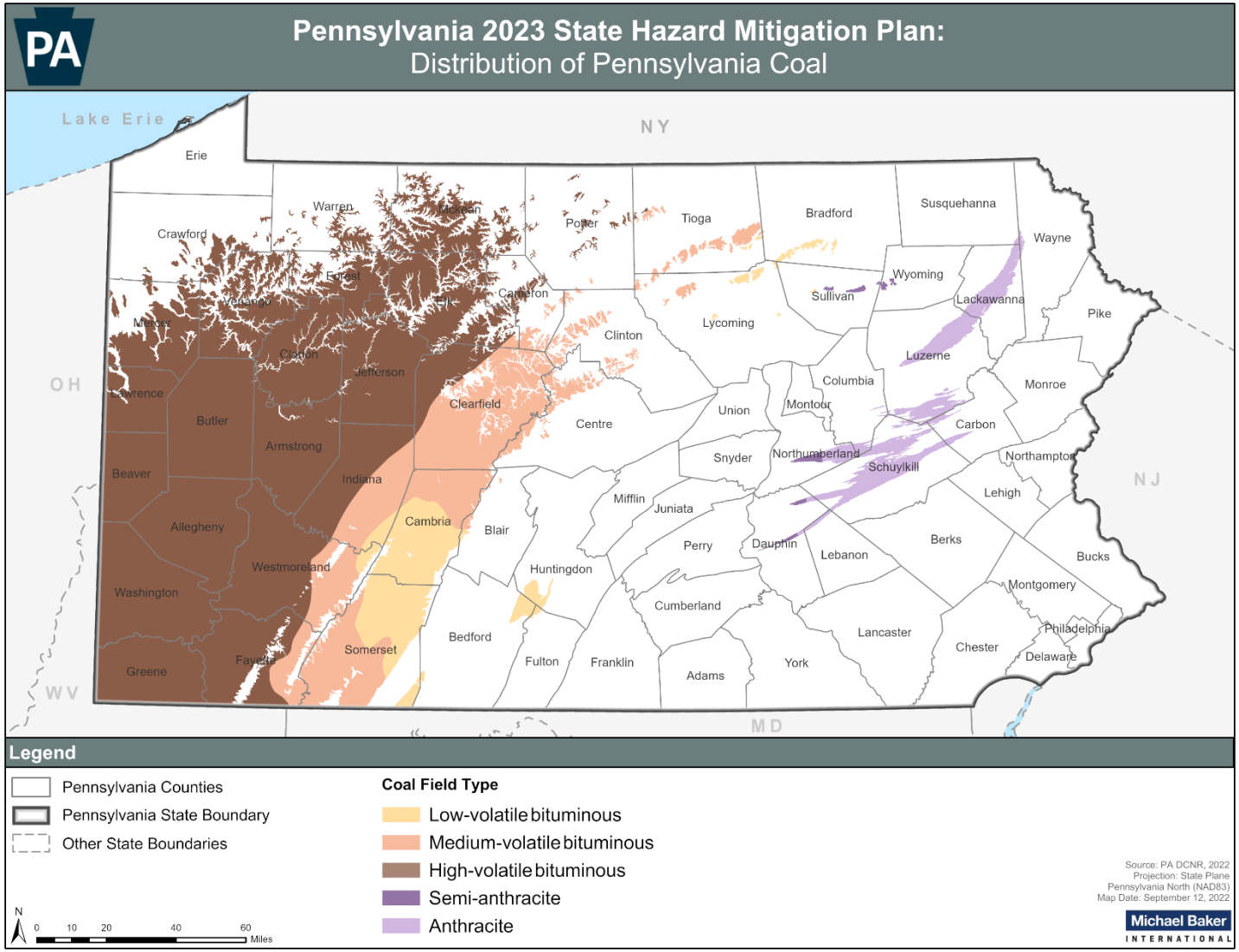


Figure 4.3.21-2 Coal Mining Operations in Pennsylvania (PA DEP, 2022h).

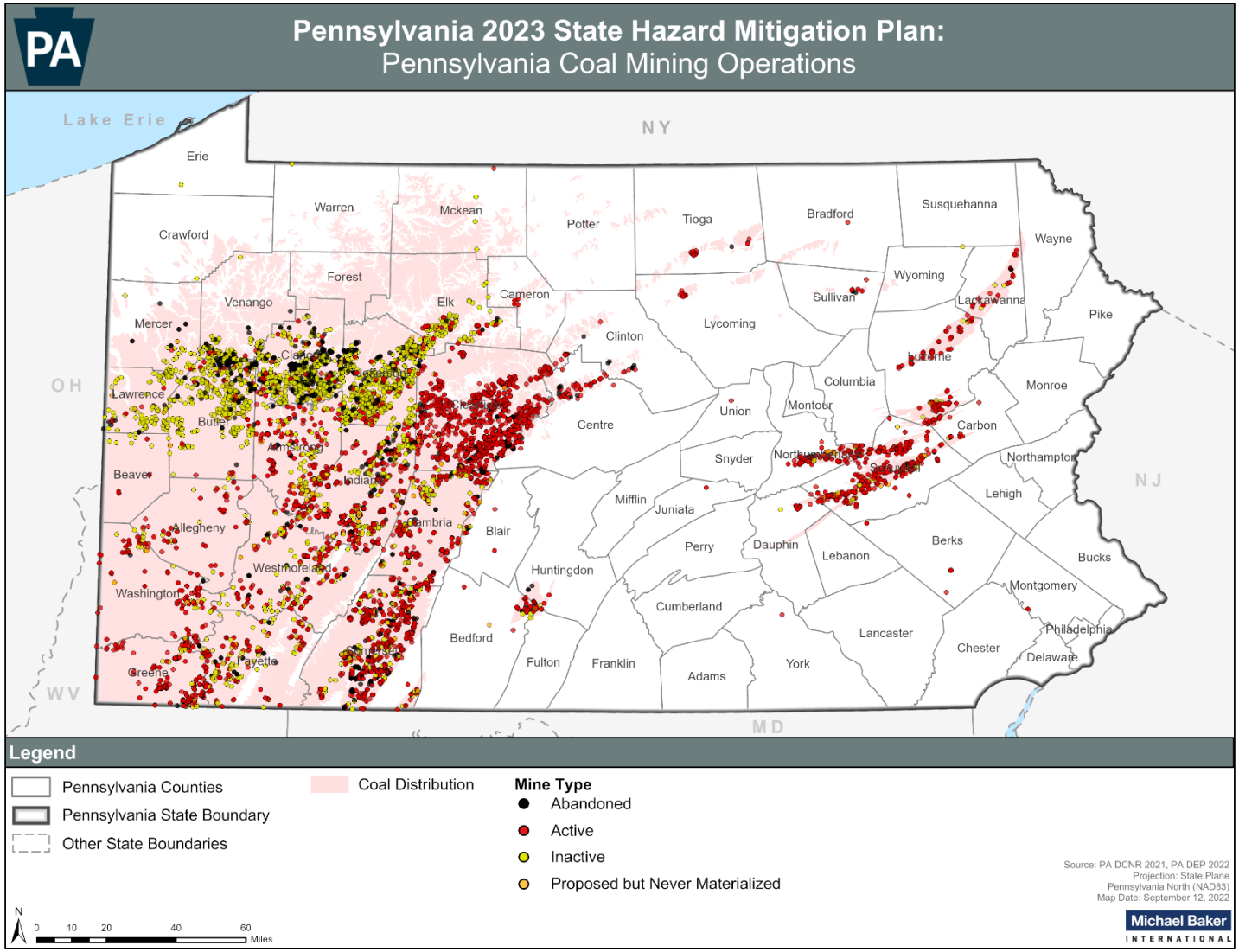


Table 4.3.21-1 Number of Active and Abandoned Coal Mines in Pennsylvania Counties (PASDA, 2022)			
COUNTY	NUMBER OF MINES	COUNTY	NUMBER OF MINES
Adams	0	Lackawanna	34
Allegheny	91	Lancaster	0
Armstrong	390	Lawrence	39
Beaver	10	Lebanon	0
Bedford	37	Lehigh	0
Berks	7	Luzerne	201
Blair	13	Lycoming	12
Bradford	1	McKean	1
Bucks	0	Mercer	14
Butler	222	Mifflin	0
Cambria	435	Monroe	0
Cameron	10	Montgomery	4
Carbon	25	Montour	0
Centre	111	Northampton	0
Chester	0	Northumberland	137
Clarion	427	Perry	0
Clearfield	1,339	Philadelphia	0
Clinton	28	Pike	0
Columbia	39	Potter	0
Crawford	0	Schuylkill	538
Cumberland	0	Snyder	0
Dauphin	13	Somerset	1,028
Delaware	0	Sullivan	14
Elk	90	Susquehanna	0
Erie	0	Tioga	18
Fayette	214	Union	1
Forest	0	Venango	65
Franklin	0	Warren	0
Fulton	6	Washington	178
Greene	247	Wayne	0
Huntingdon	13	Westmoreland	243
Indiana	598	Wyoming	0
Jefferson	407	York	1
Juniata	2	**TOTAL**	7,303

Pennsylvania was one of the first states to initiate, promulgate, and enforce environmental regulations related to mining, including mine reclamation. However, there remains a legacy of abandoned mines, waste piles, and degraded groundwater and surface water in the Commonwealth. The PA DEP notes that Pennsylvania accounts for one-third of the country's abandoned mile lands (AML) problems; the federal Office of Surface Mining AML Inventory

System has identified over $1 billion of high-priority health and safety problems in the Commonwealth (PA DEP, 2022i). According to the DEP, acid mine drainage is the number one water pollution problem in Pennsylvania, estimating there are over 5,500 miles of streams with impaired water quality from the pyrite located in mines that can persist for thousands of years after they are abandoned (Lenahan, 2022).

Table 4.3.21-2 shows coal slurry ponds in the Commonwealth including impoundment name, Mine Safety and Health Administration (MSHA) ID number and the county in which the pond is located. A slurry pond is an impoundment used to store the waste products created during coal preparation, which consists of silt, sand, clay, water, coal fines and washing/treatment chemicals (National Research Council, 2002). Coal slurry impoundments are considered dams and classified accordingly by the PA DEP.

The greatest hazard associated with coal slurry ponds is impoundment failure due to seepage, embankment weakness and undermining and resulting in flooding (National Research Council, 2002). Breakthroughs associated with deep mining have also led to flooding of underground mine operations. The slurry holding capacity of impoundments in the Commonwealth ranges from tens of millions to billions of gallons. According to DEP, there are 45 coal slurry impoundments in Pennsylvania with Greene County having the most at 20 impoundments.

Table 4.3.21-2 Summary of Coal Slurry Impoundments in the Commonwealth. (DEP, 2023).

IMPOUNDMENT NAME	COUNTY
Renton Slurry Pond No 3	Allegheny
Renton Slurry Pond No 4	Allegheny
Russelton Slurry Pond No 3	Allegheny
Harmar Refuse Bank	Allegheny
Harmar Storage Pond No 4	Allegheny
Renton Slurry Pond No 5	Allegheny
Fawn Mine #91 Refuse Impoundment	Butler
Cambria Slurry Pond #4	Cambria
Labelle Slurry Pond #3	Fayette
Banning Refuse Slurry Pond	Fayette
Labelle Slurry Pond NO 2	Fayette
Robena Pond No 6	Greene
Robena Slurry Pond No 4	Greene
Bailey Mine Slurry Impoundment	Greene
Emerald No. 1 Main Valley Eastern	Greene
Cumberland No. 1 Slurry Pond 1	Greene
Pegs Run Slurry Impoundment	Greene
Emerald No. 2 Main Valley Eastern	Greene
Bailey No 1 South Saddle Dike	Greene
Emerald No. 1 Back Valley Western	Greene
Emerald No. 2 Back Valley Western	Greene
Cumberland No. 2 Slurry Pond	Greene
Bailey Mine Area No. 3 Slurry	Greene

Table 4.3.21-2 Summary of Coal Slurry Impoundments in the Commonwealth. (DEP, 2023).

IMPOUNDMENT NAME	COUNTY
Bailey Mine Area No. 3 Saddle A	Greene
Bailey Mine Area No. 3 Saddle B	Greene
Bailey Mine Area No. 3 Saddle C	Greene
Bailey Mine Area No. 3 Saddle D	Greene
Hughes Hollow Slurry Impoundment	Greene
Bailey No 5 Slurry Impoundment	Greene
Bailey No 5 West Saddle	Greene
Bailey No. 8 Slurry Impoundment	Greene
Weisner Hollow Slurry	Jefferson
Maple Creek Slurry Pond No 2 - A	Washington
Mine No 84 - Pond 6 Main	Washington
Maple Creek Slurry Pond 1	Washington
Mathies Mine Refuse Area Pond #2	Washington
Duck Pond	Washington
Horne No 5 Slurry	Washington
Maple Creek #3 Slurry Pond #1	Washington
Maple Creek #3 Slurry Pond #2	Washington
Mine No 84 - Pond 6 West Dike	Washington
Mine No 84 - Pond 6 East Dike	Washington
Mill Service No 5	Westmoreland
West Newton Sludge	Westmoreland
West Newton Slurry	Westmoreland

4.3.21.2. Range of Magnitude

The environmental impacts of coal mining are many. Mining activities and acid mine drainage can contaminate surface and groundwater, create acid mine drainage, cause changes in water temperature and damage to streams, lakes, ponds, estuaries, and wetland ecosystems. Mine explosions or burning refuse piles can cause air quality problems. Although mine reclamation is required for much surface mining activity, there is still a loss of quality in landscape, damage to vegetation, and degradation of habitat.

Additionally, jurisdictions where longwall mining has taken place face added risks to domestic water wells. Longwall mines involve the extraction of entire coal seams leaving caverns of up to five feet tall that are left to planned subsidence. However, this earth movement can disrupt aquifers and reduce or eliminate water sources.

Major impacts from mining include surface-elevation changes and subsidence, modification of vegetation, the chemical degradation and flow redistribution of surface water and groundwater, the creation of mine voids and entry openings, adverse aesthetic impacts, and changes in land use. Under the Act 54 (of 1994) amendments to the Bituminous Mine Subsidence and Land Conservation Act (BMSLCA) of 1966, the PA DEP is required to compile data and report findings regarding the effects of underground mining on land, structures, and water resources.

DEP compiles claims of effects from bituminous underground mining on an ongoing basis and began publishing claims and incidents in the Bituminous Underground Mining Information System (BUMIS) in 2018. Current BUMIS claims are categorized as follows: land damage, methane intrusion, structure damage, utility damage, water supply contamination, water supply loss, and stream effects.

Land damage from underground coal mining is grouped into four main impact types (PA DEP, 2022j):

- Tension Cracks: Near vertical cracks or ruptures of the ground surface that can extend tens to hundreds of feet in length and several feet in depth and width. These cracks may stay open or close shortly after opening.
- Mass Wasting: Downward movement of earth material due to the force of gravity – commonly known as landslides or rock falls.
- Flooding: A new building up the stream waters as a result of the formation of a subsidence basin. A newly formed subsidence basin acts as a dam which allows the stream flow to pool. Flooding can result from the rising elevation of the stream and/or the addition of precipitation.
- Other: All remaining land damage impacts, including subsidence/sinkholes.

Methane is a naturally occurring hydrocarbon gas that can exist underground. It is lighter than air, colorless, odorless, and flammable. It is found in shallow organic rich deposits and deep coal beds as well as other rock units. Underground methane can be influenced by coal mining. In rare cases, methane can find its way into a structure via cracks in the foundation and/or basement floor. Stray gas problems are typically tied to an incident of structure damage (PA DEP, 2022k).

Structures on the ground surface can be damaged due to surface effects of underground subsidence. This can be minor, such as sticking doors or windows, or major, such as cracking in the foundation or walls (PA DEP, 2022l).

Utilities impacts are subsidence damage to piped, conduits, or wires which convey electricity, gas, water, sewage, internet, etc. These incidents are rare because mine operators and public utilities typically have agreements in place prior to undermining (PA DEP, 2022m).

Water contamination is an impact to the chemical properties of either a private or public water supply. Any change in water quality, color, taste, or smell is treated as water contamination. Water contamination can range from a general increase in the dissolved constituents to an increase in the amount of sediment/particulate matter in the water supply. Contamination can also result from the migration of acid mine drainage from the mine workings and mine pool to the surrounding aquifer. The commonly tested chemical water quality parameters most likely to reflect an impact due to underground coal mining are total dissolved solids, specific conductance, pH, iron, manganese, hardness, total coliform, acidity, alkalinity, and sulfates (PA DEP, 2022n).

Water loss is an impact to the quantity of water of either a private or public water supply. Underground mining and subsequent subsidence can affect the yield of a water supply. A water loss complaint can range from a decrease in water supply yield to a total loss of water. The cause of the water loss typically is a result of mine dewatering activities reducing the available water supply feeding a well or spring or from subsidence sealing off the fractures that were supplying groundwater to the well or spring (PA DEP, 2022o).

Stream impacts associated with underground mining can include diminished stream flow, a complete loss of flow or pooling within various areas of a stream as well as streambed fracturing and heaving. All three effects can result in a varying degree of habitat loss for aquatic fauna, while a complete flow loss can also result in impacts to terrestrial flora and fauna, such as loss of water supply. Any affected stream may contain one impact or a combination of flow loss, pooling, and heaving/fracture impacts.

Diminished flow and complete flow loss related to underground mining is usually caused by the development of new fractures, or the expansion of pre-existing fractures, under and within the stream bed. These fractures result from land subsidence/land movement in areas that have been directly undermined or areas that are located within the underground mine's angle of draw.

Pooling is a type of stream impact that can result from subsidence. Pooling develops when the stream section over a panel subsides, but the part of the stream located above the gate (entries) does not subside as significantly. This unsubsided gate acts like a dam, raising the water level on the upstream side of the gate. The result is a reduction of the stream's flow velocity to near zero at this location. This standstill results in sediment particles settling out and depositing on the stream bed, potentially effecting the habitat used by macroinvertebrates. Additionally, pooling results in a loss of oxygen, a general warming of the water in the pool location and can prevent fish and other organisms from freely navigating the stream. Most pooling occurs in streams with a gradient of less than 2%. To alleviate pooling, mine operators use a technique known as a "gate-cut." A gate-cut consists of excavating the section of the stream bed that did not subside (the pooled area) until it is at the same elevation as the rest of the stream bed. To determine if a gate-cut has successfully removed the pooling from an impacted stream, the gate-cut is required to be monitored for five years.

A heave is where the ground in or crossing the stream bed is raised from its original position in response to extension and compression of rock layers resulting from subsidence. Heaving can disrupt stream flow by halting or redirecting flow (PA DEP, 2022p).

Underground mining can have both positive and adverse effects on wetlands. A wetland occurs in flat areas and have soils that are permanently saturated in water (hydric soils) and vegetation that is adapted to survive in hydric soils. When subsidence occurs in flat areas, wetlands can spontaneously form. The subsidence creates a depression allowing water to collect and remain in the depression. Over time, the soils become saturated and eventually hydric. When waterfowl visit the saturated depressions, they bring with them vegetation seeds which get deposited and, over time, will lead to the development of characteristic wetland vegetation. The adverse effect of coal mining on wetlands is the loss of habitat/wetlands. As with streams, subsidence can significantly reduce or eliminate the water source of a wetland through land fractures. Without a

water source, the hydric soils will lose moisture and the vegetation that is adapted to survive in saturated soils will perish (PA DEP, 2021c).

In addition, active and abandoned mines can also result in injury and loss of human life. This can occur in active mines where workers are injured or killed by mine collapse, entrapment, poisonous gases, inundation, explosions, fires, equipment malfunction, and improper ventilation (CDC, 2012). Injuries and death, such as All-Terrain Vehicle (ATV) accidents, falling, and drowning, can also occur in abandoned mines.

Recently, Pennsylvania, has seen an increase in quarry trespassing due to social media posts on sites like Instagram and YouTube (The Morning Call, 2015). Local officials warn that quarries contain sharp and unpredictable edges, discarded machinery under water, strong currents, and extreme changes in water temperature just below in the surface. In addition to injuries and arrests, deaths from falls and drowning have also resulted from quarry trespassing. The U.S. Department of Labor reported that 20 people drowned in a quarry in Pennsylvania between the years 1999 to 2013. Between 2014 to 2016, the PA DEP reported four people died while trespassing at a quarry (PA DEP, N.d.). After no reported quarry deaths in 2017, there was 1 death reported in each of 2018, 2019, and 2020 (Phyrillas, 2018; Snyder, 2019; Luciew, 2020).

The mineral-waste disposal from coal mining also is a hazard. Past disposal practices have dotted Pennsylvania's landscape with, at one point, over 820 unsightly refuse piles, many containing combustible materials that cause long-term air-quality problems if ignited (Dalberto et al., 2004). Burning refuse piles have also been linked to major underground coal fires, such as those at Centralia and Shamokin in the Anthracite region of Pennsylvania.

Slurry ponds and tailings dams are also potentially dangerous (Figure 4.3.21-3). Mineral byproducts from coal mining are pumped to slurry or tailings dams for removal by sedimentation (Natural Research Council, 2002). If the dams or structures supporting the slurry ponds fail, they pose hazards similar to dam failure (see Appendix I – Dam Failure Profile).

Figure 4.3.21-3 Little Blue Run Coal Ash Pond along the Pennsylvania-West Virginia Border (Frazier, 2018a)

Reject wastes from coal mining that contain sulfide minerals can also degrade groundwater and surface water, the results of which have caused coal refuse piles to be historically prolific sources of acid mine drainage and stream impairment in Pennsylvania (Dalberto et al. 2004).

Pennsylvania has a long history of mining and there have been numerous mining accidents. The worst-case scenario event in Pennsylvania mining history occurred in 1962 in Centralia, Pennsylvania when an underground fire began in the coal mines underneath the town and continues to burn today (Blakemore, 2019). The federal government offered buyouts of homes of residents in 1983 so they could relocate from the Centralia, resulting in a cost of over $40 million; Pennsylvania then claimed eminent domain on all remaining properties in the town in 1992 and condemned all the buildings (Centralia PA, 2014). In 1981 the town had over 1,000 residents, but only 5 remained in 2020 (U.S. Census, 2020).

In Somerset County, the Quecreek Mine accident nearly became Pennsylvania's worst case scenario when 7 million tons of water flooded into the mine in late July 2002. The accident was the result of a breach in the wall between Quecreek Mine and an abandoned, flooded adjacent mine. Nine miners were trapped for 77 hours; however the accident ended with the safe rescue of all the trapped workers (Pittsburgh Post-Gazette, 2002).

One of the worst mining accidents in the United States since 1950 occurred in nearby West Virginia. On April 5, 2010 twenty-nine miners were killed at the Upper Big Branch Mine by an explosion.

Table 4.3.21-3 Most Likely Lifelines Impacted by Coal Mining		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating a causal and compounding relationship for the Safety and Security lifeline as community safety may be endangered and fire departments may be called into response and recovery if explosions or fires occur.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery. Impacts from coal mining include environmental contamination, which can impact agricultural operations and water supplies, and the potential for land subsidence and structure collapse. Mitigation actions for this lifeline should be focused on developing and enforcing regulations for mining and waste storage to ensure proper procedures are in place.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline as potential environmental contamination can have adverse health impacts on communities, leading to more strain on the local healthcare system.
Energy		Anticipating a cascading relationship for the Energy lifeline as coal mining operations play a role in energy production. Issues with mining operations may lead to additional challenges with energy production. Mitigation actions may focus on diversifying potential energy sources to reduce impacts if coal mining operations are shut down.

4.3.21.3. Past Occurrence

Under Act 54, PA DEP tracks claims of effects from underground mining relating to land damage/subsidence, methane intrusion, structure damage, utility damage, water supply contamination and water loss, and stream impairments. DEP also tracks impacts to wetlands related to mining operations. Table 4.3.25-4 below lists the number of claims reported each year since 2018. Act 54 claims are most commonly related to structure damage (396), water loss (230), stream effects (166), and water contamination (146). There have also been a significant number of wetland related claims (657). Note that Act 54 Data was available through March 2022 and wetland data was available through July 2021.

Table 4.3.21-4 Act 54 Claims and Wetland Claims Caused by Underground Mining (PA DEP, 2022) (PA DEP, 2021d)						
CLAIM TYPE	2018	2019	2020	2021	2022	TOTAL
Land Damage	33	15	24	23	0	**95**
Methane	2	0	0	0	0	**2**
Structures	122	107	121	42	4	**396**
Utilities	1	1	1	0	0	**3**
Water Contamination	26	46	44	28	2	**146**
Water Loss	49	61	80	40	0	**230**
Stream Effects - Flow Loss	30	17	18	19	0	**84**
Stream Effects - Pooling	5	10	4	4	0	**23**
Stream Effects - Heaving	16	21	8	14	0	**59**
Wetlands	200	257	168	32	0	**657**
Total	**484**	**535**	**468**	**202**	**6**	**1695**

Although state and federal (U.S. Department of Labor, EPA, and the Office of Surface Mining and Reclamation) laws require occupational health, safety, and environmental protection in all mining activities, mining accidents still occur. The U.S. Department of Labor Mine Safety and Health Administration (MSHA) tracks mining accidents and injuries. Since 2011, there have been 16 deaths in Pennsylvania resulting from surface and underground coal mining activities (MSHA, 2022). Although there have been many mining accidents in Pennsylvania's early mining history of the 1800's, there is no comprehensive database that tracks the data. The National Institute for Occupational Safety and Health (NIOSH) estimates there were 191 mining disasters in Pennsylvania between 1839 and 1977, which had a total of 3,355 fatalities. A mining disaster is defined as an incident with five or more fatalities (CDC, 2022j). Beyond operator accidents, there can be incidents that are a result of falls, drowning, electrocution, and ATV crashes.

The DEP Bureau of Mine Safety is required by law to investigate all fatal and serious accidents that occur at underground Commonwealth mines. According to the Bureau, there have been four major mine emergencies in Pennsylvania coal mines. They define a mine emergency as a serious situation or occurrence that happens unexpectedly and demands immediate action or a condition of urgent need for action or assistance such as a state of emergency. Two of these were mine fires and two were inundations (PA DEP, 2010).

4.3.21.4. Future Occurrence

It is difficult to forecast the severity and frequency of coal mining accidents and environmental damage in Pennsylvania. Throughout time, the government has strengthened mining and reclamation operation and environmental regulations, permitting, and inspection criteria, but this has not prevented mining accidents and environmental damage from occurring.

Surface subsidence resulting from underground mining continues to be a major concern of those impacted by the mining industry (see Section 4.3.13). Despite the use of deep mine roof-support methods, some subsidence will eventually occur.

It is likely that Pennsylvania will continue to modify its laws to reflect additional environmental awareness. Stricter controls on reclamation, perhaps specifically addressing the disposal of mining residuals, are likely. State and federal laws and programs have historically placed an emphasis on environmental preservation and reclamation. As in the past, it seems likely that Pennsylvania will be at the forefront of these programs and future occurrence will decrease. In November of 2021, the US Congress passed an infrastructure bill which included more than $3 billion for Pennsylvania to fund abandoned mine reclamation (Rubright, 2022). The money will be used to fund projects across the state for years to come. However, there is still an anticipated 100 percent annual probability for coal mining hazards as unfortunately incidents occur annually in the Commonwealth.

4.3.21.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to environmental hazards related to coal mining activities, all structures located within 1.5 miles the active or abandoned coal mile shown in Table 4.3.21-3. The area impacted by a coal mine incident will depend on the coal mine and atmospheric conditions. For this assessment, however, 1.5 miles was selected as a representative distance within which death, injury, or significant property damage could occur. In addition, the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 781, or 18 percent, are located within 1.5 miles of an active or abandoned coal mine. These facilities have a combined replacement value of more than $497 million, or approximately 13 percent of the known value of geolocated state facilities. Overall, there is approximately 5.28 million square feet of reported building space considered to exist in areas vulnerable to active or abandoned coal mines. Additionally, of the 781 vulnerable state facilities, 518 are reported to be owned by the state.

Table 4.3.21-5 Vulnerability of State Facilities to Environmental Hazards Related to Coal Mining.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	1	11%	0	6,070
Department of Agriculture	1	6%	0	2,975
Department of Banking and Securities		0%		
Department of Community and Economic		0%		
Department of Conservation and Natural		0%		
Department of Corrections	173	25%	171	3,527,922
Department of Education		0%		

Table 4.3.21-5 Vulnerability of State Facilities to Environmental Hazards Related to Coal Mining.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Department of Environmental Protections	6	46%	1	165,880
Department of General Services	2	2%	1	174,161
Department of Health	4	8%	0	16,250
Department of Labor and Industry	13	19%	2	105,862
Department of Military and Veterans		0%		
Department of Public Welfare	6	6%	0	63,826
Department of Revenue		0%		
Department of Transportation	360	21%	339	866,740
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	3	2%	3	16,010
Governor's Office		0%		
Historical and Museum Commission	2	7%	1	1,500
Insurance Department		0%		
Liquor Control Board	75	14%	0	258,293
Public School Employees' Retirement	2	33%	0	4,903
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System	1	25%	0	2,318
State Police	7	19%	0	58,895
State System of Higher Education	124	15%		
Thaddeus Stevens College of Technology		0%		
Treasury	1	50%	0	5,300
Total	**781**	**18%**	**518**	**5,276,905**

Of the 13,448 geolocated critical facilities, 1,983, or 15 percent are located in high environmental hazards related to coal mining activities (Table 4.3.21-6). These facilities have a combined replacement value of approximately $85.8 billion, or nearly 22 percent of the known replacement value of geolocated critical facilities.

Table 4.3.21-6 Vulnerability of Critical Facilities to Environmental Hazards Related to Coal Mining.

TYPE	# OF VULNERABLE STRUCTURES	% OF TOTAL STRUCTURES BY TYPE
Agricultural	31	11%
Banking		0%
Commercial	1	5%
Communication	71	13%

Table 4.3.21-6 Vulnerability of Critical Facilities to Environmental Hazards Related to Coal Mining.		
TYPE	# OF VULNERABLE STRUCTURES	% OF TOTAL STRUCTURES BY TYPE
Dam	282	19%
Education (colleges and universities)	44	11%
Education (public schools)	457	10%
Emergency Operation Center	7	10%
Energy	87	24%
Fire Station	515	20%
Government	1	4%
Hospital	33	11%
National Monument or Icon	1	17%
Nuclear	1	20%
Police Station	211	16%
Transportation	109	16%
Water	132	21%
Total	**1,983**	**15%**

4.3.21.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to environmental hazards related to coal mining activities, all census blocks with centers located within 1.5 miles of an active or abandoned coal mine were identified. The population, building counts, and building value of all vulnerable census blocks were then aggregated to the county scale (Table 4.3.21-7). The counties with the highest percentage of exposed building value are Clarion, Clearfield, Greene, Somerset, and Schuylkill counties. For each of these counties, more than sixty percent of the total building value is vulnerable to environmental hazards related to coal mining activities. The counties with the most people exposed to this hazard, in contrast, are Allegheny, Lackawanna, and Luzerne counties, all with a vulnerable population of over 100,000.

Table 4.3.21-7 Vulnerability of People and Buildings to Environmental Hazards Related to Coal Mining.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Adams				0%
Allegheny	173,688	75,097	$37,384,703	14%
Armstrong	31,072	16,547	$6,160,512	49%
Beaver	13,345	6,122	$2,782,281	8%
Bedford	1,794	1,113	$366,737	3%
Berks	8,713	3,274	$1,654,372	2%
Blair	3,283	1,468	$557,771	2%
Bradford	1,206	671	$438,814	3%
Bucks				0%

Table 4.3.21-7 Vulnerability of People and Buildings to Environmental Hazards Related to Coal Mining.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Butler	35,976	15,548	$8,746,778	19%
Cambria	69,040	36,195	$16,229,985	49%
Cameron	11	18	$3,721	0%
Carbon	7,408	3,669	$1,423,874	13%
Centre	8,463	4,365	$1,540,707	5%
Chester	2,788	1,030	$916,245	1%
Clarion	26,108	13,350	$5,693,782	69%
Clearfield	62,873	26,671	$12,327,504	74%
Clinton	87	167	$31,475	0%
Columbia	752	464	$108,928	1%
Crawford				0%
Cumberland				0%
Dauphin	5,718	2,906	$2,033,347	3%
Delaware				0%
Elk	3,575	2,550	$847,016	10%
Erie				0%
Fayette	61,079	31,666	$11,648,473	47%
Forest				0%
Franklin				0%
Fulton	25	30	$9,784	0%
Greene	23,069	10,689	$5,877,269	62%
Huntingdon	1,456	930	$242,920	3%
Indiana	42,327	22,966	$8,410,271	51%
Jefferson	24,778	15,574	$4,283,895	53%
Juniata	766	415	$117,202	3%
Lackawanna	101,140	37,089	$18,477,578	41%
Lancaster				0%
Lawrence	17,123	8,090	$3,207,209	22%
Lebanon				0%
Lehigh				0%
Luzerne	188,209	72,732	$30,071,387	53%
Lycoming	0	0	$0	0%
McKean	233	153	$49,851	1%
Mercer	5,202	2,704	$1,487,921	5%
Mifflin				0%
Monroe				0%
Montgomery	6,217	2,800	$2,096,515	1%

Table 4.3.21-7 Vulnerability of People and Buildings to Environmental Hazards Related to Coal Mining.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Montour				0%
Northampton				0%
Northumberland	33,308	16,378	$7,870,937	38%
Perry				0%
Philadelphia				0%
Pike				0%
Potter				0%
Schuylkill	98,661	46,149	$19,616,049	66%
Snyder				0%
Somerset	57,266	31,027	$16,064,658	69%
Sullivan	573	502	$169,408	8%
Susquehanna				0%
Tioga	1,105	595	$223,975	3%
Union	144	33	$9,392	0%
Venango	4,385	2,595	$894,442	9%
Warren				0%
Washington	56,167	28,737	$12,732,341	28%
Wayne				0%
Westmoreland	97,561	50,016	$22,705,187	28%
Wyoming				0%
York	1,808	756	$314,488	0%
Total	**1,278,502**	**593,851**	**$265,829,702**	**10%**

4.3.22. Environmental Hazard – Conventional Oil and Gas Wells

4.3.22.1. Location and Extent

Oil and gas development in Pennsylvania is extensive and has been ongoing for over 150 years, with the most recent phase of exploration and production activities targeting the Marcellus and Utica shales. Regulatory standards for the industry have evolved significantly as a function of both advances in technology and a larger focus on environmental protection. It is estimated that as many as 300,000 to 760,000 oil and gas wells have been drilled in Pennsylvania since the first commercial oil well was developed in 1859. A significant number of these wells were drilled prior to modern well permitting and plugging requirements, and it is estimated that somewhere between 100,000 and 560,000 oil and gas wells remain unaccounted for in state records (PA DEP, 2021d).

The Pennsylvania Department of Environmental Protection (PA DEP) differentiates between conventional and unconventional oil and gas wells. Conventional wells are defined as traditional vertical wells, while unconventional wells are typically horizontally drilled wells commonly associated with the Marcellus Shale. Hazards associated with unconventional oil and gas wells are profiled in Section 4.3.23.

There are approximately 190,000 conventional oil and gas wells drilled in Pennsylvania (Other types include “coalbed methane,” “dry hole,” “injection,” “multiple well bore type,”, “observation,” “storage well,” “test well,” and “waste disposal.” Other statuses include “plugged unverified,” “proposed, but never materialized,” meaning that a permit application was submitted but not approved, a well was entered erroneously into the database, or the permit was issued but the well was never drilled, and “regulatory inactive status.”

Active and abandoned oil and gas wells exist in 55 of Pennsylvania’s 67 counties, with the majority of activity occurring in the western portion of the Commonwealth. Data on conventional oil and gas wells obtained from PA DEP, provided in Figure 4.3.22-1 below, shows that over 40 percent of existing oil and gas wells are located in only four counties—McKean, Warren, Indiana, and Venango. These four counties have more than 9,000 wells each within their political boundaries totaling over 55,000 oil and gas wells combined.

Private water supplies such as domestic drinking water wells in the vicinity of oil and gas wells are at risk of contamination from brine and other pollutants including methane which can pose a fire hazard. Private drinking water is largely unregulated and therefore the existing data is largely incomplete and/or inaccurate. Some information is submitted to the Pennsylvania Topographic and Geologic Survey by water well drillers via the PaGWIS system, but this data is voluntarily reported.

Figure 4.3.22-1 Active Conventional Oil and Gas Well Locations in Pennsylvania (PA DEP, 2022h).

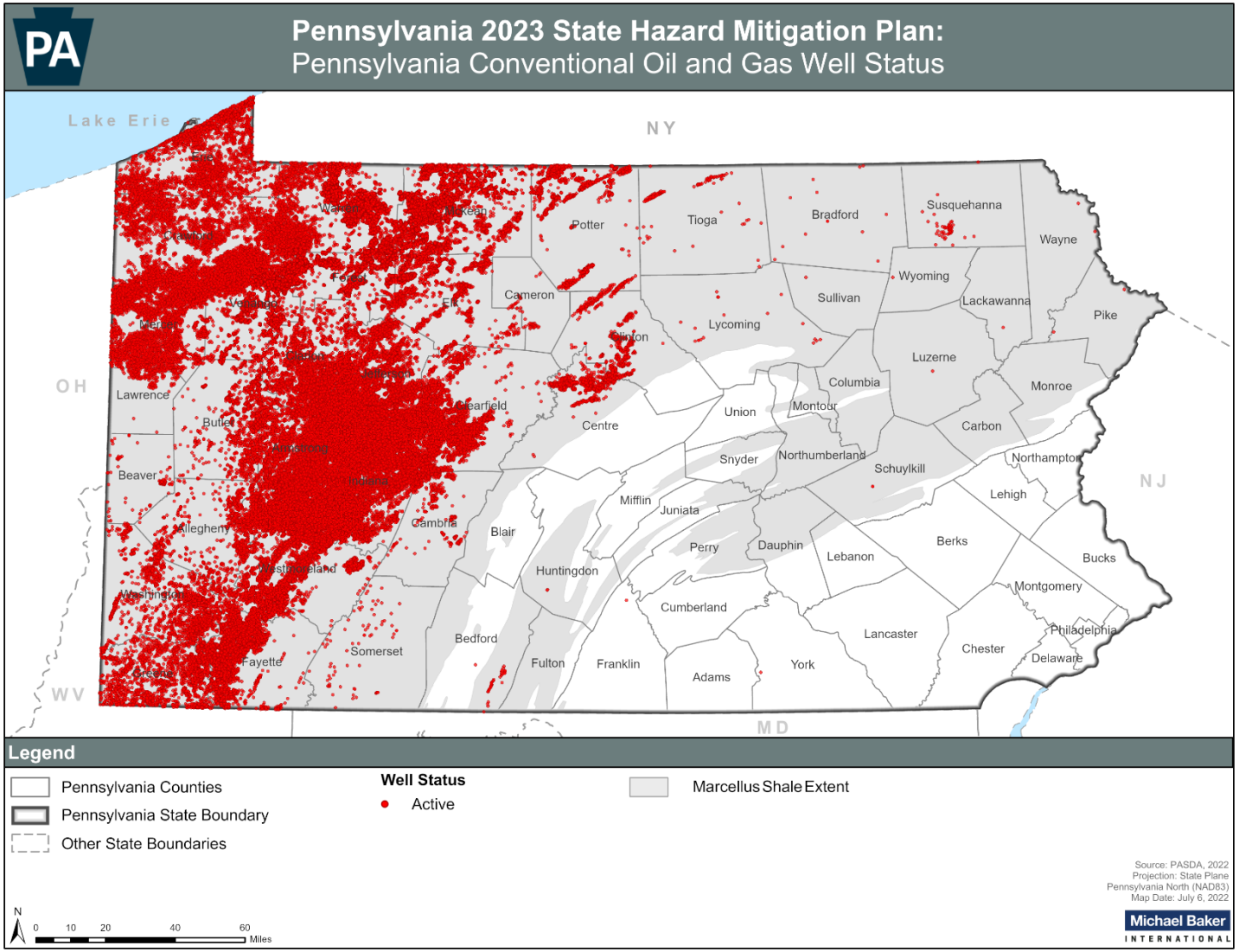


Figure 4.3.22-2 Non-Active Conventional Oil and Gas Well Locations in Pennsylvania (PA DEP, 2022h).

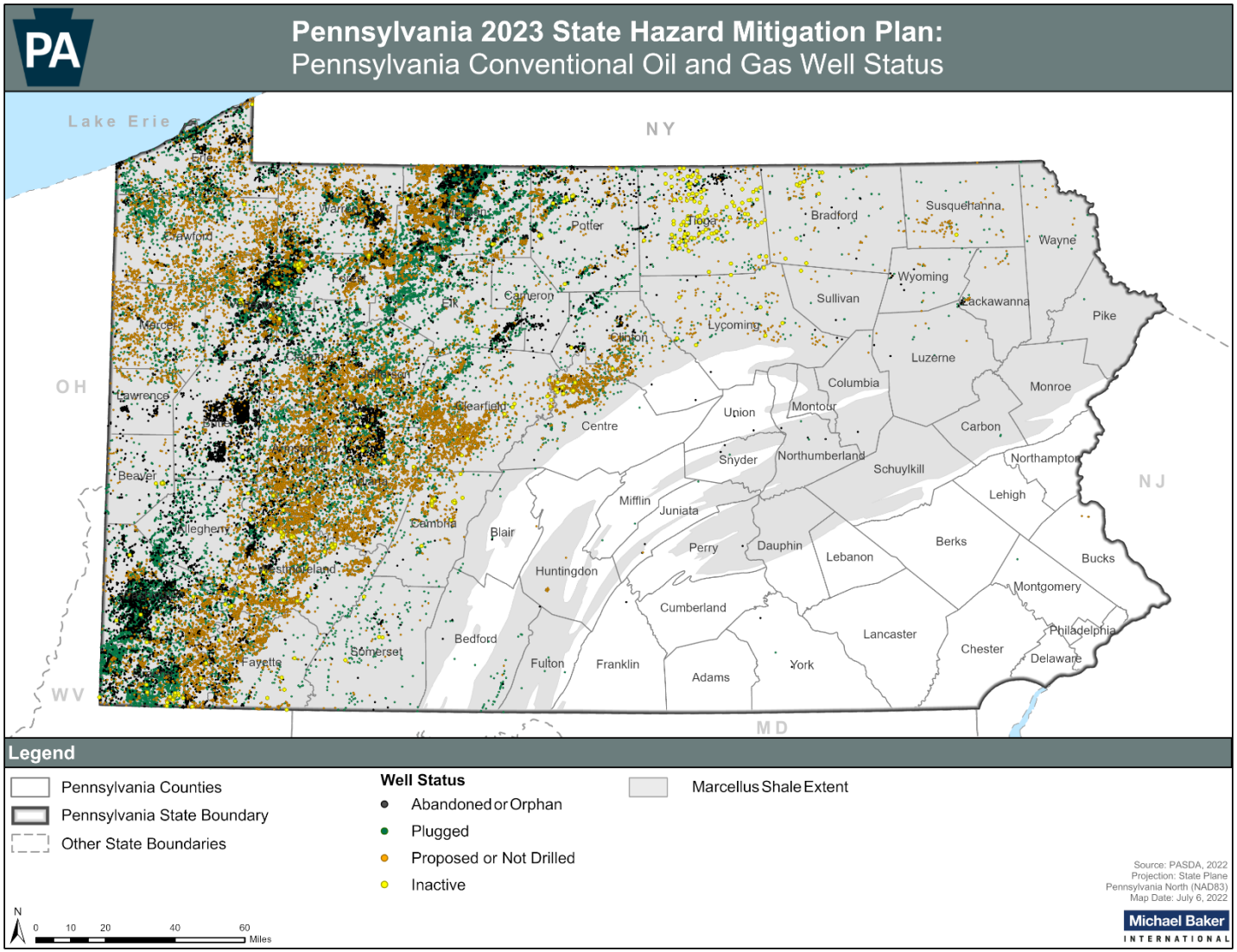


Table 4.3.22-1 Number of Conventional Oil and Gas Wells by County throughout Pennsylvania (PASDA, 2022)

COUNTY	ACTIVE WELLS	ABANDONED WELLS	ORPHANED WELLS	PLUGGED WELLS	PROPOSED OR NOT DRILLED WELL	INACTIVE WELLS	TOTAL OIL AND GAS WELLS
Adams	0	0	0	0	0	0	0
Allegheny	1,115	268	12	729	287	3	2,414
Armstrong	8,330	138	119	988	1,817	3	11,395
Beaver	143	48	1	98	39	20	349
Bedford	34	4	0	43	2	0	83
Berks	0	0	0	0	0	0	0
Blair	0	1	0	9	1	0	11
Bradford	13	9	1	62	58	10	153
Bucks	0	0	0	1	4	0	5
Butler	1,308	2,016	338	595	285	1	4,593
Cambria	555	11	0	130	235	20	951
Cameron	50	65	3	77	37	1	233
Carbon	0	0	0	2	0	0	2
Centre	682	8	0	172	563	10	1,435
Chester	0	0	0	0	0	0	0
Clarion	3,741	112	211	819	1,014	0	5,897
Clearfield	4,145	32	2	564	1,660	11	6,414
Clinton	507	126	4	290	372	2	1,301
Columbia	0	1	0	1	1	0	3
Crawford	3,066	101	36	1,099	1,089	1	5,392
Cumberland	0	0	0	0	0	0	0
Dauphin	0	0	0	0	0	0	0
Delaware	0	0	0	0	0	0	0
Elk	2,933	190	82	2,079	444	5	5,733

Table 4.3.22-1 Number of Conventional Oil and Gas Wells by County throughout Pennsylvania (PASDA, 2022)

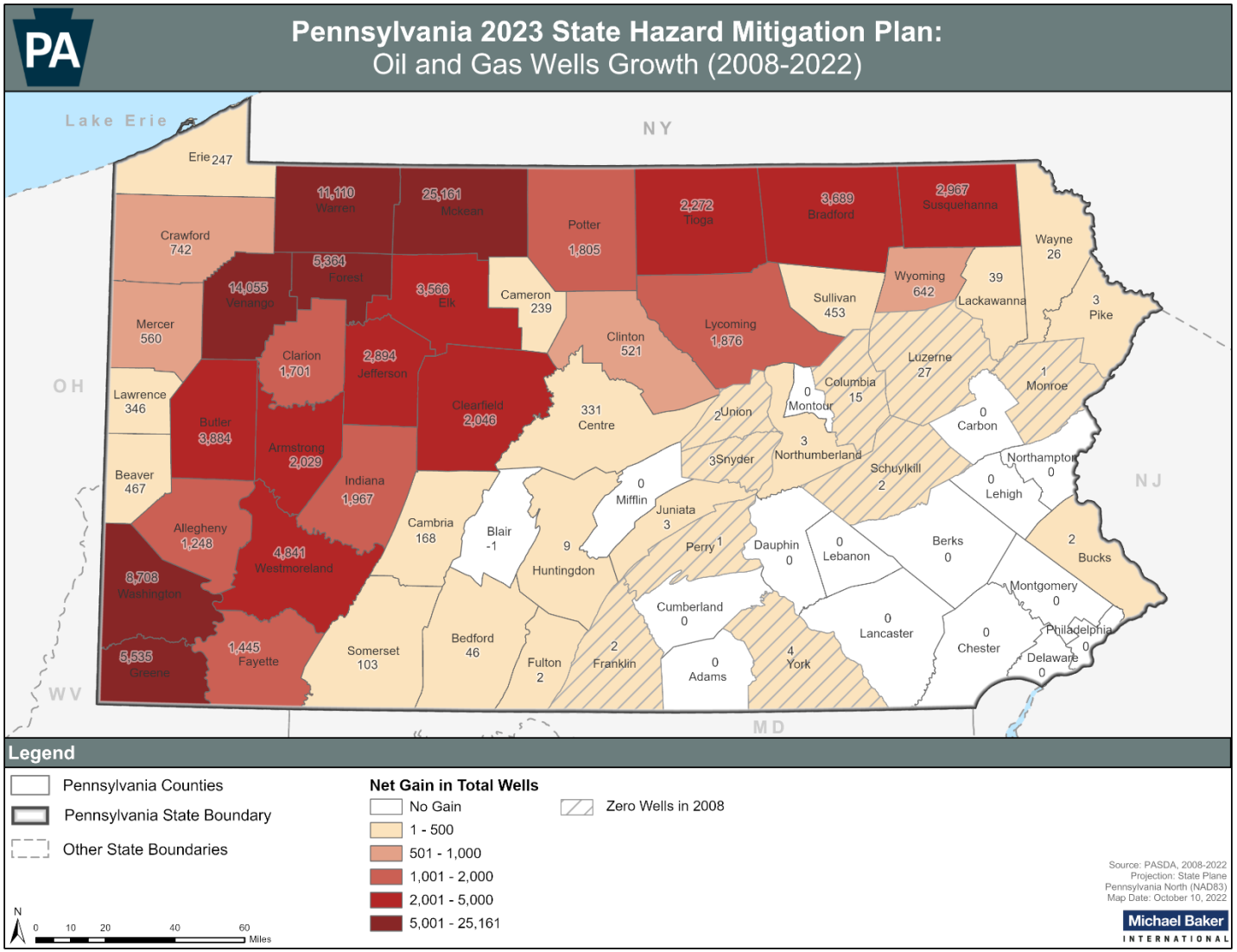
COUNTY	ACTIVE WELLS	ABANDONED WELLS	ORPHANED WELLS	PLUGGED WELLS	PROPOSED OR NOT DRILLED WELL	INACTIVE WELLS	TOTAL OIL AND GAS WELLS
Erie	2,851	372	18	845	566	2	4,654
Fayette	3,130	182	2	367	930	7	4,618
Forest	5,375	448	160	1,499	1,319	63	8,864
Franklin	1	1	0	0	0	0	2
Fulton	0	0	0	5	0	0	5
Greene	2,024	518	23	1,874	740	19	5,198
Huntingdon	2	0	0	2	8	0	12
Indiana	11,300	351	6	978	1,808	8	14,451
Jefferson	5,358	185	95	1,086	948	7	7,679
Juniata	0	2	0	2	1	0	5
Lackawanna	1	5	0	9	23	0	38
Lancaster	0	0	0	0	0	0	0
Lawrence	173	80	5	83	91	0	432
Lebanon	0	0	0	0	0	0	0
Lehigh	0	0	0	0	0	0	0
Luzerne	1	3	0	7	5	0	16
Lycoming	18	10	0	77	131	11	247
McKean	11,136	659	2,497	19,024	3,023	6	36,345
Mercer	3,199	27	90	398	926	0	4,640
Mifflin	0	0	0	2	0	0	2
Monroe	0	0	0	1	0	0	1
Montgomery	0	0	0	1	0	0	1
Montour	0	0	0	0	0	0	0
Northampton	0	0	0	0	0	0	0
Northumberland	0	2	1	2	0	0	5
Perry	0	1	0	0	0	0	1

Table 4.3.22-1 Number of Conventional Oil and Gas Wells by County throughout Pennsylvania (PASDA, 2022)

COUNTY	ACTIVE WELLS	ABANDONED WELLS	ORPHANED WELLS	PLUGGED WELLS	PROPOSED OR NOT DRILLED WELL	INACTIVE WELLS	TOTAL OIL AND GAS WELLS
Philadelphia	0	0	0	0	0	0	0
Pike	2	1	0	1	0	0	4
Potter	1,170	212	81	606	311	13	2,393
Schuylkill	2	0	0	0	0	0	2
Snyder	0	2	0	1	0	0	3
Somerset	72	25	0	144	34	4	279
Sullivan	1	1	0	4	4	1	11
Susquehanna	49	0	0	24	60	1	134
Tioga	112	113	4	206	177	95	707
Union	0	2	0	0	0	0	2
Venango	7,801	1,342	1,484	6,947	1,473	18	19,065
Warren	12,677	434	1,173	4,420	1,884	0	20,588
Washington	1,825	997	62	3,428	830	6	7,148
Wayne	2	0	1	12	10	0	25
Westmoreland	5,789	325	13	887	1,826	39	8,879
Wyoming	1	7	0	10	7	0	25
York	1	2	0	1	0	0	4
Total	100,695	9,439	6,574	50,711	25,043	387	192,849

Figure 4.3.22-3 depicts all active conventional oil and gas wells that were drilled in Pennsylvania from 2008 to 2022. It is visible that much of the active conventional wells that were drilled during this period took place in the midwestern to northwestern regions of the state, in counties that lie upon the Marcellus Shale formation. The biggest cluster of drilled wells occurred in the counties of Forest, McKean, and Warren. Each of these counties had over 1,000 active conventional oil and gas wells drilled during the 14-year period. McKean and Warren themselves have the largest amount, with 2,769 and 2,487 respectively. Northeastern counties that are within the Marcellus Shale, such as Susquehanna, Bradford, Lycoming, and Tioga, all have less than 10 conventional wells drilled during this period, some even with zero. Overall, there were nearly 13,000 active conventional oil and gas wells drilled during the 2008 to 2022 time period (PA DEP, 202

Figure 4.3.22-3 Net Gain of All Oil and Gas Wells in Pennsylvania 2008-2022 (PA DEP, 2022h).



4.3.22.2. Range of Magnitude

As is the case with all-natural resource extraction, a variety of potential hazards exist with oil and gas extraction. Abandoned oil and gas wells that are not properly plugged can contaminate groundwater and consequently domestic drinking water wells (Raimi et al., 2021). Surface waters and soil are sometimes polluted by brine, a salty wastewater product of oil and gas well drilling, and from oil spills occurring at the drilling site or from a pipeline breach. In addition to accidental contaminations, the state only recently ended the use of drilling wastewater as a dust suppressant on unpaved roads, which a study found was leading to water and soil contamination via radium and other harmful byproducts of the process (Frazier, 2018b). Additional information on incidents involving oil and gas transmission and distribution by pipeline is available in Section 4.3.33 Utility Interruption.

Methane can leak into domestic drinking wells and pose fire and explosion hazards (Raimi et al., 2021). In addition, natural gas well fires can occur when natural gas is ignited at the well site. Often, these fires erupt during drilling when a spark from machinery or equipment ignites the gas. The initial explosion and resulting flames have the potential to seriously injure or kill individuals in the immediate area. These fires are often difficult to extinguish due to the intensity of the flame and the abundant fuel source. When methane gas from unplugged gas wells seeps into underground coal mines, miners are at risk of asphyxiation and are subject to impacts of explosion (Raimi et al., 2021).

Though injury and death have resulted from oil and gas well drilling and extraction, the majority of impacts from this human-made hazard are environmental in nature. Wells that are improperly drilled or plugged can contaminate groundwater resulting in water well contamination or eventually surface water contamination. Drilling additives stored on site can leak and contaminated soil, surface water and groundwater. Oil leaks at the well site from oil pipelines contaminate soil and surface water damage aquatic life and ecosystems.

Air pollutants come from both the natural gas resource itself and equipment and machinery such as diesel engines, storage tanks containing the fluid that comes back up from the wells, and on-site materials and equipment used during production. Researchers have also noted additional health impacts may be related to excessive noise, light and chronic stress, vehicular injuries from increased truck traffic or other injuries or emergencies from explosions, leaks or floods. Populations that are especially vulnerable to these potential impacts are oil and gas workers, pregnant women, children, and the elderly (PA Department of Health, n.d.).

Figure 4.3.22-4 Photos of Natural Gas Well Fires. *Left*: Hopewell Township, Washington County, Pennsylvania. (Pittsburgh Post Gazette, June 17, 2010). *Right:* Dunkard Township, Greene County, Pennsylvania (WPXI, February 12, 2014)

Table 4.3.22-2 Most Likely Lifelines Impacted by Conventional Oil and Gas Wells		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating a causal relationship for the Safety and Security lifeline as community safety may be endangered and fire departments may be called into response and recovery if leaks or other issues result in explosions and fires.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery. Impacts from conventional wells include environmental contamination, which can impact agricultural operations and water supplies. Mitigation actions for this lifeline should be focused on developing and enforcing regulations for well drilling, operation, and waste storage to ensure proper procedures are in place.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline as potential environmental contamination can have adverse health impacts on communities, leading to more strain on the local healthcare system.
Energy		Anticipating a cascading relationship for the Energy lifeline as conventional wells play an important role in energy production. Issues with drilling operations may lead to additional challenges with energy production. Mitigation actions may focus on diversifying potential energy sources to reduce impacts if drilling operations are shut down.

4.3.22.3. Past Occurrence

Pennsylvania has a long history of oil and gas well drilling, starting in 1859 when Colonel Edwin Drake drilled the first well specifically intended to produce oil in Titusville, PA (DCNR, 2022g). Though relatively infrequent, many accidents and incidents have occurred related to the extraction of these natural resources. However, no comprehensive list of oil and gas related incidents exist for the Commonwealth, but conventional oil and gas well incidents are more

common northwestern Pennsylvania counties. In two of the more serious events in recent history, separate homes in McKean County exploded in December 2010 and February 2011 after methane gas migrated from unground wells and potentially due to new drilling activity in the area (Casey, 2011). Smaller-scale leaks and contaminations can happen at any time, and many times may happen without anyone knowing. Some examples of this are when two leaky wells were identified in Allegheny National Forest in 2018 and a DEP employee stumbling upon a leaking well dumping oil directly into the South Branch of Tionesta Creek during their work commute in 2020; all 3 were addressed by DEP (Leiter, 2018; Crable, 2022).

An example of a large-scale incident occurred in January 1988, when a four-million-gallon oil storage tank split and caused an oil spill in Floreffe, located in Allegheny County approximately 20 miles from Pittsburgh. The tank, owned by Ashland Oil Company, leaked oil into an adjacent parking lot. Eventually, the contents flowed into the Monongahela River, which led to the Ohio River. The Environment Protection Agency (EPA) reported the spill contaminated drinking water for approximately three million people in three states and their river ecosystems, killed wildlife, and damaged property and businesses (EPA, 2017).

4.3.22.4. Future Occurrence

It is difficult to predict when and where environmental hazards will arise as they are often related to equipment failure and human error. Adequate monitoring through the Department of Environment Protection (DEP) will reduce the likelihood of potential impacts to the community and the environment. The 4,386 violations of environmental regulations at conventional drilling operations reported by DEP in 2021 were the most since they began reporting them in 2013 (Hess, 2022). Categorization of the violations was not available at the time of this report, but breakdowns of the 4,049 violations reported in 2020 include 453 notices of violation for abandoning wells, 702 notices of violation for failing to submit annual production and waste reports, and 667 violations for not submitting mechanical integrity reports (Hess, 2022). In addition to active violations discovered during annual inspections, DEP reports that over the past 30 years they've identified more than 25,000 abandoned wells and estimate an additional 200,000 or more wells have yet to be located and properly documented.

There is an effort to plug these abandoned wells and properly identify more across the state, but the costs associated are high. At the current pace, it would take 2,242 years and an estimated $1.8 billion to plug all of the documented wells, with who knows how much time and money for those yet to be identified. The infrastructure bill passed by the US Congress in 2021 can provide around $400 million in funding, with $104 million already approved for identification, filling, equipment removal, environmental remediation, and more (Hall, 2022). This funding should help DEP address the most pressing situations and expand monitoring and enforcement capabilities, but still leaves most wells without funding. A glaring issue is that regulations required no registration before 1955, no insurance bond to cover state-incurred costs for plugging abandoned wells before the 1984 Oil and Gas Act, and no updates to the $2,500 requirement in the nearly 40 years since that act even though current estimates say the cost of plugging each well is $68,000 (PA DEP, 2022q; Crable, 2022). A recent effort to increase the bond requirements for new wells was halted when Act 96 was passed by the state legislature in July 2022 that set up accounts for using the federal money and halted bond increases for the next 10

years, which legislators said would provide regulatory stability for local operators (Causer, 2022; McDevitt, 2022). Risk associated with conventional oil and gas drilling is expected to remain moderate, with some of the highest risk emerging from those very old conventional wells that are either not properly mapped, their existence and location are still unknown, and whose caps and protective features have begun to deteriorate after failing to be properly maintained or abandoned outright.

4.3.22.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to conventional oil and gas wells, high risk areas were defined as areas within 1000 yards of active, inactive, or unplugged wells. The area impacted by a conventional oil and gas well incident will depend on the well, spillage, and atmospheric conditions. For this assessment, however, 1000 yards was selected as a representative distance within which death, injury, or significant property damage could occur. In addition, the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 908, or 20 percent, are located within 1000 yards of a conventional well (Table 4.3.22-3). These facilities have a combined replacement value of more than $389 million, or approximately ten percent of the known value of geolocated state facilities. Additionally, these facilities have a total reported building square footage of 4.36 million. About sixty percent of the 908 state facilities are owned by the state, with 549 total facilities reported to be owned.

Table 4.3.22-3 Vulnerability of State Facilities to Conventional Oil and Gas Wells

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	2	22%	0	19,570
Dept of Agriculture	2	13%	0	8,028
Dept of Banking & Securities		0%		
Dept of Community & Economic Development	1	25%	0	3,015
Dept of Conservation & Natural Resources		0%		
Dept of Corrections	133	19%	130	2,375,266
Dept of Education		0%		
Dept of Environmental Protection	2	15%	0	84,466
Dept of General Services		0%		
Dept of Health	14	29%	0	38,364
Dept of Labor & Industry	10	14%	1	68,327
Dept of Military and Veterans Affairs		0%		

Table 4.3.22-3 Vulnerability of State Facilities to Conventional Oil and Gas Wells				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Dept of Public Welfare	17	17%	0	223,894
Dept of Revenue	1	10%	0	4,147
Dept of Transportation	419	25%	397	1,066,258
Drug and Alcohol Programs		0%		
Emergency Management Agency	1	13%	1	4,250
Executive Offices		0%		
Fish and Boat Commission	19	12%	19	37,143
Governor's Office		0%		
Historical & Museum Commission	9	30%	1	4,712
Insurance		0%		
Liquor Control Board	89	16%	0	346,950
Pub School Employees' Ret System	1	17%	0	2,631
State Civil Service Commission		0%		
State Department		0%		
State Employees' Ret System		0%		
State Police	11	31%	0	77,619
State System of High Education	177	21%		
Thaddeus Stevens College of Technology		0%		
Treasury		0%		
Total	**908**	**20%**	**549**	**4,364,640**

There are 2,515 vulnerable critical facility structures in a high-risk area (Table 4.3.22-4). Of the Commonwealth's total number of structures, 19 percent of the buildings are vulnerable to risks associating with coal mines, resulting in $77.6 billion in replacement value.

Table 4.3.22-4 Vulnerability of Critical Facilities to Conventional Oil and Gas Wells		
TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF TOTAL STRUCTURES BY TYPE
Agricultural	30	11%
Banking		0%
Commercial	1	5%
Communication	121	22%
Dam	282	19%
Education (colleges and universities)	62	16%

Table 4.3.22-4 Vulnerability of Critical Facilities to Conventional Oil and Gas Wells		
TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF TOTAL STRUCTURES BY TYPE
Education (public schools)	730	16%
Emergency Operation Center	12	17%
Energy	126	35%
Fire Station	562	22%
Government		0%
Hospital	50	16%
National Monuments or Icons		0%
Nuclear		0%
Police Station	246	19%
Transportation	157	23%
Water	136	21%
Total	**2,515**	**19%**

4.3.22.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to conventional oil and gas well incidents, all census blocks with their centroid within a high-risk areas were identified in Table 4.3.22-5. The population, building counts, and building value of all vulnerable census blocks were then aggregated to the county scale. The counties with the highest replacement values of exposed buildings include Allegheny and Westmoreland, both estimated at over $50 billion.

Table 4.3.22-5 Vulnerability of People and Buildings to Conventional Oil and Gas Wells				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Adams				0%
Allegheny	465,250	197,244	$97,252,666	37%
Armstrong	61,854	32,217	$11,880,472	95%
Beaver	36,941	16,444	$6,972,080	20%
Bedford	421	323	$162,004	1%
Berks				0%
Blair	1,065	276	$238,763	1%
Bradford	908	504	$181,743	1%
Bucks				0%
Butler	88,551	38,765	$21,234,566	47%
Cambria	15,908	8,238	$4,645,130	14%
Cameron	196	290	$77,544	6%
Carbon				0%
Centre	1,206	815	$190,820	1%
Chester				0%
Clarion	32,327	17,490	$7,158,996	87%

Table 4.3.22-5 Vulnerability of People and Buildings to Conventional Oil and Gas Wells				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Clearfield	25,440	11,199	$5,237,167	32%
Clinton	1,126	1,079	$391,002	6%
Columbia	168	109	$49,911	0%
Crawford	50,843	30,556	$15,581,583	64%
Cumberland				0%
Dauphin				0%
Delaware				0%
Elk	10,590	7,187	$3,001,898	36%
Erie	249,330	91,081	$45,210,697	93%
Fayette	61,194	32,162	$10,160,517	41%
Forest	2,205	3,567	$1,070,495	52%
Franklin	40	21	$5,030	0%
Fulton	0	0	$0	0%
Greene	32,557	15,818	$8,482,359	90%
Huntingdon	98	43	$12,813	0%
Indiana	79,204	36,472	$15,903,616	96%
Jefferson	33,181	21,935	$6,053,633	75%
Juniata	36	19	$2,506	0%
Lackawanna	442	205	$100,253	0%
Lancaster				0%
Lawrence	13,909	6,086	$2,515,647	17%
Lebanon				0%
Lehigh				0%
Luzerne	612	291	$90,484	0%
Lycoming	829	537	$215,849	1%
McKean	31,629	16,777	$6,549,343	76%
Mercer	90,841	45,053	$22,740,243	82%
Mifflin				0%
Monroe				0%
Montgomery				0%
Montour				0%
Northampton				0%
Northumberland	673	315	$171,615	1%
Perry	102	44	$14,667	0%
Philadelphia				0%
Pike	1,047	416	$189,775	1%
Potter	6,126	3,331	$852,048	30%
Schuylkill	34	20	$7,221	0%

Table 4.3.22-5 Vulnerability of People and Buildings to Conventional Oil and Gas Wells				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Snyder	63	19	$15,527	0%
Somerset	5,372	3,759	$2,336,899	10%
Sullivan	36	47	$7,732	0%
Susquehanna	1,191	818	$496,095	4%
Tioga	9,411	5,294	$1,753,419	20%
Union	169	55	$10,825	0%
Venango	39,134	22,122	$7,616,837	78%
Warren	34,333	21,315	$6,515,652	88%
Washington	162,701	76,758	$34,110,711	75%
Wayne	117	93	$48,408	0%
Westmoreland	228,774	109,217	$52,088,059	65%
Wyoming	187	90	$34,300	1%
York	1,015	448	$140,855	0%
Total	**1,879,386**	**876,964**	**$399,780,475**	**15%**

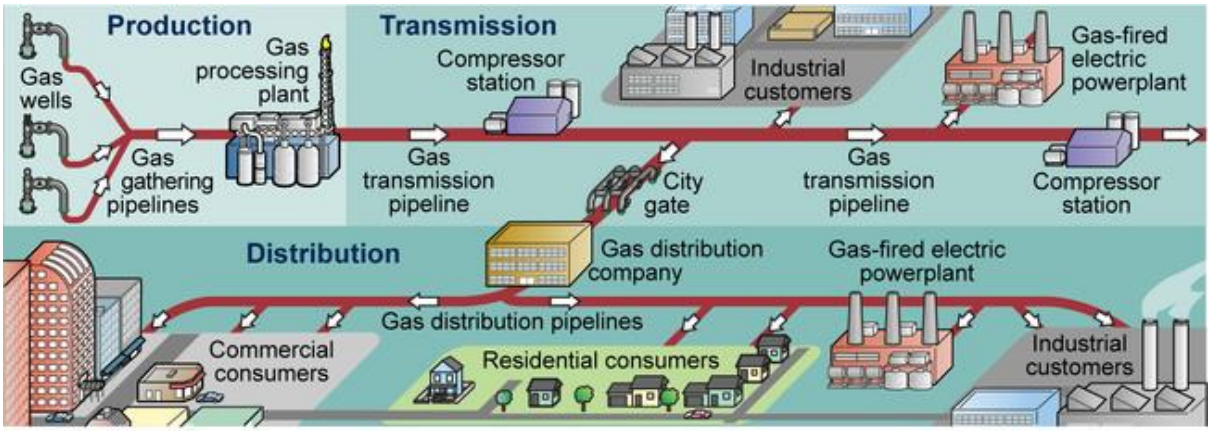
4.3.23. Environmental Hazard – Gas and Liquid Pipeline

4.3.23.1. Location and Extent

Pipelines are a vital component of the nation's infrastructure that transport two of the materials most essential to daily life – water and energy products. This profile addresses the risks posed by the gas and liquid pipeline systems that move energy products in Pennsylvania. These pipeline systems cross both rural and densely populated areas, and range in length from a few thousand feet to hundreds of miles. Pipeline systems are defined by federal regulations as all parts of a pipeline facility through which a hazardous liquid or gas moves, including piping, valves, pumps or compressors, metering and delivery stations, and storage and breakout tanks. Although pipelines are typically located underground, they may also be located aboveground when dictated by operational considerations (such as connections to pump and compressor stations) or environmental conditions (such as geological characteristics) (FEMA, 2015a).

Natural gas pipelines are the most common type of pipeline in the United States, and serve to transport natural gas from the point of production to the point of use. Three major types of pipelines move natural gas: gathering lines, transmission lines, and distribution lines. Figure 4.3.23-1 shows the entire supply chain from gathering to distribution. Gas transmission lines are large pipelines (6 to 48 inches in diameter) and are designed to transport natural gas long distances at high pressures (often 200 – 1,500 psi), while gas distribution lines are smaller (1/2 to 2 inches in diameter) and transport natural gas shorter distances at relatively low pressures (PHMSA, n.d.; Pipeline Safety Trust, 2015). There are approximately 300,000 miles of gas transmission pipelines and 2.3 million miles of distribution lines in the United States (PHMSA, 2022).

Figure 4.3.23-1 Natural Gas Pipeline Systems

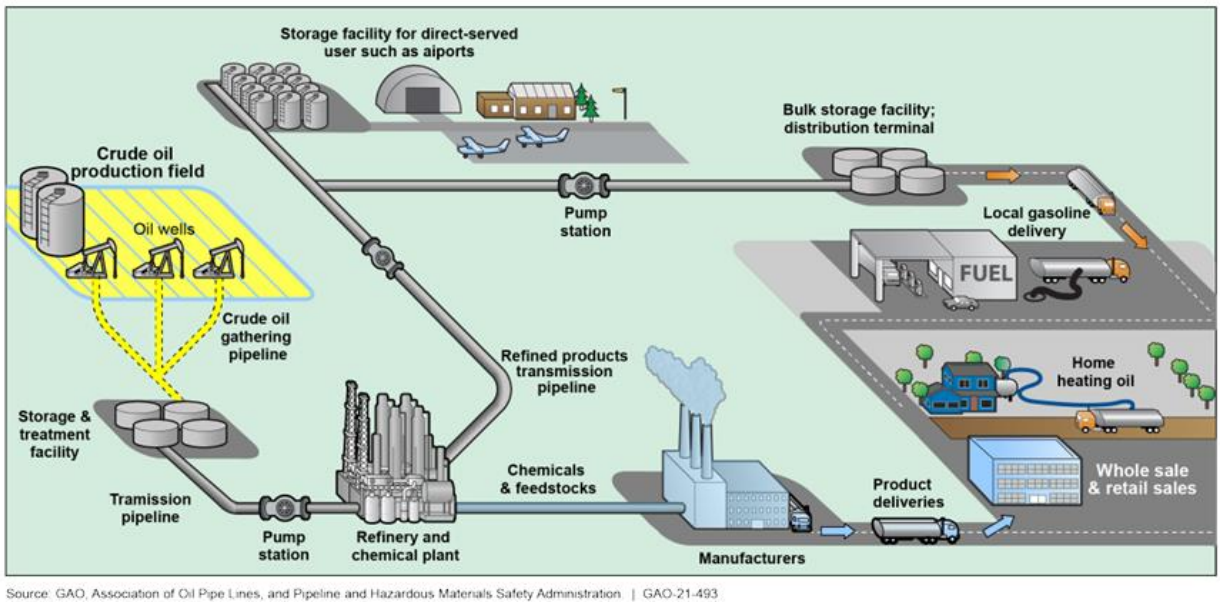


Source: GAO analysis of Energy Information Administration and Natural Gas Council documents. | GAO-20-658

Liquid petroleum pipelines are the second most common type of pipeline in the United States, and serve to transport crude oil, refined product, and highly volatile liquids (HVLs) to local distribution networks. The system for doing so has the same three categories of pipelines, as shown in Figure 4.3.23-2. Gathering lines are typically 2 to 8 inches in diameter, transmission lines are larger, cross-country pipelines (8 to 48 inches in diameter), and refined product lines are similar but typically smaller than transmission ones at 8 to 42 inches in diameter. There are approximately 85,000 miles of crude oil transmission pipelines and 64,000 miles of refined product lines in the United States (PHMSA, 2022). Tanker trucks take the refined petroleum products the last few miles from the storage terminals to gas stations and homes.

Highly volatile liquids (HVLs) are products that are liquid when stored at a certain temperature or pressure, but quickly vaporize when released into the atmosphere (49 CFR § 195.2, 2002). HVLs include natural gas liquids (NGLs), ethylene, propylene, and anhydrous ammonia. There is approximately 75,000 miles of HVL pipelines in the United States (PHMSA, 2022). These pipelines are becoming increasingly common as NGL production grows. NGLs are liquids produced at both natural gas processing plants and oil refineries that have many uses spanning nearly all sectors of the economy, and as the use of hydraulic fracturing to extract natural gas from shale gas formations expands, the production of NGLs is growing (U.S. Congressional Research Service, 2018).

Figure 4.3.23-2 Liquid Petroleum Pipeline System



Pipeline failures are low-probability, potentially high-consequence events. Although gas and liquid pipeline failures are infrequent within Pennsylvania, generally across the US they are frequent with almost 2 incidents happening daily (PHMSA, 2022). The hazardous and inflammable materials released by these events can pose a significant threat to public safety and the built and natural environment. Explosions associated with pipeline failures, for example, can cause severe injury to nearby residents and destroy homes and other property.

Corrosion is a major cause of pipeline failure, and is often associated with pipeline age. Besides corrosion, pipeline failures can be caused by excavation damage, incorrect operation, material/weld/equipment failure, natural force damage, and other outside forces. Land development tends to increase the likelihood of external impacts and pipeline failure. Land development without appropriate planning can also impede access to pipelines for operation and maintenance or emergency response (FEMA, 2015a).

Figure 4.3.23-3 Photograph of an explosion on a 30-inch interstate natural gas pipeline in rural Salem Township, Pennsylvania. Source: NPR State Impact.

According to the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA), in 2021 Pennsylvania had 90,135 miles of natural gas pipelines and 4,254 miles of liquid petroleum pipelines. The state's natural gas pipelines include 809 miles of gas gathering lines, 10,554 miles of gas transmission lines, and 78,771 miles of gas distribution lines. The state's liquid petroleum pipelines include 40 miles of crude oil pipeline, 2,392 miles of refined petroleum product pipeline, and 1,821miles of HVL pipeline (PHMSA, 2022). Both gas and liquid pipeline mileage has increased since the 2018 Pennsylvania State Hazard Mitigation Plan. Figure 4.3.23-4 and Figure 4.3.23-5 show the mix of pipeline types in Pennsylvania and in the United States. The state mix is similar to the national mix, with a smaller share of crude oil pipelines (too small to be visible in the figure) and a larger share of gas distribution lines. The state mix has changed slightly since the 2018 plan with gas distribution share dropping 2% from 85% to 83%, which coincided with a 1% increase for both Refined Liquid and HVL lines.

Figure 4.3.23-4 Pennsylvania Pipeline Mileage Percentage by Type (PHMSA, 2022).

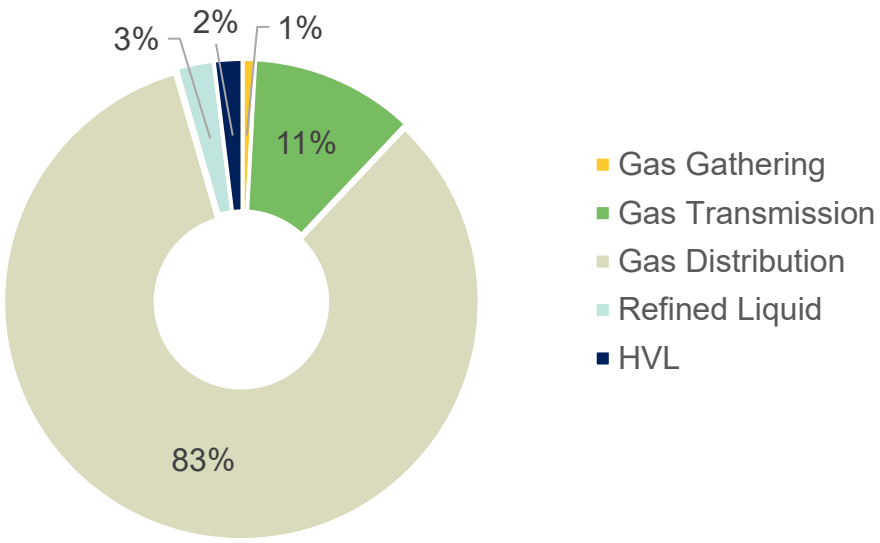
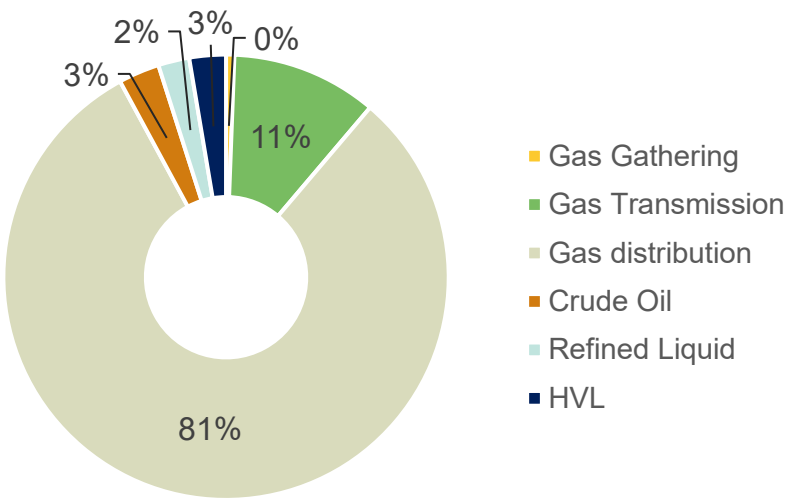


Figure 4.3.23-5 U.S. Pipeline Mileage Percentage by Type (PHMSA, 2022).



Two agencies that provide information on the location and extent of pipelines within Pennsylvania are the U.S. Energy Information Administration (EIA) and the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA). Figure 4.3.23-6 shows the location of major pipelines in Pennsylvania as compiled by the EIA. The EIA defines major pipelines as interstate trunk lines and selected intrastate lines (as well as

gathering lines for natural gas), and assembles pipeline data from the Federal Energy Regulatory Commission, industry sources, and other publicly available sources. The network of natural gas pipelines is particularly dense in the northwestern part of the state.

Table 4.3.27-1 shows the pipeline mileage per county as distributed by PHMSA. While the state totals provided above include all pipelines in the PHMSA database, the county summary provided below includes only those pipelines categorized as active as of October 2022. Excluding permanently abandoned pipelines results in a slightly lower total mileage. Among Pennsylvania counties, Washington has the second most natural gas and most liquid petroleum pipelines. Other counties with high mileage for natural gas are Greene (most), Potter, and Westmoreland. Counties with high mileage of liquid petroleum pipelines are Berks, Chester, Delaware, and Westmoreland. Wyoming, Colombia, and Montour counties more than doubled their total pipeline mileage from the 2018 plan. Wyoming's increase was mostly due to natural gas lines, while both Colombia and Montour's came completely from new natural gas. Bucks, Centre, Lackawanna, and Northampton counties all saw decreases in pipeline mileage. The changes resulted in a combination of adding and losing both types of pipelines.

Figure 4.3.23-6 Major Pipelines of Pennsylvania (EIA, 2022).

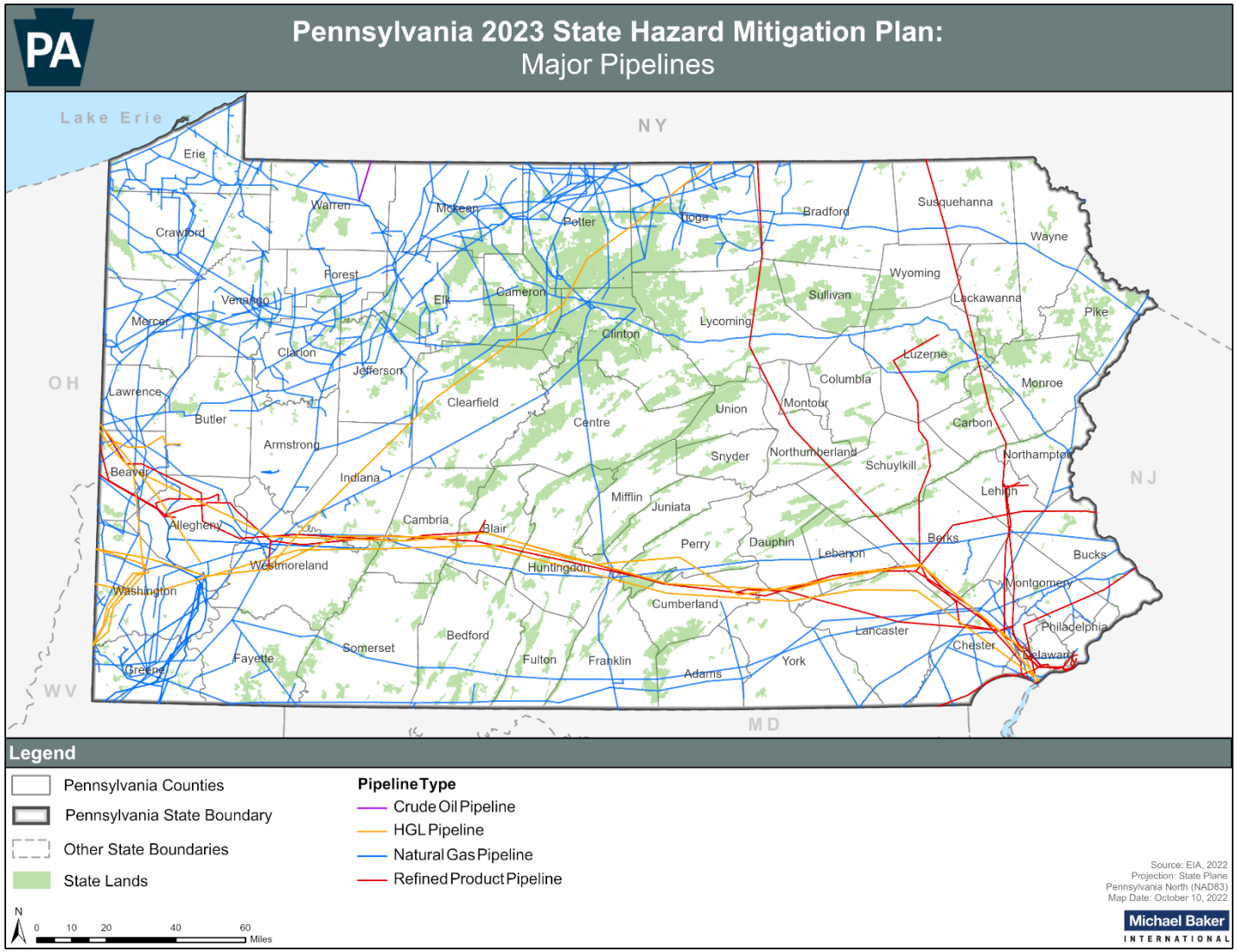


Table 4.3.23-1 Pennsylvania Active Pipeline Mileage by County (PHMSA, 2022)				
COUNTY	NATURAL GAS TRANSMISSION PIPELINES (MILES)	LIQUID PETROLEUM PIPELINES (MILES)	TOTAL GAS AND LIQUID PIPELINES (MILES)	CHANGE FROM 2018 PLAN
Adams	148	27	175	17.8%
Allegheny	278	192	470	8.0%
Armstrong	212	0	212	1.4%
Beaver	180	154	334	12.8%
Bedford	110	35	146	31.4%
Berks	169	295	463	23.2%
Blair	67	121	187	32.2%
Bradford	165	30	194	14.6%
Bucks	225	43	269	-7.5%
Butler	108	22	130	11.4%
Cambria	113	123	236	34.4%
Cameron	69	18	87	0.0%
Carbon	9	81	90	0.0%
Centre	140	0	140	-7.0%
Chester	389	247	636	9.0%
Clarion	105	0	105	6.6%
Clearfield	159	35	194	0.0%
Clinton	271	4	275	2.5%
Columbia	75	0	75	113.1%
Crawford	102	0	102	49.8%
Cumberland	18	141	159	62.4%
Dauphin	109	113	223	14.1%
Delaware	94	240	335	13.0%
Elk	213	3	216	2.0%
Erie	161	0	161	13.5%
Fayette	249	0	250	0.0%
Forest	70	0	70	0.0%
Franklin	196	26	222	12.5%
Fulton	58	16	74	26.3%
Greene	684	27	712	11.9%
Huntingdon	91	128	219	33.0%
Indiana	152	127	278	15.1%
Jefferson	165	2	167	0.0%
Juniata	50	19	69	8.8%

Table 4.3.23-1 Pennsylvania Active Pipeline Mileage by County (PHMSA, 2022)				
COUNTY	NATURAL GAS TRANSMISSION PIPELINES (MILES)	LIQUID PETROLEUM PIPELINES (MILES)	TOTAL GAS AND LIQUID PIPELINES (MILES)	CHANGE FROM 2018 PLAN
Lackawanna	24	59	83	-5.7%
Lancaster	251	120	371	34.6%
Lawrence	162	12	174	3.2%
Lebanon	116	114	230	40.8%
Lehigh	7	145	151	15.3%
Luzerne	221	144	365	14.7%
Lycoming	281	39	320	6.5%
McKean	269	0	269	6.4%
Mercer	257	0	257	5.4%
Mifflin	32	0	32	0.0%
Monroe	119	0	119	10.1%
Montgomery	242	61	303	0.1%
Montour	23	3	26	103.1%
Northampton	138	18	156	-2.2%
Northumberland	41	38	79	39.6%
Perry	111	68	179	12.5%
Philadelphia	9	82	90	12.8%
Pike	86	0	86	11.4%
Potter	495	26	521	0.0%
Schuylkill	20	75	95	24.8%
Snyder	4	0	4	N/A
Somerset	158	8	167	5.1%
Sullivan	25	0	25	0.0%
Susquehanna	162	109	271	26.2%
Tioga	358	28	386	11.7%
Union	1	0	1	N/A
Venango	114	0	114	2.4%
Warren	139	24	163	1.4%
Washington	575	303	877	14.1%
Wayne	51	0	51	14.3%
Westmoreland	459	237	696	19.9%
Wyoming	78	36	113	138.9%
York	182	61	243	21.0%
Total	**10,614.00**	**4,079.00**	**14,691.00**	**12.8%**

4.3.23.2. Range of Magnitude

Many factors determine the magnitude of the hazard posed by pipeline failures, including the chemicals released, the failure mode of the pipeline, the operating conditions of the pipeline at the time of the incident, and the characteristics of the surrounding area. Impacts to life and property can result from inhalation or ingestion of toxins, exposure to a fire or explosion, or exposure to contaminated soils or drinking water. These impacts may include (FEMA, 2015a):

- Serious injuries or fatalities;
- Damage to buildings and infrastructure;
- Environmental impacts, including pollution of air, waterways and drinking water sources, and contamination of environmentally sensitive areas;
- Disruptions and closures to critical infrastructure and services, including transportation routes and emergency medical services;
- Residential, commercial, and industrial energy supply losses;
- Disruption of local businesses and regional economies; and
- Displacement of residential communities or businesses.

Understanding pipeline threats and hazards begins with understanding the physical and chemical properties of the products in the pipeline. Natural gas is a clean-burning fuel that consists mostly of methane (94 percent) and ethane (4 percent). Some relevant characteristics of natural gas are summarized below (FEMA, 2015a):

- Although natural gas is nontoxic, it can cause asphyxiation if released in an enclosed area.
- Natural gas is combustible and natural gas fires produce large amounts of radiant heat.
- If an ignition source exists, natural gas releases can result in a sudden fire or explosion near the point of release. Once the release ends, however, the hazard declines very quickly as the gas disperses.
- If natural gas migrates into a building and accumulates inside, the hazard can persist for longer.

Liquid petroleum pipelines can carry many different crude oil and refined petroleum products with widely varying physical and chemical properties. Many of these products can spread over land and water, flowing into valleys, ravines, and waterways. Relevant characteristics of some liquid petroleum products are summarized below (FEMA, 2015a):

- Most crude oils are heavier and less toxic than refined petroleum products, and do not penetrate porous surfaces such as soil and sand. Because these products do not evaporate and tend to adhere to surfaces, however, they remain in the environment longer than refined products. Oil spills may take weeks, months, or even years to clean up.
- Most refined petroleum products are highly fluid, spready quickly over land or water surfaces, and penetrate porous surfaces. These products are usually flammable, and their volatile components can burn the eyes and skin and irritate the nose, eyes, and mouth. Because these products have a high evaporation rate and generally do not

adhere to surfaces, they are easier to clean up. Refined petroleum products also produce vapors that are heavier than air. These vapors will collect in low areas.

Highly volatile liquids (HVLs) belong to a category of their own. While they are liquid, they can contain gasses like ethane, propane, and butane which can form vapor clouds in low-lying areas. Anhydrous ammonia is a highly volatile liquid that is particularly toxic and corrosive. It is typically transported under pressure as liquefied gas, and rapidly expands when released. Its vapors are extremely irritating and may be fatal if inhaled, ingested, or absorbed through the skin.

Assessing the potential consequences of releases from pipelines in specific locations should be based on pipeline- and location-specific evaluation of the following four elements:

- Which commodity or commodities might be released?
- How much of the transported commodity might be released? This differs at different locations along a pipeline and can be derived from pipeline flow rates, spill detection time, pipeline shutdown time, drain down volume, and other technical factors.
- Where might the released substance go? Consider the released commodity, release volume, and potential flow paths over land and water, as well as potential air dispersion.
    - Overland flow can be affected by factors such as gas or liquid properties, topography at and near the spill location, soil type, nearby drainage systems, and flow barriers.
    - Flow in water can be affected by the water flow rate and direction and properties of the spilled product.
    - Air dispersion can be affected by the properties of released vapors and wind direction and speed.
- What locations might be impacted? Consider how potential impacts, including thermal impacts from fire, blast overpressure from explosion, toxic and asphyxiation effects, and environmental contamination could affect locations where the released commodity travels.

Issues can also occur at plants or storage facilities along a pipeline, like the Christmas morning explosion at an Energy Transfer plant in Washington County (Marcellus Drilling News, 2023).

The environmental impacts of hazardous material releases from pipelines could include (EPA, 1999):

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

These impacts are a particular concern for liquid petroleum pipelines, since liquid petroleum products can flow into valleys, ravines, and waterways. To minimize the environmental impacts of liquid petroleum pipelines, federal regulations require pipeline operators to include drinking water sources and unusually sensitive ecological resources in the “high consequence areas” that they prioritize for integrity management (PHMSA, 2021).

In some cases, natural hazard events can cause pipeline failures and/or complicate emergency response activities. The most common cause of pipeline failures from natural hazards are geological events like landslides or earthquakes (Girgin and Krausmann, 2014). While not the leading cause of failures, hazard events like severe storms are accompanied by winds, thunderstorms, or floods that can spread contamination more quickly and exacerbate the threat to local water supplies, air quality, soil, and agriculture. When a pipeline failure occurs during a natural disaster, access to the pipeline may be restricted, waterlines for fire suppression may be compromised, and response personnel and resources may be limited. In October of 2016, for example, water supplies in several towns in north-central Pennsylvania were threatened when flash floods and landslides caused a pipeline to rupture near Wallis Run Creek, spilling nearly 55,000 gallons of gasoline into the tributary of the West Branch Susquehanna River. Response officials reported that access to the site of the rupture was limited by the severe flooding, and Pennsylvania American Water suspended operations at their downstream drinking water plant as a precaution (State Impact, 2016). Other natural hazard events that can lead to pipeline failure include earthquakes, land subsidence, avalanches, lightning, fires, and severe winter storms (FEMA, 1997).

Several exacerbating or mitigating circumstances can affect the severity of a pipeline failure. Mitigating circumstances include precautionary measures taken in advance to reduce the impact of a release on the surrounding environment. After a release, primary and secondary containment or shielding by sheltering-in-place can help protect people and property. Exacerbating circumstances can include weather conditions, the micro-meteorological effects of buildings and terrain, and lack of code compliance or maintenance. 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 pipelines and surrounding buildings. An important part of the pipeline maintenance process is periodic the use of Pipeline Inspection Gauges (PIGs). These devices not only clean build-up inside pipes that can restrict the flow of product, but also help identify cracks or flaws in pipes (PHMSA, 2014). This requires proper permits as the pressure inside the pipeline must be reduced to use the PIGs to clean, which is done by venting any existing pressure and potentially releasing polluting substances into the air. First Responders should be made aware of the pressurized materials inside pipelines as well as known pollutants that can be released while using the PIGs to respond appropriately and effectively to any issues.

Table 4.3.23-2 Most Likely Lifelines Impacted by Gas and Liquid Pipelines		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating a causal relationship for the Safety and Security lifeline as community safety may be endangered and fire departments may be called into response and recovery if leaks or other issues result in explosions and fires.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery. Impacts from pipelines include environmental contamination, which can impact agricultural operations and water supplies. There also may be impacts to food supply chains if there are disruptions to transportation infrastructure. Mitigation actions for this lifeline should be focused on developing and enforcing regulations for operation and maintenance of pipelines, including proper siting.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline as potential environmental contamination can have adverse health impacts on communities, leading to more strain on the local healthcare system.
Energy		Anticipating a cascading relationship for the Energy lifeline as pipelines play an important role in energy production and distribution. Issues with pipelines may lead to additional challenges with energy production and availability. Mitigation actions may focus on diversifying potential energy sources to reduce impacts if operations are impacted or shut down.

4.3.23.3. Past Occurrence

The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) is the federal agency charged with prescribing safety standards for transportation pipelines and pipeline facilities. PHMSA has collected pipeline incident reports in various formats since 1970 and has created a comprehensive database of all pipeline incident reports submitted from 2002 through 2022 (available at https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-20-year-trends). This database includes a wealth of information on the causes and impacts of pipeline failures in the U.S. Table 4.3.23-3 presents a summary of significant pipeline incidents in Pennsylvania by pipeline type. Significant incidents

are those that involve 1) Fatality or injury requiring in-patient hospitalization, 2) $50,000 or more in total costs, measured in 1984 dollars, 3) HVL releases of 5 or more barrels or other liquid releases of 50 or more barrels, and/or liquid releases resulting in an unintentional fire or explosion.

Natural gas mains and service lines (the components of the gas distribution system) accounted for the most significant pipeline incidents reported to PHMSA between 2002 and 2022, with hazardous liquid pipeline incidents not far behind. The natural gas distribution system has accounted for most of the fatalities and injuries though. Gas transmission and hazardous liquid pipelines, however, accounted for most of the cost.

Table 4.3.23-3 Significant Pipeline Incidents in Pennsylvania by Pipeline Type, 2002-2022* (PHMSA, 2022)

PIPELINE TYPE	NUMBER	FATALITIES	INJURIES	TOTAL COST CURRENT YEAR DOLLARS
Gas Distribution	121	21	48	$23,900,333
Gas Gathering	4	0	1	$9,244,560
Gas Transmission	69	0	4	$111,204,715
Hazardous Liquid	114	0	1	$64,738,165
Total	**308**	**21**	**54**	**$209,087,773**

*As of October 2022

Figure 4.3.23-7 and Figure 4.3.23-8 provide a year-by-year summary of the frequency and consequence of significant pipeline incidents for gas transmission pipelines and hazardous liquid pipelines. The figures show that significant incidents tend to occur every year, and that the associated costs vary widely. The five most costly incidents occurred in 1999, 2000, 2005, 2011, and 2016. The reported causes of these incidents included corrosion, material or welding failure, and temperature extremes (such as when cold weather causes frost heaves or frozen instrumentation lines).

Figure 4.3.23-7 Frequency of Significant Pipeline Incidents in Pennsylvania (PHMSA, 2022).

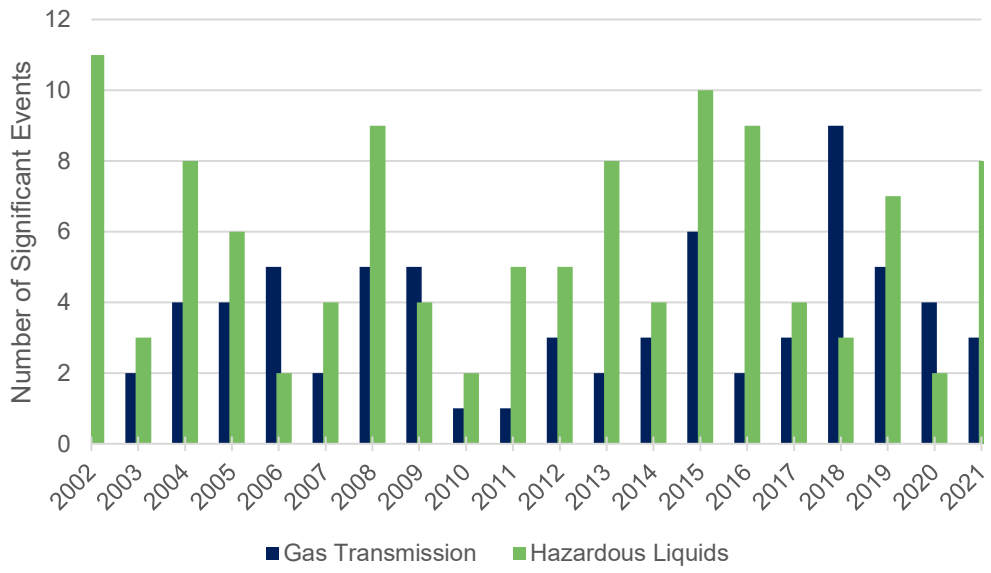


Figure 4.3.23-8 Cost of Significant Pipeline Incidents in Pennsylvania (PHMSA, 2022).

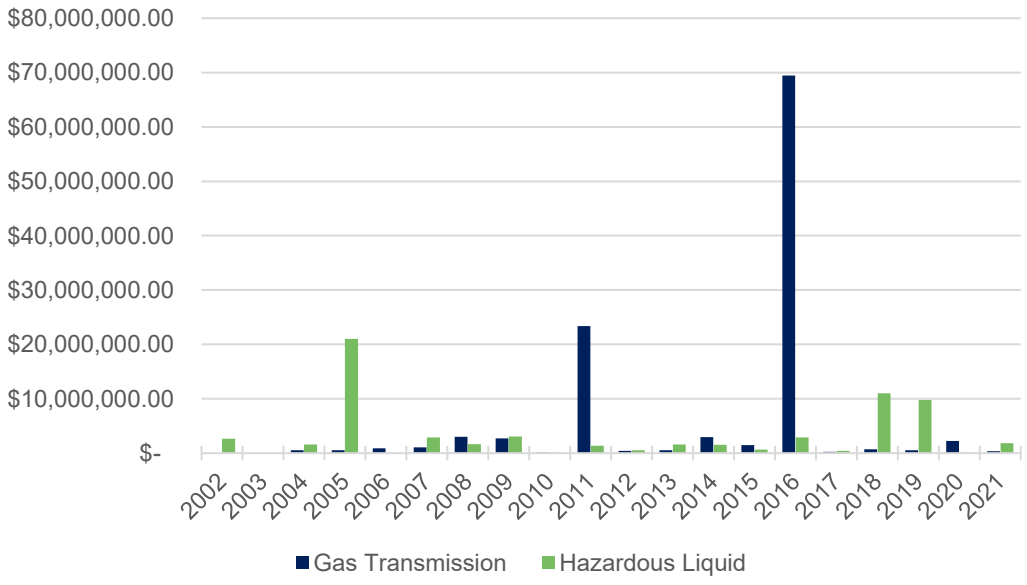


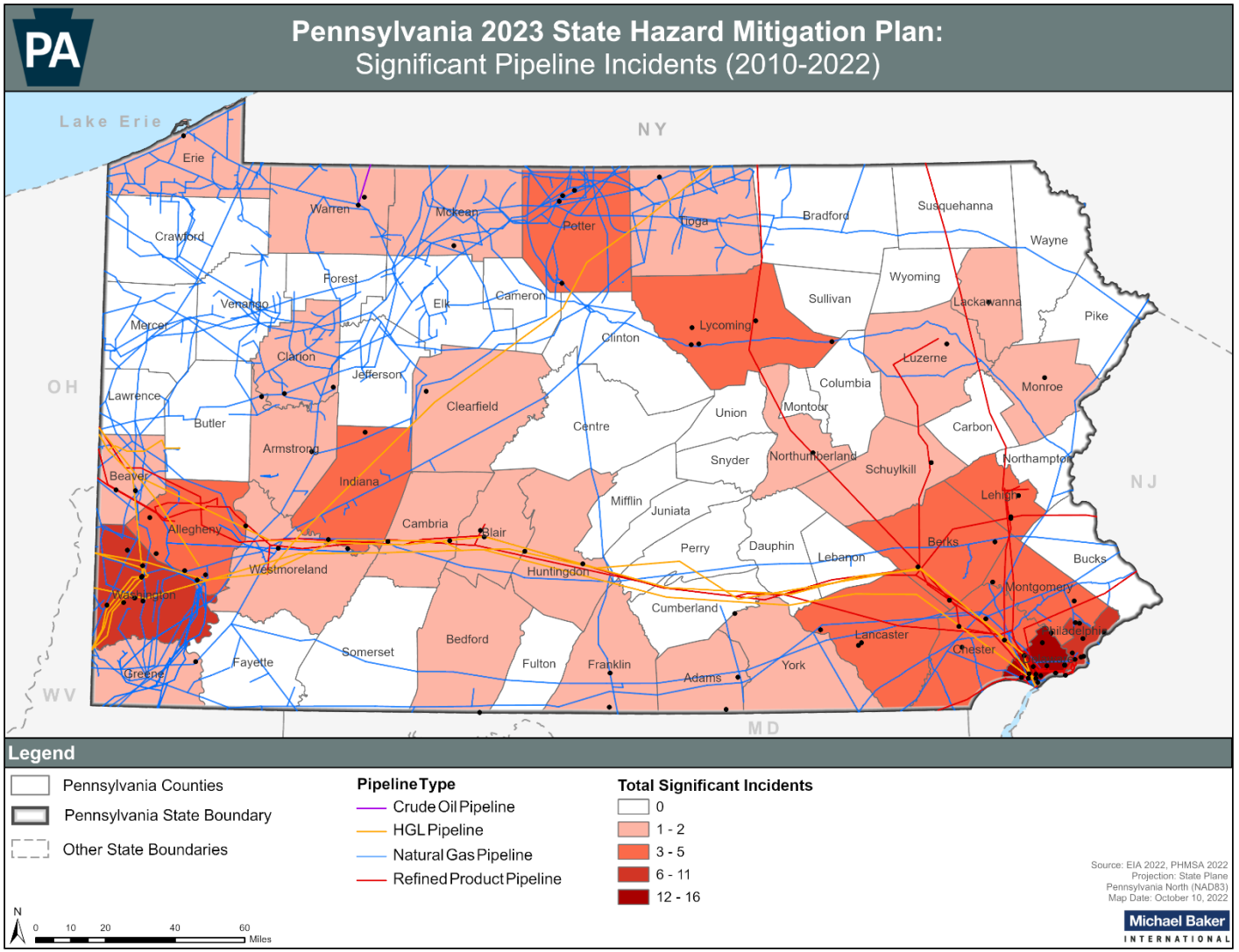
Table 4.3.23-4 Cost of Significant Pipeline Incidents in Pennsylvania 2002-2022 (PHMSA, 2022)

CALENDAR YEAR	GAS TRANSMISSION	HAZARDOUS LIQUID
2002	N/A	$2,646,583
2003	$0	$17,250

Table 4.3.23-4 Cost of Significant Pipeline Incidents in Pennsylvania 2002-2022 (PHMSA, 2022)		
CALENDAR YEAR	GAS TRANSMISSION	HAZARDOUS LIQUID
2004	$538,700	$1,602,660
2005	$562,300	$21,006,315
2006	$915,130	$16,000
2007	$1,043,700	$2,866,450
2008	$3,009,692	$1,648,000
2009	$2,725,506	$3,058,361
2010	$121,530	$101,000
2011	$23,359,400	$1,383,678
2012	$435,776	$525,463
2013	$564,402	$1,590,667
2014	$2,941,426	$1,555,228
2015	$1,482,612	$637,758
2016	$69,482,540	$2,903,161
2017	$213,330	$405,431
2018	$711,782	$11,040,798
2019	$531,181	$9,760,243
2020	$2,222,950	$131,620
2021	$342,758	$1,841,499
2022	$9,924,408	$170,321
2023*	$362,152	N/A
*As of April 2023		

Figure 4.3.23-9 below shows the locations of significant pipeline incidents between 2010 and 2022. The counties with the most incidents were Washington and Delaware. Incidents were most likely in the areas surrounding these counties as well, suburbs of either Pittsburgh or Philadelphia. There is a high concentration of natural gas pipelines through Washington County and the Southwest, yet the same is true of the Northwest but the region did not experience many significant incidents. Lycoming County experienced 5 incidents yet only has two major pipelines, one for natural gas and another for refined product.

Figure 4.3.23-9 Major Pipeline Incidents in Pennsylvania (EIA 2022).



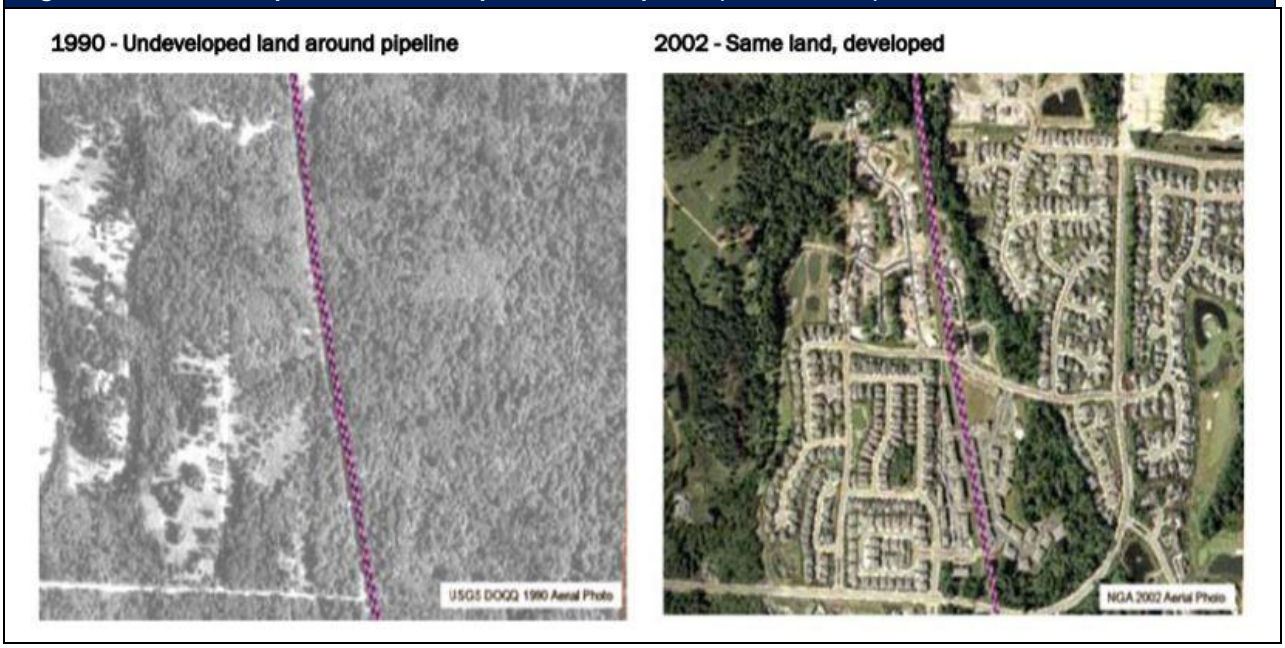
4.3.23.4. Future Occurrence

The future probability of high-impact pipeline failures will be shaped by the maintenance of existing pipeline systems, the construction of new pipeline systems, and the amount of new development that occurs near pipelines. According to the annual reports submitted to PHMSA, 75 percent of Pennsylvania's liquid petroleum pipelines were installed before 1970, and 56 percent were installed before 1960. As the metal in these aging pipelines reacts with the environment, it can become corroded, causing a loss of pipe strength that can lead to leakage or rupture. Corrosion is one of the most prevalent causes of pipeline incidents, and was listed as the cause for 20 percent of significant pipeline incidents nationwide between 1998 and 2017, and 15 percent of pipeline incidents in Pennsylvania. Maintenance and repair, however, can reduce the risk of corrosion. Improved technologies have led to better prevention, monitoring, detection, and mitigation of external pipeline corrosion for older as well as newer pipelines (PHMSA, 2018).

The future occurrence of high impact pipeline failures will also be determined by the location and character of new pipeline construction. The development of the Marcellus Shale has made Pennsylvania the nation's second largest natural gas-producing state, and is driving a new wave of pipeline construction (EIA, 2018). According to the Pennsylvania Department of Environmental Protection (DEP), the state can expect "unprecedented" growth in its natural gas pipeline system to transport natural gas and related byproducts from thousands of wells throughout the state (PA DEP, 2016).

Finally, land development near a pipeline right-of-way can bring people in close proximity to pipeline hazards. Figure 4.3.23-10 provides an example of new development surrounding an existing pipeline. Land development adjacent to natural gas and liquid petroleum pipelines increases the likelihood of damage to the pipeline, and also increase the exposure of people and property to pipeline failure hazards.

Figure 4.3.23-10 Example of New Development Near Pipeline (FEMA, 2015a).



4.3.23.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to pipeline failures, all structures located within one-quarter mile of the major pipelines shown in Table 4.3.27-2 were identified. The area impacted by a given pipeline incident will depend on the pipeline contents, pipeline diameter and operating pressure, and atmospheric conditions. For this assessment, however, one-quarter mile was selected as a representative distance within which death, injury, or significant property damage could occur. In addition, the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 495, or 11 percent, are located within a quarter mile of a major gas or liquid pipeline (Table 4.3.25-3). These facilities have a combined replacement value of more than $241 million, or approximately 6% of the known value of geolocated state facilities. A total of 333, of the 495 vulnerable facilities, are owned by the state. Overall, more than 5.1 million square feet of building space are reported to exist within high hazard pipeline areas.

Table 4.3.23-5 Vulnerability of State Facilities to Pipeline Failure.

DEPARTMENT	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF DEPARTMENT STRUCTURES	STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Department of Agriculture	2	13%	0	7,494
Department of Conservation and Natural Resources	1	50%	0	37,703
Department of Corrections	126	18%	124	3,938,639
Department of Health	8	17%	0	67,464
Department of Labor and Industry	7	10%	1	133,851
Department of Public Welfare	6	6%	0	114,233
Department of Revenue	1	10%	0	6,526
Department of Transportation	215	13%	208	458,222
Executive Offices	1	50%	0	11,282
Liquor Control Board	69	13%	0	312,101
PA Historical and Museum Commission	4	13%	0	0
PA State Police	6	17%	0	52,850
PA State System of Higher Education	49	6%	0	0
Total	**495**	**11%**	**333**	**5,140,365**

Of the 13,448 geolocated critical facilities, 1,406 or 10 percent, are located within a quarter mile of a major gas or liquid pipeline (Table 4.3.21-6). These facilities have a combined replacement value of more than $45 billion, or approximately 11% of the known value of geolocated critical facilities.

Table 4.3.23-6 Vulnerability of Critical Facilities to Pipeline Failure		
TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF TOTAL STRUCTURES BY TYPE
Agricultural	18	7%
Banking		0%
Commercial		0%
Communication	55	10%
Dam	123	8%
Education (colleges and universities)	44	11%
Education (public schools)	459	10%
Emergency Operation Center	4	6%
Energy	74	20%
Fire Station	287	11%
Government	1	4%
Hospital	23	7%
National Monument		0%
Nuclear	1	20%
Police Station	130	10%
Transportation	112	17%
Water	75	12%
Total	**1,406**	**10%**

4.3.23.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to pipeline failures, all census blocks with centers located within one-quarter mile of a major pipeline were identified. The population, building counts, and building value of all vulnerable census blocks were then aggregated to the county scale. The counties with the highest percentage of exposed building value are Greene, Beaver, and Tioga counties. For each of these counties, more than a quarter of the total building value is vulnerable to a gas or liquid pipeline failure. The counties with the most people exposed to pipeline failure, in contrast, are Allegheny, Delaware, and Chester counties. In each of these counties, more than 100,000 people are vulnerable to a gas or liquid pipeline failure, with Allegheny over 200,000 people. Across the state, about 15 percent of total building value is vulnerable to a gas or liquid pipeline failure.

Table 4.3.23-7 Vulnerability of People and Buildings to Pipeline Failure				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Adams	13,019	4,852	$2,806,187	14%
Allegheny	201,479	85,953	$42,163,367	16%
Armstrong	2,577	1,483	$455,747	4%
Beaver	48,274	21,143	$11,037,117	32%
Bedford	461	324	$97,745	1%
Berks	42,647	16,706	$9,905,475	12%

Table 4.3.23-7 Vulnerability of People and Buildings to Pipeline Failure

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Blair	13,602	6,718	$3,852,643	14%
Bradford	3,773	2,083	$893,579	6%
Bucks	42,278	15,925	$11,829,752	7%
Butler	12,888	5,389	$3,272,133	7%
Cambria	6,144	3,379	$1,530,807	5%
Cameron	399	322	$88,852	7%
Carbon	922	508	$151,890	1%
Centre	2,196	929	$530,656	2%
Chester	130,097	45,800	$37,904,104	26%
Clarion	4,945	2,933	$966,178	12%
Clearfield	2,979	1,271	$878,159	5%
Clinton	378	310	$68,131	1%
Columbia	300	183	$56,513	0%
Crawford	10,321	6,005	$3,104,083	13%
Cumberland	45,085	16,077	$10,347,843	19%
Dauphin	23,858	9,675	$5,312,750	9%
Delaware	122,552	42,778	$25,930,256	22%
Elk	5,269	3,408	$1,408,129	17%
Erie	52,566	18,318	$8,865,217	18%
Fayette	8,007	4,485	$1,611,994	7%
Forest	748	1,007	$310,679	15%
Franklin	5,967	2,887	$1,255,316	4%
Fulton	376	267	$150,393	3%
Greene	9,505	4,990	$2,994,675	32%
Huntingdon	1,777	1,066	$334,768	4%
Indiana	10,667	5,596	$2,364,051	14%
Jefferson	6,039	3,651	$1,091,932	13%
Juniata	73	55	$8,485	0%
Lackawanna	1,967	803	$399,387	1%
Lancaster	58,961	21,930	$12,275,400	12%
Lawrence	10,997	5,216	$1,768,477	12%
Lebanon	17,060	7,103	$3,311,128	11%
Lehigh	33,507	11,975	$8,115,729	11%
Luzerne	18,193	8,089	$3,263,463	6%
Lycoming	5,546	2,350	$1,041,576	5%
McKean	5,425	3,212	$1,179,897	14%
Mercer	22,391	11,322	$5,396,512	19%

Table 4.3.23-7 Vulnerability of People and Buildings to Pipeline Failure				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Mifflin	507	245	$103,081	1%
Monroe	5,380	2,192	$1,039,007	3%
Montgomery	86,475	30,312	$23,935,535	12%
Montour	11	5	$1,920	0%
Northampton	14,374	5,886	$2,861,531	5%
Northumberland	2,756	1,124	$587,013	3%
Perry	2,991	1,339	$485,181	6%
Philadelphia	25,696	9,375	$5,900,217	2%
Pike	4,421	2,628	$1,057,331	6%
Potter	3,791	2,099	$664,091	24%
Schuylkill	5,134	2,416	$950,244	3%
Somerset				0%
Susquehanna	2,859	1,850	$1,214,916	5%
Tioga				0%
Venango	1,074	913	$478,265	3%
Warren	10,572	5,646	$2,225,537	26%
Washington				0%
Wayne	12,606	6,502	$2,127,309	22%
Westmoreland	7,401	4,202	$1,391,735	19%
Wyoming	54,650	26,090	$11,687,519	26%
York	1,873	1,049	$529,979	4%
Total	**49,746**	**23,082**	**$11,906,295**	**15%**

4.3.24. Environmental Hazard – Hazardous Materials Releases

4.3.24.1. Location and Extent

Hazardous material releases pose threats to the natural environment, the built environment, and public safety through the diffusion of harmful substances, materials, or products. Hazardous materials can include toxic chemicals, infectious substances, biohazardous waste, and any materials that are explosive, corrosive, flammable, or radioactive. Hazardous material releases can occur wherever hazardous materials are manufactured, used, stored, or transported. Such releases can occur along transportation routes or at fixed-site facilities. Hazardous material releases can result in human and wildlife injury, property damage, and contamination of air, water, and soils.

Transportation of hazardous materials on highways involves tanker trucks or trailers, which are responsible for the greatest number of hazardous material release incidents (FEMA, 1997). There are over 120,000 miles of highway in the Commonwealth and many of those are used to transport hazardous materials (PennDOT, 2016). These roads also cross rivers and streams at many points and have the potential to pollute surface water and groundwater that serve as domestic water supplies for parts of the Commonwealth.

Potential also exists for hazardous material releases to occur along rail lines as collisions and derailments of train cars can result in large spills. Several railroad accidents have occurred in Pennsylvania involving hazardous materials (NTSB, 2018).

Pipelines also transport hazardous liquids and flammable substances such as natural gas. Incidents can occur when pipes corrode, are damaged during excavation, incorrectly operated, or damaged by other forces. Pipelines exist in all but two counties in Pennsylvania (see Section 4.3.25.3). Pipelines transporting natural gas compose most of the total pipeline miles in the Commonwealth. According to the Pipeline and Hazardous Materials Safety Administration, Pennsylvania has 10,554 miles of active natural gas transmission pipelines and 4,254 miles of active liquid pipelines. Of the liquid pipeline mileage, approximately 1,821 miles carry highly volatile liquids (PHMSA, 2022). In addition, hazardous materials can be transported by aircraft or by watercraft. Crashes, spills of materials, and fires on these vessels can pose a hazard.

Fixed-site facilities that use, manufacture, or store hazardous materials in Pennsylvania pose significant risk to public health and the environment and 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 Commonwealth's reporting requirements under the Hazardous Materials Emergency Planning and Response Act (1990-165), as amended. These statutes require that all owners or operators of facilities that manufacture, produce, use, import, export, store, supply, or distribute any extremely hazardous substance, as defined by the EPA, at or above the threshold planning quantity, as established

by EPA, report to the county where the facility is located and the Commonwealth. Such facility is subject to the requirement to assist the Local Emergency Planning Committee (LEPC) in the development of an Off-site Emergency Response Plan. The community right-to-know reporting requirements keep communities abreast of the presence and release of chemicals at individual facilities. In 2021, there were 3,615 SARA Title III facilities in Pennsylvania.

The list of SARA Title III facilities is not an exhaustive, fully-comprehensive inventory of all hazardous material locations within the Commonwealth. The EPA also tracks key information about chemicals handled by industrial facilities through its Toxics Release Inventory (TRI) database. Facilities which employ ten or more full-time employees and which manufacture or process 25,000 pounds or more, or otherwise use 10,000 pounds or more, of any SARA Section 770-listed toxic chemicals in the course of a calendar year are required to report TRI information to the EPA, the federal enforcement agency for SARA Title III, and PEMA. In November 2021, the US EPA added natural gas processing facilities to the list of those required to report. As of 2022, there were 1,051 facilities on EPA's TRI (EPA, 2022d). The breakdown of these facilities by county is shown in Table 4.3.24-1.

Table 4.3.24-1 TRI Facilities in Pennsylvania by County (EPA, 2022d)

COUNTY	NUMBER OF TRI FACILITIES	COUNTY	NUMBER OF TRI FACILITIES
Adams	13	Lackawanna	11
Allegheny	62	Lancaster	60
Armstrong	5	Lawrence	18
Beaver	31	Lebanon	21
Bedford	9	Lehigh	25
Berks	39	Luzerne	31
Blair	13	Lycoming	18
Bradford	5	McKean	12
Bucks	49	Mercer	30
Butler	32	Mifflin	4
Cambria	9	Monroe	8
Cameron	3	Montgomery	51
Carbon	8	Montour	2
Centre	8	Northampton	30
Chester	28	Northumberland	10
Clarion	3	Perry	0
Clearfield	12	Philadelphia	26
Clinton	3	Pike	0
Columbia	5	Potter	4
Crawford	16	Schuylkill	18
Cumberland	18	Snyder	3
Dauphin	16	Somerset	6
Delaware	19	Sullivan	0

Table 4.3.24-1 TRI Facilities in Pennsylvania by County (EPA, 2022d)			
COUNTY	NUMBER OF TRI FACILITIES	COUNTY	NUMBER OF TRI FACILITIES
Elk	23	Susquehanna	1
Erie	46	Tioga	6
Fayette	4	Union	5
Forest	0	Venango	16
Franklin	14	Warren	8
Fulton	2	Washington	19
Greene	2	Wayne	1
Huntingdon	2	Westmoreland	37
Indiana	9	Wyoming	1
Jefferson	13	York	45
Juniata	3	**TOTAL**	**1,051**

Additional hazardous materials are contained at the military installations within Pennsylvania. Nuclear facilities are another type of fixed-facility that poses risk of hazard material release. For more information about nuclear incidents, reference Section 4.3.29.

4.3.24.2. Range of Magnitude

Hazardous material releases can contaminate air, water, and soils possibly resulting in death and/or injuries. Dispersion can take place rapidly when transported by water and wind. While often accidental, releases can occur as a result of human carelessness, intentional acts, or natural hazards. When caused by natural hazards, these incidents are known as secondary events. As previously mentioned, materials can include toxic chemicals, radioactive materials, infectious substances and hazardous wastes. Such releases can affect nearby populations and contaminate critical or sensitive environmental areas.

With a hazardous material release, whether accidental or intentional, there are several potentially mitigating or exacerbating circumstances that will affect its severity or impact. Mitigating conditions are precautionary measures taken in advance to reduce the impact of a release on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place protects people and property from the harmful effects of a hazardous material release. Exacerbating conditions, characteristics that can enhance or magnify the effects of a hazardous material release include:

- **Weather conditions:** affects how the hazard occurs and develops
- **Micro-meteorological effects of buildings and terrain:** alters dispersion of hazardous materials
- **Non-compliance with applicable codes (e.g. building or fire codes) and maintenance failures (e.g. fire protection and containment features):** can substantially increase the damage to the facility itself and to surrounding buildings

The severity of the incident is dependent not only on the circumstances described above, but also on the type of material released and the distance and related response time for emergency response teams (FEMA, 2019). The areas within closest proximity to the releases are generally at greatest risk, yet depending on the agent, a release can travel great distances or remain present in the environment for a long period of time (e.g. centuries to millennia for radioactive materials), resulting in extensive impacts on people and the environment.

Generally, the ways hazardous materials are harmful to humans and other animals can be broken into several categories referred to as the TRACEM model (FEMA, 2019):

- Thermal Harm: exposure to extreme temperatures either through contacting a heated surface or inhaling fumes
- Radiological Harm: exposure to ionizing radiation removes electrons from atoms and causes damage to living cells and DNA
- Asphyxiation: exposure to materials that reduce oxygen levels, typically in confined spaces or with very concentrated forms of hazardous material, that tissues cannot be oxygenated enough
- Chemical Harm: exposure to chemicals that include poisons, corrosive agents, certain metals, opioids, pesticides, and more. The injuries and illnesses that result will depend entirely on the material.
- Etological (Biological) Harm: exposure to organic materials such as bacteria, viruses, and biological toxins which can produce delayed responses as pathogens take time to multiply
- Mechanical Harm: either contact with fragmentation or debris created in pressure releases or explosions, injuries caused solely by pressure increases (eardrum and blood vessel rupture), or secondary blast injuries when victims are thrown by blasts.

The environmental impacts of hazardous material releases include:

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

One of the worst recorded hazardous materials incidents known in Pennsylvania occurred in March 2009 when a tractor trailer overturned spilling 33,000 pounds of toxic hydrofluoric acid near Wind Gap, Pennsylvania resulting in the evacuation of 5,000 people (USA Today, 2009). Residents were evacuated because contact with concentrated solutions of the acid can cause severe burns and inhaling the gas can cause respiratory irritation, severe eye damage, and pulmonary edema. In August 2017, a train derailment incident required the evacuation an entire town of approximately 1,000 residents roughly 100 miles southeast of Pittsburgh when at least

32 cars on a CSX freight train derailed causing cars containing liquid petroleum gas and molten sulfur to leak and catch fire. Additionally, one of the cars collided with a home and set fire to the garage (CBS News, 2017). Even incidents in other states may impact Pennsylvania if they

occur close enough to the border. In February 2023, a train derailment incident in East Palestine, Ohio resulted in a significant hazardous materials release. Eleven of the derailed train cars were carrying hazardous materials, headlined by vinyl chloride that was burned in a controlled burn to avoid an explosion (McDaniel, 2023). The incident caused the evacuation of the town and warnings were issued to Pennsylvania residents in Beaver County, just across the border. DEP will complete independent testing of water samples for at least the next six months, but since groundwater around the site flows westward there is not expected to be long-term consequence for Pennsylvania residents. There are concerns about air pollution as a result of the materials being burned, but DEP also reports that no long-term air quality concerns are expected (PA DEP, 2023).

East Palestine, OH

A worst-case scenario event of a hazardous material release would be one equivalent to the Lac-Megantic train derailment in July 2013. An unmanned train broke loose and sped downhill before jumping the tracks near the Montreal-Maine border. The train carried 72 cars of petroleum crude oil. The derailment resulted in the fire and explosion of multiple tanks. This event had no warning time, exacerbating the damage. The derailment and explosions destroyed an estimated 30 buildings and forced the evacuation of 2,000 residents. The death toll was 47 (TSB, 2014).

Table 4.3.24-2 Most Likely Lifelines Impacted by Hazardous Materials		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating a causal relationship for the Safety and Security lifeline as community safety may be endangered and fire departments may be called into response and recovery if leaks or other issues result in explosions and fires.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery. Impacts from hazardous materials releases include environmental contamination, which can impact agricultural operations and water supplies. Mitigation actions for this lifeline should be focused on developing and enforcing regulations for building facilities and ensuring proper procedures are in place for operation and maintenance.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline as releases can have adverse health impacts on communities, leading to more strain on the local healthcare system.
Transportation		Anticipating a causal relationship for the Transportation lifeline as releases can be highway-, rail-, or air-related. Releases may directly impact transportation infrastructure, either due to the release itself or resulting explosions and fires. Mitigation actions for this lifeline should be focused on developing and enforcing proper inspection and maintenance procedures.

4.3.24.3. Past Occurrence

Since the passage of SARA Title III, facilities that produce, use, or store hazardous chemicals must notify the public through their county's emergency dispatch center and PEMA if an accidental release of a hazardous substance meets or exceeds a designated reportable quantity, and affects or has the potential to affect persons and/or the environment outside the facility. SARA Title III and Pennsylvania Hazardous Material Emergency Planning and Response Act (Act 165) also require a written follow-up report to PEMA and the county where the facility is located. These written follow-up reports include any known or anticipated health risks associated with the release and actions to be taken to mitigate potential future incidents. In addition, Section 204(a)(10) of Act 165 requires PEMA to staff and operate a 24-hour State

Emergency Operations Center (EOC) to provide effective emergency response coordination. Table 4.3.24-32 shows the number of hazardous material incidents by county from 2018 through April 2023 as reported to PEMA's incident management system, PEMA-KC. The table does not include incidents reported at a state or regional level.

Table 4.3.24-3 Number of Hazardous Materials Incidents by County, 2018 - April 2023 (PEMA-KC, 2023).

COUNTY	2018	2019	2020	2021	2022	2023	TOTAL
Adams	2	9	7	2	8	8	**36**
Allegheny	53	78	126	103	64	14	**438**
Armstrong	4	2	7	5	2	1	**21**
Beaver	10	13	31	16	23	3	**96**
Bedford	5	8	14	10	6	3	**46**
Berks	54	71	130	60	66	22	**403**
Blair	10	6	11	7	4	4	**42**
Bradford	1	6	7	13	17	4	**48**
Bucks	26	26	41	32	27	9	**161**
Butler	5	12	28	24	11	3	**83**
Cambria	8	14	31	9	13	6	**81**
Cameron	0	1	1	0	1	0	**3**
Carbon	4	5	10	4	12	2	**37**
Centre	3	4	9	5	8	1	**30**
Chester	24	25	96	45	53	7	**250**
Clarion	3	12	16	14	10	2	**57**
Clearfield	3	7	6	6	23	4	**49**
Clinton	2	4	16	13	21	4	**60**
Columbia	1	1	5	1	2	1	**11**
Crawford	2	5	8	1	5	2	**23**
Cumberland	14	17	41	16	15	4	**107**
Dauphin	15	19	29	28	32	7	**130**
Delaware	22	31	58	28	56	11	**206**
Elk	1	0	1	1	5	0	**8**
Erie	11	11	31	9	24	5	**91**
Fayette	8	6	26	22	6	7	**75**
Forest	2	4	0	2	0	0	**8**
Franklin	18	12	40	21	31	5	**127**
Fulton	1	2	2	1	1	0	**7**
Greene	74	15	43	52	82	17	**283**
Huntingdon	3	2	5	5	7	2	**24**
Indiana	2	4	5	6	3	0	**20**
Jefferson	8	8	24	8	10	2	**60**
Juniata	0	1	2	1	2	0	**6**

Table 4.3.24-3 Number of Hazardous Materials Incidents by County, 2018 - April 2023 (PEMA-KC, 2023).							
COUNTY	2018	2019	2020	2021	2022	2023	TOTAL
Lackawanna	9	20	21	16	17	4	**87**
Lancaster	18	32	62	35	55	18	**220**
Lawrence	4	8	16	8	15	2	**53**
Lebanon	15	16	55	33	34	8	**161**
Lehigh	24	40	57	52	42	11	**226**
Luzerne	20	27	32	27	23	5	**134**
Lycoming	5	3	19	11	7	1	**46**
McKean	1	7	5	7	3	0	**23**
Mercer	3	10	19	14	18	6	**70**
Mifflin	2	4	4	2	4	3	**19**
Monroe	5	6	11	12	14	6	**54**
Montgomery	33	43	65	40	39	16	**236**
Montour	0	1	0	1	3	0	**5**
Northampton	220	259	452	294	244	104	**1573**
Northumberland	7	10	8	7	7	2	**41**
Perry	1	2	2	5	6	1	**17**
Philadelphia	30	49	80	66	59	25	**309**
Pike	1	2	2	1	2	1	**9**
Potter	3	5	3	5	3	1	**20**
Schuylkill	5	12	22	17	15	2	**73**
Snyder	2	0	5	8	5	2	**22**
Somerset	9	14	37	27	41	15	**143**
Sullivan	3	0	3	0	0	0	**6**
Susquehanna	7	3	5	4	6	3	**28**
Tioga	2	2	8	4	1	1	**18**
Union	2	1	6	9	6	0	**24**
Venango	0	3	5	6	3	2	**19**
Warren	5	10	17	5	16	0	**53**
Washington	103	139	321	252	177	49	**1041**
Wayne	0	1	2	1	4	0	**8**
Westmoreland	29	56	63	63	29	10	**250**
Wyoming	1	4	1	3	6	0	**15**
York	15	34	57	37	30	14	**187**
TOTAL	**983**	**1264**	**2372**	**1642**	**1584**	**472**	**8317**

Transportation-related hazardous material release incidents are also tracked by the federal government. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) maintains information on highway-related hazardous material release

incidents. PHMSA reports that between 2012 and October 2022, there were more than 9,400 highway-related incidents resulting in 59 injuries, one fatalities, and just over $15 million in damages (Table 4.3.24-4).

Table 4.3.24-4 Highway-Related Hazardous Material Release Incident Statistics (PHMSA, 2022)

YEAR	NO. OF INCIDENTS	MAJOR INJURIES	MINOR INJURIES	FATALITIES	DAMAGES
2022	694	0	0	0	$411,727
2021	1,115	0	3	0	$1,239,574
2020	1,014	3	4	0	$1,433,922
2019	1,042	1	4	0	$1,508,662
2018	928	0	4	0	$1,278,800
2017	769	1	4	0	$1,597,464
2016	782	0	7	1	$1,798,875
2015	772	2	11	0	$1,122,313
2014	814	2	5	0	$2,535,651
2013	761	3	2	0	$1,427,005
2012	745	1	2	0	$2,444,939
Total	**9,436**	**13**	**46**	**1**	**$15,373,359**

PHMSA also tracks rail incidents that result in the release of hazardous materials, with a number of severe rail events involving the release of hazardous materials occurring in Pennsylvania including the August 2017 and May 2022 incidents discussed above. Between 2012 and April 2023, there were 219 rail-related incidents resulting in five injuries, no fatalities, and over $47 million in damages (Table 4.3.24-5). The damages from the May 2022 incident were totaled at $30,800,000.

Table 4.3.24-5 Rail-Related Hazardous Material Release Incident Statistics (PHMSA, 2022).

YEAR	NO. OF INCIDENTS	MAJOR INJURIES	MINOR INJURIES	FATALITIES	DAMAGES
2022	7	0	1	0	$30,803,000
2021	20	0	1	0	$3,079,500
2020	17	0	1	0	$173,400
2019	5	0	0	0	$15,800
2018	20	0	0	0	$67,740
2017	21	0	0	0	$7,628,699
2016	20	0	0	0	$135,701
2015	18	0	1	0	$63,274
2014	34	0	0	0	$4,609,233
2013	38	1	0	0	$787,150
2012	19	0	0	0	$177,003
Total	**219**	**1**	**4**	**0**	**$47,540,500**

There have been 269 air-related incidents resulting in eight injuries, no fatalities, and over $24,000 in damages (Table 4.3.24-6). There have only been 1 water-related incidents since 2012 occurring in 2013, 2014, 2020 resulting in no injuries or fatalities and approximately $16, 200 in damages.

Table 4.3.24-6 Air-Related Hazardous Material Release Incident Statistics (PHMSA, 2023a

YEAR	NO. OF INCIDENTS	MAJOR INJURIES	MINOR INJURIES	FATAILITIES	DAMAGES
2023	6	0	0	0	$0
2022	13	0	0	0	$0
2021	13	0	0	0	$0
2020	49	0	0	0	$0
2019	38	0	0	0	$0
2018	31	1	0	0	$1,000
2017	24	0	0	0	$0
2016	15	0	0	0	$14,000
2015	21	0	0	0	$0
2014	34	0	0	0	$3,345
2013	20	0	0	0	$0
2012	21	0	8	0	$6,500
Total	**269**	**1**	**8**	**0**	**$24,845**

Pipeline releases can also result in fatality, injury, damage, the release highly volatile liquids, or liquid releases that result in unintentional fire or explosion. Section 4.3.25.3 contains information on injuries, fatalities, and property damage from gas distribution and transmission incidents and hazardous liquid incidents with respect to pipelines.

4.3.24.4. Future Occurrence

While many hazardous materials release incidents have occurred in Pennsylvania in the past, they are generally considered difficult to predict. An occurrence is largely dependent upon the accidental or intentional actions of a person or group. Intentional acts are addressed under Section 4.3.30. Risk associated with hazardous materials release is expected to remain moderate. Since hazardous materials release incidents occur annually in Pennsylvania, a 100 percent annual probability is anticipated.

4.3.24.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to hazardous material release, all facilities located in areas characterized as high risk were identified. High-risk areas are defined as those within one-quarter mile of major Interstates, U.S. highways, state highways, and rail lines, and areas within 1.5 miles of hazardous materials sites identified in Hazus.

As shown in Table 4.3.24-7, 3,782 state-owned or leased facilities were identified in areas at high risk to hazardous material release, the highest concentration of which are structures owned

or leased by the Department of Transportation; 1,493 Department of Transportation facilities are identified as vulnerable. High percentages, between 73 and 100 percent, of structures owned or leased by all state departments are at risk to hazardous material release. The replacement value of the 3,782 total vulnerable facilities is estimated to be more than $3.6 billion, or 92 percent of the value of all state-owned or leased facilities. Nearly 57% of the vulnerable facilities are owned by the state, with a total of 2,154. Overall, 34.1 million square feet of building space is reported to be vulnerable to hazardous materials.

Table 4.3.24-7 Vulnerability Of State Facilities to Hazard Materials Release.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF DEPARTMENT STRUCTURES	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	9	100%	0	189,068
Department of Agriculture	15	94%	11	1,164,699
Department of Banking and Securities	2	100%	0	49,820
Department of Community and Economic Development	4	100%	0	9,750
Department of Conservation and Natural Resources	2	100%	1	37,703
Department of Corrections	554	80%	526	10,407,577
Department of Education	1	100%	1	0
Department of Environmental Protection	12	92%	1	336,529
Department of General Services	130	99%	117	11,939,433
Department of Health	47	98%	0	203,430
Department of Labor and Industry	63	91%	4	855,310
Department of Military and Veterans Affairs	1	100%	0	2,500
Department of Public Welfare	85	87%	0	1,405,518
Department of Revenue	10	100%	0	153,216
Department of Transportation	1,493	88%	1,334	3,566,379
Drug and Alcohol Programs	1	100%	0	17,503
Emergency Management Agency	7	88%	7	105,180
Executive Offices	1	50%	0	11,282
Fish and Boat Commission	129	84%	128	251,646
Governor's Office	1	100%	0	535
Historical and Museum Commission	24	80%	3	8,942
Insurance Department	2	100%	0	42,511
Liquor Control Board	503	92%	1	2,807,922
Public School Employees' Retirement System	5	83%	0	81,707
State Civil Service Commission	1	100%	0	620
State Department	1	100%	0	84,349
State Employees' Retirement System	3	75%	0	57,641
State Police	32	89%	0	309,813
State System of Higher Education	622	73%		
Thaddeus Stevens College of Technology	20	100%	20	2,200
Treasury Department	2	100%	0	7,483
Total	**3,782**	**85%**	**2,154**	**34,110,266**

With respect to critical facilities, the types of facilities most vulnerable to hazardous material release in terms of number of facilities include fire departments, public schools, and police departments water facilities, and dams (Table 4.3.24-8). Water treatment facilities and water suppliers are particularly vulnerable to hazardous material releases. If a hazardous materials release impacted one of these facilities, the effects could be widespread depending on the service area of each entity. In total, approximately 72 percent of all identified critical facilities are vulnerable to hazardous materials release.

Table 4.3.24-8 Vulnerability of Critical Facilities to Hazardous Materials Release.

TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF STRUCTURES BY TYPE
Agricultural	226	82%
Banking	4	100%
Commercial	17	81%
Communication	283	51%
Dam	521	35%
Education (colleges and universities)	334	84%
Education (public schools)	3,301	70%
Emergency Operation Center	65	92%
Energy	229	63%
Fire Station	2,186	84%
Government	23	92%
Hospitals	260	84%
National Monuments or Icon	3	50%
Nuclear	4	80%
Police Station	1,113	85%
Transportation	619	91%
Water	456	72%
TOTAL	**9,644**	**72%**

A total of 9,644 critical facilities were identified in areas at high risk to hazardous material release. The total replacement cost of these critical facilities is estimated to be approximately $317 billion, or 81 percent of the total known value of all critical facilities in the Commonwealth. Not all facilities will experience equal losses in the case of a hazardous material release. Losses will depend on the magnitude of the spill and the type of facility. For example, losses may be higher for a water supply facility where multiple municipalities depend on a contaminated source.

4.3.24.6. Jurisdictional Vulnerability Assessment and Loss Estimation

The vulnerability of a community and the environment to a spill or release of an extremely hazardous substance at a facility or from a transportation accident depends on many variables. These include: the specific chemical, the extent of the spill or release, the proximity of

waterways, and the number of people residing in a radius from the facility or accident location that can reasonably be expected to be adversely affected.

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

All types of population are evaluated in determining the population at risk within the radius of vulnerability including hospitals, schools, homes for the elderly, and critical infrastructure facilities. There are 1,051 facilities in Pennsylvania included on the EPA's TRI that store hazardous substances. Populations in communities that contain these facilities are more vulnerable to facility releases, particularly those within 1.5 miles of a given facility. Jurisdictions within one-quarter mile of major highways and railways are considered more vulnerable in the event of a transportation incident involving hazardous materials. Note that there is some overlap among these vulnerable jurisdictions. For example, an individual that lives within 1.5 miles of a hazardous materials site may also live within one-quarter mile of a major highway.

To determine jurisdictional vulnerability to hazardous materials release, GIS analysis was conducted to identify all census blocks with centers located in areas characterized by high risk of hazardous material release. As previously defined, high-risk areas are those within one-quarter mile of major Interstates, U.S. highways, state highways, and rail lines, and areas within 1.5 miles of hazardous materials sites identified in Hazus. The total population and buildings within these census blocks were summed by county to determine the total vulnerable population and the total number and value of vulnerable buildings. Table 4.3.24-9 shows the results of this assessment.

Table 4.3.24-9 Vulnerability of People and Buildings Vulnerable to Hazardous Material Release.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Adams	58,083	23,116	$11,858,437	58%
Allegheny	772,900	326,559	$170,160,942	65%
Armstrong	31,016	15,695	$6,585,187	53%
Beaver	97,512	43,753	$22,033,835	65%
Bedford	20,641	11,738	$5,643,634	47%
Berks	294,733	103,277	$57,852,613	68%
Blair	76,848	34,526	$18,159,564	66%
Bradford	26,398	12,335	$6,554,649	46%
Bucks	382,043	139,179	$90,501,792	57%
Butler	107,542	42,899	$27,655,659	61%
Cambria	76,917	38,838	$19,212,215	58%
Cameron	3,191	2,018	$886,826	70%
Carbon	36,122	16,834	$6,028,575	53%
Centre	92,775	29,183	$14,298,776	47%
Chester	332,244	114,695	$86,850,766	60%
Clarion	16,125	7,912	$3,466,803	42%
Clearfield	40,883	18,677	$10,057,901	61%
Clinton	22,974	8,954	$3,956,841	63%
Columbia	37,344	14,830	$8,196,409	64%
Crawford	44,819	21,961	$12,214,257	50%
Cumberland	167,551	58,752	$36,600,229	67%
Dauphin	171,575	65,495	$41,889,974	67%
Delaware	409,539	135,380	$80,482,980	68%
Elk	24,038	13,680	$6,214,597	74%
Erie	216,017	81,059	$40,766,301	83%
Fayette	57,999	29,244	$12,327,256	50%
Forest	1,211	1,386	$551,676	27%
Franklin	87,495	35,290	$18,633,327	59%
Fulton	5,407	3,040	$1,468,818	32%
Greene	15,222	6,812	$3,905,057	41%
Huntingdon	18,711	8,336	$3,474,645	44%
Indiana	45,187	18,359	$9,521,225	57%
Jefferson	27,344	16,013	$5,213,465	64%
Juniata	10,165	4,725	$2,347,281	54%
Lackawanna	165,037	60,920	$31,050,152	69%
Lancaster	374,538	136,972	$73,949,488	70%
Lawrence	58,961	26,489	$10,589,558	72%

Table 4.3.24-9 Vulnerability of People and Buildings Vulnerable to Hazardous Material Release.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Lebanon	101,108	39,028	$20,606,327	70%
Lehigh	263,454	86,643	$54,372,866	72%
Luzerne	222,114	85,553	$40,616,473	72%
Lycoming	69,202	27,395	$11,994,485	55%
McKean	25,292	11,987	$4,948,880	57%
Mercer	68,861	32,012	$17,046,504	61%
Mifflin	27,454	12,878	$5,723,321	62%
Monroe	56,506	23,079	$15,139,513	41%
Montgomery	604,511	206,460	$146,045,397	71%
Montour	8,131	3,417	$1,813,729	55%
Northampton	231,277	79,562	$43,528,554	74%
Northumberland	60,739	28,309	$15,068,194	73%
Perry	16,852	7,581	$3,129,921	38%
Philadelphia	1,286,159	417,438	$217,731,626	84%
Pike	9,767	6,294	$3,128,050	19%
Potter	7,209	3,789	$1,367,708	49%
Schuylkill	99,300	46,024	$19,974,207	68%
Snyder	19,102	7,890	$4,740,876	55%
Somerset	37,112	18,462	$9,539,313	41%
Sullivan	1,897	1,670	$623,369	30%
Susquehanna	13,915	7,757	$3,887,343	28%
Tioga	17,349	8,630	$4,141,442	48%
Union	26,879	8,061	$4,901,124	71%
Venango	30,044	15,250	$5,985,218	62%
Warren	21,753	11,961	$4,297,957	58%
Washington	120,802	57,205	$26,811,154	59%
Wayne	16,595	7,534	$3,405,069	29%
Westmoreland	225,602	107,830	$51,090,391	64%
Wyoming	10,076	4,571	$2,291,706	40%
York	273,648	98,970	$55,069,902	65%
TOTAL	**8,399,817**	**3,202,171**	**1,760,182,329**	**65%**

Using the methodology defined above, all 67 counties were identified as having population and buildings vulnerable to hazardous material releases. Throughout the Commonwealth, nearly 8.4 million people have been identified as vulnerable to hazardous material release. The counties with the largest vulnerable populations include Philadelphia, Allegheny, Montgomery, Delaware, Bucks, and Lancaster Counties.

Jurisdictional losses from hazardous material releases come from damage to buildings and infrastructure, as well as the cost of cleanup. In terms of building exposure, Philadelphia is also the most threatened by hazardous materials releases with 417,438 exposed buildings valued at approximately $ billion. Allegheny County is the second-most threatened jurisdiction in with just over 326,000 potentially impacted buildings valued at approximately $170 billion. Sullivan County is least threatened by hazardous materials releases with 1,386 exposed buildings value at nearly $552 million, which represents only 27 percent of the total value of all buildings in the County. The assessment reveals that much of the Commonwealth is vulnerable to hazardous material release with 65 percent of the total value of all buildings in Pennsylvania at risk.

PEMA assigned chemical facility ratings and transportation threat ratings for counties in Pennsylvania in its 2007 Hazardous Material Emergency Response Preparedness Report. In the report, four counties in Pennsylvania were assigned a “high” chemical facility rating and fourteen counties were assigned a “high” transportation threat rating. This information is included in Table 4.3.24-10. More recent chemical and transportation threat ratings are not currently available. In addition, PEMA maintains a list of how many emergency response teams are in each county in Pennsylvania. Allegheny has five teams while all other counties have one or two teams. Counties with fewer response teams could result in increased vulnerability due reduced response capabilities.

Table 4.3.24-10 Pennsylvania County Chemical Facility and Transportation Threat Ratings (PEMA, 2007a)

COUNTY	CHEMICAL FACILITY RATING	TRANSPORTATION THREAT RATING	NO. OF EMERGENCY RESPONSE TEAMS
Adams	Moderate	Moderate	1
Allegheny	High	High	5
Armstrong	Moderately Low	Moderate	1
Beaver	High	High	1
Bedford	Significant	Significant	1
Berks	Moderate	Significant	1
Blair	Moderate	Not Provided	1
Bradford	Low to High	Low	1
Bucks	Low	Moderate	1
Butler	Low to Moderate	Moderate	1
Cambria	Low to Moderate	Low to Moderate	1
Cameron	Moderate	Low	1
Carbon	N/A	N/A	N/A
Centre	Significant	Significant	1
Chester	Low to Moderate	Moderate to High	1
Clarion	Moderate	Moderate to Significant	1
Clearfield	Significant	Significant	1
Clinton	Significant	Significant	1

Table 4.3.24-10 Pennsylvania County Chemical Facility and Transportation Threat Ratings (PEMA, 2007a)

COUNTY	CHEMICAL FACILITY RATING	TRANSPORTATION THREAT RATING	NO. OF EMERGENCY RESPONSE TEAMS
Columbia	Low to Moderate	Low to Moderate	1
Crawford	Low	Moderate	1
Cumberland	Low to Moderate	High	1
Dauphin	Low	Moderate	1
Delaware	Significant	Significant	1
Elk	Moderate	Moderate	1
Erie	Moderate	High	1
Fayette	Significant	Significant	1
Forest	No Threat	Moderate	1
Franklin	Moderate	Not Provided	1
Fulton	Low	High	1
Greene	Low	Moderate	1
Huntingdon	Low to Moderate	High	1
Indiana	Low to Significant	Moderate	1
Jefferson	Not Provided	High	2
Juniata	Moderate	High	1
Lackawanna	N/A	N/A	N/A
Lancaster	Significant	Significant	1
Lawrence	Not Provided	Not Provided	1
Lebanon	Not Provided	High	1
Lehigh	Moderate	Moderate	1
Luzerne	Low	High	2
Lycoming	Low to Moderate	Moderate	1
McKean	Moderate	Moderate	1
Mercer	Low	High	1
Mifflin	Not Provided	Not Provided	1
Monroe	Moderate	Significant	1
Montgomery	High	High	1
Montour	Low to Moderate	Moderate	2
Northampton	Moderate to Significant	Significant	1
Northumberland	High	Moderate	1
Perry	Low to Moderate	Moderate	1
Philadelphia	Not Provided	Not Provided	2
Pike	Low	Moderate	1
Potter	Not Provided	Moderate	1

Table 4.3.24-10 Pennsylvania County Chemical Facility and Transportation Threat Ratings (PEMA, 2007a)

COUNTY	CHEMICAL FACILITY RATING	TRANSPORTATION THREAT RATING	NO. OF EMERGENCY RESPONSE TEAMS
Schuylkill	Moderate	Moderate	1
Snyder	Not Provided	Not Provided	1
Somerset	Moderate	Moderate	1
Sullivan	Moderate	Not Provided	1
Susquehanna	Low to Moderate	Not Provided	1
Tioga	Moderate	High	1
Union	Significant	Significant	2
Venango	Low	High	1
Warren	Moderate	Moderately High	1
Washington	N/A	N/A	N/A
Wayne	Low	Low	1
Westmoreland	Moderate	Moderate	1
Wyoming	Low	Low	1
York	Moderate	Moderate to High	1

4.3.25. Environmental Hazard – Unconventional Wells

4.3.25.1. Location and Extent

The Pennsylvania Department of Environmental Protection (PA DEP) defines unconventional wells as wells drilled deep into shale rock formations found thousands of feet underground. These formations, mainly Marcellus Shale and Utica Shale, contain and produce natural gas. These wells use horizontal drilling techniques that use large quantities of high-pressured water, approximately one to eight million gallons, mixed with sand and other additives including hydrochloric and muriatic acid, to hydraulically fracture the rock. This practice is more commonly known as fracking (PA DEP, 2022r). This type of extraction presents new and unique challenges and hazards in the Commonwealth. Approximately 30,000 permits have been issued for unconventional oil and gas well drilling to date in Pennsylvania, skyrocketing in the years 2009 to 2014, with nearly 18,000 permits issued. However, the number of permits for unconventional well drilling has decreased each year since 2018. There were 3,348 permits issued years 2018 to 2019, and 1,690 permits issues for 2020 to 2021 (PA DEP, 2022h). Table 4.3.25-1 depicts the presence of Marcellus Shale in 58 of the 67 Commonwealth counties. The Marcellus Shale formation underlies more than 75 percent of Pennsylvania as illustrated in Figure 4.3.25-1.

Figure 4.3.25-1 Unconventional Oil and Gas Well Locations and the location in Pennsylvania (PA DEP, 2022h).

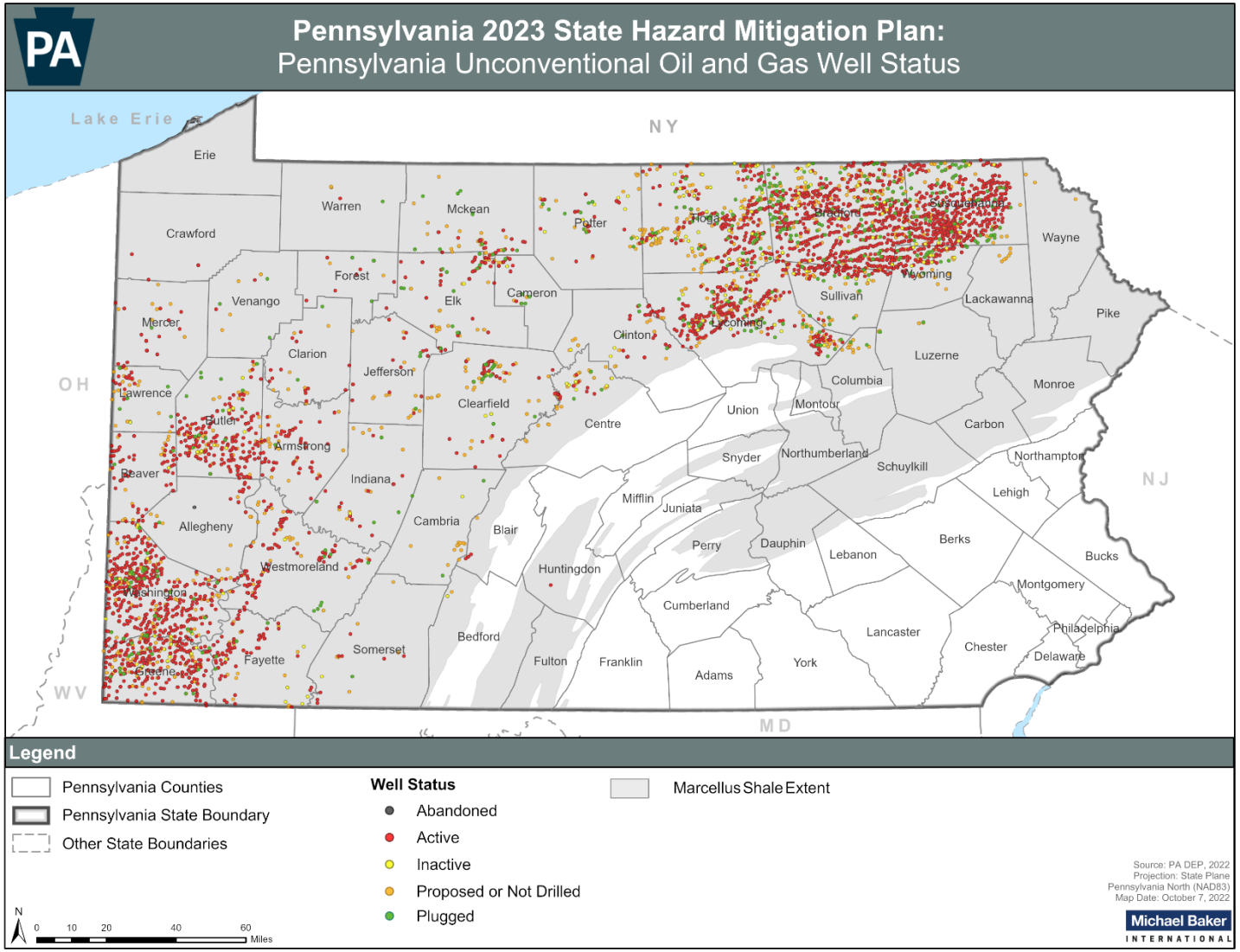
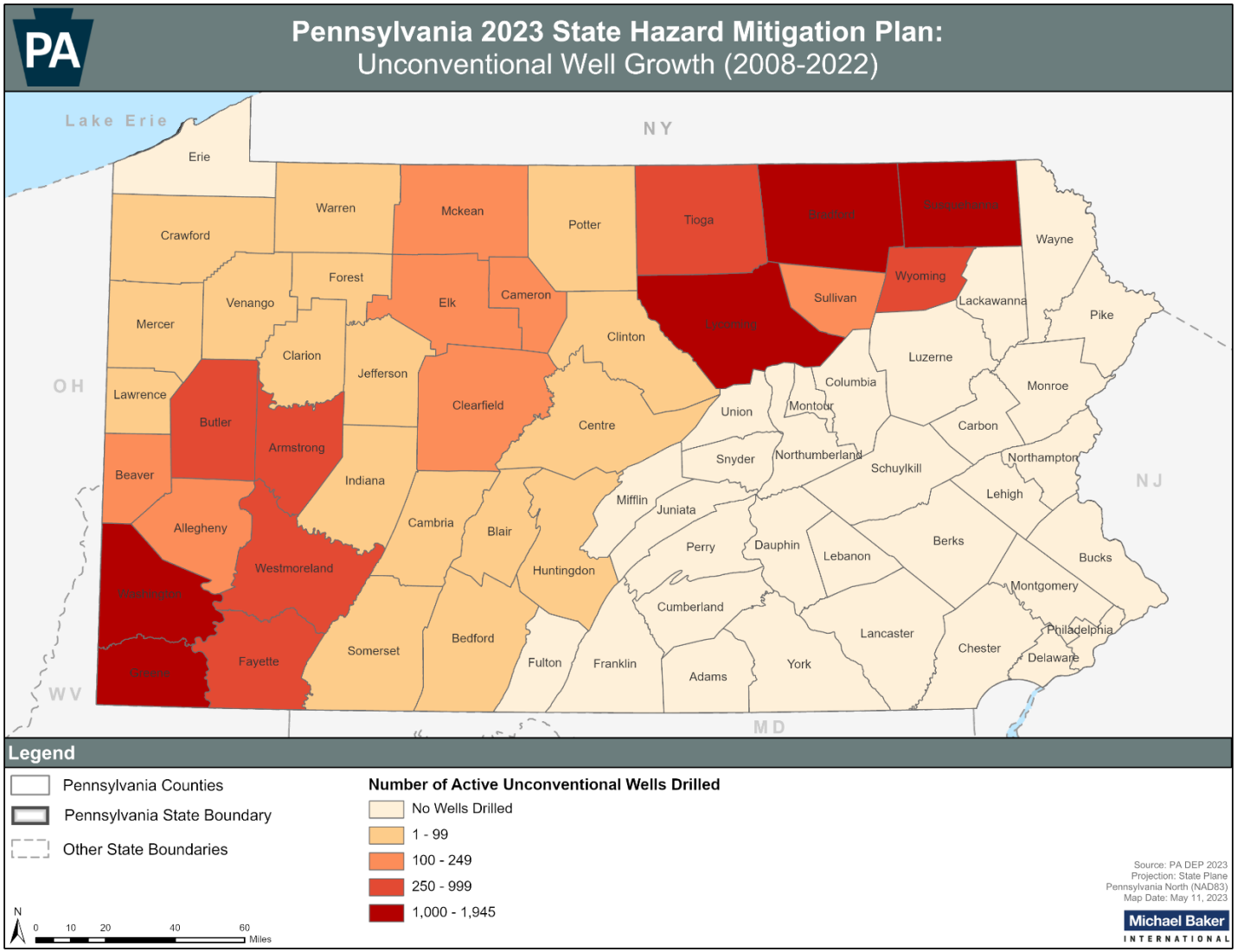


Figure 4.3.25-13 depicts the growth of unconventional oil and gas wells in Pennsylvania between the years 2008 and 2022. This map shows the amount active unconventional wells that were drilled in the given years. Unconventional wells largely take place in two regions of the Marcellus Shale, the northeast and the southwest. In the northeast, Bradford, Lycoming, and Susquehanna Counties went from low amounts to over 1,000 each. Susquehanna County has the highest amount in Pennsylvania with 1,945 active unconventional wells. In the southwest, Greene and Washington County each possess over 1,000 wells, with Washington has the second highest total in the state at 1,926 active unconventional wells. Overall, from the start of 2008 to the end of 2022, 12,236 active unconventional oil and gas wells were drilled in Pennsylvania (PA DEP, 2023).

Figure 4.3.25-2 Unconventional Oil and Gas Well Percent Gain By County 2008-2022 (PA DEP, 2023).



Since the 2010 Hazard Mitigation Plan, Marcellus Shale related natural gas extraction has become widespread throughout the Commonwealth. It should be noted that the number of unconventional well permits issued is not an indication of the number of unconventional wells drilled. Wells are permitted a minimum of several months prior to construction, and some permitted wells are never drilled.

Table 4.3.25-1 Number of Unconventional Well Permits Issued and Unconventional Wells Drilled to 2018 in Pennsylvania Counties (PASDA, 2022).

COUNTY	MARCELLUS SHALE FORMATION PRESENT	# OF UNCONVENTIONAL PERMITS ISSUED	# OF ACTIVE UNCONVENTIONAL DRILLED WELLS
Adams	No	0	0
Allegheny	Yes	487	179
Armstrong	Yes	606	311
Beaver	Yes	477	142
Bedford	Yes	2	0
Berks	Yes	0	0
Blair	Yes	9	6
Bradford	Yes	4,347	1,516
Bucks	No	0	0
Butler	Yes	1,362	630
Cambria	Yes	25	1
Cameron	Yes	222	89
Carbon	Yes	0	0
Centre	Yes	205	30
Chester	No	0	0
Clarion	Yes	157	40
Clearfield	Yes	460	104
Clinton	Yes	217	91
Columbia	Yes	18	0

Table 4.3.25-1 Number of Unconventional Well Permits Issued and Unconventional Wells Drilled to 2018 in Pennsylvania Counties (PASDA, 2022).			
COUNTY	MARCELLUS SHALE FORMATION PRESENT	# OF UNCONVENTIONAL PERMITS ISSUED	# OF ACTIVE UNCONVENTIONAL DRILLED WELLS
Crawford	Yes	10	3
Cumberland	Yes	0	0
Dauphin	Yes	0	0
Delaware	No	0	0
Elk	Yes	592	210
Erie	Yes	1	0
Fayette	Yes	629	323
Forest	Yes	68	11
Franklin	Yes	0	0
Fulton	Yes	0	0
Greene	Yes	3,413	1,529
Huntingdon	Yes	3	1
Indiana	Yes	145	41
Jefferson	Yes	201	41
Juniata	Yes	0	0
Lackawanna	Yes	29	0
Lancaster	No	0	0
Lawrence	Yes	219	60
Lebanon	Yes	0	0
Lehigh	No	0	0
Luzerne	Yes	15	0
Lycoming	Yes	2,316	1,005
McKean	Yes	348	118
Mercer	Yes	112	57
Mifflin	Yes	0	0
Monroe	Yes	0	0
Montgomery	No	0	0
Montour	Yes	0	0
Northampton	Yes	0	0
Northumberland	Yes	0	0
Perry	Yes	0	0
Philadelphia	No	0	0
Pike	Yes	0	0
Potter	Yes	373	84
Schuylkill	Yes	0	0

Table 4.3.25-1 Number of Unconventional Well Permits Issued and Unconventional Wells Drilled to 2018 in Pennsylvania Counties (PASDA, 2022).			
COUNTY	MARCELLUS SHALE FORMATION PRESENT	# OF UNCONVENTIONAL PERMITS ISSUED	# OF ACTIVE UNCONVENTIONAL DRILLED WELLS
Snyder	Yes	0	0
Somerset	Yes	59	18
Sullivan	Yes	528	160
Susquehanna	Yes	3,645	1,923
Tioga	Yes	2,456	879
Union	Yes	0	0
Venango	Yes	22	2
Warren	Yes	14	1
Washington	Yes	4,170	1,927
Wayne	Yes	21	0
Westmoreland	Yes	963	352
Wyoming	Yes	716	323
York	No	0	0
Total		**29,662**	**12,202**

4.3.25.2. Range of Magnitude

Unconventional well drilling has introduced a new set of hazards to the oil and gas industry in addition to the normal risks associated with the industry. The fluid or “frac fluid” that is recovered from this process must be properly treated as the water quality is very poor. Not only can it be extremely saline, but it also typically contains other contaminants like aluminum, arsenic, barium, bromine, chloride, PFAS/PFOA, sulfate, and very high concentrations of total dissolved solids (TDS) (Erikson, 2019). High levels of TDSs, though not harmful to humans, can be extremely harmful to aquatic life and can damage industrial equipment. Radioactivity is also a concern with the leftover fluid and general operation of wells, with testing showing elevated radiation levels downwind of fracking sites and the DEP requiring landfills test for radioactivity from fracking waste (Frazier, 2021; Frazier, 2020). The most common way of dealing with leftover frac fluid is reusing it when drilling new wells, but other ways include treating the water to reuse it for either agricultural purposes or to discharge it into surface waters and injecting it into deep underground wells no longer in use (Erikson, 2019). Temporary storage tanks of up to 20,000 gallons, impoundments and embankments, pit or surface spreading of drill cuttings, and both oil and condensate tanks are allowed with permits and often present at drilling sites. The storage of this waste can present a hazard to both workers and the local community.

Potential impacts from Marcellus Shale gas well drilling include (Srebotnkaj, 2018):

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

    - Surface spills
    - Well casing leaks
    - Gases & liquids moving through fractured rock to groundwater supply
    - Abandoned wells (also discussed in Section 4.3.22 about Conventional Wells)
- Soil contamination via toxic material surface spills.
- Methane and other hydrocarbon emissions from drilling, production, and intentional venting.

These potential impacts have been playing out across the Commonwealth. American Rivers, a leading national river conservation organization, listed the Lower Youghiogheny River as its #10 most endangered river in 2020, citing natural gas development in the form of fracking as the biggest threat to the river that empties into the Monongahela River in McKeesport, Allegheny County (American Rivers, 2020). In a 2017 report compiled by Penn Environment, it was found that fracking companies committed 4,351 violations between 2008 and 2016, with just 17% of them accompanied with a fine; when fines were levied, the median was only $5,263 (Penn Environment, 2017). For example, in 2014, a tank exploded and spilled approximately 3,000 gallons of frac fluid onto the well pad and surrounding soil. Between 2007 to 2016, there have been approximately 300 cases of drinking water contamination, and river pollution has also found from fracking (Penn Environment, 2017). Recent studies on the public health impacts have reported that proximity to fracking operations may be linked to adverse health outcomes such as increased risk of juvenile leukemia in children, associations of migraines, fatigue, and chronic rhinosinusitis, elevated mortality in the elderly, and more adverse prenatal, respiratory, cardiovascular, and carcinogenic outcomes (St. Martin, 2022; Harvard School of Public Health, 2022; Hall, 2016).

To further address community concerns, DOH is funding the University of Pittsburgh Graduate School of Public Health to conduct two observational epidemiologic studies focusing on known or suspected health effects of unconventional oil and natural gas drilling. One study will investigate the relationship between unconventional drilling and the development of childhood cancers in southwestern Pennsylvania, the most heavily drilled area of the state. The other study will aim to replicate earlier studies centered on northcentral/northeastern Pennsylvania evaluating the acute conditions of asthma and birth outcomes. The new studies will use data from southwestern Pennsylvania. (PA DOH, n.d.b).

Table 4.3.25-2 Most Likely Lifelines Impacted by Unconventional Oil and Gas Wells		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating a causal relationship for the Safety and Security lifeline as community safety may be endangered and fire departments may be called into response and recovery if leaks or other issues result in explosions and fires.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery. Impacts from unconventional wells include environmental contamination, which can impact agricultural operations and water supplies. Mitigation actions for this lifeline should be focused on developing and enforcing regulations for well drilling, operation, and waste storage to ensure proper procedures are in place.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline as potential environmental contamination can have adverse health impacts on communities, leading to more strain on the local healthcare system.
Energy		Anticipating a cascading relationship for the Energy lifeline as unconventional wells play an important role in energy production. Issues with drilling operations may lead to additional challenges with energy production. Mitigation actions may focus on diversifying potential energy sources to reduce impacts if operations are shut down.

4.3.25.3. Past Occurrence

There is no comprehensive database of unconventional oil and gas well incidents in Pennsylvania. However, major gas and oil well incidents in Pennsylvania are captured in PEMA's incident management system, PEMA-KC. An incident management system provides a centralized communication platform for state and local agencies engaged in incident response, allowing for more effective cross-agency and cross-jurisdictional collaboration. Incidents entered into the system typically involve responses from multiple organizations within a single jurisdiction; responses from organizations outside the jurisdiction in which the incident occurred; and/or significant public health, environmental, or economic effects with regional or national implications. For this plan update, PEMA-KC data for all gas and oil well incidents were available from 2018 to April 2023; PEMA-KC does not differentiate between conventional and

unconventional wells, and 300 gas and oil well incidents were recorded in 16 counties. Many of these incidents occurred in the western part of the state (Table 4.3.25-3).

Table 4.3.25-3 Number of Gas and Oil Well Incidents per County by Year between 2018 to April 2023 (PEMA-KC, 2023)

COUNTY	2018	2019	2020	2021	2022	2023	TOTAL
Adams	0	0	0	0	0	0	**0**
Allegheny	0	0	0	0	0	0	**0**
Armstrong	0	0	0	0	0	0	**0**
Beaver	0	0	0	0	0	0	**0**
Bedford	0	0	0	0	0	0	**0**
Berks	1	0	8	0	1	0	**10**
Blair	0	0	0	0	0	0	**0**
Bradford	0	0	0	0	0	1	**1**
Bucks	0	1	5	0	0	0	**6**
Butler	0	0	0	2	0	0	**2**
Cambria	0	0	0	0	0	0	**0**
Cameron	0	0	0	0	0	0	**0**
Carbon	0	0	0	0	0	0	**0**
Centre	0	0	0	0	0	0	**0**
Chester	0	0	1	0	0	0	**1**
Clarion	0	0	0	0	0	0	**0**
Clearfield	0	0	0	0	0	0	**0**
Clinton	0	0	0	0	1	0	**1**
Columbia	0	0	0	0	0	0	**0**
Crawford	0	0	0	0	0	0	**0**
Cumberland	0	0	0	0	0	0	**0**
Dauphin	0	0	0	0	0	0	**0**
Delaware	0	0	0	0	1	0	**1**
Elk	0	0	0	0	0	0	**0**
Erie	1	1	0	0	0	0	**2**
Fayette	0	0	0	0	0	0	**0**
Forest	0	0	0	0	0	0	**0**
Franklin	0	0	0	0	0	0	**0**
Fulton	0	0	0	0	0	0	**0**
Greene	3	0	1	8	27	2	**41**
Huntingdon	0	0	0	0	0	0	**0**
Indiana	0	0	0	0	0	0	**0**
Jefferson	0	0	0	0	0	0	**0**
Juniata	0	0	0	0	0	0	**0**
Lackawanna	0	0	0	0	0	0	**0**
Lancaster	0	0	0	0	0	0	**0**
Lawrence	0	0	0	0	0	0	**0**

Table 4.3.25-3 Number of Gas and Oil Well Incidents per County by Year between 2018 to April 2023 (PEMA-KC, 2023)							
COUNTY	2018	2019	2020	2021	2022	2023	TOTAL
Lebanon	0	0	0	0	0	0	**0**
Lehigh	0	0	0	0	0	0	**0**
Luzerne	0	0	0	0	0	0	**0**
Lycoming	0	0	0	0	0	0	**0**
McKean	0	0	0	0	0	0	**0**
Mercer	0	0	0	0	0	0	**0**
Mifflin	0	0	0	0	0	0	**0**
Monroe	0	0	0	0	0	0	**0**
Montgomery	0	0	3	0	0	0	**3**
Montour	0	0	0	0	0	0	**0**
Northampton	0	0	0	0	0	0	**0**
Northumberland	0	0	0	0	0	0	**0**
Perry	0	0	0	0	0	0	**0**
Philadelphia	0	0	0	0	0	0	**0**
Pike	0	0	0	0	0	0	**0**
Potter	1	1	1	0	0	1	**4**
Schuylkill	0	0	0	0	0	0	**0**
Somerset	0	0	0	0	0	0	**0**
Snyder	0	0	0	0	0	0	**0**
Sullivan	0	0	0	0	0	0	**0**
Susquehanna	2	0	0	0	0	0	**2**
Tioga	0	0	0	0	0	0	**0**
Union	0	0	0	0	0	0	**0**
Venango	0	0	0	0	0	0	**0**
Warren	0	0	0	0	1	0	**1**
Washington	22	43	66	40	33	18	**222**
Wayne	0	0	0	0	0	0	**0**
Westmoreland	1	0	0	0	0	1	**2**
Wyoming	0	0	0	0	0	0	**0**
York	0	0	1	0	0	0	**1**
Total	**31**	**46**	**86**	**50**	**64**	**23**	**300**

4.3.25.4. Future Occurrence

As is the case with conventional wells, it remains difficult to predict the number or frequency of unconventional well site incidents. Based on the short history of past occurrence, Pennsylvania should expect multiple incidences to occur annually. However, the number of unconventional wells in Pennsylvania has stabilized in recent years, as opposed to the explosive growth of this industry seen in 2009-2010. If the number of oil and gas wells remains steady moving forward, the probability of occurrence is likely to stabilize, though it remains high. Continued research

and technological development on ways to treat and dispose of wastewater could lead to lower risk levels from contamination. In addition to this, better regulations can help reduce risks. In June of 2020, Pennsylvania's 43rd Grand Jury found that government agencies failed to uphold their responsibility to protect Pennsylvanians from the risks of the unconventional industry. They also provided recommendations for the future that included expanding no-drill zones, requiring public disclosure of chemicals used, better assessment of air pollution impacts, better transport practices, and responses to health impacts of workers and locals (Office of Attorney General Josh Shapiro, 2020). DEP is currently drafting new regulations for the industry.

4.3.25.5. State Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to unconventional wells, all structures located within 1000 yards of active, inactive, or unplugged wells in were identified. The area impacted by an incident will depend on the well, the nature of the incident, and atmospheric conditions. For this assessment, however, 1000 yards was selected as a representative distance within which death, injury, or significant property damage could occur. In addition, the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 68, or 2 percent, are located within 1000 yards of an unconventional well with active, inactive, or unplugged status. These facilities have a combined replacement value of more than $100 million, or approximately 3 percent of the known value of geolocated state facilities. Nearly all of the vulnerable facilities are owned by the state, with 63 of the 68. A total of 1.1 million square feet of building space are reported from the 68 vulnerable facilities.

Table 4.3.25-4 Vulnerability of State Facilities to Unconventional Wells

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	1	11%	0	9,061
Department of Banking and Securities		0%		
State Civil Service Commission		0%		
Department of Community and Economic Development		0%		
Department of Agriculture		0%		
Department of Conservation and Natural	38	5%	38	1,056,178
Department of Corrections		0%		
Department of Education		0%		
Department of Environmental Protections		0%		
Department of General Services		0%		
Department of Health		0%		
Department of Labor and Industry		0%		
Department of Military and Veterans		0%		
Department of Public Welfare		0%		
Department of Revenue	28	2%	24	31,208
Department of Transportation		0%		
Drug and Alcohol Programs	1	13%	1	4,250
Executive Offices		0%		
Fish and Boat Commission		0%		
Governor's Office		0%		
Insurance Department		0%		
Liquor Control Board		0%		
Emergency Management Agency		0%		
Historical and Museum Commission		0%		
State Police		0%		
Public School Employees' Retirement		0%		
State Department		0%		
State Employees' Retirement System		0%		
Thaddeus Stevens College of Technology		0%		
Treasury		0%		
State System of Higher Education		0%		
Total	**68**	**2%**	**63**	**1,100,697**

There are 229 vulnerable critical facility structures in a high-risk area (Table 4.3.21-6). Of the Commonwealth's total number of structures, 2 percent of the buildings are vulnerable to risks associating with unconventional wells, resulting in $16.7 billion in replacement value.

Table 4.3.25-5 Vulnerability of Critical Facilities to Unconventional Wells		
TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF TOTAL STRUCTURES BY TYPE
Agricultural	5	2%
Banking		0%
Commercial		0%
Communication	7	1%
Dam	92	6%
Education (colleges and universities)	3	1%
Education (public schools)	31	1%
Emergency Operation Center	1	1%
Energy	18	5%
Fire Station	39	1%
Government		0%
Hospital	2	1%
National Monuments or Icons		0%
Nuclear		0%
Police Station	13	1%
Transportation	4	1%
Water	14	2%
Total	**229**	**2%**

4.3.25.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to unconventional wells risk, all census blocks with centroid within 1000 yards of active or abandoned unconventional wells were identified. The population, building counts, and building value of all vulnerable census blocks were then aggregated to the county scale. The counties with the highest vulnerable population are Bradford, Butler, Susquehanna, and Washington. Majority of the vulnerable areas are the in the northeast and southwest of the commonwealth. Overall, approximately 77,000 buildings, with a replacement estimation total of nearly $34 billion are considered in high hazard areas in regards to unconventional oil and gas wells.

Table 4.3.25-6 Vulnerability of People and Buildings to Unconventional Wells				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Adams				0%
Allegheny	7,143	3,289	$1,682,823	1%
Armstrong	2,295	1,256	$508,971	4%
Beaver	6,302	2,818	$1,224,036	4%
Bedford				0%
Berks				0%
Blair	226	101	$39,619	0%

Table 4.3.25-6 Vulnerability of People and Buildings to Unconventional Wells

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Bradford	14,688	8,918	$3,464,638	24%
Bucks				0%
Butler	20,629	9,397	$4,730,310	10%
Cambria				0%
Cameron	17	29	$5,352	0%
Carbon				0%
Centre	6	15	$4,886	0%
Chester				0%
Clarion	347	222	$62,635	1%
Clearfield	292	155	$50,299	0%
Clinton	37	79	$21,087	0%
Columbia				0%
Crawford	204	135	$57,804	0%
Cumberland				0%
Dauphin				0%
Delaware				0%
Elk	189	128	$48,878	1%
Erie				0%
Fayette	7,121	4,164	$1,177,635	5%
Forest	10	47	$11,376	1%
Franklin				0%
Fulton				0%
Greene	10,776	4,841	$2,851,705	30%
Huntingdon	32	18	$7,511	0%
Indiana	826	512	$241,718	1%
Jefferson	460	300	$48,721	1%
Juniata				0%
Lackawanna				0%
Lancaster				0%
Lawrence	1,460	666	$262,320	2%
Lebanon				0%
Lehigh				0%
Luzerne				0%
Lycoming	4,671	2,849	$1,092,063	5%
McKean	31	49	$13,095	0%
Mercer	1,022	525	$269,426	1%
Mifflin				0%

Table 4.3.25-6 Vulnerability of People and Buildings to Unconventional Wells				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Monroe				0%
Montgomery				0%
Montour				0%
Northampton				0%
Northumberland				0%
Perry				0%
Philadelphia				0%
Pike				0%
Potter	125	111	$17,453	1%
Schuylkill				0%
Somerset				0%
Snyder	237	243	$121,284	1%
Sullivan	1,218	1,334	$386,469	19%
Susquehanna	11,882	9,416	$4,879,086	35%
Tioga	5,001	3,036	$898,842	10%
Union				0%
Venango	137	71	$30,103	0%
Warren	46	19	$3,955	0%
Washington	26,944	14,590	$5,686,085	12%
Wayne				0%
Westmoreland	11,146	5,989	$3,070,766	4%
Wyoming	3,334	1,580	$728,168	13%
York				0%
Total	**138,854**	**76,902**	**$33,699,119**	**1%**

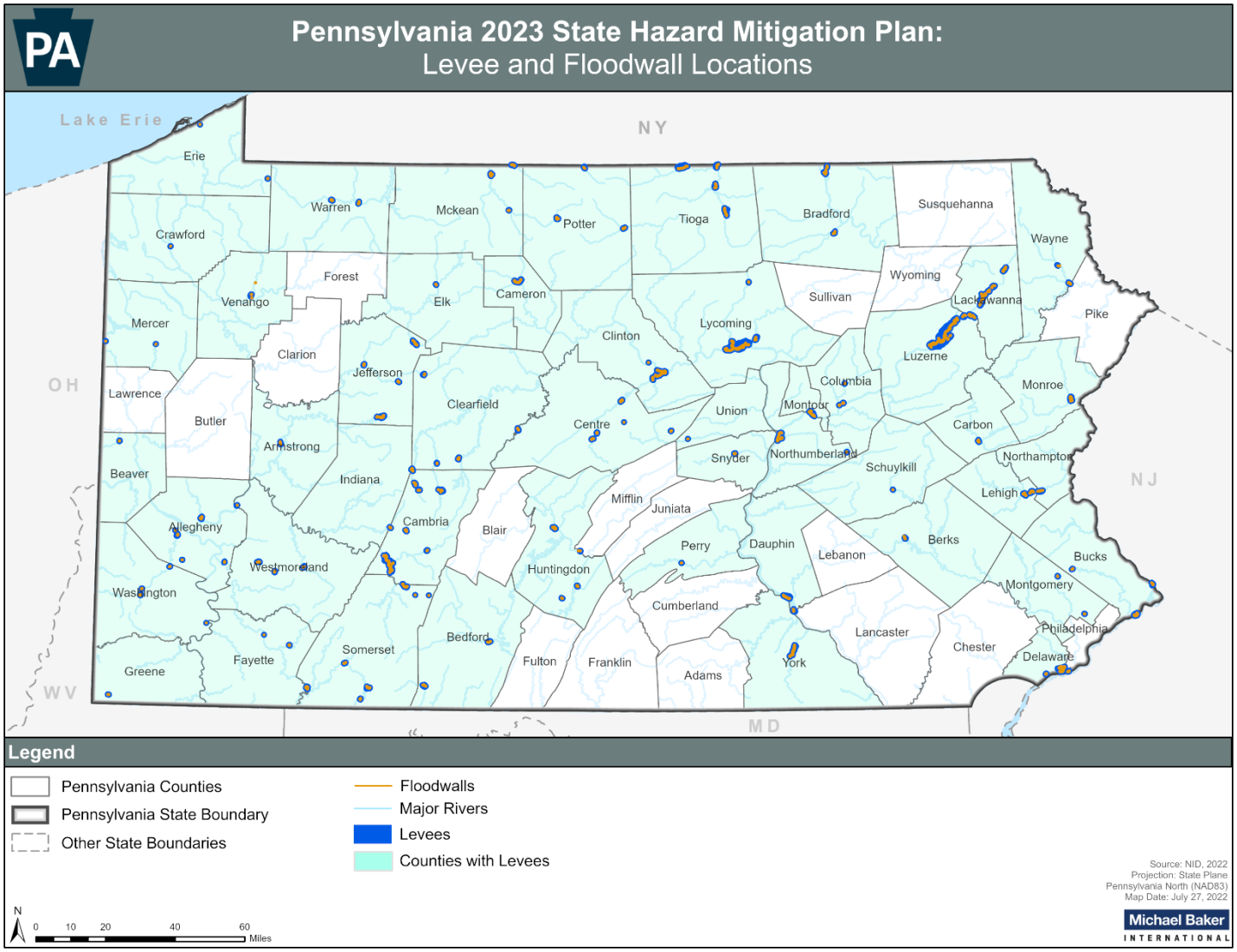
4.3.26. Levee Failure

4.3.26.1. Location and Extent

In 2016, FEMA and USACE completed an effort to integrate two separate levee databases into one comprehensive inventory of levees in the United States, known as the National Levee Database (NLD). This database is updated on an ongoing basis with information provided by other Federal agencies, State agencies, and communities. It contains information for levees within the USACE Levee Safety Program and non-USACE Program levees (FEMA, 2020a).

The National Levee Database (NLD) is maintained and operated through the USACE. The database provides information to link activities or evaluations related to the NFIP, and is a source for levee information for the nation's levees. It is a publicly available and regularly being updated. However, not all levees within a state or county may not be accounted for within the NLD. FEMA's Map Service Center also provides levee information within NFHL data. The NFHL data for Pennsylvania includes 350 levee and floodwall segments, with at least one levee or floodwall within 47 of 67 counties. Many of these segments may be a part of a larger levee system. According to the NLD, there are 206 levee systems in Pennsylvania. Figure 4.3.26-1 shows the locations of the levees and floodwalls as identified through FEMA's MSC. Note that levees generally protect small areas that may not be able to be seen on the map. As shown in the map, the distribution of these systems is relatively scattered throughout the Commonwealth with many having been constructed in more populated areas to protect property and structures from flood events. Particularly extensive levee systems have been built in the Scranton Wilkes-Barre area in Luzerne and Lackawanna Counties; Lycoming County also has a significant amount of levee systems.

Figure 4.3.26-1 Levee and Floodwall Locations in Pennsylvania (NLD 2022).



In the event of a levee failure, flood waters will ultimately inundate the protected area landward of the levee. The extent of inundation is dependent on the flooding intensity. Failure of a levee during a 1%-annual-chance flood will inundate the approximate 100-year flood plain previously protected by the levee. Residential and commercial buildings located nearest the levee overtopping or breach location will suffer the most damage from the initial embankment failure flood wave. Landward buildings will be damaged by inundation.

Levees require maintenance to continue to provide the level of protection for which they were designed and built. Maintenance and operational responsibilities, referred to as sponsorship, belong to a variety of entities including local, state, and federal government and private land owners. Table 4.3.30-1 shows the entity responsible for constructing, operating, and maintaining levee systems as reported by the number of levee miles per county. This information was obtained from the National Levee Database (NLD) maintained by the USACE.

Table 4.3.26-1 Sponsorship of Levee Systems by County (USACE NLD, 2022)

COUNTY	LOCALLY CONSTRUCTED, LOCALLY OPERATED & MAINTAINED (MILES)	USACE CONSTRUCTED & USACE OPERATED (MILES)	USACE CONSTRUCTED, TURNED OVER TO PUBLIC SPONSOR OPERATIONS & MAINTENANCE (MILES)	TOTAL (MILES)
Adams	0.00	0.00	0.00	0.00
Allegheny	0.45	0.00	1.19	1.63
Armstrong	0.00	0.00	0.07	0.07
Beaver	0.35	0.00	0.00	0.35
Bedford	1.82	0.00	0.00	1.82
Berks	0.00	0.00	0.00	0.00
Blair	0.00	0.00	0.00	0.00
Bradford	2.78	0.00	0.00	2.78
Bucks	3.02	0.00	0.00	3.02
Butler	0.00	0.00	0.00	0.00
Cambria*	5.41	0.58	0.34	6.33
Cameron	2.28	0.00	0.00	2.28
Carbon	0.91	0.00	0.00	0.91
Centre*	1.94	1.25	0.00	3.20
Chester	0.00	0.00	0.00	0.00
Clarion	0.00	0.00	0.00	0.00
Clearfield*	2.52	0.00	0.46	2.98
Clinton	0.60	0.00	6.87	7.47
Columbia	1.67	0.00	1.55	3.22
Crawford	0.00	0.00	0.00	0.00
Cumberland	0.00	0.00	0.00	0.00
Dauphin	3.37	0.00	0.00	3.37

Table 4.3.26-1 Sponsorship of Levee Systems by County (USACE NLD, 2022)				
COUNTY	LOCALLY CONSTRUCTED, LOCALLY OPERATED & MAINTAINED (MILES)	USACE CONSTRUCTED & USACE OPERATED (MILES)	USACE CONSTRUCTED, TURNED OVER TO PUBLIC SPONSOR OPERATIONS & MAINTENANCE (MILES)	TOTAL (MILES)
Delaware	7.31	0.00	0.51	7.82
Elk	0.00	0.00	0.35	0.35
Erie	0.47	0.00	0.00	0.47
Fayette	0.57	0.00	0.00	0.57
Forest	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00
Fulton	0.00	0.00	0.00	0.00
Greene	0.45	0.00	0.00	0.45
Huntingdon	2.76	0.00	0.00	2.76
Indiana*	1.67	0.00	0.00	1.67
Jefferson	4.45	0.00	2.31	6.77
Juniata	0.00	0.00	0.00	0.00
Lackawanna	4.52	0.00	5.17	9.69
Lancaster	0.00	0.00	0.00	0.00
Lawrence	0.00	0.00	0.00	0.00
Lebanon	0.00	0.00	0.00	0.00
Lehigh	2.77	0.00	0.80	3.58
Luzerne	1.64	0.00	13.40	15.05
Lycoming	1.56	0.00	12.71	14.27
McKean	3.14	0.00	0.00	3.14
Mercer	0.25	0.00	0.00	0.25
Mifflin	0.00	0.00	0.00	0.00
Monroe	2.96	0.00	0.00	2.96
Montgomery	0.42	0.00	0.00	0.42
Montour	3.40	0.00	0.00	3.40
Northampton	0.00	0.00	1.34	1.34
Northumberland	0.17	0.00	2.62	2.79
Perry	0.18	0.00	0.00	0.18
Philadelphia*	2.16	0.00	0.00	2.16
Pike	0.00	0.00	0.00	0.00
Potter	2.13	0.00	0.00	2.13
Schuylkill	0.10	0.00	0.00	0.10
Snyder	0.64	0.00	0.00	0.64
Somerset	5.34	0.13	0.00	5.46

Table 4.3.26-1 Sponsorship of Levee Systems by County (USACE NLD, 2022)				
COUNTY	LOCALLY CONSTRUCTED, LOCALLY OPERATED & MAINTAINED (MILES)	USACE CONSTRUCTED & USACE OPERATED (MILES)	USACE CONSTRUCTED, TURNED OVER TO PUBLIC SPONSOR OPERATIONS & MAINTENANCE (MILES)	TOTAL (MILES)
Sullivan	0.00	0.00	0.00	0.00
Susquehanna	0.00	0.00	0.00	0.00
Steuben	2.85	0.00	0.00	2.85
Tioga*	5.35	1.63	2.91	9.89
Union	0.14	0.00	0.00	0.14
Venango	0.00	0.00	0.17	0.17
Warren	1.86	0.00	0.00	1.86
Washington	1.09	0.00	0.05	1.13
Wayne	1.56	0.00	0.00	1.56
Westmoreland	1.75	0.00	0.00	1.75
Wyoming	0.00	0.00	0.00	0.00
York	0.00	5.59	0.00	5.59
TOTAL	**90.80**	**9.18**	**52.83**	**152.81**
*Includes some levee systems that span 2 or more counties.				

Well-maintained levees may obtain accreditation through independent inspections. Levee owners need to both maintain levees and pay for an independent inspection and analysis to have the levee certified as providing flood protection in accordance with CFR 65.10. The impacts of a non-accredited levee include levee failure and insurance rate increases as FEMA identifies that these structures are not designed to protect to the 1%-annual-chance flood height on Flood Insurance Rate Maps. Table 4.3.26-2 shows the number of levees by accreditation type across Pennsylvania. A99 means that construction is ongoing, but it has already reached specific requirements (FEMA, 2022k).

Table 4.3.26-2 Accreditation Status (USACE NLD, 2022)	
ACCREDITATION TYPE	NUMBER OF LEVEES
A99	3
Accredited Levee System	14
Provisionally Accredited Levee (PAL) System	32
Non-Accredited Levee System	147

4.3.26.2. Range of Magnitude

Flood-related hazards due to levee failures range in magnitude including: overtopping, when the water-level rises over the top of the levee; back-ending, when water flows around the back of

the levee, outside of the edge of the levee system; and total failure as seen during Hurricane Katrina. Levee failure can be structural in nature due to improper maintenance, inadequate foundations, seismic activity, erosion, seepage, or burrowing animals (FEMA, 2020b). Levees are typically designed with three feet of freeboard to prevent overtopping, but older levees were not built to that standard (FEMA, 2016a).

A levee failure causes flooding in landward areas adjacent to the levee system. The failure of a levee or other flood protection structure could be devastating depending on the level of flooding against which the structure is designed to protect and the amount of landward development present. In some instances, the magnitude of flooding could be more severe under a levee failure event compared to a normal flooding event (FEMA, 2020b). If an abrupt failure occurs, the rushing waters of a flood wave could result in catastrophic losses.

The National Flood Insurance Program (NFIP) requires new or substantially improved residential and commercial structures, even those landward of both accredited and non-accredited levees, to be built either at or above the 100-year flood elevation if they are in Special Flood Hazard Areas (SFHAs) (FEMA, 2021d). For existing structures, FEMA states that structures landward of certified levees are not required to have flood insurance if they have a federally backed mortgage, but those landward of non-accredited or un-accredited levees do require it (FEMA, 2007). Certification does not mean the levees aren't at risk to fail or be inadequate however, and since levee failures can create even more significant impacts than flooding, any uninsured homes in this situation could be severely impacted with no insurance.

The environmental impacts of a levee failure result in significant water quality and debris disposal issues. Flood waters will back-up sanitary sewer systems and inundate wastewater treatment plants, causing raw sewage to contaminate residential and commercial buildings and the flooding waterway. The contents of unsecured containers of oil, fertilizers, pesticides and other chemicals get added to flood waters. Water supplies and waste water treatment could be off-line for weeks. After the flood waters subside, contaminated and flood-damaged building materials and contents must be properly disposed. Contaminated sediment must be removed from buildings, yards and properties.

The worst-case levee failure is one which occurs abruptly with little warning and results in deep, fast-moving flood waters through a highly-developed or highly-populated area. While any levee may be overtopped and fail, it is the levees with large and densely-populated protected areas that have the potential to cause the most damage. In 2011, during Tropical Storm Lee, the levee system in Wilkes-Barre effectively protected the City; if its levee and floodwall system had failed, the flood impact would have been much more severe.

Table 4.3.26-3 Most Likely Lifelines Impacted by Levee Failure		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal, compounding, and cascading impacts where community safety is threatened and government operations and facilities, including police, fire, and search and rescue are involved with response and recovery. Actions to protect communities are focused on proper local planning that manages development near levee systems and educating people on the potential risks.
Food, Water, Shelter		Anticipating a causal, compounding, and cascading relationship for the Food, Water, Shelter lifeline in response and recovery. Levee failure events present significant risk to buildings, and the potential compounding and cascading impacts from additional hazards and damage to infrastructure may create issues for food and water access. Ways to mitigate damage to this lifeline are similar to those above and include insurance programs for homes.
Hazardous Materials		Anticipating a causal, compounding, and cascading relationship for the Hazardous Materials lifeline in response and recovery due to potential contamination because of flood damage to facilities. Mitigation for this should be focused on increasing the resiliency of sites through specific building codes and development regulations that either provide protection or result in hazardous sites being located outside hazard areas.

4.3.26.3. Past Occurrence

There is no comprehensive list of levee failures in Pennsylvania, and historically few, if any, have been reported. However, in 2011, Tropical Storm Lee exceeded the design storm level for many levees in Pennsylvania. Tropical Storm Lee placed extreme stress on Pennsylvania's levees since the event was relatively long in duration and the ground was already saturated from Hurricane Irene the week prior. In Sayre, the levee system was overtopped and the levee was back-ended. The pump station at Sayre also flooded during this event, compounding the effects of the overtopping. While there is not a comprehensive list, there are news reports of a small agricultural levee failure in Columbia County and some levee-related flood damage from the Chemung Levee in Athens, Bradford County (Colombia County, 2017; U.S. Army Corps of Engineers, 2018). In the case of Athens, the Susquehanna rose much faster than expected, and the extreme pressure exerted by the swollen river caused damage to a 125-foot portion of the levee, damaging 300 homes (U.S. Army Corps of Engineers, 2018). While Pennsylvania was

affected by extreme rainfall and flooding from Tropical Storm Ida, there was no widespread impact on levee systems compared to Tropical Storm Lee. A levee was under construction in Bedford County during the storm, and emergency backfill was placed to slow erosion in an area that had been excavated. More recent accounts of levee failure in Pennsylvania have not been widely reported.

4.3.26.4. Future Occurrence

Similar to dam failures, given certain circumstances, a levee failure can occur at any time. However, the probability of future occurrence can be reduced through proper design, construction, and maintenance measures. The age of the levee can increase the potential for failures if it is not maintained. In Pennsylvania, the average age of the levees is 58 years old; the typical life-span of a levee is 50 years (ASCE, 2022). Table 4.3.26-3 shows the enrollment status of 202 non-federally operated levee systems in USACE Rehabilitation Program, which provides funding for repairs. The 2022 American Society of Civil Engineer's Report Card on Pennsylvania Infrastructure graded the Commonwealth's levees as a C, with recommendations of increased funding and data collection, providing state-level support for locally owned levees, discouraging development in floodplains, encouraging both new development and repairs to increase design standards above current 100-year flood level, and more (ASCE, 2022).

Table 4.3.26-4 Status of Levees in USACE Rehabilitation Program (ASCE, 2022)

LEVEE STATUS	NUMBER OF LEVEES
Active in Program	75
Inactive in Program	32
Not Enrolled	95

Most levees are designed to operate safely at a specified level of flooding. While FEMA focuses on mapping levees that will reduce the risk of a 1%-annual-chance flood, other levees may be designed to protect against smaller or larger floods. Design specifications provide information on the percent-annual-chance flood a structure is expected to withstand, provided that structure has been adequately constructed and maintained. Projects to build new and maintain old levees have been consistently undertaken in the years since the last plan.

Levee failure is also influenced by the frequency and severity of flood events. Therefore, potential future changes in climate and weather conditions, such as predicted increases in heavy precipitation events, may impact the future occurrences of levee failure. For more information on the future occurrence of flood events, please see Section 4.3.5.1.

4.3.26.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to levee failure, all facilities located in areas characterized as high risk were identified. High-risk areas include the levee protected area and areas within 2,000 feet of a levee. Not all levees have protected areas identified. Therefore, the 2,000-foot buffer around each levee is intended to fill the potential gap in the analysis. While this will provide an overestimation of the risk to a levee failure, the 2,000-foot measurement was selected based on a review of the existing levee protected areas, which found that 2,000 feet was the approximate, typical size of the identified

levee protected areas. The high-risk areas were then intersected with state-owned or leased facilities and critical facilities.

As shown in Table 4.3.27-4, 197 state-owned or leased facilities were identified in areas at high risk to levee failure, the highest concentration of which are facilities owned or leased by the Department of Corrections. The State System of Higher Education also has a relatively larger number of structures identified as vulnerable. However, these vulnerable facilities represent a relatively small percentage, 4%, of the total facilities for these departments. The replacement value of the 197 total vulnerable facilities is estimated to be more than $108 million, or three percent of the value of all state-owned or leased facilities. Less than half of these facilities are owned by the state, with 91 out of the 197 reported as owned from the DGS inventory. The total reported building space in these high-risk areas is 1.25 million square feet.

Table 4.3.26-5 Vulnerability of State Facilities to Levee Failure.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF DEPARTMENT STRUCTURES	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	1	11%	0	6,070
Department of Agriculture	1	6%	0	4,105
Department of Banking and Securities		0%		
Department of Community and Economic Development		0%		
Department of Conservation and Natural Resources		0%		
Department of Corrections	84	12%	81	829,452
Department of Education		0%		
Department of Environmental Protection	3	23%	0	59,270
Department of General Services		0%		
Department of Health	5	10%	0	13,960
Department of Labor and Industry	8	12%	0	59,782
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	9	9%	0	164,242
Department of Revenue		0%		
Department of Transportation	15	1%	10	11,418
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission		0%		
Governor's Office		0%		
Historical and Museum Commission	1	3%	0	0
Insurance Department		0%		
Liquor Control Board	30	5%	0	100,128

Table 4.3.26-5 Vulnerability of State Facilities to Levee Failure.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF DEPARTMENT STRUCTURES	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Public School Employees' Retirement System	1	17%	0	2,272
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System		0%		
State Police		0%		
State System of Higher Education	39	5%		
Thaddeus Stevens College of Technology		0%		
Treasury Department		0%		
Total	**197**	**4%**	**91**	**1,250,699**

With respect to critical facilities, the types of facilities most vulnerable to levee failure include fire departments, public schools, police departments, and water facilities (Table 4.3.26-5). All critical facilities identified as vulnerable represent a small percentage of the total structures for each facility type, with 3% overall represented in Pennsylvania.

Table 4.3.26-6 Vulnerability of Critical Facilities to Levee Failure.

TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF STRUCTURES BY TYPE
Agricultural	12	4%
Banking		0%
Commercial		0%
Communication	8	1%
Dam	10	1%
Education (colleges and universities)	13	3%
Education (public schools)	105	2%
Emergency Operation Center	2	3%
Energy	4	1%
Fire Station	102	4%
Government	1	4%
Hospitals	11	4%
National Monuments or Icon		0%
Nuclear		0%
Police Stations	68	5%
Transportation	24	4%

Table 4.3.26-6 Vulnerability of Critical Facilities to Levee Failure.		
TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF STRUCTURES BY TYPE
Water	23	4%
TOTAL	**383**	**3%**

A total of 383 critical facilities were identified in areas at high risk to levee failure. The total replacement cost of these critical facilities is estimated to be approximately $7.8 billion, or two percent of the total value of all critical facilities in the Commonwealth.

4.3.26.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To determine jurisdictional vulnerability to levee failure, GIS analysis was conducted to identify all census blocks with centers located in areas characterized as high risk to levee failure. As previously defined, high-risk areas include levee protected areas and areas within 2,000 feet of a levee. The total population and buildings within these census blocks were summed by county to determine the total vulnerable population and the total number and value of vulnerable buildings. Table 4.3.27-6 shows the results of this assessment.

Table 4.3.26-7 Vulnerability of People and Buildings to Levee Failure.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Adams				0.0%
Allegheny	10,323	4,250	$1,639,084	0.6%
Armstrong	1,695	664	$264,727	2.1%
Beaver	92	59	$11,133	0.0%
Bedford	2,771	1,346	$577,733	4.8%
Berks	867	363	$155,193	0.2%
Blair				0.0%
Bradford	3,094	1,249	$658,174	4.6%
Bucks	6,422	2,578	$1,446,747	0.9%
Butler				0.0%
Cambria	25,706	13,255	$6,674,797	20.1%
Cameron	1,843	864	$497,156	39.4%
Carbon	2,172	839	$356,756	3.1%
Centre	2,151	894	$434,323	1.4%
Chester				0.0%
Clarion				0.0%
Clearfield	2,345	1,160	$884,546	5.3%
Clinton	2,494	1,080	$471,330	7.5%
Columbia	1,936	918	$587,184	4.6%

Table 4.3.26-7 Vulnerability of People and Buildings to Levee Failure.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Crawford	711	396	$321,978	1.3%
Cumberland				0.0%
Dauphin	88	106	$301,179	0.5%
Delaware	8,878	3,730	$2,015,762	1.7%
Elk	867	466	$150,610	1.8%
Erie	2,857	1,173	$505,310	1.0%
Fayette	966	430	$203,889	0.8%
Forest				0.0%
Franklin				0.0%
Fulton				0.0%
Greene	77	49	$22,085	0.2%
Huntingdon	5,344	1,653	$887,952	11.2%
Indiana	249	162	$73,648	0.4%
Jefferson	8,769	4,367	$1,579,179	19.5%
Juniata				0.0%
Lackawanna	26,490	10,190	$5,190,307	11.5%
Lancaster	49	30	$9,709	0.0%
Lawrence				0.0%
Lebanon				0.0%
Lehigh	15,228	3,637	$2,120,466	2.8%
Luzerne	25,523	9,459	$3,801,616	6.7%
Lycoming	5,269	2,238	$911,668	4.2%
Mckean	1,059	498	$234,047	2.7%
Mercer	2,895	1,272	$697,107	2.5%
Mifflin	109	81	$20,484	0.2%
Monroe	4,645	1,679	$1,328,900	3.6%
Montgomery	4,602	1,743	$968,316	0.5%
Montour	3,146	1,352	$713,071	21.5%
Northampton	11,433	3,080	$2,560,680	4.4%
Northumberland	5,472	2,585	$1,438,521	6.9%
Perry	67	37	$7,646	0.1%
Philadelphia				0.0%
Pike				0.0%
Potter	1,875	928	$317,345	11.3%
Schuylkill	1,885	793	$358,310	1.2%
Snyder	679	346	$223,649	2.6%

Table 4.3.26-7 Vulnerability of People and Buildings to Levee Failure.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Somerset	6,928	3,532	$1,539,432	6.7%
Sullivan				0.0%
Susquehanna				0.0%
Tioga	4,354	1,560	$809,523	9.4%
Union				0.0%
Venango	440	252	$156,431	1.6%
Warren	1,327	700	$186,519	2.5%
Washington	2,926	1,601	$817,528	1.8%
Wayne	1,364	704	$423,930	3.6%
Westmoreland	11,252	5,463	$2,414,029	3.0%
Wyoming				0.0%
York	20,458	6,404	$4,407,516	5.2%
Total	**252,192**	**102,215**	**$52,377,224**	**1.9%**

In terms of vulnerable populations identified, Cambria, Luzerne, Lehigh, York, and Lackawanna Counties are at the greatest risk of levee failure. These are the counties in which extensive levee systems have been built. Similarly, these three counties are amongst the highest risk in terms of number and total value of vulnerable buildings. Cameron County has the highest percentage of building value at risk, with 39.4% found to be in high hazard areas.

In total, 252,192 people and 102,215 buildings throughout Pennsylvania were identified as vulnerable to levee failure. The value of the total buildings at high risk is estimated to be nearly $52.37 billion, or almost two percent of the total value of all buildings in the Commonwealth.

4.3.27. Mass Food and Animal Feed Contamination

4.3.27.1. Location and Extent

Mass food or animal feed contamination hazards occur when food or food sources are contaminated with pathogenic bacteria, viruses, or parasites, as well as chemical or natural toxins. They may lead to foodborne illnesses and/or interruptions in the food supply. Contamination may occur due to natural foodborne illnesses and chemical, biological, radiological, or nuclear exposure (c-BRNE). Most foodborne illnesses are caused by Campylobacter in poultry; E. Coli in beef, leafy greens, and raw milk; Listeria in deli meats, unpasteurized soft cheeses, and produce; Salmonella in eggs, poultry, meat, and produce; Vibrio in raw oysters; Norovirus in many foods; and Toxoplasma in meats (WHO, 2022b).

Food can get contaminated at any point in the production, processing, or distribution phases of the supply chain. Production examples are livestock infections, using contaminated water for irrigation, pesticides, and feed contamination. Processing contamination includes water contamination from washing or cleaning, cross-contamination from the slaughter and butchering process, and unclean work surfaces/factories. Contamination during the distribution phase could be from a lack of proper refrigeration and unclean transport vehicles (CDC, 2022k).

These events can happen at any time and in any place in Pennsylvania and are sometimes regional or even national events. At the same time, though, Pennsylvania is one of the nation's leading agricultural producers with 53,000 total farms, 5,000 dairy farms, 2,300 food-processing companies, large numbers of organic farms in operation and total organic farm sales, and large recent growth in corn and soybean production (PA Department of Agriculture, 2022b; Team Pennsylvania, 2018). Pennsylvania is constantly at risk for small-scale contaminations with such high levels of agricultural production, with mass contamination events being possible but less likely.

In addition, a major concern of mass food and animal feed contamination hazards is that, in general, places generally only have a three-day supply of food. The food supply chain is very vulnerable to interruption, whether the product comes from Pennsylvania or not, as was showcased during the early stages of the COVID-19 pandemic and how issues in other states and even other countries impacted Pennsylvania. While it wasn't caused by food or animal feed contamination, the impacts of significantly lowered capacity in production, processing, and distribution were evident in the availability and price of certain foodstuffs (OECD, 2020). An interruption in the food supply would be a major vulnerability for the health and survival of Pennsylvania communities.

4.3.27.2. Range of Magnitude

Like invasive species, mass food and animal feed contamination hazards can vastly vary based on the type of contamination, the method of contamination, and the origin of contamination.

Different pathogens and chemicals that can contaminate human food and animal feed have varying degrees of aggressiveness that can range from a sore stomach to serious illness, hospitalization, and even death. For example, the Centers for Disease Control and Prevention (CDC) reports approximately 1.35 million illnesses, 26,500 hospitalizations, and 420 deaths in the United States each year from *salmonella* alone (CDC, 2022l). In 2021, 38 people in Pennsylvania were infected with *salmonella* during a six-month span from handling live poultry (CDC, 2021b).

The major identified environmental impact of mass food and animal feed contamination is the disposal of significant numbers of animals if the contamination causes a mass die-off, as rotting carcasses could cause environmental degradation including water pollution if they are not properly taken care of. They might also have a role in spreading further disease. Additionally, there are primary impacts to public health and to the agricultural economy in Pennsylvania. Should there be a mass food or animal feed contamination event, even if the event is not focused in Pennsylvania, the potential losses from fear-based cancellation of food orders could be devastating. This would also cause a surplus of animals on Pennsylvania farms that agricultural producers cannot feed but also cannot sell.

A possible worst-case scenario would be if there was large-scale campylobacter or salmonella outbreak found in Pennsylvania's poultry farms. An event like this would cause human suffering and would also have a crippling effect on the state's poultry production and farm-based economy.

Table 4.3.27-1 Most Likely Lifelines Impacted by Mass Food and Animal Feed Contamination		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating a causal and cascading relationship for the Safety and Security lifeline as community safety may be at risk and the administration of government services may be impacted due to contaminations and potential widespread illnesses.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery, as mass food and animal feed contamination would have significant impacts on agricultural operations and the food supply chain. Mitigation actions for this lifeline should be focused on proper inspections and facility maintenance.
Health and Medical		Anticipating a causal and cascading relationship for the Health and Medical lifeline due to the direct impacts that contaminations can have on public health and also the strain on resources that may impact the administration of other services or create staffing issues. Mitigation actions may include developing response plans for facilities to install proper procedures in the event of contaminations that cause illness.

4.3.27.3. Past Occurrence

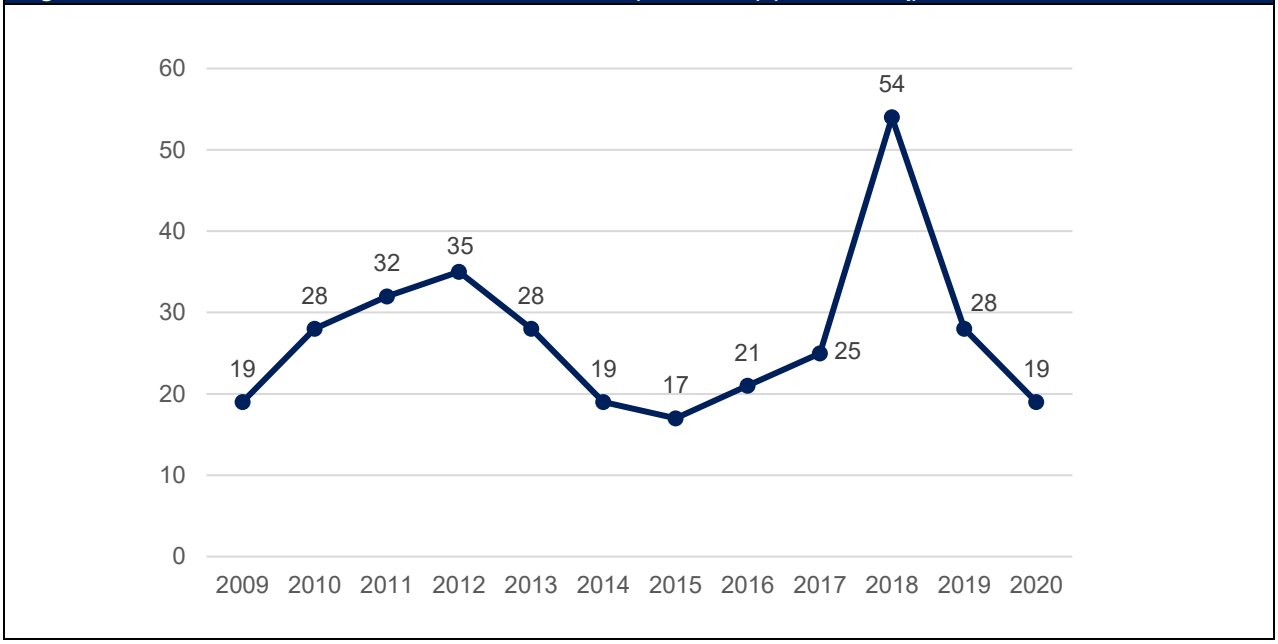
According to representatives from the Department of Agriculture, mass food and animal feed contamination events are difficult to capture as they occur because of the lapse in time between infection and manifestation of an illness. Usually, they are isolated events. However, in recent years, the CDC has tracked the following outbreak events in Pennsylvania (CDC, 2022m) (CDC, 2022n) (CDC, 2022o):

- *2022 – Ice Cream - Listeriosis*
- 2021 – Salami Sticks - *Salmonella*
- 2021 – Baby Spinach - *E. Coli*
- 2021 – Seafood - *Salmonella*
- 2021 – Onions - *Salmonella*
- 2021 – Prepackaged Salads - *Salmonella*
- 2021 – Ground Turkey - *Salmonella*
- *2021 – Fresh Express Packaged Salads – Listeriosis*
- *2021 – Dole Packaged Salads - Listeriosis*
- 2020 – Wood Ear Mushrooms - *Salmonella*

- 2020 – Leafy Greens - *E. Coli*
- 2020 – Peaches - *Salmonella*
- 2020 – Onions - *Salmonella*
- 2019 – Northfork Bison - *E. Coli*
- 2019 – Romaine Lettuce - *E.Coli*
- 2019 – Cut Fruit - Salmonella
- 2019 – Flour - *E. coli*
- *2019 – Hard-boiled Eggs - Listeriosis*
- *2019 – Deli-Sliced Meats and Cheeses - Listeriosis*
- 2019 – Papayas - Salmonella
- 2018 – Kellogg's Honey Smacks Cereal - Salmonella
- 2018 – Raw Turkey Products - Salmonella
- 2018 – Raw Chicken Products - *Salmonella*
- 2018 – Shell Eggs - *Salmonella*
- 2018 – Romaine Lettuce - *E. coli*
- 2018 – Frozen Shredded Coconut – *Salmonella*
- 2017 – Leafy Greens - *E. coli*
- 2017 – Maradol Papayas – Salmonella
- 2016 – Beef Products - *E. coli*
- 2016 – Flour - *E. coli*
- 2016 – Organic Shake and Meal Products – *Salmonella*
- 2016 – Packaged Salads - *Listeria monocytogenes*
- 2015 – Chipotle Mexican Grill Restaurants - *E. coli*
- 2015 – Cucumbers - *Salmonella*

This is not an exhaustive list of past occurrences but illustrates that Pennsylvanians have been sickened by contaminations in other states. An example of a dangerous contamination that occurred but was not captured is the February 2022 recall of baby formula from plants in the state of Michigan. This situation required action from hospitals to find and recommend alternatives (De Tore, 2022). Pennsylvania has not been the origin or cause of a mass food or animal feed contamination. Figure 4.3.31-1 shows the amount of foodborne outbreaks in Pennsylvania between 2009 and 2020. Starting in 2013, the CDC has been using whole genome sequencing (WGS) to better identify, investigate, and eradicate the sources of contamination and stop mass outbreaks (CDC, 2022p).

Figure 4.3.27-1 Foodborne Disease Outbreaks in PA (2009-2020) (CDC, 2022q)



4.3.27.4. Future Occurrence

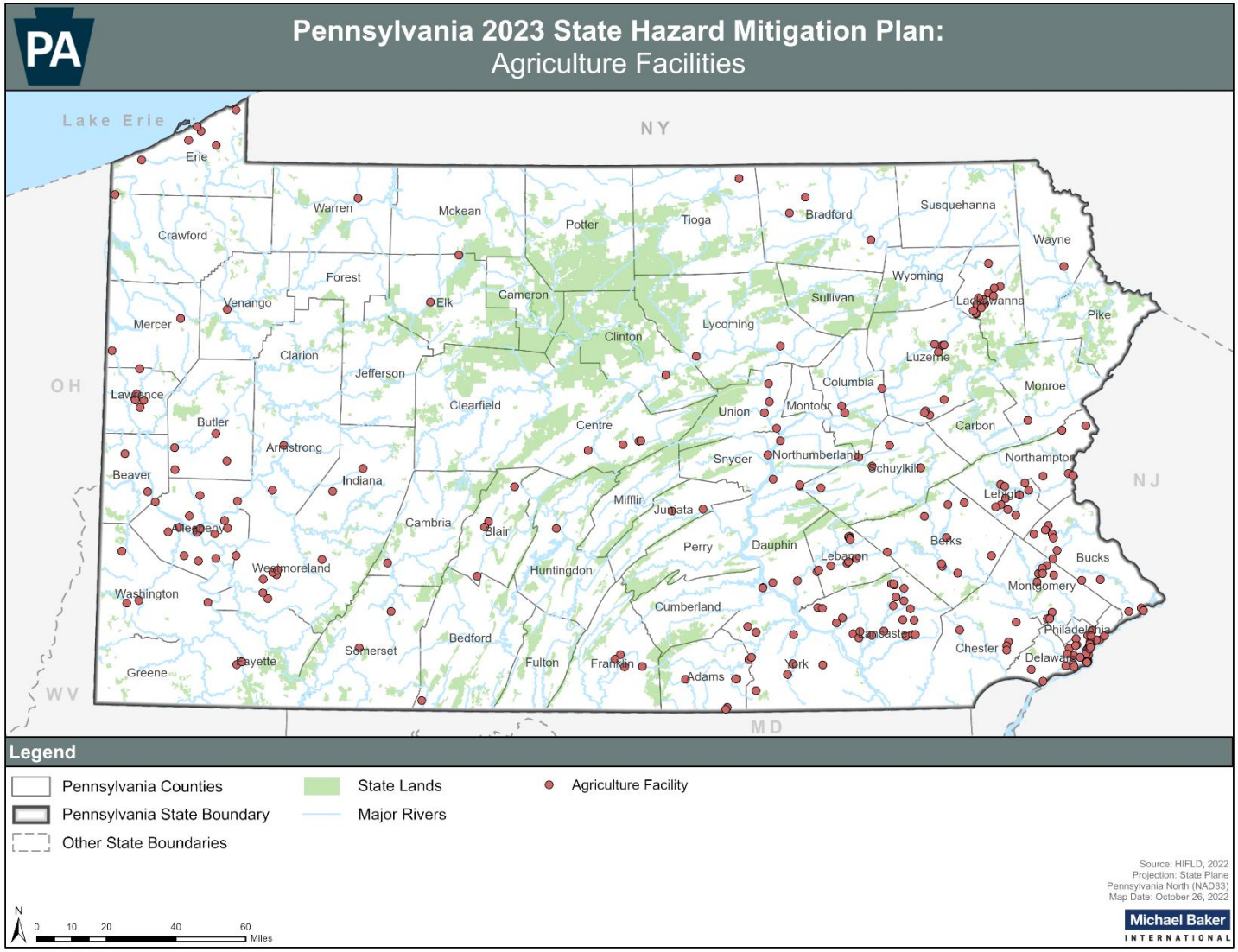
The CDC estimates that one in six people gets sick from contaminated food each year with 3,000 dying, but those events are expected to be individualized and small in scope and the focus of this profile is on large-scale contamination and illness (CDC, 2022r). The agency identifies the shift towards central processing and widespread distribution, emerging antibiotic resistance, and previously unexpected sources of disease being the main challenges of the future. With the aggressive testing and food safety outreach the Department of Agriculture conducts, along with developments in WGS that have increased detection abilities, the overall probability of a mass food or animal feed contamination event is *possible* according to the Risk Factor Methodology (see Section 4.1).

4.3.27.5. State Facility Vulnerability Assessment and Loss Estimation

State facilities generally are no more or less vulnerable to mass food and animal feed contamination than the general population. However, the 275 agricultural critical facilities identified in the critical facility inventory are likely to be the most vulnerable to a food or animal feed contamination event. The location of the agricultural facilities in the state critical facilities inventory is shown in Figure 4.3.27-2.

The physical plant and facilities of the Commonwealth are not likely to be damaged by a mass food or animal feed contamination event. However, high rates of absenteeism associated with a pandemic or an infectious disease will likely lead to significant economic costs in lost productivity and increased medical costs in nearly all state agencies. Additionally, the 106 agricultural critical facilities would face lost revenues depending on the type and magnitude of the contamination event.

Figure 4.3.27-2 Distribution of Agricultural Critical Facilities throughout Pennsylvania (HIFLD, 2022).



4.3.27.6. Jurisdictional Vulnerability Assessment and Loss Estimation

Jurisdictional losses in a mass food or animal feed contamination event stem from lost wages and productivity, not losses to buildings or land. Losses are difficult to estimate because the exact rates of absenteeism and cost of treating a widespread disease will depend on the virus or bacterium in question, the availability of vaccination or treatment, and the severity of symptoms. The CDC estimates that infections of *Salmonella* alone create $365 million in direct medical costs annually, some of which would certainly be experienced in Pennsylvania. Communities with large populations of the elderly and the very young are more vulnerable to this kind of an event as they are usually the most susceptible to foodborne illnesses.

4.3.28. Nuclear Incident

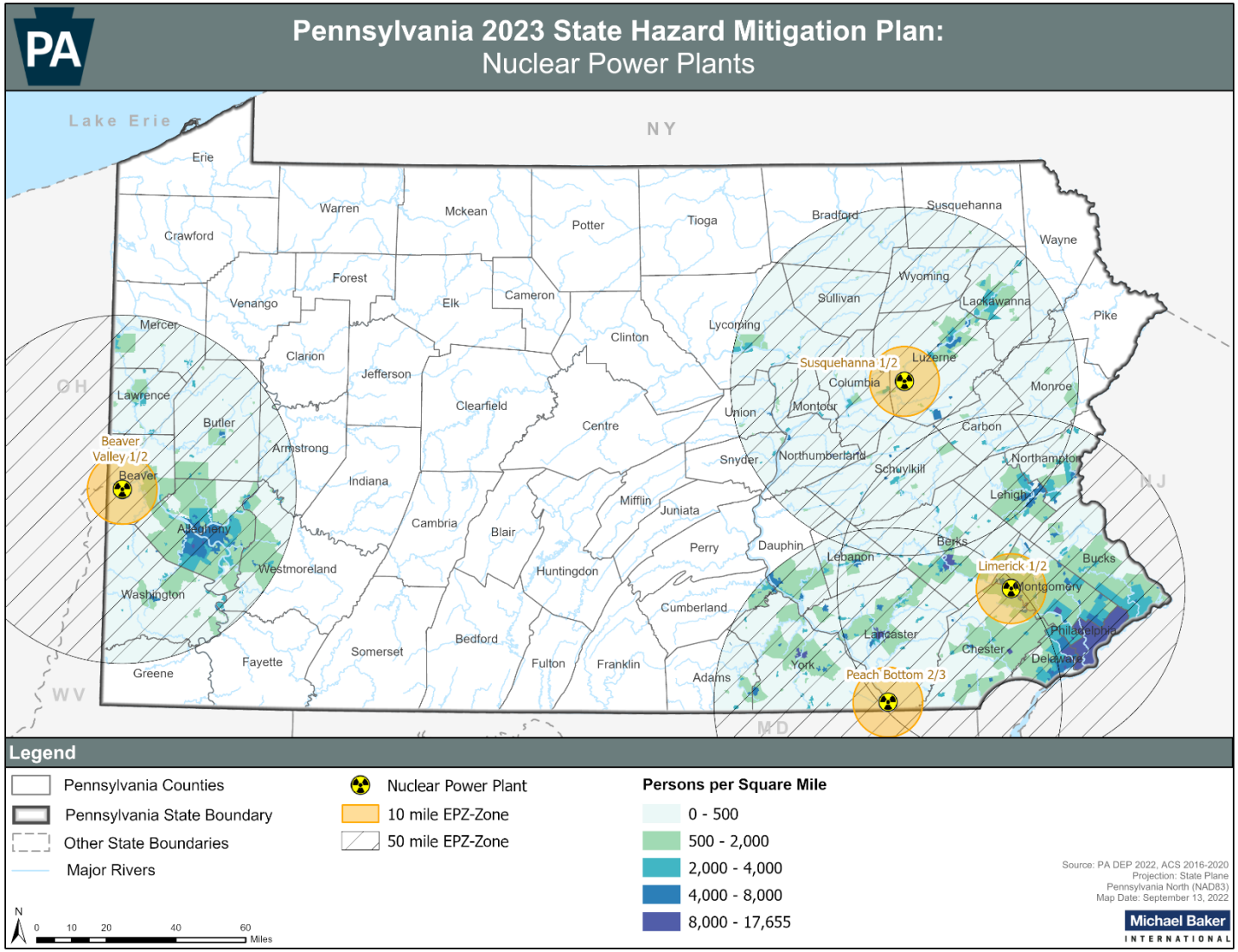
4.3.28.1. Location and Extent

Nuclear power is an important source of energy in the Commonwealth, and there are four nuclear power stations in Pennsylvania, one less than there were in the 2018 plan due to Three Mile Island shutting down in 2019:

1. Beaver Valley Power Station, Shippingport Borough, Beaver County;
2. Limerick Generating Station, Limerick Township, Montgomery County;
3. Peach Bottom Atomic Power Station, Peach Bottom Township, York County;
4. Susquehanna Steam Electric Station, Salem Township, Luzerne County; and

Most of these generating stations are concentrated in the eastern portion of the state, as seen in Figure 4.3.28-1. All four nuclear power plants in the Commonwealth have two operating licensed units.

Figure 4.3.28-1 Location of Pennsylvania Nuclear Power Stations, Their Emergency Planning Zones (EPZs), and the Population Density of Affected Municipalities (PA DEP 2022 and US Census, 2020).



The Nuclear Regulatory Commission encourages the use of Probabilistic Risk Assessments (PRA) to estimate quantitatively the potential risk to public health and safety considering the design, operations and maintenance practices at nuclear power plants. PRAs typically focus on accidents that can severely damage the core and that may challenge containment (USNRC, 2020a). FEMA, PEMA and county governments have formulated Radiological Emergency Response Plans that include a *Plume Exposure Pathway Emergency Planning Zone (EPZ)* with a radius of about ten miles from each nuclear power facility and an *Ingestion Exposure Pathway EPZ* with a radius of about fifty miles from each facility. The exact size and configuration of the EPZ may vary in relation to local emergency response capabilities, topography, road networks, and political boundaries (USNRC, 2020b).

The estimated populations located in the Plume Exposure Pathway EPZ range from 28,255 at Peach Bottom Atomic Power Station to 295,310 at Limerick Generating Station, as shown in Table 4.3.28-1 (Pennsylvania populations only). The estimated populations located in the Ingestion Exposure EPZ range from 1,834,457 at the Susquehanna Steam Electric Station to 5,964,918 at the Limerick Generating Station.

The combined population of Pennsylvanians in all four Plume Exposure EPZs is approximately 465,755. As indicated in Figure 4.3.28-1, the municipalities located within the 50-mile Ingestion Pathway EPZs of these nuclear power-generating stations are some of the most densely populated in the state; approximately 10,317,122 Pennsylvanians live within the four Ingestion Pathway EPZs. This comprises approximately 82% of the total population of the Commonwealth. In addition to the Ingestion Pathway EPZs in Pennsylvania, populations in Erie, Crawford, and Mercer Counties fall within the Ingestion Pathway EPZ of the Perry Nuclear Power Plant in Northeast Ohio. Similarly, Pike County falls within the 50-mile radius of Indian Point Nuclear Generating Station in New York, and populations in Bucks, Chester, Delaware, Lancaster, Philadelphia, and Montgomery Counties fall within the Ingestion Pathway EPZs of Salem Nuclear Generating Station in Salem County, New Jersey.

Table 4.3.28-1 Population Located in the Plume Exposure and Ingestion EPZs for PA Nuclear Power Generating Stations (ACR 5-Year, 2016).

FACILITY	AT-RISK POPULATION: PLUME EXPOSURE EPZ (10-MILE RADIUS)	AT-RISK POPULATION: INGESTION EXPOSURE EPZ (50-MILE RADIUS)
Beaver Valley Power Station	82,954	2,276,013
Limerick Generating Station	295,310	5,964,482
Peach Bottom Atomic Power Station	28,255	2,589,918
Susquehanna Steam Electric Station	59,256	1,834,457
Total	**465,755**	**10,317,122**

4.3.28.2. Range of Magnitude

The magnitude of a nuclear incident differs for those within the Plume Exposure Pathway EPZ and those within the Ingestion Exposure Pathway EPZ. The Plume Exposure Pathway refers to whole-body external exposure to gamma radiation from a radioactive plume and from deposited materials and inhalation exposure from the passing radioactive plume. The duration of primary

exposures could range in length from hours to days. The Ingestion Exposure Pathway refers to exposure primarily from ingestion of water or foods such as milk and fresh vegetables that have been contaminated with radiation (USNRC, 2020b).

Nuclear accidents themselves are classified into three categories:

- **Criticality accidents:** Involves loss of control of nuclear assemblies or power reactors.
- **Loss-of-coolant accidents:** Occurs whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by the normally operating make-up system (USNRC, 2021a).
- **Loss-of-containment accidents:** Involves the release of radioactivity from materials such as tritium, fission products, plutonium, and natural, depleted, or enriched uranium. Points of release have been containment vessels at fixed facilities or damaged packages during transportation accidents.

Nuclear facilities must notify the appropriate authorities in the event of an accident. The Nuclear Regulatory Commission uses four classification levels for nuclear incidents (USNRC, 2021b):

- **Notification of Unusual Event:** A situation is in progress of already completed which could potentially degrade the plant's level of safety or indicate a security threat to the facility. No releases of radioactive material requiring offsite actions are expected unless safety systems degrade further.
- **Alert:** Events are in progress or have occurred which have (or could) substantially degrade the plant safety; or, a security event that could threaten site personnel or damage to site equipment is in progress. Any offsite releases of radioactive material that could occur are expected to be minimal and far below limits established by the US EPA's protective action guides (PAGs).
- **Site Area Emergency:** Events are in progress or have occurred which have caused (or likely will cause) major failures of plan functions that protect the public, or involve security events with intentional damage or malicious acts that could lead to the likely failure of (or prevent effective access to) equipment needed to protect the public. Any offsite releases of radioactive material are expected to remain below EPA PAG exposure levels beyond the site boundary.
- **General Emergency:** Events are in progress or have occurred which: a) have caused (or shortly will cause) substantial reactor core damage, with the potential for uncontrolled releases of radioactive material; or, b) involve security events that deny plant staff physical control of the facility. Offsite releases can be reasonably expected to exceed EPA PAG exposure levels beyond the site.

The accident at the Three Mile Island Generating Station in March 1979 remains the nation's only nuclear incident at the *General Emergency level* and remains the worst nuclear incident on record in the Commonwealth and the nation. During this incident, equipment malfunctions,

design-related problems, and worker errors led to a partial meltdown of the TMI Unit 2 reactor core at TMI (USNRC, 2018a).

Potential environmental impacts include the long-term effects of radioactive contamination in the environment and, particularly in Pennsylvania, in agricultural products. Spills and releases of radiologically active materials from accidents can result in the contamination of soil and water (CDC, 2022s). Areas underlain by limestone and some types of glacial sediments are particularly susceptible to contamination.

After a nuclear incident, another significant impact is the effect of radiation on the health of the population near the incident. The duration of primary exposure could range in length from hours to months depending on the proximity to the point of radioactive release. External radiation and inhalation and ingestion of radioactive isotopes can cause acute health effects (e.g. death, severe health impairment), chronic health effects (e.g. cancers) and psychological effects (EPA, 2022e).

The nuclear industry has adopted pre-determined, site-specific Emergency Action Levels (EALs). The EALs provide the framework and guidance to observe, address, and classify the severity of site-specific events and conditions that are communicated to off-site emergency response organizations (USNRC, 2022). There are additional EALs that specifically deal with issues of security, such as threats of airborne attack, hostile action within the facility, or facility attack (Nuclear Energy Institute, 2012). These EALs ensure that appropriate notifications for the security threat are made in a timely manner. Each facility is also equipped with a public alerting system, which includes a number of sirens to alert the public located in the Plume Ingestion Pathway EPZ. This alerting system is activated by the counties of each specific EPZ. Emergency notifications and instructions are communicated to the public via the Emergency Alert System as activated by the Commonwealth of Pennsylvania Emergency Operations Center. State officials also have the capability to send emergency messages as text messages to mobile devices.

Table 4.3.28-2 Most Likely Lifelines Impacted by Nuclear Incident		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating a causal relationship where community safety is directly threatened due to potential harm from radioactivity. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the dangers, best safety precautions, and evacuation plans.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery. There are potential long-term effects of radioactive contamination for water resources and agricultural operations.
Health and Medical		Anticipating a causal and cascading relationship for the Health and Medical lifeline in response and recovery due to immediate impact on public health and the potential long-term health impacts including cancers and psychological impacts that will increase the amount of resources needed at local healthcare facilities.

4.3.28.3. Past Occurrence

Nuclear incidents rarely occur, but the incident at Three Mile Island is the worst fixed-nuclear facility accident in U.S. history. The resulting contamination and state of the reactor core led to the development of a fourteen-year cleanup and scientific effort (New York Times, 1993). Additionally, the *President's Commission on the Accident at Three Mile Island* examined the costs of the accident, concluding, "The accident at Three Mile Island on March 28, 1979, generated considerable economic disturbance. Some of the impacts were short term, occurring during the first days of the accident. Many of the impacts were experienced by the local community; others will be felt at the regional and national levels." The report concluded: "It appears clear that the major costs of the TMI Unit 2 accident are associated with the emergency management replacement power and the plant refurbishment or replacement. The minimum cost estimate of nearly $1 billion supports the argument that considerable additional resources can be cost effective if spent to guard against future accidents." (President's Commission on the Accident of Three Mile Island, 1979).

Despite the severity of the damage, no injuries due to radiation exposure occurred. However, numerous studies were conducted to determine the measurable health effects related to radiation and/or stress. More than a dozen epidemiological and stress related studies conducted to date have found no discernible direct health effects to the population in the vicinity of the

plant, but there was evidence of psychological stress in those closest to the site that persisted over time (USNRC, 2018a; Cleary and Houts, 1984).

The issue of radiation effects resulting from the accident at TMI will continue to be debated. Radiation science does accept thresholds of expected mortality and morbidity resulting from the exposure to radiation. Administrative standards have been incorporated into plans used by public health officials and emergency planners for the purpose of making protective actions decisions pertaining to sheltering and evacuation.

The accident at Three Mile Island had a profound effect on the residents, emergency management community, government officials and nuclear industry, not only in Pennsylvania, but nationwide. There were minimal requirements for off-site emergency planning for nuclear power stations prior to this accident. Afterwards, comprehensive, coordinated, and exercised plans were developed for the state, counties, school districts, special facilities (hospitals, nursing homes and detention facilities) and municipalities to assure the safety of the population (PA DEP, 2014). Costs associated with an event at one of the Commonwealth's nuclear facilities, be it real or perceived, are significant. The mitigation efforts put in place immediately following the 1979 continue until today. The Commonwealth Nuclear/Radiological plan which is a successor of the original "Annex E" is a result of the Commonwealth's efforts to address the many components of mitigation planning. The comprehensive planning involved with the five nuclear facilities is an ongoing effort. Plans are reviewed and amended on an annual basis. Recent amendments to various planning documents and station procedures include the efforts to enhance station security measures and the means to bolster communications and response in the event of terrorist activities.

There have been no significant nuclear incidents in the Commonwealth since the 2018 Plan. The most recent nuclear incident to occur worldwide was that which involved the Fukushima Daiichi nuclear reactor in Okuma, Fukushima, Japan. This incident occurred on March 11, 2011 when an earthquake in the area resulted in a series of equipment failures, nuclear meltdowns and releases of radioactive materials. The World Health Organization completed a report that indicated there were only small proportional increases in the occurrence of certain cancers following the radiation exposure from the plant (World Health Organization, 2016).

Following this incident, the United States Nuclear Regulatory Commission developed a set of recommendations based on the lessons learned from the Fukushima incident. These recommendations are meant to enhance reactor safety for US-based nuclear reactors against a variety of factors. Recommendations included the categories of regulatory framework, ensuring protection (of the facilities and equipment), enhancing mitigation, strengthening emergency preparedness and improving the efficiency of NRC programs One of the specific recommendations involves the re-evaluation and upgrade of seismic and flooding protection of structures, systems and components for each reactor (USNRC, 2018b). As more information comes out, and more lessons learned are developed, it should only serve to reinforce the protections in place against any type of incident involving nuclear power stations.

4.3.28.4. Future Occurrence

Pennsylvania is home to the only nuclear power plant *General Emergency* in the nation. Since the Three Mile Island incident, nuclear power has become significantly safer and is one of the most heavily regulated industries in the nation. Despite the knowledge gained since then, there is still the potential for a similar accident to occur again at one of the five nuclear generating facilities in the Commonwealth. The Nuclear Energy Agency of the Organization for Economic Co-Operation and Development notes that studies estimate the chance of protective barriers in a modern nuclear facility at less than one in 100,000 per year (Nuclear Energy Agency 2005). Nuclear incident occurrences may also occur as a result of intentional actions; these acts are addressed under Section 4.3.30.

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

4.3.28.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical facilities to nuclear incidents, all structures located within the 10-mile Plume Exposure EPZ and all agricultural facilities located within the 50-mile Ingestion Exposure EPZ were identified. As in the state vulnerability assessment for drought hazard, agricultural facilities were defined based on the facility use for state facilities (Ag-Animal Facility, Ag-Nursery/Greenhouse, Ag-Storage, and Land were all assumed to represent agricultural uses), and based on the facility type for critical facilities (facilities assigned to the type “Agricultural” were known to represent agricultural uses).

Of the 4,460 geolocated state facilities, 49, or 1.1 percent, met the criteria for high nuclear hazard (Table 4.3.28-2).These facilities have a combined replacement value of more than $34.2 million, or approximately 0.9% of the known value of geolocated state facilities. Of the 49 vulnerable state facilities, 67 are reported to be owned by the state. The reported building space of the 49 vulnerable facilities totals nearly 1.25 million square feet.

Table 4.3.28-3 Vulnerability of State Facilities to Nuclear Incident.

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General		0%		
Department of Agriculture	12	75%	10	1,096,523
Department of Banking and Securities		0%		
Department of Community and Economic Development		0%		
Department of Conservation and Natural Resources		0%		
Department of Corrections		0%		
Department of Education		0%		
Department of Environmental Protection		0%		
Department of General Services		0%		
Department of Health	1	2%	0	990
Department of Labor and Industry		0%		
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	2	2%	0	35,331
Department of Revenue		0%		
Department of Transportation	27	2%	26	27,928
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission		0%		
Governor's Office		0%		
Historical and Museum Commission		0%		
Insurance Department		0%		
Liquor Control Board	16	3%	0	74,143
Public School Employees' Retirement System		0%		
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System		0%		
State Police	2	6%	0	18,619
State System of Higher Education		0%		
Thaddeus Stevens College of Technology		0%		
Treasury Department		0%		
Total	**49**	**1.1%**	**26**	**160,409**

Of the 13,448 geolocated critical facilities, 683, or 5 percent, met the criteria for high nuclear hazard (Table 4.3.28-3). These facilities have a combined replacement value of approximately $35.6 billion, or 9 percent of the known value of geolocated critical facilities.

Table 4.3.28-4 Vulnerability of Critical Facilities to Nuclear Incident.

TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	230	84%
Banking		0%
Commercial		0%
Communication	7	1%
Dam	45	3%
Education (colleges and universities)	8	2%
Education (public schools)	161	3%
Emergency Operation Center	16	4%
Energy		0%
Fire Station	96	4%
Government		0%
Hospital	9	3%
National Monuments or Icon		0%
Nuclear	4	80%
Police Station	55	4%
Transportation	31	5%
Water	21	3%
Total	**683**	**5%**

4.3.28.6. Jurisdictional Vulnerability Assessment and Loss Estimation

In Pennsylvania, 94 municipalities and 41 school districts in seven counties are located in the 10-mile Plume Exposure Pathway EPZs of the four Pennsylvania nuclear power generating stations. The breakdown of jurisdictional vulnerability is shown in Table 4.3.28-5. A further fourteen counties provide support services related to monitoring and the mass care of evacuees from at-risk jurisdictions. In total, approximately 1,553 municipalities and 38 counties (of 67) are located within the 50-mile Ingestion Pathway Exposure EPZ (PEMA, 2010a). This does not include the communities vulnerable to nuclear incidents in neighboring states.

Table 4.3.28-5 Counties and Municipalities Located Within Each 10-mile Plume Exposure Pathway EPZ (DEP Bureau of Radiation Protection, 2009)

BEAVER VALLEY POWER STATION			
RISK COUNTY	RISK MUNICIPALITIES		
Beaver County	City of Aliquippa	Glasgow Borough	Ohioville Borough
	Beaver Borough	Greene Township	Patterson Township
	Bridgewater Borough	Hanover Township	Patterson Heights Borough
	Brighton Township	Hookstown Borough	Potter Township

Table 4.3.28-5 Counties and Municipalities Located Within Each 10-mile Plume Exposure Pathway EPZ (DEP Bureau of Radiation Protection, 2009)			
	Center Township	Hopewell Township	Raccoon Township
	Chippewa Township	Independence Township	Shippingport Borough
	Fallston Borough	Industry Borough	South Beaver Township
	Frankfort Springs Borough	Midland Borough	South Heights Borough
	Georgetown Borough	Monaca Borough	Vanport Township
LIMERICK GENERATING STATION			
RISK COUNTY	RISK MUNICIPALITIES		
Berks County	Amity Township	Douglass Township	Washington Township
	Boyertown Borough	Earl Township	
	Colebrookdale Twp.	Union Township	
Montgomery County	Collegeville Borough	Lower Salford Twp.	Skippack Township
	Douglass Township	Marlborough Twp.	Trappe Borough
	Green Lane Borough	New Hanover Twp.	Upper Frederick Twp.
	Limerick Township	Perkiomen Township	Upper Pottsgrove Twp.
	Lower Frederick Twp.	Pottstown Borough	Upper Providence Twp.
	Lower Pottsgrove Twp.	Royersford Borough	Upper Salford Twp.
	Lower Providence Twp.	Schwenksville Borough	West Pottsgrove Twp.
Chester County	Charlestown Township	North Coventry Twp.	Upper Uwchlan Twp.
	East Coventry Twp.	Phoenixville Borough	Uwchlan Township
	East Nantmeal Twp.	Schuylkill Township	Warwick Township
	East Pikeland Twp.	South Coventry Twp.	West Pikeland Twp.
	East Vincent Twp.	Spring City Borough	West Vincent Twp.
PEACH BOTTOM ATOMIC POWER STATION			
RISK COUNTY	RISK MUNICIPALITIES		
York County	Delta Borough	Fawn Township	Lower Chanceford Township
	Peach Bottom Township	Fawn Grove Borough	
SUSQUEHANNA STEAM ELECTRIC STATION			
RISK COUNTY	RISK MUNICIPALITY		
Columbia County	Beaver Township	Briar Creek Twp.	North Centre Twp.
	Berwick Borough	Fishing Creek Twp.	South Centre Twp.
	Briar Creek Borough	Mifflin Township	
Luzerne County	Black Creek Township	Huntington Township	Salem Township
	Butler Township	Nanticoke City	Shickshinny Borough
	Conyngham Borough	Nescopeck Borough	Slocum Township
	Conyngham Township	Nescopeck Township	Sugarloaf Township
	Dorrance Township	New Columbus Borough	Union Township
	Hollenback Township	Newport Township	
	Hunlock Township	Nuangola Borough	

The loss experienced by each jurisdiction in the case of a nuclear incident will depend on the magnitude of the event. The example of the Three Mile Island incident gives an indication of local and regional economic losses, though. The President's Commission on the Three Mile Incident calculated the economic impact of the accident, looking at direct and indirect losses and other potential growth impacts. Direct impacts to the manufacturing sector were estimated at $6.3 million. These losses occurred within a few days after the accident and quickly subsided thereafter with no evidence of permanents layoffs resulting. Food processors incurred extraordinary expenses of $250,000 with some firms purchasing equipment to detect radiation levels and converting dairy production to powdered milk.

The utility itself incurred significant costs in the areas of emergency management and plant refurbishment and replacement power. Emergency management costs ran into the hundreds of millions of dollars and replacement power for both units at a cost of $24 million a month. The unaffected unit TMI Unit 1 was shut down for 6.5 years. During this time, more than $100 million in plant upgrades and refurbishment took place. Replacement power costs today are estimated at nearly twice the 1979 dollars. Cost of the accident cleanup and placing the facility in monitored storage cost approximately $1 billion.

The impact to tourism was estimated at approximately $6.5 million with lost wages in this sector estimated from $2.8 million to $3.8 million. Losses to the agricultural sector appeared to be minimal due to off-growing season. The Pennsylvania Department of Agriculture indicated that losses were significantly less than $1 million.

To quantify the relative jurisdictional vulnerability due to impacts to people and buildings within the 10-mile Plume Exposure EPZ, GIS analysis was conducted to identify all census blocks with centers located within 10 miles of a nuclear power station. The population, building counts, and exposed building value within these census blocks was then aggregated to the county scale. As shown in Table 4.3.28-6, only eight counties in Pennsylvania have census blocks within the 10-mile Plume Exposure EPZ. The county with the largest number of vulnerable people is Montgomery County. Nearly 170,000 residents of the densely populated Montgomery County live in census blocks within the 10-mile Plume Exposure EPZ. The county with the largest percentage of exposed building value, in contrast, is Beaver County. Approximately 50 percent of the total value of all buildings in Beaver County is located in census blocks within the 10-mile Plume Exposure EPZ.

Table 4.3.28-6 Vulnerability of People and Buildings to Nuclear Incident.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Beaver	81,312	36,192	$16,985,785	50%
Berks	26,535	10,270	$5,436,115	6%
Chester	79,670	28,831	$19,904,739	14%
Columbia	17,459	8,091	$3,421,822	27%
Lancaster	17,397	7,257	$2,836,670	3%

Table 4.3.28-6 Vulnerability of People and Buildings to Nuclear Incident.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF COUNTY BUILDING VALUE
Luzerne	33,049	15,614	$6,001,630	11%
Montgomery	169,297	60,167	$39,839,694	19%
York	9,969	4,138	$1,522,259	2%
Total	**434,688**	**170,560**	**$95,948,714**	**4%**

Potential jurisdictional losses in the 50-mile EPZ will solely originate from losses in farm products and contamination of farmland in counties within the 50-mile ingestion exposure pathway. Table 4.3.28-7 illustrates possible agricultural losses resulting from a nuclear incident, enumerating farmland acreage and the associated market value of products for counties where more than half the land area falls under the 50-mile EPZ.

Table 4.3.28-7 Estimated 50-mile EPZ Jurisdictional Losses Relating to Agricultural Production (USDA, 2017).		
COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD
Allegheny	28,970	$13,743,000
Beaver	53,832	$23,653,000
Berks	224,722	$554,656,000
Bucks	77,255	$75,757,000
Butler	133,954	$49,522,000
Carbon	19,498	$13,029,000
Chester	150,514	$712,468,000
Columbia	106,748	$67,287,000
Dauphin	81,252	$93,074,000
Delaware	2,385	$9,494,000
Lackawanna	36,556	$16,469,000
Lancaster	393,949	$1,507,207,000
Lawrence	82,125	$34,773,000
Lebanon	107,577	$350,804,000
Lehigh	74,511	$79,216,000
Luzerne	49,087	$17,793,000
Mercer	156,397	$65,748,000
Monroe	27,607	$9,933,000
Montgomery	30,896	$35,374,000
Montour	38,635	$60,225,000
Northampton	59,195	$36,058,000
Northumberland	124,136	$154,583,000

Table 4.3.28-7 Estimated 50-mile EPZ Jurisdictional Losses Relating to Agricultural Production (USDA, 2017).

COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD
Philadelphia	284	$327,000
Schuylkill	96,886	$143,439,000
Sullivan	43,424	$12,182,000
Union	65,719	$147,420,000
Washington	190,447	$36,999,000
Wyoming	61,303	$13,243,000
York	252,713	$260,927,000
Total	**2,770,577**	**$4,595.403,000**

4.3.29. Substance Use Disorder

4.3.29.1. Location and Extent

Substance use disorder (SUD) is when a person suffers from a medical condition due to the physical dependence on a drug, either legal or illegal. These disorders are treatable, chronic diseases characterized by a problematic pattern of use of a substance or substances leading to impairments in health, social function, and control over substance use. It is a cluster of cognitive, behavioral, and physiological symptoms indicating that the individual continues using the substance despite harmful consequences. Patterns of symptoms resulting from substance use (drugs or alcohol) can help a doctor diagnose a person with a SUD or SUDs. SUDs can range in severity from mild to severe and can affect people of any race, gender, income level, or social class.

The most likely cause are opioids, a class of drugs that reduces pain. “Opioid” is used as a broad term and includes opiates, which are drugs naturally extracted from certain types of poppy plants, and narcotics. Opioids can also be synthetically made to emulate opium. According to the Drug Enforcement Administration (DEA) opioids come in various forms: tablets, capsules, skin patches, powder, chunks in various colors from white to shades of brown and black, liquid form for oral use and injection, syrups, suppositories, and lollipops (DEA, 2020).

The Centers for Disease Control and Prevention (CDC) defines the following as the three most common types of opioids:

- **Prescription Opioids:** Opioid medication prescribed by doctors for pain treatment. Prescription opioids can be synthetic - methadone, oxycodone (OxyContin), or hydrocodone (Vicodin), or natural, like morphine (CDC, 2017b).
- **Fentanyl:** A powerful synthetic opioid that is 50 to 100 times more powerful that morphine and used for treating severe pain. Illegally made and distributed fentanyl is becoming more prevalent (CDC, 2022t).
- **Heroin:** An illegal, highly addictive natural opioid processed from morphine that is also becoming more commonly used in the United States. It is commonly used along with other substances including cocaine and prescription opioids (CDC, 2022u).

Opioids are highly addictive. They block the body’s ability to feel pain and can create a sense of euphoria. Additionally, individuals often build a tolerance to opioids, which can lead to misuse and overdose.

Addiction to these drugs impacts the entire Commonwealth, and it is listed as the #1 public health and safety crisis (Office of the Attorney General, N.d.). Pennsylvania is typically among the hardest hit states from total drug overdose deaths each year, ranking 4th in 2020 behind California, Florida, and New York (CDC, 2022v). The CDC estimates that nearly 42 out of every 100,000 Pennsylvania residents died from drug overdoses in 2021, which ranked 10th in the nation. This data was broken down by different drug classes and it was found that the death rate for opioids was 36 per 100,000 while the rate for stimulants, such as cocaine or

methamphetamine, was 21 per 100,000. These ranked 11th and 12th in the nation, respectively, and were each higher than the national average (CDC, 2022v). In Pennsylvania, overdoses caused by opioids have become the leading cause of accidental death, surpassing automobile accidents (CDC, 2017b).

Xylazine, a powerful animal sedative, has become a growing problem for Pennsylvania in recent years. There were 90 reported overdoses deaths due to the drug in 2017, but that number jumped to 575 in 2021. This represents an increase of over 600 percent in just 5 years. Philadelphia reported that 90 percent of opioid samples tested contained xylazine (Governor Josh Shapiro, 2023).

People under the age of 35 have been particularly vulnerable to the substance use crisis. According to a joint intelligence report prepared by the DEA Philadelphia Division and the University of Pittsburgh, between 2015 and 2016 in Pennsylvania, fentanyl use increased 380 percent among 15- to 24-year-olds while heroin use increased 970 percent in the 25- to 34-year age range. The report also documented a higher percentage of drug-related deaths attributed to opioid use in Pennsylvania's rural communities at 42 percent, compared to 34 percent in urban comminutes.

4.3.29.2. Range of Magnitude

Substance use can lead to overdose, which can be fatal. 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. Signs and symptoms include respiratory depression, drowsiness, disorientation, pinpoint pupils, and clammy skin. Opioid use by the mother can also impact a child in the womb. The incidence of this condition, known as neonatal abstinence syndrome, increased from 4.6 per 1,000 births to 6.7 per 1,000 between 2012 and 2016 in the US, with opioid usage during pregnancy continuing to rise (Anbalagan and Mendez, 2022).

There are additional ways substance use disorder can impact more than just those that suffer from it. Those individuals are a part of families, potentially mothers and fathers, and the impacts of their substance use can disrupt their families across generations. They are also a part of our communities. There may be impacts on our educational system, social services such as child welfare, food insecurity, reducing productivity, and more. There are emotional, societal, and fiscal impacts that go beyond the direct effects to individuals, or the economic impacts calculated at the local and state level. This range of impacts suggests that treatments and mitigation measures should consider a more holistic perspective, even pursuing goals around community resilience as compared to targeting individuals.

First responders—paramedics, police officers, and fire fighters, are also affected by Pennsylvania's substance use crisis. In addition to the crisis consuming time and resources, first responders also face exposure risk, particularly to synthetic fentanyl. The most likely method of exposure is skin exposure, which clinical toxicology experts state presents an extremely low risk. Additional methods of exposure are inhalation, ingestion, contact with a mucous membrane, or with a needlestick (North Carolina Department of Health and Human Services, 2017). According to the DEA, it takes two to three milligrams of fentanyl to induce respiratory

depression, arrest, and possibly death. Since fentanyl is indistinguishable from several other narcotics and powdered substances, first responders must take extra precaution when dealing with calls related to drug abuse (DEA, 2017).

According to a recent study, environmental scientists at the Cary Institute of New York found traces of opioids and other drugs in streams, rivers, and lakes. These traces came from human urine and feces, and medications that have been flushed down the toilet. However, the ecological and environmental impacts are unknown. The United States Environmental Protection Agency (EPA) suggests while the risks of pharmaceuticals found in wastewater, ambient water, and drinking water is low, further research is needed (EPA, 2014).

One of the worst examples of the impacts of the crisis occurred in September 2021 when over 100 people were admitted to the hospital after overdoses in Berks County. Officials reported that xylazine along with heroin, fentanyl, lidocaine, and clonidine were recovered from police raids in response to the public health emergency (Henshaw, 2021). In April 2022, Berks County was again put on alert when there were 20 reported overdoses in one weekend, four of which resulted in fatalities. Analysis of drugs found at the scenes of the overdoses revealed they contained cocaine, heroin, and fentanyl (Reinhard, 2022). Erie County experienced a similar situation in March 2023 after eight overdoses were reported over one weekend, resulting in four fatalities (Hahn, 2023).

Table 4.3.29-1 Most Likely Lifelines Impacted by Substance Use Disorder

Lifelines	Impact Type	Notes
Safety and Security		Anticipating causal impacts as government services are needed to aid individuals with substance use disorder and police officers and other first responders may be at risk to exposure for certain substances. Mitigation actions should be aimed at increasing awareness of available services.
Health and Medical	 	Anticipating a causal and cascading relationship for the Health and Medical lifeline in response and recovery as substance use has negative impacts on public health and may require medical treatment and mental health services. There may be cascading impacts to family and friends, who may require mental health services as well. Mitigation actions for this lifeline may be focused on stockpiling and administering emergency treatments.

4.3.29.3. Past Occurrence

The CDC found that opioids are the main cause of drug-related overdoses and deaths, being responsible for nearly seventy-five percent of drug-related deaths nationally in 2017. Table 4.3.29-1 lists the total number of drug overdoses by county in 2020 and 2021. Drug-related

overdose and death statistics account for all drug types, however, as noted above, the majority of drug-related deaths involve opioids. Philadelphia and Allegheny Counties reported the largest total numbers of drug overdoses in 2020 and 2021. Drug overdose and drug-related deaths were not reported for seven counties.

Table 4.3.29-2 Number of Drug Overdoses Reported in Pennsylvania by County in 2020 and 2021 (PA DOH, 2022b).

COUNTY	2020	2021	COUNTY	2020	2021
Adams	18	17	Lackawanna	92	100
Allegheny	683	700	Lancaster	143	138
Armstrong	27	33	Lawrence	38	53
Beaver	65	64	Lebanon	36	31
Bedford	13	20	Lehigh	139	183
Berks	128	128	Luzerne	169	189
Blair	52	45	Lycoming	39	23
Bradford	12	16	McKean	0	12
Bucks	210	160	Mercer	44	64
Butler	72	65	Mifflin	0	13
Cambria	68	94	Monroe	83	67
Cameron	0	0	Montgomery	219	185
Carbon	29	37	Montour	14	19
Centre	14	12	Northampton	82	72
Chester	111	105	Northumberland	29	26
Clarion	0	0	Perry	14	15
Clearfield	20	29	Philadelphia	1217	1240
Clinton	0	0	Pike	15	17
Columbia	15	22	Potter	0	0
Crawford	24	36	Schuylkill	65	57
Cumberland	67	50	Snyder	0	0
Dauphin	111	106	Somerset	22	23
Delaware	197	174	Sullivan	0	0
Elk	0	13	Susquehanna	0	10
Erie	81	91	Tioga	0	16
Fayette	65	82	Union	0	0
Forest	0	0	Venango	14	14
Franklin	30	26	Warren	0	0
Fulton	0	0	Washington	100	101
Greene	12	15	Wayne	15	17
Huntingdon	0	10	Westmoreland	120	160
Indiana	32	38	Wyoming	0	0
Jefferson	0	10	York	204	139
Juniata	0	0	**Total**	**5069**	**5182**

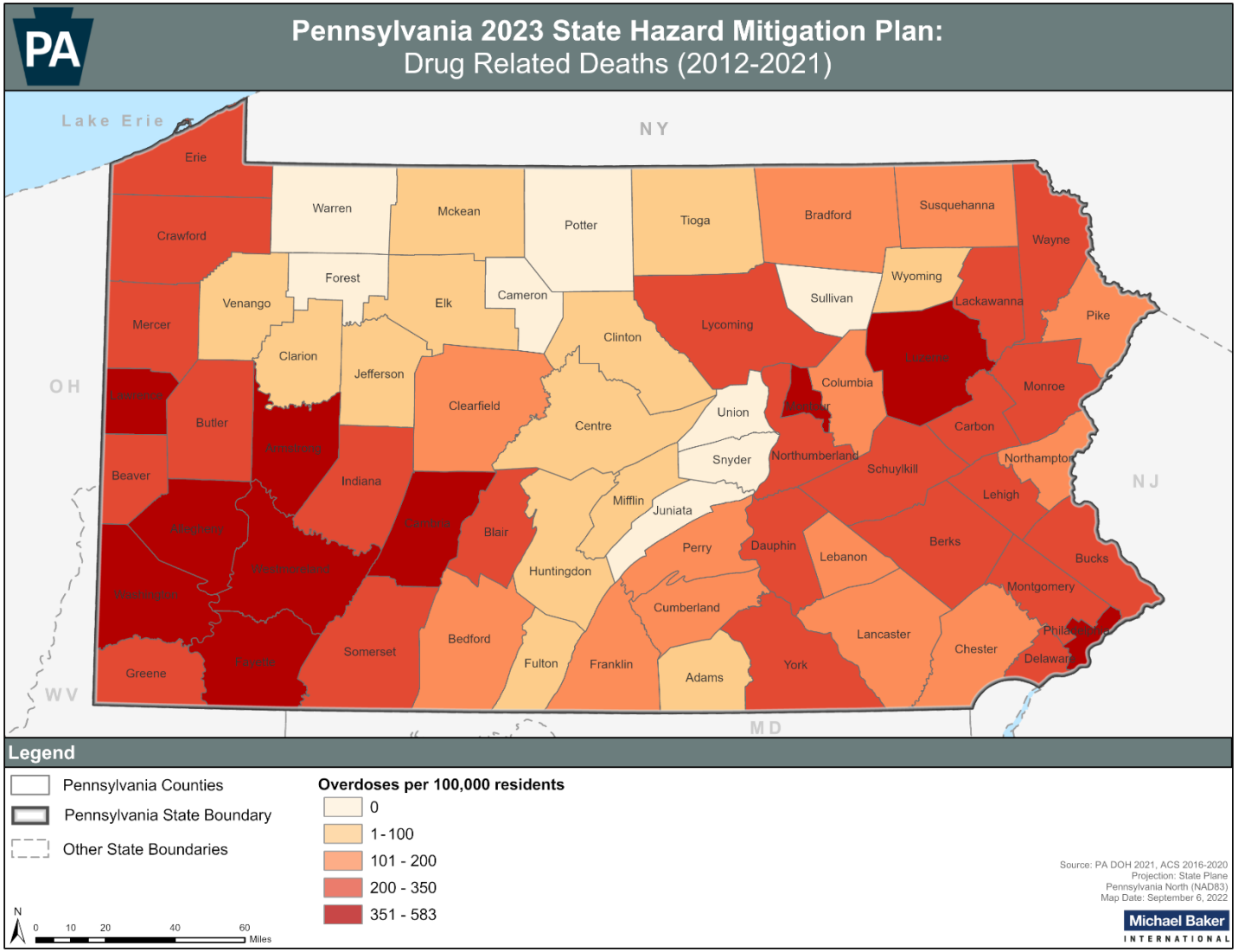
As shown in Table 4.3.29-2 Pennsylvania has experienced an increase in drug-related deaths nearly every year since 2014.

Table 4.3.29-3 Number of Drug-Related Deaths per Year in Pennsylvania 2014-2021 (CDC, 2022w)

YEAR	TOTAL DEATHS
2014	2,732
2015	3,264
2016	4,627
2017	5,545
2018	4,415
2019	4,317
2020	5,071
2021	5,331
Total	**35,399**

Figure 4.3.29-1 illustrates the overall number of all drug-related deaths per 100,000 people in each Pennsylvania county between years 2012 to 2020. Philadelphia and Allegheny Counties experienced the largest total numbers of drug-related deaths, with both over 5,000 drug related deaths in this time period. However, the five counties with the highest number of drug-related deaths per capita were Montour, Philadelphia, Cambria, Allegheny, and Lawrence, respectively. Over 50% over drug overdoses in 2020 occurred among those between the ages of 25-44 (PA DOH 2021) County specific data for 2021-2022 has not yet been released by CDC.

Figure 4.3.29-1 Number of Drug Related-Deaths per 100,000 People (DOH2021).



Though the opioid crisis is complex and unprecedented, it is widely acknowledged that it began in the late 1990s when pharmaceutical companies introduced opioid-based pain medication, such as OxyContin, Percocet, and Vicodin. As these drugs became more frequently prescribed, misuse and overdose increased, and it became clear that prescription opioids were highly addictive. (NIDA, 2018).

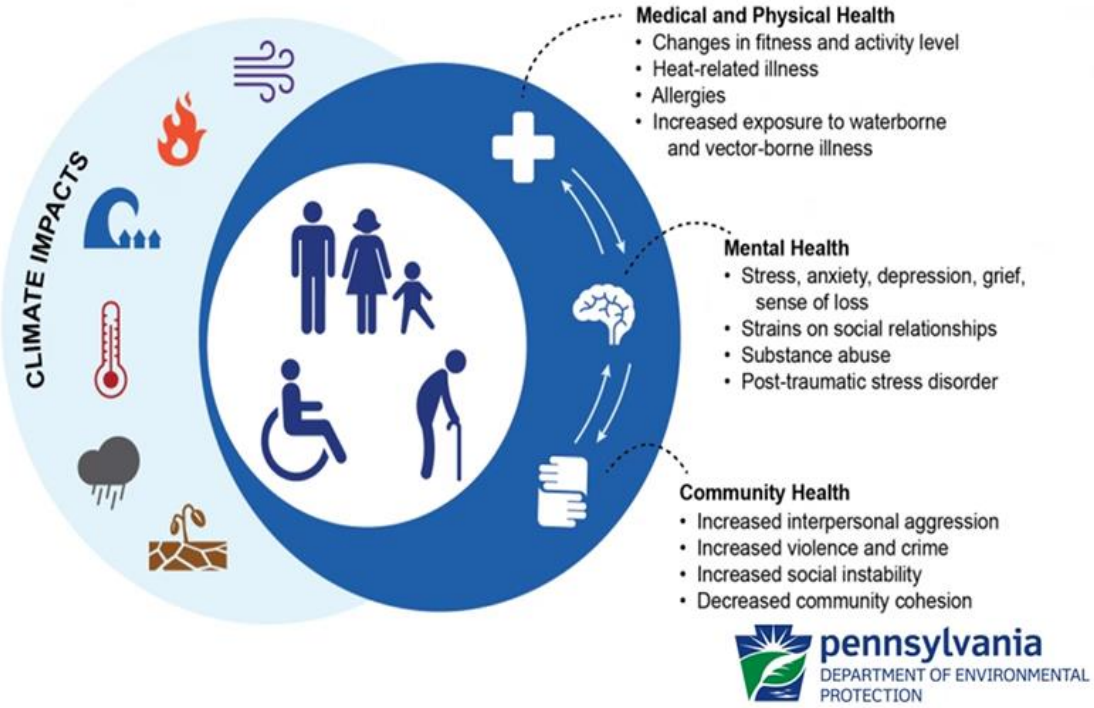
4.3.29.4. Future Occurrence

Pennsylvania has seen a steady rise in opioid related deaths over the last several years, with total drug-related deaths increasing 95 percent between 2014 and 2021. The 2018 SHMP suggested that if opioid related deaths continue to increase at the pace they did between 2014-2017 then the Commonwealth could experience an estimated 10,000 drug-related deaths in the year 2020. While this level of increase was not observed and there were even some year-to-year decreases, the overall trend is still showing that deaths resulting from substance use are increasing over time.

Future occurrences of substance use and misuse, overdose, and fatalities are ever changing as the state moves forward with overdose prevention initiatives. In January 2018, Governor Tom Wolf declared Pennsylvania's opioid addictions epidemic a disaster emergency. This declaration enhanced coordination and data collection between state and local responders, improved tools for families and first responders, and expanded treatment access. Naloxone, a lifesaving drug that reverses the effects of a drug-overdose, has become more available as a result. In addition, a new Opioid Coordination Group was housed within the Pennsylvania Emergency Management Agency. (PA DOH, 2018). These measures may have contributed to the large decreases in deaths from 2017-2019, yet deaths increased to similar levels to 2017 in both 2020 and 2021. These increases may not be the fault of inadequate policies, and instead an unfortunate consequence of how the Covid-19 pandemic increased opioid and stimulant use across the country (Abramson, 2021). Research has documented that isolation and solitude negatively impact the experience of those in recovery and the survival of those with substance use disorder frequently depends upon maintaining social networks (Roe, et al., 2021). In addition to increased usage, the delivery and effectiveness of prevention and treatment programs may have been severely impacted by the pandemic. Our understanding of the factors, demographics, and substances involved in this crisis is constantly evolving, and treatments should reflect this.

Part of this evolution is the impacts of climate change on public health. Figure 4.3.29-2 below depicts the different aspects of public health that changes such as higher temperatures, flooding, severe storms, and more may have. The mental and community health aspects are particularly relevant to substance use disorder, as listed impacts include increased stress, strains on social relationships, increased social instability, and decreased community cohesion.

Figure 4.3.29-2 Climate Impacts on Aspects of Public Health (DEP Grid Resilience Presentation, 2022)



Governor Wolf's disaster declaration expired on August 25, 2021, but work is still being done to reduce the impact of SUD. In December 2022, a settlement was reached with the pharmaceutical industry for its role in the substance use crisis, resulting in over $2.2 billion in recovery funds for Pennsylvania and requires certain pharmacies to monitor, report, and share data about suspicious activity related to opioid prescriptions. Payments are expected to begin in 2023 and will go towards remediation activities such as prevention, harm reduction, treatment, and recovery services (Office of the Attorney General, 2022). In April 2023, Governor Josh Shapiro directed his administration to schedule xylazine as a controlled substance, which places additional regulations that aim to ensure proper handling, storage, ordering, and distribution (Governor Josh Shapiro, 2023). The demographics of those impacted and the substances they use are consistently evolving,

Despite the wide variety of newer policies and programs, the probability of future opioid overdose and death is still *highly likely* as defined by the Risk Factor Methodology (see Section 4.1).

4.3.29.5. State Facility Vulnerability Assessment and Loss Estimation

State facilities are not at risk to the substance use 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. Since fentanyl can be ingested orally, inhaled

through the nose or mouth, or absorbed through the skin or eyes, any substance suspected to contain fentanyl should be handled with extreme caution. Exposure to a small amount of fentanyl can lead to respiratory depression or death. As stated above, fentanyl exposure through skin contact present a relatively low risk. Fentanyl-related substances have been found in powders, pills, capsules, liquids, and on blotter paper. The DEA recommends that all first responders carry a Personal Protective Equipment (PPE) kit that includes: nitrile gloves, N-95 dust masks, sturdy eye protection, paper coveralls and shoe protection, and naloxone injectors. The DEA also suggests using extreme caution when using police dogs, as they are at serious risks to health complications from inhaling fentanyl and fentanyl-related substances (DEA, 2017).

The physical plant and facilities of the Commonwealth are not likely to experience losses from the substance use crisis. However, 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.

4.3.29.6. Jurisdictional Vulnerability Assessment and Loss Estimation

In general, jurisdictions that are more densely populated are more vulnerable to substance use threats as access to the drugs increases. However, as stated above, rural communities in general experienced larger per-capita opioid-related deaths.

28 counties profiled Substance Use Disorder in their multi-jurisdictional hazard mitigation plans, with 22 ranking the hazard as High Risk. The following link is a dashboard on treatment facilities, peer support systems, and state hospitals in each county that can help provide mental health and substance use support: https://public.tableau.com/app/profile/peoplestat/viz/NewOMHSAS_0/Dashboard1.

Jurisdictional losses in the substance use crisis stem from lost wages, productivity, and resources rather than losses to buildings or land. Locally, many Pennsylvania counties have seen an increase of time and resources devoted to the situation as overdose and response increases however there is no comprehensive tracking mechanism to record total local losses associated with the substance use crisis.

Impacts including total costs to jurisdictions are only beginning to be understood, researched, and tracked. There is no comprehensive database currently tracking monetary losses at the local level. However, the American Enterprise Institute (AEI), using national data from the CDC and White House Council of Economic Advisors, calculated a total cost per capita ($1,799), of specifically the opioid crisis for Pennsylvania. AEI's estimates were calculated by utilizing national estimates based on variations in local wages, health care costs, and criminal justice costs along with variation in opioid-related death and addiction rates, and average age-adjusted value of statistical lives lost and divided by each state's population in the 2012-2016 American Community Survey (AEI, 2018). Using this per capita estimate in combination with county population estimates, losses have been distributed by county as depicted in Table 4.3.29.3. The total estimated cost to Pennsylvania is more than $23 billion. It is important to note that this methodology assumes equal per capita opioid misuse and fatality across all counties however, based on reported drug overdoses and drug related deaths, it is known that some counties,

including those in the southwestern region, are more vulnerable and more likely to experience higher per capita costs while counties in central and north central Pennsylvania tend to be less vulnerable and likely have lesser costs per capita. Another important caveat regarding this methodology is that that a portion of the costs will have been state losses rather than county or jurisdictional but the ratio of state to local cost burden is unknown at this time.

The U.S. Congress Joint Economic Committee (JEC) released an analysis that found the national economic cost of the opioid use to be nearly $1.5 trillion in 2020. This represents a 37% increase from the last analysis that was done in 2017 (Joint Economic Committee, 2022).

Table 4.3.29-4 Estimated Total Cost of Opioid Addiction through 2015 based on Per Capita Estimates by County (AEI 2018, US Census 2018)

COUNTY	COST ($)	COUNTY	COST ($)
Adams	184,102,464	Lackawanna	379,159,039
Allegheny	2,200,263,352	Lancaster	976,682,497
Armstrong	118,089,958	Lawrence	156,637,131
Beaver	298,885,860	Lebanon	251,417,446
Bedford	87,215,520	Lehigh	659,322,706
Berks	751,719,346	Luzerne	570,900,057
Blair	222,099,143	Lycoming	204,799,959
Bradford	109,474,547	McKean	74,352,670
Bucks	1,130,385,459	Mercer	201,038,250
Butler	336,607,292	Mifflin	83,452,012
Cambria	239,364,146	Monroe	302,314,754
Cameron	8,261,008	Montgomery	1,486,108,925
Carbon	114,871,547	Montour	32,871,328
Centre	292,625,340	Northampton	545,825,595
Chester	934,208,107	Northumberland	165,560,171
Clarion	69,185,942	Perry	82,982,473
Clearfield	143,353,315	Philadelphia	2,843,972,537
Clinton	70,157,402	Pike	100,188,109
Columbia	118,611,668	Potter	30,226,798
Crawford	155,000,041	Schuylkill	256,481,631
Cumberland	449,868,734	Snyder	73,400,999
Dauphin	496,002,290	Somerset	134,027,299
Delaware	1,015,888,104	Sullivan	10,954,111
Elk	54,324,403	Susquehanna	73,732,015
Erie	493,899,259	Tioga	73,386,607
Fayette	236,575,696	Union	80,226,405
Forest	13,127,303	Venango	93,119,838
Franklin	277,466,966	Warren	71,346,541
Fulton	26,247,410	Washington	372,929,102
Greene	66,149,230	Wayne	92,117,795
Huntingdon	81,838,309	Westmoreland	634,375,973
Indiana	152,830,447	Wyoming	49,152,278
Jefferson	78,803,396	York	802,494,322
Juniata	44,100,686	**TOTAL**	**23,037,161,063**

One of the worst examples of the impacts of the crisis occurred in September 2021 when over 100 people were admitted to the hospital after overdoses in Berks County. Officials reported that xylazine along with heroin, fentanyl, lidocaine, and clonidine were recovered from police raids in response to the public health emergency (Henshaw, 2021). In April 2022, Berks County was again put on alert when there were 20

reported overdoses in one weekend, four of which resulted in fatalities. Analysis of drugs found at the scenes of the overdoses revealed they contained cocaine, heroin, and fentanyl (Reinhard, 2022). Erie County experienced a similar situation in March 2023 after eight overdoses were reported over one weekend, resulting in four fatalities (Hahn, 2023)."

4.3.30. Terrorism

4.3.30.1. Location and Extent

Terrorism is a threat everywhere. Though there is no universal definition of terrorism, the Federal Bureau of Investigation (FBI) defines terrorism 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).

There are many important considerations in evaluating terrorism hazards, such as the existence of facilities, landmarks, or other buildings of international, national, or regional importance. Military and civilian government facilities, international airports, large cities, and high-profile landmarks are considering high-risk targets, according to FEMA. Other targets can include large public gatherings, water and food supplies, utilities, and corporate centers. Terrorists can also use cyber-attacks or send explosive, chemical, or biological agents through the mail (FEMA, n.d.a). Terrorism can take many forms and terrorists have a wide range of personal, political, or cultural agendas. Any location could therefore be a potential terrorist target.

Of particular concern to Pennsylvania are the many critical facilities in the Commonwealth. Police stations, hospitals, military installations, fire stations, schools, wastewater treatment plants, and nuclear power generation stations along with critical infrastructure such as bridges, tunnels, electric generation and distribution facilities, public water supplies, and government buildings may be potential terrorist targets. Damage to these facilities and infrastructure could cripple transportation routes and commerce. Additionally, there are over 3,300 SARA Title III facilities as well as many transportation routes vital to the entire nation traversing the Commonwealth, making intentional hazard material releases a potential threat to citizens and the environment. Environmental hazards related to hazardous material releases are addressed in full in Section 4.3.24.

4.3.30.2. Range of Magnitude

The term “terrorism” refers to intentional, criminal, and malicious acts, but the functional definition of terrorism can be interpreted in many ways. The Federal Bureau of Investigation (FBI) classifies terrorism into two categories (FBI, 2022a):

- **International terrorism**: Violent acts committed by individuals and/or groups inspired by or associated with designated foreign terrorist organizations or nations (state-sponsored), and
- **Domestic terrorism**: Violet, criminal acts carried out by individuals and/or groups to further ideological goals stemming from domestic influences, such as those of a political, religious, social, racial, or environmental nature.

FEMA defines the three main goals of terrorism as causing public fear, convincing citizens that the government cannot protect against terrorism, and making the motivating causes known to the public. Terrorist attacks can take many forms. FEMA identifies the following as some of the common tactics of terrorism (FEMA, n.d.a):

- Agriterrorism—food contamination or destruction of crops via pest introduction or disease agents
- Arson/incendiary attack
- Armed attack
- Assassination
- Biological agent
- Chemical agent
- Cyberterrorism
- Conventional bomb
- Hijackings
- Intentional hazardous material release
- Kidnapping
- Nuclear bomb
- Radiological agent

Explosives have been a prominent method of conducting terrorism, but intelligence suggests that the possibility of biological or chemical terrorism is increasing. The FBI has found that the Internet, the rise of social media, and domestic extremists known as Homegrown Violent Extremists (HVEs) are reshaping terrorism and changing its form (FBI, 2018).

The severity of terrorist incidents depends upon the method of attack, the proximity of the attack to people, animals, or other assets and the duration of exposure to the incident or attack device. For example, chemical agents are poisonous gases, liquids or solids that have toxic effects on people, animals, or plants. Many chemical agents can cause serious injuries or death. In this case, severity of injuries depends on the type and amount of the chemical agent used and the duration of exposure.

Biological agents are organisms or toxins that have illness-producing effects on people, livestock and crops. There may be a deliberate effort to impact the environment in order to impact things like food production, water supplies, and more (FEMA, N.d.a). Some biological agents cannot be easily detected and may take time to develop, which makes it difficult to know that a biological attack has occurred until victims display symptoms. In other cases, the effects are immediate. Those affected by a biological agent require the immediate attention of professional medical personnel. Some agents are contagious which may result in the need for victims to be quarantined.

In recent years, cyber terrorism has become a larger threat than in years past. 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 (PA Governor’s Office of Homeland Security, 2022). 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. One of the more prominent groups involved in large-scale hacking events recently is the group Fancy Bears from Russia. They have been known to overtake websites, steal information, and alter the content that is presented to the public. The largest threat to institutions from cyber terrorism comes from any processes that are networked and controlled via computer. Any vulnerability that could allow access to sensitive data or processes should be addressed and any possible measures taken to harden those resources to attack. Further information about cyber-terrorism can be found in Section 4.3.19.

An active shooter, as defined by the FBI, is an individual actively engaged in killing or attempting to kill people in a confined area (FBI, 2022b). In most cases, active shooters use firearms and there is no pattern or method to their selection of victims. Recent high-profile incidents involving active shooters since the last plan update include: Uvalde (2022), Buffalo (2022), El Paso (2019), Dayton (2019), and Thousand Oaks (2018). A significant active shooter scenario occurred in Pittsburgh in 2018 when 11 people were killed as a gunman entered a synagogue and opened fire (CBS Pittsburgh, 2018). No substantive research has yet been compiled to address the potential vulnerability to an active shooter incident. Some of these incidents have occurred in public places, and some in places that are considered more restricted like schools. There is no discernible pattern to the location chosen by the shooters.

Instances of terrorism in the Commonwealth have thus far been limited; in the September 11, 2001, attacks, while United Flight 93 crashed in Pennsylvania, its target lay elsewhere. In this incident, four individuals hijacked the plane with the intent of crashing it into a target in Washington, D.C. They failed to reach their destination, and all 40 passengers and crew members on board perished (NPS, 2022).

The worst-case scenario for a terrorism event in Pennsylvania would be if a “dirty bomb” combining radioactive material with conventional explosives were to be detonated in Center City Philadelphia at lunchtime on a weekday. At that time of day and location, a significant number of individuals would be exposed to the bomb’s radiation both at the time of detonation and after the fact as the radiation spread. The explosive device could damage or even topple buildings, spark utility outages citywide, and/or ignite large-scale urban fires. This worst-case scenario is based on a planning scenario used in developing the Pittsburgh Central Business District Evacuation Plan; the location was switched to Philadelphia as the state’s largest population center.

Table 4.3.30-1 Most Likely Lifelines Impacted by Terrorism		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal, compounding, and cascading impacts where community safety is threatened and police, fire, and other government services are either targeted or needed to respond to terroristic threats or actions. Actions to protect communities may be focused on proper planning, procedures, and exercises to ensure government personnel is prepared to respond to events.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery as water resources and the food supply chain may be targeted by biological terrorism.
Energy		Anticipating a causal relationship for the Energy lifeline in response and recovery due to energy infrastructure being a potential target for terrorism.
Hazardous Materials		Anticipating a causal relationship for the Hazardous Materials lifeline in response and recovery due to facilities being a potential target for terrorism due to the potential consequences of material releases.

4.3.30.3. Past Occurrence

There has been a high consciousness of terrorist activity in the press due to the few catastrophic events experienced across the country. The most significant terrorist attack on US soil occurred on September 11, 2001; Flight 93, the fourth hijacked aircraft in the attack, crashed in Somerset County, Pennsylvania. Another significant, and more recent, terrorist event was the detonation of a pair of homemade pressure cooker bombs at the finish line of the 2013 Boston Marathon. This event killed three people and injured a further 264 people. While this event did not happen in Pennsylvania, numerous cities throughout the Commonwealth host similar large scale outdoor activities that could be potential target. PEMA was on a state of heightened alert for the 2013 Philadelphia Marathon, which occurred shortly after the bombing in Boston.

Pennsylvania regularly experiences threats and suspected terrorist activity, as documented in PEMA's incident management system, PEMA-KC. The annual number of incidents reported across the state in the years 2012 to 2017 are summarized in Table 4.3.30-2. Bomb threats represented the majority of incidents in every year.

Table 4.3.30-2 Threat and Suspected Terrorist Activity Events, 2012-2018 (PEMA-KC, 2018)

THREAT/SUSPECTED TERRORIST ACTIVITY TYPE	2012	2013	2014	2015	2016	2017
Biological Threat	0	0	0	0	0	0
Bomb Found	2	5	1	2	2	1
Bomb Threat	29	182	207	206	152	132
Cyber Attacks	0	0	0	0	0	2
Hostage Situation	2	3	3	6	5	2
Sabotage	0	0	0	0	0	0
School Bomb Threat	5	41	37	46	39	24
Suspected Terrorism	0	1	0	0	1	0
Terroristic Threat	1	9	2	4	1	1
Terrorist Activity - totals	*39*	*241*	*250*	*264*	*200*	*162*

Table 4.3.30-3 Threat and Suspected Terrorist Activity Events, 2018-2023 (PEMA-KC, 2023)

THREAT/SUSPECTED TERRORIST ACTIVITY TYPE	2018	2019	2020	2021	2022	2023*	TOTAL
Active Shooter	0	5	1	4	13	15	*38*
Bomb Found	2	16	21	21	17	10	*87*
Bomb Threat	109	69	75	48	65	26	*392*
Chemical Threat	0	0	0	0	0	1	*1*
Cyber Attacks	0	2	7	6	7	3	*25*
Hostage Situation	4	9	13	10	16	4	*56*
Sabotage	0	0	1	0	0	0	*1*
School Bomb Threat	8	6	2	0	9	2	*27*
Suspected Terrorism	0	0	0	1	6	5	*12*
Terroristic Threat	8	24	15	14	6	0	*67*
Terrorist Activity - totals	*131*	*131*	*135*	*104*	*139*	*66*	*706*

*Events totaled through April 2023

In addition, suspicious activity plays into terrorism hazards because of the uncertainty associated with those events. Table 4.3.30-4 displays suspicious activity events as reported to PEMA-KC from 2012 to 2017. Table 4.3.30-5 displays the same information for 2018 to April 2023.

Table 4.3.30-4 Threat and Suspected Suspicious Activity Events, 2012-2017 (PEMA-KC, 2018)						
THREAT/SUSPECTED SUSPICIOUS ACTIVITY TYPE	2012	2013	2014	2015	2016	2017
Suspicious Activity	24	171	117	107	88	70
Suspicious Device	5	20	11	15	12	8
Suspicious Package	8	62	44	38	47	38
Suspicious Substance	0	6	3	6	1	1
Terrorist Activity - totals	*37*	*259*	*175*	*166*	*148*	*117*

Table 4.3.30-5 Threat and Suspected Suspicious Activity Events, 2018-2023 (PEMA-KC, 2023)							
THREAT/SUSPECTED SUSPICIOUS ACTIVITY TYPE	2018	2019	2020	2021	2022	2023*	TOTAL
Suspicious Activity	26	20	24	19	20	16	125
Suspicious Device	4	9	24	18	17	8	80
Suspicious Package	27	13	57	32	24	5	158
Suspicious Substance	0	4	7	2	0	0	13
Terrorist Activity - totals	57	46	112	71	61	29	376
*Events totaled through April 2023							

4.3.30.4. Future Occurrence

Based on historical events, Pennsylvania can expect to experience several terrorist incidents and suspicious activities each year. Note that this estimate is based on the occurrence of past events over a short period of time and is not the result of detailed statistical sampling. Although previous events have not resulted in what are considered significant terrorist attacks, the severity of a future incident cannot be predicted with a sufficient level of certainty. Prediction of terrorist attacks is almost impossible because terrorism is a result of human factors. As long as fringe groups maintain radically different ideas than that of the government or general population, terrorism is a possibility.

4.3.30.5. State Facility Vulnerability Assessment and Loss Estimation

Since the probability of terrorism occurring cannot be quantified in the same way as that of many natural hazards, it is not possible to assess vulnerability in terms of likelihood of occurrence. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets in Pennsylvania, planning efforts can be put in place to reduce the risk of attack. FEMA's *Integrating Manmade Hazards into Mitigation Planning* (2003) encourages site-specific assessments that should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist and vulnerabilities including:

- **Inherent vulnerability:**
  - Visibility – How aware is the public of the existence of the facility?
  - Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
  - Accessibility – How accessible is the place to the public?

- Asset mobility – is the asset's location fixed or mobile?
- Presence of hazardous materials – Are flammable, explosive, biological, chemical and/or radiological materials present on site? If so, are they well secured?
- Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?

- **Tactical vulnerability:**

Site Perimeter

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

Building Envelope

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

Facility Interior

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

All state facilities are vulnerable to terrorism in some way, whether or not the facility itself is the target of an attack. While highly unlikely that all critical facilities would be destroyed in a single event, the total replacement cost of all state critical facilities with known replacement values is $193,956,142,183.

4.3.30.6. Jurisdictional Vulnerability Assessment and Loss Estimation

All communities in the Commonwealth are vulnerable on some level, directly or indirectly, to a terrorist attack. However, larger cities like Philadelphia and Pittsburgh are the most vulnerable to terrorist attacks due to the sheer size of these urban areas, density of the population, and concentration of critical infrastructure located there. Port facilities in Pittsburgh, Philadelphia, and Erie are also possible targets because of their role as logistics hubs. Because of its status as the state capital, Harrisburg also has elevated vulnerability.

Jurisdictional loss estimates can vary greatly in a terrorism event based on the magnitude and type of terrorist action. Catastrophic terrorism events will have proportionally catastrophic losses for the jurisdiction in question. For example, losses may be greater in an event that results in the complete destruction of a high-rise building; in that scenario, losses will stem from loss of life, the actual destruction of the building, and business interruptions. For comparison's sake, the total losses incurred by New York City in the September 11, 2001 attacks are estimated at $83-95 billion. This loss estimate includes lost tax revenue for the city, the cost of response and recovery, business interruptions, deaths, building damage, and infrastructure damage. The cost of evacuation could be significant; the City of Pittsburg estimates that should a large-scale terrorist event occur in the central business district, they would have to evacuate approximately 65,000 workers and approximately 7,000 university students. Likewise, many visitors to the central business district would require evacuation assistance. While Pennsylvania's cities are certainly smaller than New York, losses could still be severe.

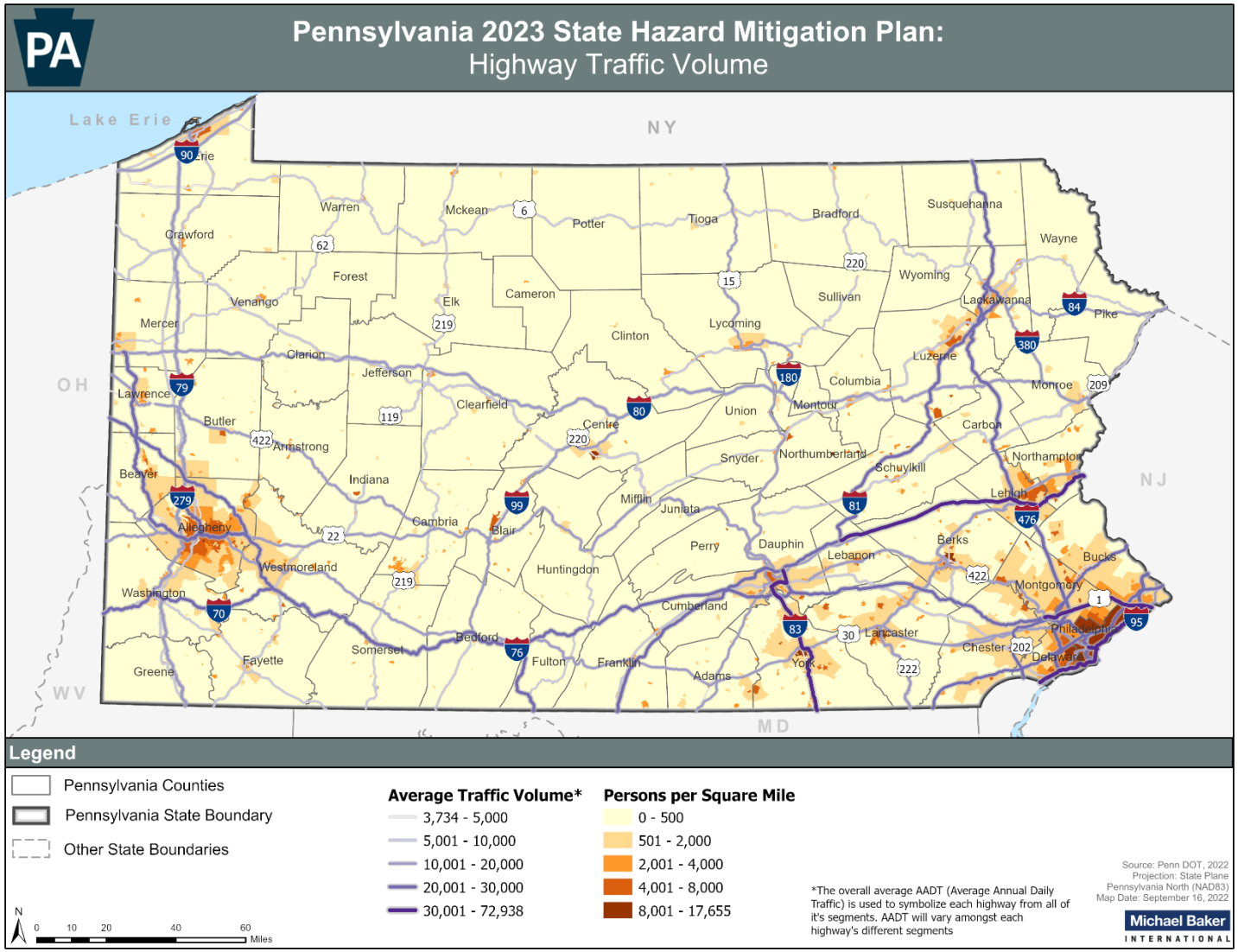
4.3.31. Transportation Incidents

4.3.31.1. Location and Extent

Transportation incidents are defined as incidents involving highway, air, and rail travel. These incidents are collectively the costliest of all hazards in the Commonwealth in terms of lives lost, injuries, and economic losses. Pennsylvania has the fifth largest state highway system in the United States – larger than New York, New Jersey, and New England combined. Pennsylvania's highway transportation network consists of over 120,000 linear miles of roadway, of which Pennsylvania Department of Transportation (PennDOT) is responsible for 41,500 miles, and over 32,000 bridges, of which 25,400 are owned by PennDOT (PennDOT, 2020) (PennDOT, 2022c) . Daily vehicle miles traveled (DVMT) on the Pennsylvania highway system is 233,688,192; 64% of this total occurs in urban areas while 36% occurs in rural areas (PennDOT, 2020). The sheer amount of roadway coupled with the high volume of traffic creates the potential for serious incidents along the Commonwealth's roads and bridges.

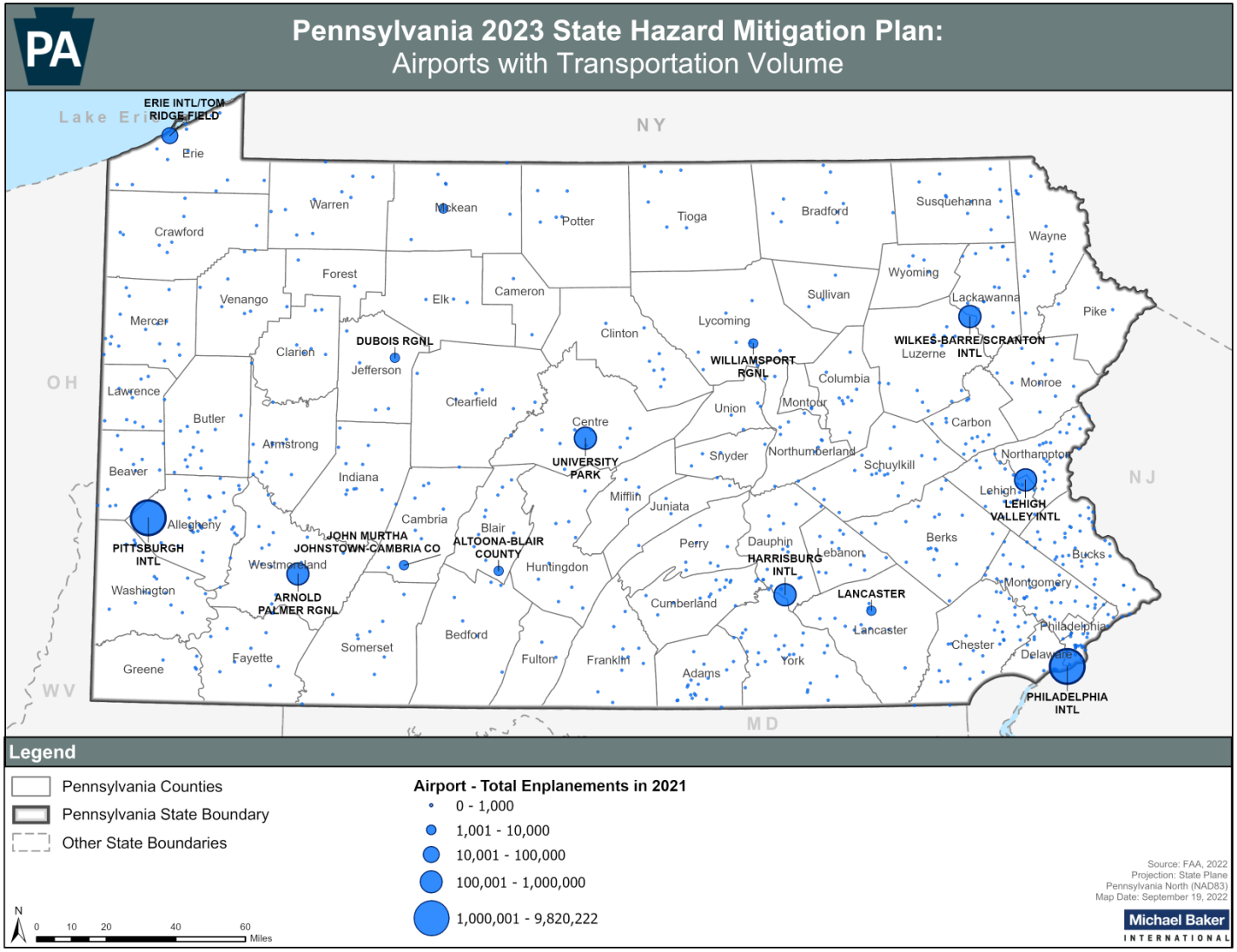
Pennsylvania's highway transportation network encompasses a number of key routes for the movement of goods and people, including Interstates 76 (PA Turnpike), 78, 79, 80, 81, 95, and 476 (PA Turnpike Northeast Extension) and US Routes 1, 15, 22, 30, 202, and 422 (PennDOT, 2016). Figure 4.3.31-1 illustrates the average annual daily traffic for Pennsylvania roads; this map highlights the volume of traffic on these and other key routes. The busiest routes are those connecting major cities. Specifically, the routes connecting cities in the southeast contain the most traffic, as seen between the Philadelphia region, Lehigh valley, and Harrisburg region.

Figure 4.3.31-1 Average Annual Daily Traffic on the Pennsylvania Highway System (PennDOT 2022).



With 121 public use airports (which includes 15 commercial airports), 230 private-use airports and 283 private-use heliports across the Commonwealth (PennDOT, 2023). Considering the number of commercial air traffic flyovers that occur every day, there exists a potential extent for air transportation accidents statewide. However, a five-mile radius around each airport can be considered a high-risk area since most aviation incidents occur near take-off and landing site. Figure 4.3.31-2 illustrates Pennsylvania's major airports and their associated yearly passenger enplanements as reported by the FAA. In total, there 14 airports in Pennsylvania with 1,000 or more passenger enplanements recorded in 2021. The busiest three airports in the Commonwealth include Harrisburg International, Pittsburgh International, and Philadelphia International, with 512,551, 3,069,259, and 9,820,222 passenger enplanements in 2021, respectively.

Figure 4.3.31-2 Pennsylvania Airports and Their Air Transportation Volumes (FAA 2022).



Rail transportation incidents are generally classified as one of three types:

- Derailment – an incident on a railway in which a train leaves the rails;
- Collision – an incident in which a train strikes something such as another train or highway motor vehicle; and
- Other – incidents caused by other circumstances like obstructions on rails, fire, or explosion.

Rail incidents can occur anywhere along the more than 5,000 linear miles of track in the Commonwealth. Rail transportation is divided into two major categories: freight and passenger. Each category can be subdivided according to carrier type: major carrier (SFX, Norfolk Southern, Amtrak, etc.) and local or regional carriers (company/business owned and operated, regional transit agencies, etc.). There are more than 63 railroad companies operating in Pennsylvania (PennDOT, 2022d).

River traffic is now a planning consideration for the Commonwealth. Barges breaking away from moorings or their pilot boats can be a hazard. These barges can carry a wide variety of loads, including hazardous materials. Runaway barges can pose a threat to other river traffic, physical structures over and next to the waterway, and even the properties that line a waterway. Much of the potential threat depends on the load being carried. Recent events in April of 2018 included a barge colliding with a major bridge in downtown Pittsburgh. In addition to barges, recreational boating incidents can pose a threat. There were 56 reported in 2021, the majority of which were from a collision with another vessel or capsizing; the number is down from 54 in 2020 (Walt, 2022).

4.3.31.2. Range of Magnitude

Significant passenger vehicle, air, and rail transportation incidents can result in a wide range of outcomes from damage solely to property to serious injury or death. Most air incidents are non-fatal and cause minor injuries or property damage. The majority of motor vehicle crashes are non-fatal in Pennsylvania, but PennDOT estimates that every hour several people are injured in a car crash, and there are a handful of deaths as a result of a car crash each day. Most fatal crashes occur in May-August but the highest number of crashes overall occur in October-January (PennDOT, 2021).

Some of the most important components of vehicle crashes and their severity are speed, lane departures, and alcohol and seat belt use. Speeding is correlated with both more frequent and more severe crashes, as it reduces the driver's ability to react. Research has even shown that traveling above 50 mph can begin to cancel out many new safety features (Insurance Institute for Highway Safety, 2021a). From 2016-2020, 52% of statewide highway fatalities involved a lane departure (PennDOT, 2022e). In 2020, 21 alcohol-related crashes occurred each day and 44% of driver fatalities in the 31-35 age group were from drinking drivers; roughly 3 out of 4 drinking drivers were male (PennDOT, 2021). Seat belts can reduce the risk of fatal injuries by as much as 60%, while reducing the risk of injury by 65% (PennDOT, 2021).

A growing concern is the size and weight of cars and trucks has been increasing, which has led to a deadlier environment for pedestrians even though they are safer for the driver and any passengers (Insurance Institute for Highway Safety, 2021b). An additional growing concern is electric vehicle considerations for first responders, as EV crashes must be handled a bit different than typical internal combustion engine (ICE) ones. EV fires are less likely to occur, but they burn hotter, require more water, and can even reignite hours or weeks after the initial fire, all of which can create issues for first responders and towing companies (DVRPC, 2022).

The environmental impacts of transportation incidents can vary greatly. In the case of a simple motor vehicle crash, train derailment, or aviation incident, the environmental impact is minimal. However, if the incident involves any type of vehicle moving chemicals or other hazardous materials, the impact will be considerably larger and may include an explosion or the release of potentially hazardous material. Railway and roadway incidents in particular have the potential to result in hazardous materials release (See Section 4.3.24). A train derailment in August 2017 forced the evacuation of a town due to a chemical release, while one in May 2022 resulted in minimal environmental impact according to the EPA. For a complete discussion of the environmental impacts of hazardous materials releases, see Section 4.3.24.

The worst transportation incident on record occurred in May 1998 when a tanker carrying gasoline exploded on Interstate 95 in Delaware County, causing two deaths and significant damage. The fire was so hot that it buckled the bridge girders and forced months of repairs that affected the nation’s major east coast roadway (New York Times 1998). The governor declared this event a disaster; because of its wider impact and declaration status, it can be considered the worst-case event.

Table 4.3.31-1 Most Likely Lifelines Impacted by Transportation Incidents		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal relationship due to the direct harm for the community, including drivers, bicyclists, and pedestrians. Actions to protect communities may focus implementing safety for all road users into project design and implementation.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline in response and recovery due to the significant risk for injury and death that transportation incidents represent.
Hazardous Materials		Anticipating a direct relationship for the Hazardous Materials lifeline due to potential negative consequences of incidents occurring while transporting these materials. These incidents may cascade into impacts associated with environmental contamination. Mitigation actions should focus on proper inspection and maintenance of infrastructure that carries hazardous materials.

4.3.31.3. Past Occurrence

Vehicular transportation crashes are a daily occurrence in the Commonwealth. Every traffic crash involves 3 elements: the driver, roadway, and vehicle (PennDOT, 2021). It has been stated nationally that 85-90% of all traffic crashes involve some sort of driver error that contributes to the crash.

According to PennDOT, in 2020, there was an average of 286 reportable crashes, 3 fatalities, and 168 injuries each day. This comes out to about 12 crashes and 7 injuries every hour, along with 1 fatality every 8 hours. Reportable crashes are crashes resulting in a death or injury in any degree to any person involved or crashes resulting in damage to any vehicle serious enough to require towing. Table Figure 4.3.31-1 shows the leading causes of crashes in 2020.

Table 4.3.31-2 Leading Cause of Crashes in 2020 (PennDOT, 2021)	
CAUSE	NUMBER OF CRASHES
Speeding	25,021
Distracted Driving	11,019
Improper Turning	10,483
Proceeding without clearance	6,799
Drinking Driver	6,565
Improper Passing	4,545
Tailgating/Following Too Closely	4,476
Drowsy Driving	1,948

Reported crashes decreased significantly from 2019 to 2020, partly due to the Covid-19 pandemic and restrictions on non-essential travel. However, as travel restrictions loosened, crash rates increased to pre-COVID-19 levels. This was a 16.6% decrease, which was accompanied by a 6.6% decrease in fatalities and a 19.7% decrease in injuries. Even with this downtrend, 1 out of every 57 people were involved in a reportable crash, with 1 out of every 209 people injured in a reportable crash in 2020. The same statistics were 1:44 and 1:164 in 2018 and 1:45 and 1:168 in 2019. The 1.04 and 1.10 deaths per million vehicle-miles in 2019 and 2020 respectively were the lowest since PennDOT started keeping records in 1935. An increase was seen in 2021 for deaths per 100 million vehicles-miles, increasing to 1.44.

In 2020, pedestrian crashes represented 2.4% of reported crashes, but 12.9% of fatalities. The number one action being taken by pedestrians in crashes and fatal crashes is entering a street crossing. Bicycle crashes represented 0.8% of reported crashes and 1.9% of fatalities. Over one-third of bicycle injuries were suffered by victim's aged 5-19; the 30-34 age group was the most at risk as they accounted for 22.7% of fatalities and 25.4% of injuries.

Table 4.3.31-3 illustrates trends in crashes, deaths, and injuries from 2016-2021 (PennDOT, 2021).

Table 4.3.31-3 Pennsylvania Vehicular Transportation Incident Trends, 2016-2021 (PennDOT, 2021)

	2016	2017	2018	2019	2020	2021
Reported Crashes	129,395	128,188	128,420	125,267	104,472	117,899
Total Fatalities	1,188	1,137	1,190	1,059	1,129	1,230
Total Injuries	82,971	80,612	78,219	76,243	61,248	69,599
Suspected Serious Injury	*4,397*	*4,227*	*4,504*	*4,680*	*4,425*	*5,122*
Suspected Minor Injury	*26,284*	*27,237*	*33,551*	*35,539*	*30,727*	*35,412*
Possible Injury	*23,050*	*22,629*	*17,290*	*15,188*	*10,745*	*12,448*
Unknown Severity	*29,240*	*26,519*	*22,844*	*20,836*	*15,340*	*16,617*
Pedestrian Fatalities	172	150	201	154	146	182
Pedestrian Injuries	4,218	4,106	4,090	4,099	2,788	3,053
Motorcyclist Fatalities	192	185	164	174	217	226
Motorcyclist Injuries	3,321	3,052	2,611	2,860	3,227	3,361
Bicyclist Fatalities	16	21	18	16	22	24
Bicyclist Injuries	1,298	1,127	962	1,003	799	754
Deaths per 100 Million Vehicle-Miles	1.18	1.12	1.17	1.04	1.10	1.44

Aviation incidents are the least frequent type of transportation incident. The National Transportation Safety Board, the federal agency responsible for aviation incident information, indicates that from 2018 - October 2022, there were 145 air transportation incidents in

Pennsylvania. Most of these incidents involved small aircraft and many resulted in only minimal injuries. Of the total incidents, 18 were fatal, resulting in 32 deaths (NTSB, 2022).

According to the Federal Railroad Administration (FRA), there have been 2,110 rail incidents from 2017-2021 in the Commonwealth. During this time, there were reported a total of 1,543 injuries and 103 deaths from these incidents. Table 4.3.31-4 provides an account of these recent rail incidents and their associated damages (FRA, 2022).

Table 4.3.31-4 Rail Incidents in Pennsylvania (2018-2022) (FRA, 2022)

	2018		2019		2020		2021		2022		TOTALS	
COUNTY	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	**TOTAL INCIDENTS**	**TOTAL DAMAGES**
Adams	0	$0	2	$27,604	2	$590,552	0	$0	0	$0	**4**	**$618,156**
Allegheny	12	$1,873,935	6	$183,283	3	$73,598	12	$1,529,543	3	$2,111,768	**36**	**$5,772,127**
Armstrong	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Beaver	15	$304,810	12	$304,103	14	$1,923,872	10	$363,990	6	$498,515	**57**	**$3,395,290**
Bedford	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Berks	1	$200	4	$644,560	0	$0	0	$0	2	$90,306	**7**	**$735,066**
Blair	3	$96,541	2	$1,105,639	2	$27,160	2	$638,099	2	$81,516	**11**	**$1,948,955**
Bradford	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Bucks	4	$232,321	7	$163,753	4	$139,195	3	$59,040	1	$19,863	**19**	**$614,172**
Butler	2	$110,716	0	$0	0	$0	0	$0	0	$0	**2**	**$110,716**
Cambria	2	$86,221	3	$279,498	5	$363,319	1	$210,817	2	$43,208	**13**	**$983,063**
Cameron	0	$0	1	$15,012	0	$0	0	$0	0	$0	**1**	**$15,012**
Carbon	0	$0	0	$0	1	$146,975	0	$0	0	$0	**1**	**$146,975**
Centre	0	$0	0	$0	0	$0	2	$44,504	0	$0	**2**	**$44,504**
Chester	1	$130,000	1	$18,100	4	$55,459	3	$272,000	1	$381,709	**10**	**$857,268**
Clarion	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Clearfield	0	$0	0	$0	0	$0	2	$100,000	0	$0	**2**	**$100,000**
Clinton	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Columbia	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Crawford	0	$0	1	$14,858	0	$0	0	$0	0	$0	**1**	**$14,858**
Cumberland	6	$119,053	7	$323,849	9	$260,986	8	$815,644	11	$168,688	**41**	**$1,688,220**
Dauphin	4	$85,119	2	$345,219	2	$134,438	2	$115,010	0	$0	**10**	**$679,786**
Delaware	5	$2,765,828	5	$82,677	1	$106,075	6	$129,834	2	$15,437	**19**	**$3,099,851**
Elk	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Erie	0	$0	0	$0	1	$67,000	2	$60,319	0	$0	**3**	**$127,319**

Table 4.3.31-4 Rail Incidents in Pennsylvania (2018-2022) (FRA, 2022)												
	2018		2019		2020		2021		2022		TOTALS	
COUNTY	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	**TOTAL INCIDENTS**	**TOTAL DAMAGES**
Fayette	4	$154,909	0	$0	1	$13,317	2	$45,931	0	$0	**7**	**$214,157**
Forest	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Franklin	0	$0	0	$0	0	$0	2	$66,500	0	$0	**2**	**$66,500**
Fulton	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Greene	1	$106,618	1	$18,235	1	$12,734	1	$694,784	1	$451,643	**5**	**$1,284,014**
Huntingdon	1	$786,139	0	$0	0	$0	1	$15,935	0	$0	**2**	**$802,074**
Indiana	2	$853,515	1	$45,700	2	$312,560	0	$0	1	$1,470,299	**6**	**$2,682,074**
Jefferson	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Juniata	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Lackawanna	3	$67,527	2	$342,305	0	$0	3	$193,431	0	$0	**8**	**$603,263**
Lancaster	1	$23,100	0	$0	0	$0	3	$29,889	0	$0	**4**	**$52,989**
Lawrence	2	$26,770	0	$0	0	$0	0	$0	0	$0	**2**	**$26,770**
Lebanon	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Lehigh	1	$191,641	2	$262,284	2	$84,589	5	$74,320	0	$0	**10**	**$612,834**
Luzerne	1	$12,809	0	$0	0	$0	1	$26,731	3	$0	**5**	**$39,540**
Lycoming	0	$0	0	$0	0	$0	1	$19,056	0	$0	**1**	**$19,056**
McKean	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Mercer	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Mifflin	0	$0	1	$938,806	0	$0	0	$0	1	$0	**2**	**$938,806**
Monroe	0	$0	1	$26,296	0	$0	0	$0	1	$0	**2**	**$26,296**
Montgomery	4	$232,872	0	$0	4	$54,638	0	$0	0	$0	**8**	**$287,510**
Montour	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Northampton	3	$86,828	0	$0	0	$0	3	$95,486	2	$0	**8**	**$182,314**
Northumberland	2	$19,322	0	$0	0	$0	0	$0	0	$0	**2**	**$19,322**
Perry	0	$0	0	$0	0	$0	2	$2,025,576	0	$0	**2**	**$2,025,576**
Philadelphia	12	$471,138	14	$651,549	11	$459,243	10	$250,565	9	$0	**56**	**$1,832,495**

Table 4.3.31-4 Rail Incidents in Pennsylvania (2018-2022) (FRA, 2022)												
	2018		2019		2020		2021		2022		TOTALS	
COUNTY	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	INCID.	DAMAGE	**TOTAL INCIDENTS**	**TOTAL DAMAGES**
Pike	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Potter	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Schuylkill	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Snyder	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Somerset	1	$136,887	1	$69,484	0	$0	1	$93,769	0	$0	**3**	**$300,140**
Sullivan	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Susquehanna	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Tioga	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Union	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Venango	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Warren	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Washington	1	$18,961	0	$0	0	$0	0	$0	0	$0	**1**	**$18,961**
Wayne	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
Westmoreland	0	$0	5	$1,549,204	1	$257,400	0	$0	0	$0	**6**	**$1,806,604**
Wyoming	0	$0	0	$0	0	$0	0	$0	0	$0	**0**	**$0**
York	0	$0	1	$59,899	0	$0	3	$4,655,100	0	$0	**4**	**$4,714,999**
TOTAL	**94**	**$8,993,780**	**82**	**$7,471,917**	**70**	**$5,083,110**	**91**	**$12,625,873**	**48**	**$5,332,952**	**385**	**$39,507,632**

4.3.31.4. Future Occurrence

With the volume of goods and people moving through Pennsylvania, transportation incidents will continue to occur routinely, especially passenger vehicle incidents.

In the case of highway incidents, PennDOT has taken great strides to reduce the number of highway transportation incidents through programs such as the Pennsylvania Highway Safety Corridor. In this program, PennDOT designates sections of highway where traffic citation fines are doubled in the hope that higher fines will deter unsafe driving and reduce incidents. PennDOT's 2022 Highway Safety Plan reported that 2000-2020 included the 12 lowest fatality years on record, and states that the department wants to continue this by achieving a 2% annual reduction for fatalities through an increased safety culture, improved integration of Highway Safety Manual methodologies to choose the best safety return on investment for projects, reducing transportation inequities, and more (PennDOT, 2022e). For EVs, DVRPC has begun facilitating training sessions focused on understanding the unique challenges presented by this new model of vehicle by introducing them to the anatomy of EVs, how to tow them, and what hazards they need to be aware of. This effort should help responses to incidents be more standardized and effective in the future, as more EVs hit the road (DVRPC, 2022).

Changes to Pennsylvania's climate will also have an impact on future occurrences of transportation incidents. Changes in precipitation, extreme weather events, and heat pose risks to transportation infrastructure, affecting performance, safety, and reliability. Flooding can weaken roadways and tunnels and potentially lead to landslides that affect highways, railways, and bridges. Rising temperatures can damage roadways, rail infrastructure, and make it more difficult for airplanes to take off (EPA, 2022f). For example in neighboring Maryland, the Department of Health and Mental Hygiene did a review of motor vehicle collisions that found extreme precipitation events led to a 23% increase in motor vehicle incident risk, with incidents 46% more likely on roads with defects or obstructions (Maryland Department of Health and Mental Hygiene, 2017).

An emerging industry in transportation is autonomous or "self-driving" vehicles, often referred to as Highly Automated Vehicles (HAVs). Pennsylvania, and Pittsburgh in particular as Carnegie Mellon is considered the birthplace of the autonomous vehicle, is a hub for research in HAV technology. PennDOT has aided efforts by deploying roadside communication units to enable communication between infrastructure and vehicles and actively contributing to the national effort of developing uniform standards and practices (PennDOT, 2022f). As of October 2022, HAV testing in Pennsylvania required a driver in the car, but legislation was moving to remove this requirement (Irvin-Mitchell, 2022). PennDOT does not currently require reporting on testing activities and no crash records specific to HAVs are maintained; details about oversight, regulations, and liability are in development and not clear at this moment (PennDOT, n.d./2022).

Additionally, the probability of aviation incidents nationwide was 3.45 incidents per 100,000 flight hours in 2016. This incident rate has decreased each year since 2013 when it was 4.95 incidents per 100,000 flight hours (FAA, 2018). This means that the likelihood of air transportation incidents in the Commonwealth remains low.

Overall, the probability of future transportation incidents is *highly likely* as defined by the Risk Factor Methodology (see Section 4.1).

4.3.31.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to highway accidents, all structures located within one-quarter mile of major Interstates, US Highways, and/or state highways, shown in Figure 4.3.31-1, were identified. For this assessment, one-quarter mile was selected as a representative distance within which death, injury, or significant property damage could occur. In addition, the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 2,988, or 67 percent, are located within a quarter mile of an Interstate, US highway, or state highway (Table 4.3.31-5). These facilities have a combined replacement value of more than $1.5 billion, or approximately 39 percent of the known value of geolocated state facilities. The buildings that are reported as owned by the state totals 1,775 of the 2,988 vulnerable state facilities. Overall, the 2,988 vulnerable facilities report 19.9 million square feet of building space.

Table 4.3.31-5 Vulnerability of State Facilities to Highway Accidents

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	8	89%	0	182,998
Department of Agriculture	9	56%	7	1,133,135
Department of Banking and Securities	1	50%	0	4,859
Department of Community and Economic Development	2	50%	0	3,214
Department of Conservation and Natural Resources	1	50%	0	37,703
Department of Corrections	406	58%	383	6,725,335
Department of Education	1	100%	1	0
Department of Environmental Protection	10	77%	1	255,937
Department of General Services	61	47%	56	3,562,184
Department of Health	37	77%	0	171,742
Department of Labor and Industry	41	59%	2	542,484
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	61	62%	0	972,263
Department of Revenue	7	70%	0	132,630
Department of Transportation	1,335	79%	1,186	3,186,959

Table 4.3.31-5 Vulnerability of State Facilities to Highway Accidents				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Drug and Alcohol Programs		0%		
Emergency Management Agency	7	88%	7	105,180
Executive Offices	1	50%	0	11,282
Fish and Boat Commission	108	70%	108	215,996
Governor's Office	1	100%	0	535
Historical and Museum Commission	21	70%	3	8,942
Insurance Department		0%		
Liquor Control Board	421	77%	1	2,400,260
Public School Employees' Retirement System	3	50%	0	8,742
State Civil Service Commission	1	100%	0	620
State Department		0%		
State Employees' Retirement System	1	25%	0	2,115
State Police	24	67%	0	227,867
State System of Higher Education	398	47%		
Thaddeus Stevens College of Technology	20	100%	20	2,200
Treasury Department	2	100%	0	7,483
Total	**2,988**	**67%**	**1,775**	**19,902,665**

Of the 13,448 geolocated critical facilities, 6,687 or 50 percent, are located within a quarter mile of an Interstate, US highway, or state highway (Table 4.3.31-6). These facilities have a combined replacement value of more than $145 billion, or approximately 37 percent of the known value of geolocated critical facilities.

Table 4.3.31-6 Vulnerability of State Critical Facilities to Highway Accidents by Facility Type		
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	156	57%
Banking	4	100%
Commercial	13	62%
Communication	158	28%
Dam	327	22%
Education (colleges and universities)	234	59%
Education (public schools)	2188	47%
Emergency Operation Center	53	75%
Energy	128	35%
Fire Station	1697	65%

Government	6	24%
Hospital	168	54%
National Monument or Icon	1	17%
Nuclear	1	20%
Police Station	893	69%
Transportation	349	51%
Water	311	49%
Total	**6,687**	**50%**

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to air transportation accidents, all structures located within five miles of both public and private airports and heliports with more than 1,000 enplanements per year (14 facilities across state), shown in Figure 4.3.31-2, were identified. For this assessment, five miles was selected as a representative distance within which death, injury, or significant property damage could occur. In addition, the damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 137, or 3 percent, are located within five miles of an airport with more than 1,000 enplanements per year (Table 4.3.31-7). These facilities have a combined replacement value of more than $50 million, or approximately 1.3 percent of the known value of geolocated state facilities. Of the 137 state facilities found to be vulnerable to air transportation accidents, 71 are reported as owned by the state. The total building space comes of all 137 facilities comes to 865,189 square feet.

Table 4.3.31-7 Vulnerability of State Facilities to Air Transportation Accidents

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	2	22%	0	48,269
Department of Agriculture	2	13%	0	7,494
Department of Banking and Securities		0%		
Department of Community and Economic Development	2	50%	0	3,214
Department of Conservation and Natural Resources	1	50%	0	37,703
Department of Corrections		0%		
Department of Education		0%		
Department of Environmental Protection		0%		
Department of General Services		0%		
Department of Health	3	6%	0	16,679
Department of Labor and Industry	2	3%	0	28,747

Table 4.3.31-7 Vulnerability of State Facilities to Air Transportation Accidents

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Department of Military and Veterans Affairs		0%		
Department of Public Welfare	2	2%	0	46,821
Department of Revenue	1	10%	0	11,672
Department of Transportation	78	5%	68	160,426
Drug and Alcohol Programs		0%		
Emergency Management Agency		0%		
Executive Offices		0%		
Fish and Boat Commission	2	1%	2	3,599
Governor's Office	1	100%	0	535
Historical and Museum Commission	2	7%	0	0
Insurance Department		0%		
Liquor Control Board	24	4%	1	465,812
Public School Employees' Retirement System		0%		
State Civil Service Commission		0%		
State Department		0%		
State Employees' Retirement System	1	25%	0	2,291
State Police	2	6%	0	31,927
State System of Higher Education	12	1%		
Thaddeus Stevens College of Technology		0%		
Treasury Department		0%		
Total	**137**	**3%**	**71**	**865,189**

Of the 13,448 geolocated critical facilities, 444, or 3 percent, are located within 5 miles of airports with more than 1,000 enplanements per year (Table 4.3.31-8). These facilities have a combined replacement value of more than $17 billion, or approximately 4.4% of the known value of geolocated critical facilities.

Table 4.3.31-8 Vulnerability of State Critical Facilities to Air Transportation Accidents by Facility Type

TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	9	3%
Banking		0%
Commercial	1	5%
Communication	23	4%
Dam	24	2%
Education (colleges and universities)	25	6%

Table 4.3.31-8 Vulnerability of State Critical Facilities to Air Transportation Accidents by Facility Type		
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Education (public schools)	174	4%
Emergency Operation Center	1	1%
Energy	12	3%
Fire Station	101	4%
Government		0%
Hospital	11	4%
National Monument or Icon		0%
Nuclear	1	20%
Police Station	59	5%
Transportation	51	8%
Water	25	4%
Total	**517**	**4%**

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to rail transportation accidents, all structures located within a quarter mile of rail lines were identified. Rail accidents do not usually cause damage to buildings because of the fixed nature of this mode of transportation, but there still may be damage to state facilities located within one-quarter mile of rail lines. The damage to a given facility will depend on many different facility characteristics, including use, function, construction type, and age. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 1,098, or 25 percent, are located within a quarter mile of a rail line (Table 4.3.31-9). These facilities have a combined replacement value of more than $1.27 billion, or approximately 32 percent of the known value of geolocated state facilities. Nearly half of the vulnerable facilities, 528 to be exact, are owned by the state. Of all the 1,098 vulnerable facilities, reported building space totals 15.1 million square feet.

Table 4.3.31-9 Vulnerability of State Facilities to Rail Transportation Accidents				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	4	44%	0	97,306
Department of Agriculture	4	25%	3	1,056,493
Department of Banking and Securities	2	100%	0	49,820
Department of Community and Economic Development	3	75%	0	6,229
Department of Conservation and Natural Resources	1	50%	1	0
Department of Corrections	136	20%	115	2,491,195

Table 4.3.31-9 Vulnerability of State Facilities to Rail Transportation Accidents

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Department of Education	1	100%	1	0
Department of Environmental Protection	6	46%	0	194,716
Department of General Services	58	44%	48	6,691,116
Department of Health	22	46%	0	99,312
Department of Labor and Industry	39	57%	4	695,945
Department of Military and Veterans Affairs	1	100%	0	2,500
Department of Public Welfare	53	54%	0	1,000,294
Department of Revenue	8	80%	0	141,946
Department of Transportation	357	21%	323	1,208,734
Drug and Alcohol Programs		0%		
Emergency Management Agency	7	88%	7	105,180
Executive Offices		0%		
Fish and Boat Commission	27	18%	26	73,568
Governor's Office	1	100%	0	535
Historical and Museum Commission	10	33%	0	0
Insurance Department	2	100%	0	42,511
Liquor Control Board	205	38%	0	980,065
Public School Employees' Retirement System	4	67%	0	79,076
State Civil Service Commission	1	100%	0	620
State Department		0%		
State Employees' Retirement System	2	50%	0	55,526
State Police	4	11%	0	25,541
State System of Higher Education	138	16%		
Thaddeus Stevens College of Technology		0%		
Treasury Department	2	100%	0	7,483
Total	**1,098**	**25%**	**528**	**15,105,711**

Of the 14,011 geolocated critical facilities, 3,573 or 27 percent, are located within a quarter mile of rail lines (Table 4.3.31-10). These facilities have a combined replacement value of more than $186 billion, or approximately 47 percent of the known value of geolocated critical facilities.

Table 4.3.31-10 Vulnerability of State Critical Facilities to Rail Transportation Accidents by Facility Type

TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Agricultural	110	40%
Banking	3	75%
Commercial	7	33%

Table 4.3.31-10 Vulnerability of State Critical Facilities to Rail Transportation Accidents by Facility Type		
TYPE	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR FACILITY TYPE
Communication	79	14%
Dam	136	9%
Education (colleges and universities)	131	33%
Education (public schools)	854	18%
Emergency Operation Center	18	25%
Energy	124	34%
Fire Station	839	32%
Government	18	72%
Hospital	85	27%
National Monument or Icon	3	50%
Nuclear	3	60%
Police Station	452	35%
Transportation	489	72%
Water	222	35%
Total	**3,573**	**27%**

4.3.31.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to transportation accidents, all census blocks with centers located within one-quarter mile of an Interstate highway, U.S. highway, or State highway were identified. The population, building counts, and building value of all vulnerable census blocks were then aggregated to the county scale.

For highway accidents, the counties with the highest percentage of exposed building value are Cameron, Clinton, and Schuylkill Counties (Table 4.3.31-11). In each of these counties, more than half of the total building value is vulnerable to a highway accident. The counties with the most people exposed to highway accidents, in contrast, are the most populous counties: Philadelphia, Allegheny, and Montgomery. In each of these counties, more than 300,000 people are located within one-quarter mile of a highway. Across the state, about 39 percent of total building value is vulnerable to a highway accident.

Table 4.3.31-11 Vulnerability of People and Buildings to Highway Accidents.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Adams	42,020	16,863	$8,728,886	43%
Allegheny	392,246	164,597	$93,881,610	36%
Armstrong	25,010	12,544	$5,000,848	40%
Beaver	65,559	29,593	$15,145,293	44%
Bedford	16,665	9,557	$4,594,294	38%
Berks	174,320	62,036	$35,534,970	42%
Blair	57,642	25,994	$13,865,906	50%

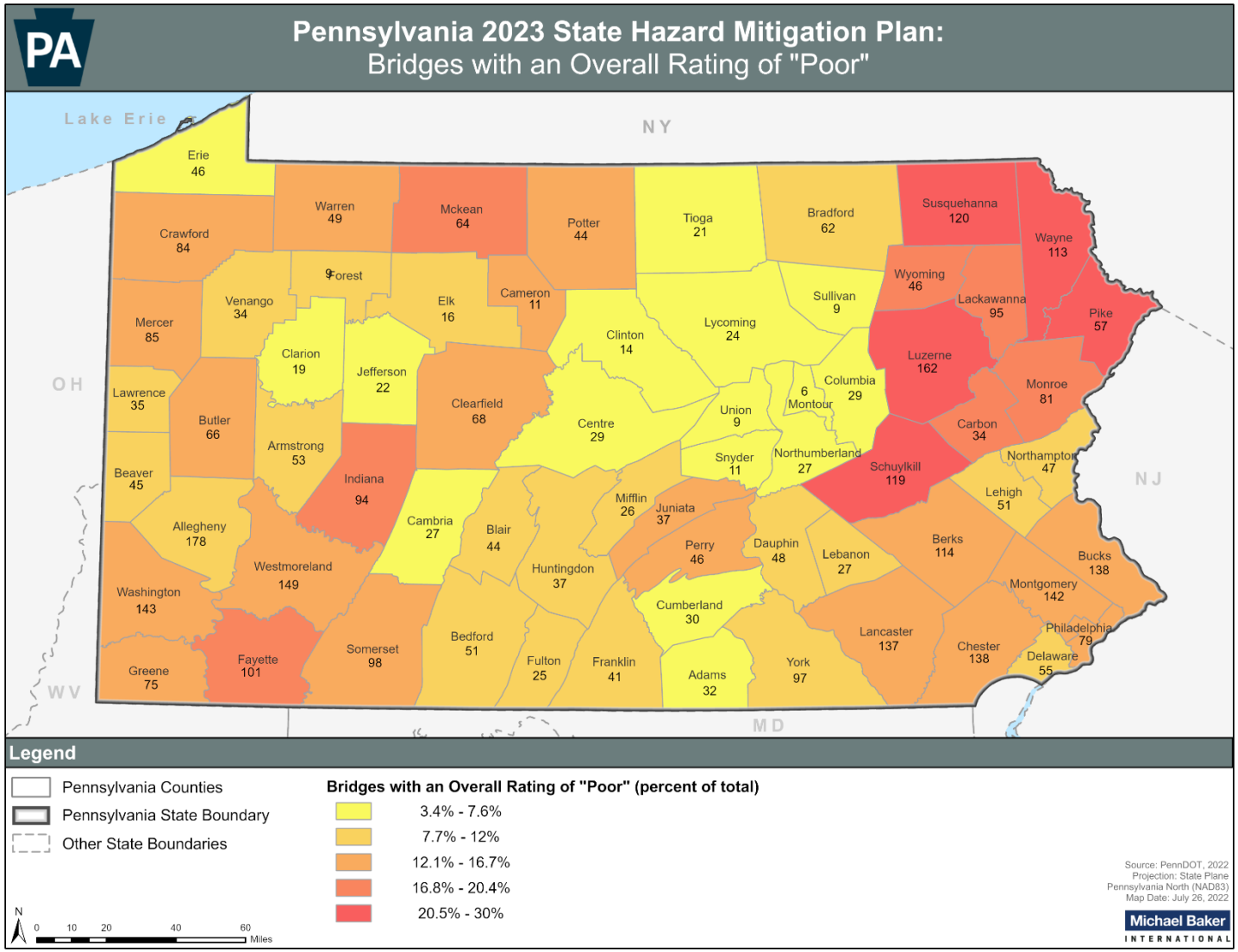
Table 4.3.31-11 Vulnerability of People and Buildings to Highway Accidents.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Bradford	21,113	9,810	$5,131,525	36%
Bucks	217,704	78,863	$55,236,334	35%
Butler	50,174	20,989	$13,608,921	30%
Cambria	50,902	26,400	$13,550,826	41%
Cameron	2,972	1,868	$833,786	66%
Carbon	23,280	11,111	$3,859,772	34%
Centre	73,513	21,540	$10,626,373	35%
Chester	214,705	72,738	$55,961,555	38%
Clarion	14,687	7,073	$3,039,905	37%
Clearfield	26,038	12,385	$6,512,325	39%
Clinton	19,052	7,471	$3,396,167	54%
Columbia	30,015	11,781	$6,271,785	49%
Crawford	30,874	15,419	$8,842,971	36%
Cumberland	103,195	37,355	$22,801,486	42%
Dauphin	102,074	40,173	$26,481,760	43%
Delaware	225,341	76,730	$47,930,534	40%
Elk	12,465	7,228	$3,347,306	40%
Erie	122,355	48,541	$24,025,132	49%
Fayette	38,528	19,557	$8,870,792	36%
Forest	1,159	1,325	$536,969	26%
Franklin	59,645	24,186	$11,705,072	37%
Fulton	4,134	2,372	$1,088,976	24%
Greene	13,156	5,539	$3,237,308	34%
Huntingdon	15,989	7,256	$3,066,939	39%
Indiana	33,635	13,102	$6,951,614	42%
Jefferson	19,924	11,381	$3,872,956	48%
Juniata	8,519	3,904	$1,843,788	42%
Lackawanna	79,406	30,026	$16,695,398	37%
Lancaster	242,271	89,887	$47,807,331	46%
Lawrence	39,220	17,843	$7,343,119	50%
Lebanon	47,335	18,641	$9,634,933	33%
Lehigh	114,171	36,530	$24,237,779	32%
Luzerne	101,671	40,005	$17,939,527	32%
Lycoming	31,591	14,198	$6,099,096	28%
McKean	19,477	9,142	$3,940,494	46%
Mercer	48,581	22,127	$12,129,365	44%
Mifflin	16,700	7,654	$3,094,192	33%
Monroe	43,406	18,498	$11,617,575	31%
Montgomery	308,321	104,107	$75,702,072	37%

Table 4.3.31-11 Vulnerability of People and Buildings to Highway Accidents.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Montour	5,888	2,608	$1,316,956	40%
Northampton	95,254	32,946	$17,256,412	29%
Northumberland	47,366	22,052	$11,586,400	56%
Perry	15,809	7,114	$2,991,613	36%
Philadelphia	601,256	180,394	$110,532,822	43%
Pike	9,048	5,826	$2,931,900	17%
Potter	6,447	3,357	$1,241,365	44%
Schuylkill	78,974	37,784	$15,520,001	53%
Snyder	13,361	6,204	$3,556,393	41%
Somerset	31,239	14,997	$7,878,099	34%
Sullivan	1,897	1,670	$623,369	30%
Susquehanna	12,764	7,076	$3,607,667	26%
Tioga	14,322	7,253	$3,564,034	41%
Union	14,988	5,830	$3,275,940	48%
Venango	16,540	8,718	$3,816,537	39%
Warren	16,253	9,037	$3,339,876	45%
Washington	79,681	37,745	$18,331,213	40%
Wayne	13,218	7,142	$3,212,557	27%
Westmoreland	130,061	64,054	$30,872,865	38%
Wyoming	9,758	4,398	$2,213,268	38%
York	178,531	66,505	$34,240,412	41%
Total	**4,793,415**	**1,858,649**	**$1,047,535,264**	**39%**

With highway accidents, there is an added vulnerability that stems from the age and upkeep of bridges throughout the Commonwealth. Pennsylvania has the second largest number of deficient bridges in the nation with over 4,500 structurally deficient bridges, which is nearly 20% of Pennsylvania's bridges. These bridges have a sufficiency rating of 80 or less and are in need of costly repairs (ASCE, 2017). Unrepaired deficient bridges may be more likely to break, thus leading to highway transportation damages or deaths. Figure 4.3.31-3 illustrates the distribution of structurally deficient and functionally obsolete bridges. Indiana, McKean, and Wayne counties all have at least 25% of their bridges rated as structurally deficient; Allegheny County has by far highest number of deficient bridges with 284. Dauphin, Montour. Northumberland, Snyder, and Union Counties have the lowest proportion of deficient bridges with between 4.4-9% total deficient bridges (PennDOT, 2022).

Figure 4.3.31-3 Structurally-Deficient Bridges in Pennsylvania (PennDOT, 2022).



For air transportation accidents, the counties with the highest percentage of exposed building value are Centre, Lehigh, and Erie Counties (see Table 4.3.31-12). The counties with the most people exposed to air transportation accidents, in contrast, are Erie, Lehigh, and Delaware counties. In each of these counties, more than 50,000 people are vulnerable to an air transportation accident. Across the state, more than $122 billion, or about 5 percent, of total building value is vulnerable to these types of accidents.

Table 4.3.31-12 Vulnerability of People and Buildings to Air Transportation Accidents.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Adams				0%
Allegheny	40,978	15,934	9,781,904	4%
Armstrong				0%
Beaver				0%
Bedford	395	225	94,812	1%
Berks				0%
Blair	5,429	2,728	1,626,108	6%
Bradford				0%
Bucks				0%
Butler				0%
Cambria	25,250	12,067	6,418,826	19%
Cameron				0%
Carbon				0%
Centre	41,898	7,647	11,124,008	36%
Chester				0%
Clarion				0%
Clearfield				0%
Clinton				0%
Columbia				0%
Crawford				0%
Cumberland				0%
Dauphin	27,184	10,310	5,814,189	9%
Delaware	60,811	21,353	9,901,822	8%
Elk				0%
Erie	50,198	19,846	10,552,005	22%
Fayette				0%
Forest				0%
Franklin				0%
Fulton				0%
Greene				0%
Huntingdon				0%
Indiana				0%

Table 4.3.31-12 Vulnerability of People and Buildings to Air Transportation Accidents.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Jefferson	1,579	962	188,580	2%
Juniata				0%
Lackawanna	20,799	8,445	4,187,993	9%
Lancaster	65,619	23,552	12,837,544	12%
Lawrence				0%
Lebanon				0%
Lehigh	104,545	31,989	17,542,359	23%
Luzerne	19,997	8,716	4,263,778	8%
Lycoming	21,083	8,496	3,822,276	17%
McKean	1,441	481	194,937	2%
Mercer				0%
Mifflin				0%
Monroe				0%
Montgomery				0%
Montour				0%
Northampton	34,830	12,309	7,119,168	12%
Northumberland				0%
Perry				0%
Philadelphia	37,719	13,739	9,064,170	3%
Pike				0%
Potter				0%
Schuylkill				0%
Snyder				0%
Somerset				0%
Sullivan				0%
Susquehanna				0%
Tioga				0%
Union				0%
Venango				0%
Warren				0%
Washington				0%
Wayne				0%
Westmoreland	27,083	12,285	6,406,464	8%
Wyoming				0%
York	8,745	3,380	1,222,551	1%
Total	595,583	214,464	$122,163,494	5%

Rail accidents pose a risk to people and property in 65 of Pennsylvania's 67 counties. Table 4.3.31-13 summarizes the exposure of people and buildings to rail accidents in each of Pennsylvania's counties. Philadelphia County has the highest vulnerable population with over 600,000 people living in areas that could be impacted by rail accidents. Philadelphia also has the most vulnerable buildings in both relative and absolute terms. More than 216,000 buildings in Philadelphia are located in areas that could be impacted by rail accidents, representing more than 49 percent of the total building value.

Table 4.3.31-13 Vulnerability of People and Buildings to Rail Transportation Accidents.

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Adams	11,543	4,184	$2,933,160	14%
Allegheny	300,391	128,157	$73,605,791	28%
Armstrong	7,816	3,993	$1,725,496	14%
Beaver	33,931	16,144	$10,580,259	31%
Bedford	1,018	558	$166,037	1%
Berks	96,657	33,434	$20,105,281	24%
Blair	31,246	14,044	$8,090,175	29%
Bradford	8,565	3,932	$2,199,050	15%
Bucks	70,568	28,432	$21,432,472	14%
Butler	16,750	7,318	$4,205,967	9%
Cambria	27,366	14,229	$7,652,574	23%
Cameron	2,616	1,567	$695,042	55%
Carbon	13,490	6,025	$2,225,298	20%
Centre	14,435	4,560	$2,294,802	7%
Chester	82,218	28,791	$22,549,960	15%
Clarion	3,288	1,660	$678,828	8%
Clearfield	18,927	9,026	$5,345,778	32%
Clinton	9,099	3,192	$1,542,561	24%
Columbia	11,936	5,139	$3,303,142	26%
Crawford	9,343	5,311	$3,647,847	15%
Cumberland	52,073	17,622	$12,709,835	23%
Dauphin	50,435	19,253	$13,669,716	22%
Delaware	203,064	63,928	$39,800,080	33%
Elk	7,196	4,284	$2,101,042	25%
Erie	44,943	17,078	$10,938,928	22%
Fayette	22,875	11,338	$4,875,619	20%
Forest	416	450	$183,015	9%
Franklin	21,693	8,548	$6,358,368	20%
Fulton				0%
Greene	6,566	2,558	$1,433,878	15%
Huntingdon	7,250	3,437	$1,598,969	20%
Indiana	14,170	5,865	$3,490,900	21%

Table 4.3.31-13 Vulnerability of People and Buildings to Rail Transportation Accidents.				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	EXPOSED BUILDING VALUE (THOUSAND $)	% OF TOTAL BUILDING VALUE
Jefferson	10,077	5,861	$1,995,681	25%
Juniata	1,495	706	$275,356	6%
Lackawanna	65,109	23,697	$13,613,096	30%
Lancaster	61,324	24,291	$17,461,023	17%
Lawrence	9,100	4,440	$2,450,308	17%
Lebanon	25,442	9,263	$5,978,484	20%
Lehigh	52,520	17,579	$12,458,947	16%
Luzerne	92,413	36,395	$17,509,460	31%
Lycoming	17,576	6,641	$3,685,201	17%
McKean	10,059	5,062	$2,409,352	28%
Mercer	15,719	7,308	$4,438,576	16%
Mifflin	9,582	4,477	$2,292,679	25%
Monroe	7,954	2,722	$2,140,942	6%
Montgomery	175,362	57,135	$42,052,671	20%
Montour	3,268	1,438	$906,146	27%
Northampton	48,233	16,817	$9,834,180	17%
Northumberland	29,712	13,574	$7,701,725	37%
Perry	5,854	2,548	$1,065,873	13%
Philadelphia	681,262	216,990	$126,120,019	49%
Pike	939	577	$250,895	1%
Potter	1	21	$2,241	0%
Schuylkill	31,564	15,545	$6,405,752	22%
Snyder	5,639	1,904	$1,375,678	16%
Somerset	13,210	7,264	$3,709,721	16%
Sullivan				0%
Susquehanna	4,895	2,299	$1,062,040	8%
Tioga	1,950	953	$464,351	5%
Union	11,741	3,559	$2,683,264	39%
Venango	8,027	3,920	$2,010,473	21%
Warren	7,307	3,892	$1,557,065	21%
Washington	41,346	20,564	$10,218,522	22%
Wayne	3,685	1,875	$1,118,001	9%
Westmoreland	64,523	32,251	$15,674,119	20%
Wyoming	2,676	1,247	$670,594	12%
York	63,223	20,949	$14,764,067	18%
Total	2,784,671	1,047,821	$628,496,372	23%

Pennsylvania's metropolitan areas like Greater Philadelphia and the Pittsburgh region maintain the largest risk of both highway transportation and rail transportation accidents due to the high

number of railway tracks, roadway miles, and vehicle miles traveled coupled with high population and economic activity densities.

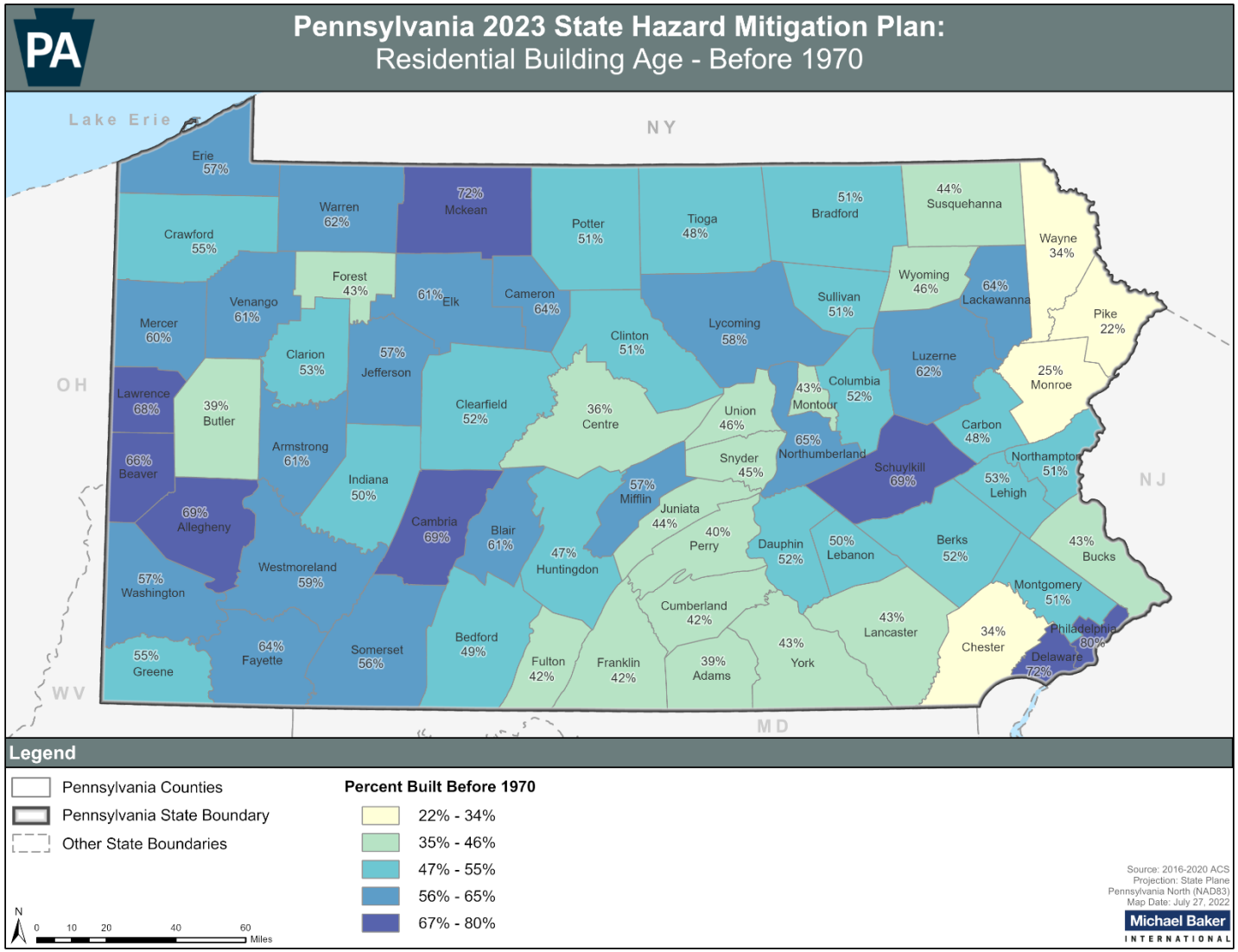
4.3.32. Urban Fire and Explosion

4.3.32.1. Location and Extent

Urban fire and explosion hazards include vehicle and building/structure fires as well as overpressure rupture, overheat, or other explosions that do not ignite. This hazard occurs in denser, more urbanized areas statewide and most often occurs in residential structures. In 2020, there were an estimated 475,000 fires in both residential and nonresidential buildings, resulting in 2,710 deaths and over $11.75 billion in damage (U.S. Fire Administration, 2022). Urban fires can more easily spread from building to building in denser areas. Furthermore, urban fires are a more significant threat in the many areas of the Commonwealth with a significant proportion of buildings built before 1970. Electrical equipment is often a major cause of fire in areas with older buildings, yet cooking has been found be the most common cause of structural fires nationally (U.S. Fire Administration, 2022). Figure 4.3.32-1 illustrates the concentration of residential structures built before 1970 in Pennsylvania.

Urban fires and explosions often begin as a result of other hazards—particularly storms, lightning strikes, drought, transportation accidents, hazardous materials releases, criminal activity (arson), and terrorism.

Figure 4.3.32-1 Percent of Residential Buildings Built Before 1970 (ACS 2016-2020).



4.3.32.2. Range of Magnitude

Fire safety in urban areas is impacted by many factors, including demographics, street layouts, building codes, and more. In general, the extensive networks of roads and streets coupled with the number of local fire departments should provide swift access to fire events. It is anticipated that blockage by damage, debris, and operations will be localized and temporary. However, urban fires have the potential to cause extensive damage to residential, commercial, or public property. Damage ranges from minor smoke and/or water damage to the destruction of buildings. People are often displaced for several months to years depending on the magnitude of the event. Urban fires and explosions can also cause injuries and death.

In Pennsylvania, the fire mortality rate is approximately 2.5 deaths and 9.6 injuries per 1,000 fires. This is higher than the national average which is 2.3 deaths and 7.9 injuries per 1,000 fires. The casualty rate for residential structure fires is greater, with 6.0 deaths and 20.5 injuries per 1,000 fires in Pennsylvania and a national average of 6.0 deaths and 21.7 injuries. Structural fires, including residential and nonresidential buildings, caused 90.0% of deaths, 87.4 % of injuries, and 89.3% of firefighter injuries in 2020. As of April 2023, 36 fatalities caused by home fires have been reported by the U.S. Fire Administration, and in 2022, 168 deaths were caused by home fires. As of April 2023, zero on-duty firefighter deaths have been reported (U.S. Fire Administration, 2023).

There may be environmental impacts related to hazardous materials when a fire event or explosion releases dangerous materials. Economic consequences related to this hazard may also occur. Urban fires and explosions may result in lost wages due to temporarily or permanently closed businesses, destruction and damage involving business and personal assets, loss of tax base, recovery costs, and lost investments in destroyed property.

The secondary effects of urban fire and explosion events relate to the ability of public, private, and non-profit entities to provide post-incident relief. Human services agencies (community support programs, health and medical services, public assistance programs and social services) can be affected by urban fire and explosion events as well. Effects may consist of physical damage to facilities and equipment, disruption of emergency communications, loss of health and medical facilities and supplies, or an overwhelming load of victims who are suffering from the effects of the urban fire, including loss of their home or place of business.

In the most serious urban fire events, the extreme heat of a fire event can damage the underlying infrastructure. For example, in 1996, an eight-alarm tire fire ignited in Philadelphia under Interstate 95. The extreme heat of the fire caused the bridge to buckle and forced two months of repairs to the bridge. The governor declared this event a disaster shortly after it occurred. The worst-case urban fire or explosion event in Pennsylvania occurred in February 1991, when a fire broke out in the One Meridian Plaza skyscraper in Philadelphia. The fire started on the 22nd floor and burned for 18 hours, gutting eight floors and causing an estimated $100 million in property loss. This event also caused the windows in the building to break, granite to crack, and other structural weakening.

Table 4.3.32-1 Most Likely Lifelines Impacted by Urban Fire and Explosion		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and cascading impacts where community safety is threatened, and government personnel are important for response and recovery. Actions to protect communities may be focused on education and awareness programs that increase public knowledge of the risks and best safety precautions.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery as fires and explosions have direct impact on houses and other forms of shelter. Mitigation actions for this lifeline should be focused on protecting buildings from fire damage through building codes.
Health and Medical		Anticipating a cascading relationship for the Health and Medical lifeline in response and recovery due to potential injuries and deaths that may occur.

4.3.32.3. Past Occurrence

Urban fire events occur daily in communities across Pennsylvania. The U.S. Fire Administration's National Fire Data Center (NFDC) provides annual data releases of fire incident information. The NFDC utilizes data reported by fire departments via the National Fire Incident Reporting System (NFIRS) to track and categorize incidents. Table 4.3.32-2 summarizes the categorization of structural fires by their causes in Pennsylvania between 2016-2021. Cooking includes stoves, ovens, deep fryers, and grills. Heating includes confined chimney or flute fires, fuel burners/boilers, central heating, portable units, furnaces, and water heaters. Appliances includes a wide variety of items, including televisions, radios, dryers, washing machines, irons, heat pumps, and air conditioners. The number of structural fires reported in 2021 increased significantly compared to the previous five years, with increases in each listed category aside from cooking, which is typically the main cause of structural fires in the Commonwealth.

Table 4.3.32-2 Number of Structure Fires per Year by Cause (NFDC, 2022)						
CAUSE	2021	2020	2019	2018	2017	2016
Cooking	5,842	4,944	5,892	6,362	4,425	3,479
Heating	1,772	1,258	1,429	1,252	1,281	1,431
Electrical	1,066	743	802	721	726	578
Intentional	927	719	576	495	495	495
Appliances	650	463	478	440	489	327

Table 4.3.32-2 Number of Structure Fires per Year by Cause (NFDC, 2022)						
CAUSE	2021	2020	2019	2018	2017	2016
Smoking	347	266	245	233	258	160
Other	6,436	4,726	4,831	4,398	4,280	3,494
Total	**17,040**	**13,119**	**14,253**	**13,901**	**11,954**	**9,964**

PEMA's State Disaster History lists a number of significant fire events resulting in disaster declarations. An April 1978 fire in East Stroudsburg resulted in a President's Declaration of Major Disaster. A tire fire in March 1997 in Washington County triggered a Gubernatorial Proclamation of Disaster Emergency, as did a fire in McKeesport, Allegheny County in 1976 and a refuse bank fire in August 1972 in Plymouth, Luzerne County. Apartment fires in January 2022, July 2020, and May 2020 along with a December 2018 fire in Philadelphia all warranted Small Business Administration Disaster Declarations since the 2018 SHMP. For more details, see Section 4.2.1.

4.3.32.4. Future Occurrence

Many factors contribute to the cause of urban fires and explosions. Due to the various factors, urban areas in Pennsylvania are considered at risk to one degree or another. Minor urban fires can be expected every day in Pennsylvania. Major fires will continue to occur several times a year, particularly in dense, urban areas with aging building stock. Reducing the risk associated with this hazard requires targeted measures that strengthen both fire resistance and suppression capabilities. The probability of future occurrences may decrease with the construction of new buildings to building codes that address fire prevention, detection, and extinguishment. Also, continued efforts to increase public awareness of the dangers of urban fires will help to mitigate injury, death, and property loss. The probability of future occurrence may increase in communities whose populations are growing and where new areas are developed.

Climate change could potentially impact the future of urban fire risk by impacting the availability of water resources for fire departments and by creating more favorable conditions for fires to both start and burn. While research typically focuses on wildfires, air becoming hotter and drier can lead to higher amounts of moisture drawn from the surrounding environment, increasing the flammability of certain materials (NOAA NIDIS, 2021). Prolonged periods of low precipitation combined with hotter temperatures can create more favorable conditions for fires to start and may increase the likelihood that a fire spreads.

4.3.32.5. State Facility Vulnerability Assessment and Loss Estimation

To assess the vulnerability of state-owned or leased facilities and critical infrastructure to urban fires and explosions, all structures located in high risk census tracts were identified. Urban fire hazard was characterized based on the share of the residential building stock built before 1970. All census tracts in which more than 60 percent of housing units were built before 1970 were defined as high hazard census tracts, and all structures within these census tracts were identified as vulnerable facilities. Note that the magnitude of fire losses will depend on many different conditions, including the nature of the fire, meteorological conditions, and building

characteristics. The results of this assessment represent the potential impacts to state assets based on location, but do not account for these other factors.

Of the 4,460 geolocated state facilities, 1,476, or 33 percent, are located within census tracts characterized by high urban fire hazard (Table 4.3.32-3). These facilities have a combined replacement value of just over $2.5 billion, or approximately 64 percent of the known value of geolocated state facilities. Nearly half of the vulnerable facilities are owned by the state. Overall, of the 1,476 state facilities considered vulnerable total over 18.5 million square feet of building space.

Table 4.3.32-3 Vulnerability of State Facilities to Urban Fire and Explosion

DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
Attorney General	3	33%	0	91,236
Department of Agriculture	3	19%	3	1,051,440
Department of Banking and	1	50%	0	44,961
Department of Community and	4	100%	0	9,750
Department of Conservation and		0%		
Department of Corrections	244	35%	223	3,371,655
Department of Education	1	100%	1	0
Department of Environmental	6	46%	0	115,982
Department of General Services	43	33%	34	7,928,503
Department of Health	28	58%	0	118,873
Department of Labor and Industry	47	68%	7	1,078,326
Department of Military and Veterans Affairs	1	100%	0	2,500
Department of Public Welfare	61	62%	0	1,158,371
Department of Revenue	9	90%	0	146,690
Department of Transportation	453	27%	412	1,559,697
Drug and Alcohol Programs	1	100%	0	17,503
Emergency Management Agency	7	88%	7	105,180
Executive Offices	2	100%	0	39,265
Fish and Boat Commission	2	1%	2	1,504
Governor's Office	1	100%	0	535
Historical and Museum	10	33%	0	0
Insurance Department	2	100%	0	42,511
Liquor Control Board	296	54%	0	1,360,711
Public School Employees' Retirement System	3	50%	0	75,049
State Civil Service Commission		0%		
State Department	1	100%	0	84,349
State Employees' Retirement	1	25%	0	53,208

Table 4.3.32-3 Vulnerability of State Facilities to Urban Fire and Explosion				
DEPARTMENT	# OF VULNERABLE STRUCTURES	% OF ALL STRUCTURES FOR DEPARTMENT	# OF STRUCTURES THAT ARE OWNED	TOTAL REPORTED SQUARE FOOTAGE
State Police	12	33%	0	103,144
State System of Higher Education	213	25%		
Thaddeus Stevens College of	20	100%	20	2,200
Treasury	1	50%	0	2,183
Total	**1,476**	**33%**	**709**	**18,565,326**

Of the 13,448 geolocated critical facilities, 5,243**,** or 37 percent, are located within census tracts characterized by high urban fire hazard (Table 4.3.32-4). These facilities have a combined replacement value of nearly $137 billion, or 35 percent of the known value of geolocated facilities.

Table 4.3.32-4 Vulnerability of Critical Facilities to Urban Fire and Explosion		
TYPE	NUMBER OF VULNERABLE STRUCTURES	PERCENT OF TOTAL STRUCTURES BY TYPE
Agricultural	103	37%
Banking	3	75%
Commercial	10	48%
Communication	175	31%
Dam	209	14%
Education (colleges and universities)	203	51%
Education (public schools)	2000	43%
Emergency Operation Center	38	54%
Energy	83	23%
Fire Station	1112	43%
Government	18	72%
Hospital	169	54%
National Monument or Icon	3	50%
Nuclear	1	20%
Police Station	635	49%
Transportation	383	56%
Water	168	26%
Total	**5,313**	**40%**

4.3.32.6. Jurisdictional Vulnerability Assessment and Loss Estimation

To assess the relative vulnerability of each county to urban fire hazards, the population, building counts, and building value of all high hazard census tracts were aggregated to the county scale (Table 4.3.32-5). As in the state vulnerability assessment, high hazard census tracts were defined as those in which more than 60 percent of the residential building stock was built before

1970. The counties with the highest percentage of exposed building value are McKean, Philadelphia, and Delaware counties. In each of these counties, more than 69 percent of the total building value is vulnerable to urban fire or explosion. The counties with the most people exposed to this hazard are Philadelphia, Allegheny, and Delaware counties.

Table 4.3.32-5 Vulnerability of People and Buildings to Urban Fire and Explosion

COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Adams	7,105	2,198	$1,746,051	9%
Allegheny	836,192	358,675	$161,241,172	61%
Armstrong	31,513	15,771	$5,983,232	48%
Beaver	99,513	43,912	$20,676,818	61%
Bedford	2,805	1,412	$714,681	6%
Berks	149,929	49,321	$24,266,106	28%
Blair	58,993	25,647	$11,379,403	41%
Bradford	12,092	5,317	$2,679,536	19%
Bucks	192,341	67,496	$36,664,466	23%
Butler	25,925	10,559	$4,892,315	11%
Cambria	75,019	37,876	$16,864,178	51%
Cameron	1,923	898	$501,942	40%
Carbon	32,229	15,045	$5,323,882	47%
Centre	7,564	3,026	$1,412,352	5%
Chester	68,985	23,965	$16,977,377	12%
Clarion	5,630	3,160	$974,650	12%
Clearfield	22,655	10,199	$5,524,989	33%
Clinton	5,414	1,742	$660,498	10%
Columbia	20,533	7,005	$4,129,302	32%
Crawford	23,261	8,688	$5,118,874	21%
Cumberland	61,285	22,655	$12,001,504	22%
Dauphin	105,553	40,586	$23,390,666	38%
Delaware	440,269	147,620	$82,369,666	69%
Elk	12,199	6,258	$2,793,990	33%
Erie	122,084	45,209	$21,322,653	44%
Fayette	65,708	32,027	$11,598,415	47%
Forest				0%
Franklin	14,519	5,736	$2,976,840	9%
Fulton				0%
Greene	9,340	4,158	$1,953,341	21%
Huntingdon	12,440	3,575	$1,926,565	24%
Indiana	16,006	7,511	$3,011,356	18%

Table 4.3.32-5 Vulnerability of People and Buildings to Urban Fire and Explosion				
COUNTY	VULNERABLE POPULATION	VULNERABLE BUILDINGS	DOLLAR VALUE OF EXPOSED BUILDINGS, THOUSAND $	PERCENT OF TOTAL COUNTY BUILDING VALUE
Jefferson	14,589	7,533	$2,649,596	33%
Juniata				0%
Lackawanna	119,669	43,085	$20,556,687	45%
Lancaster	103,872	35,124	$18,193,768	17%
Lawrence	51,776	22,798	$8,432,135	58%
Lebanon	44,507	15,303	$7,322,597	25%
Lehigh	181,377	57,971	$27,928,557	37%
Luzerne	178,619	68,604	$26,115,818	46%
Lycoming	53,367	18,870	$8,905,207	41%
McKean	35,227	18,718	$7,505,007	87%
Mercer	57,057	25,355	$11,789,447	42%
Mifflin	10,561	4,484	$1,755,633	19%
Monroe	8,558	2,138	$2,121,205	6%
Montgomery	366,468	122,819	$76,582,845	37%
Montour	4,237	2,004	$920,000	28%
Northampton	111,940	38,243	$16,857,284	29%
Northumberland	55,501	24,544	$12,658,633	61%
Perry				0%
Philadelphia	1,398,825	478,600	$203,948,826	78%
Pike	3,456	1,541	$662,416	4%
Potter				0%
Schuylkill	88,432	42,188	$17,157,003	58%
Snyder	3,638	1,463	$898,285	10%
Somerset	28,806	15,818	$7,749,161	34%
Sullivan				0%
Susquehanna	5,207	2,612	$1,163,853	8%
Tioga	7,164	3,553	$1,689,439	20%
Union	6,649	1,384	$1,201,631	17%
Venango	24,891	12,366	$4,720,731	49%
Warren	18,301	9,864	$3,578,659	48%
Washington	89,647	43,916	$17,660,245	39%
Wayne	4,458	2,000	$985,813	8%
Westmoreland	151,395	74,424	$31,682,162	39%
Wyoming				0%
York	99,142	35,447	$19,268,761	23%
Total	**5,866,360**	**2,240,016**	**$1,053,738,224**	**39%**

4.3.33. Utility Interruption

4.3.33.1. Location and Extent

Utility interruption includes any impairment of the functioning of telecommunication, gas, electric, water, or waste networks. These interruptions or outages occur because of geomagnetic storms, fuel or resources shortage, electromagnetic pulses, information technology failures, transmission facility or linear utility accident, and major energy, power, or utility failure. The focus of utility interruptions as a hazard lies in fuel, energy, or utility failure; this hazard is often secondary to other natural hazard events, particularly transportation accidents, lightning strikes, extreme heat or cold events, and coastal and winter storms.

Utility interruptions occur throughout the Commonwealth but are usually small-scale, localized incidents. Utility interruptions are possible anywhere there is utility service. Figure 4.3.33-1 and Figure 4.3.33-2 illustrate the geographic extent and mileage of liquid pipelines and gas pipelines per county. Figure 4.3.33-3 shows the different parts of the electric grid, with the three main sections being generation, transmission, and distribution. Outages often occur in the distribution grid, which is part of the reason that interruptions are usually small scale and localized.

This hazard has the potential to affect a significant number of Pennsylvanians. According to the 2016 estimates of the American Community Survey, there are 5.6 million occupied housing units in the Commonwealth. The U.S. Energy Information Administration (EIA) estimates that 51 percent of these households use natural gas as their main heating fuel, while 22 percent use electricity to heat their home, and 18 percent use fuel oil (EIA, 2017). This means that should a utility interruption occur statewide, nearly 4.6 million households could be without heat or cooling.

An emerging utility concern is the overall dependence on internet access. Telecommunications companies operate throughout the Commonwealth; each of these is subject to outages of a few minutes to weeks.

Figure 4.3.33-1 Liquid Pipeline Mileage per County (NPMS, 2022).

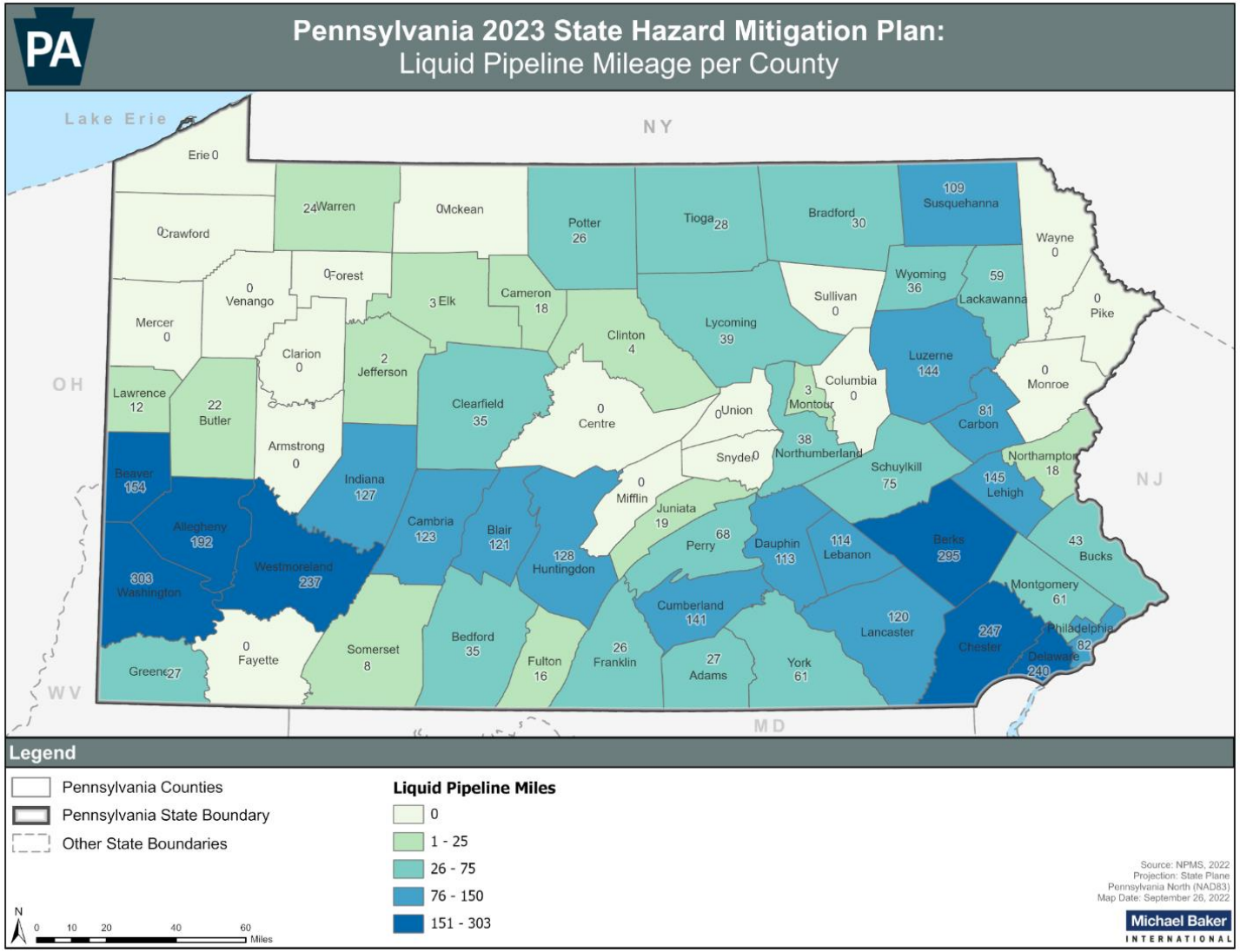


Figure 4.3.33-2 Gas Pipeline Mileage per County (NPMS, 2022).

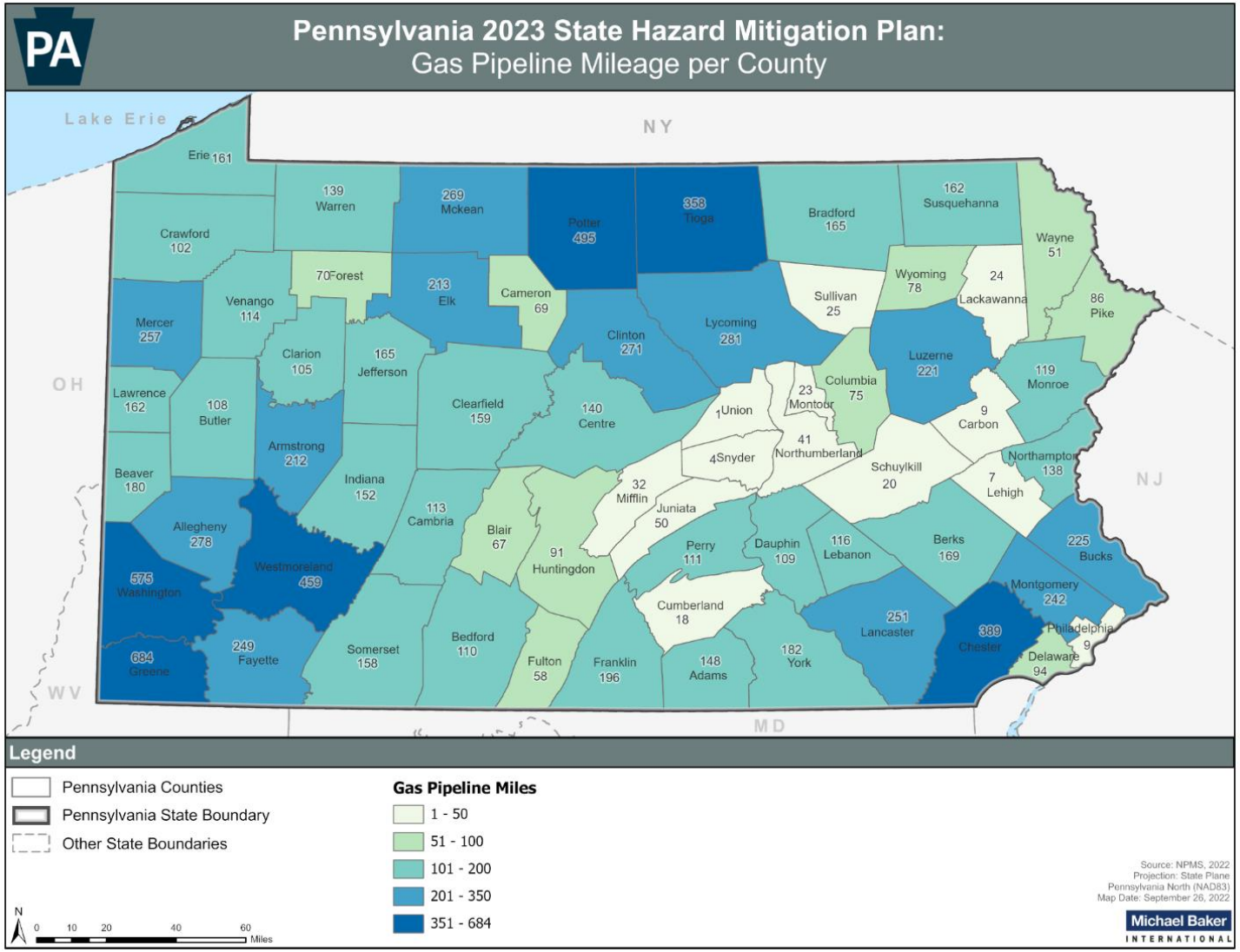
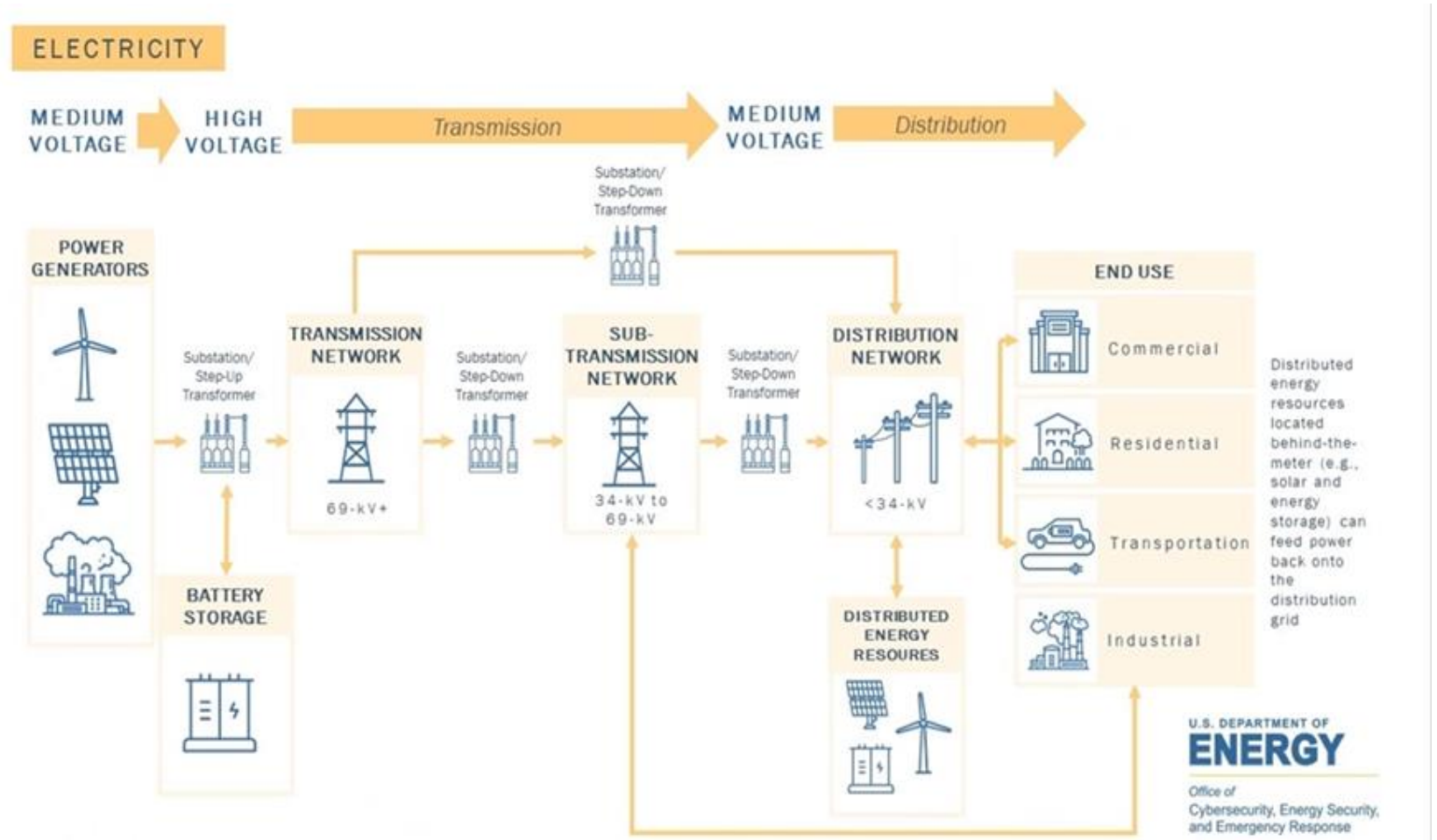


Figure 4.3.33-3 Parts of the Electric Grid



4.3.33.2. Range of Magnitude

The most severe utility interruptions will be regional or widespread power and telecommunications outages. With the loss of power, electrically powered equipment and systems will not be operational. Examples may include lighting; HVAC and ancillary support equipment; communication (e.g., public-address systems, telephone, computer servers, and peripherals); ventilation systems; fire and security systems; refrigerators, sterilizers, trash compactors, office equipment; and medical equipment. Power outages can cause food spoilage, loss of heat or air conditioning, basement flooding (sump pump failure), lack of light, loss of water (well pump failure), lack of phone service, or lack of internet service. However, this is most often a short-term nuisance rather than a catastrophic hazard. The most significant impact associated with utility interruptions is when the interruption involves a release of hazardous materials. This hazardous material may be released in a pipeline accident or when a material is in transit. For a complete discussion on the impacts of a hazardous materials release, see Section 4.3.23. Utility pipelines carrying flammable materials also have the possibility of exploding or starting a fire.

There are a number of secondary impacts associated with utility interruptions. First, interruptions could affect the ability of the government to function, especially if backup power generation/supply is inadequate or unavailable. Utility interruptions also can reduce the efficient and effective communication that is essential to first responders. Heating loss and severe cold can also impact the health and safety of at-risk populations like young children, the elderly and disabled individuals.

The severity of a utility interruption can be compounded with extreme weather events, especially winter weather events. Interruptions can also be more severe for special needs populations that are dependent on electronic medical equipment. Utility interruptions can significantly hamper first responders in their efforts to provide aid in a compound disaster situation, especially with losses of telecommunications and wireless capabilities. Telecommunications interruptions will also hinder first responders' efforts. Additionally, an internet outage could be crippling to the economy of the state, especially as recent industry changes have led to both significant increases in employees working from home.

In a possible worst-case scenario, a winter storm event causes widespread power outages, leaving citizens without heat in the midst of subzero temperatures. The power outage also means that elderly populations or others at risk of health problems due to the lack of heat are unable to call for assistance or leave their homes. Power lines are unable to be repaired because of the magnitude of the storm, and the power outage lasts for several days.

Table 4.3.33-3 Most Likely Lifelines Impacted by Utility Interruption		
Lifelines	Impact Type	Notes
Safety and Security		Anticipating both causal and cascading impacts where government facilities may be impacted directly and the capability to administer services diminished. Mitigation for this lifeline should include plans to install backup power generation to ensure essential services are still available.
Food, Water, Shelter		Anticipating a causal relationship for the Food, Water, Shelter lifeline in response and recovery as water and electrical utilities in homes and potentially different aspects of the food supply chain will be impacted. Mitigation actions for this lifeline should be focused on developing more grid resilience to reduce the number and severity of interruption events.
Health and Medical		Anticipating both causal and cascading impacts for the Health and Medical lifeline as healthcare facilities may be impacted directly and therefore the capacity to deal with patients is diminished. Mitigation for this lifeline is similar to Safety and Security.
Energy		Anticipating cascading impacts for the Energy lifeline as fuel usage may increase as a result of electricity no longer being available for an extended period of time.

4.3.33.3. Past Occurrence

Utility interruptions are largely minor, routine events, but there have been several Presidential and Gubernatorial Disaster Declarations in which a utility interruption was a major component of a disaster. A series of bankruptcies in 1972 led the major steam heat provider in Lower Merion Township to cut off heat to residents with no intention of resuming service in the wintertime; the governor declared the event a disaster. December 1974 brought heavy snow that led to widespread power outages in the Southwestern Counties, leading to a Gubernatorial Disaster Declaration. In January 1977, the nation's gas shortage coupled with severe winter weather led to a President's Declaration of Emergency. In March 2018, four nor'easters struck southeastern Pennsylvania, affecting Philadelphia, Delaware, Montgomery, Chester, Lehigh, Pike, Carbon, and Northampton counties. The storms' high winds and heavy snowfall caused down trees and powerlines, leaving an estimated 500,000 customers without power (PEMA, 2018).

According to data compiled by the Pennsylvania Public Utility Commission (PUC), rain and high winds are the most common cause of utility interruptions. In 2021, for example, 39 of the 40 electricity interruption events reported to PUC were caused by rain and high winds. These 40 events affected a total of 1,213,585 electricity customers in the course of the year (Table 4.3.33-4).

Table 4.3.33-4 Electricity Interruption Events Reported to Pennsylvania Public Utilities Commission in 2021 (PUC, 2022)

ELECTRIC DISTRIBUTION COMPANY	OUTAGE DATE	NUMBER OF CUSTOMERS AFFECTED	CAUSE
Penelec	1/1/21	11,873	Freezing rain & ice
Penelec	1/3/21	13,135	Heavy, wet snow
PPL	2/15/21	8,903	Ice, sleet, snow, wind
PPL	3/1/2021	18,979	High wind event
DLC	3/26/21	14,163	Cold front w/high winds & rain
Met-Ed	3/26/21	19,515	Cold front w/high winds & rain
Penelec	3/26/21	54,784	Cold front w/high winds & rain
Penn Power	3/26/21	18,666	Cold front w/high winds & rain
Met-Ed	4/30/21	25,280	High wind event
Penelec	4/30/21	38,925	High wind event
Met-Ed	5/26/21	14,731	Severe tstorms, lightning, high winds
DLC	6/13/21	51,762	Severe tstorms, lightning, high winds
Met-Ed	6/21/21	25,398	Severe tstorms, lightning, high winds
Penelec	6/29/21	23,146	Severe tstorms, lightning, high winds
Penelec	7/11/21	18,417	Severe tstorms, high winds, heavy rains
DLC	7/13/21	10,945	Severe tstorms, high winds, heavy rains
Penelec	7/16/21	22,729	Severe tstorms, high winds, heavy rains
PECO	7/17/21	28,299	High winds, heavy rain, lightning
PECO	7/21/21	92,950	High winds, heavy rain, lightning
Met-Ed	7/28/21	9,840	High winds, heavy rain, lightning
PECO	7/29/21	11,417	High winds, heavy rain, lightning
Met-Ed	7/6/21	34,472	Stalled cold front & severe tstorms
Penelec	7/6/21	61,821	Stalled cold front & severe tstorms
DLC	7/7/21	30,312	Severe tstorms, high winds, heavy rains
Penelec	7/12/2021	42,137	Severe tstorms, high winds, heavy rains
Met-Ed	8/10/21	32,810	Severe tstorms & high winds
Penelec	8/11/21	29,544	Severe tstorms & high winds
DLC	8/12/21	51,904	Severe tstorms & high winds
DLC	8/29/21	22,389	Severe tstorms & high winds
Penelec	8/29/21	10,225	Severe tstorms & high winds
Met-Ed	9/1/21	61,317	Hurricane Ida remnants
PECO	9/1/21	164,989	Hurricane Ida remnants

Table 4.3.33-4 Electricity Interruption Events Reported to Pennsylvania Public Utilities Commission in 2021 (PUC, 2022)			
ELECTRIC DISTRIBUTION COMPANY	OUTAGE DATE	NUMBER OF CUSTOMERS AFFECTED	CAUSE
DLC	10/21/21	3,928	Severe storms & tornadoes
Met-Ed	10/29/21	17,199	Heavy rains, lightning, & high winds
PECO	10/29/21	43,755	Heavy rains, lightning, & high winds
DLC	12/11/21	12,310	Severe tstorms & high winds
Met-Ed	12/11/21	10,005	Severe tstorms & high winds
Penelec	12/11/21	29,855	Severe tstorms & high winds
Met-Ed	12/21/21	5,331	(Substation) Transformer tap changer failure
Met-Ed	12/6/21	15,425	High winds and heavy rains
Total Customers Affected		**1,213,585**	

Table 4.3.33-5 illustrates past occurrences of gas distribution and transmission incidents and hazardous liquid incidents as reported to the Pipeline and Hazardous Materials Safety Administration (PHMSA, 2023b).

Table 4.3.33-5 Utility Interruption Events Reported to Pipeline and Hazardous Materials Safety Administration 2010 to 2022 in Pennsylvania (PHMSA, 2023b)			
GAS DISTRIBUTION INCIDENTS			
YEAR	INJURIES	FATALITIES	TOTAL COST AS REPORTED ($)
2010	1	0	$87,962
2011	7	6	$2,592,795
2012	0	0	$0
2013	0	0	$521,399
2014	1	1	$1,017,026
2015	1	0	$411,679
2016	4	0	$563,967
2017	5	1	$1,483,322
2018	1	0	$266,762
2019	1	2	$1,699,401
2020	2	1	$1,161,401
2021	0	0	$287,602
2022	7	5	$191,149
Total	**30**	**16**	**$10,284,465**
GAS TRANSMISSION INCIDENTS			
YEAR	INJURIES	FATALITIES	TOTAL COST AS REPORTED ($)
2010	0	0	$122,819
2011	0	0	$23,709,144
2012	1	0	$435,776
2013	0	0	$564,402
2014	0	0	$2,941,426
2015	0	0	$1,482,612
2016	1	0	$20,893,540
2017	0	0	$213,330
2018	0	0	$507,964

Table 4.3.33-5 Utility Interruption Events Reported to Pipeline and Hazardous Materials Safety Administration 2010 to 2022 in Pennsylvania (PHMSA, 2023b)			
GAS DISTRIBUTION INCIDENTS			
YEAR	INJURIES	FATALITIES	TOTAL COST AS REPORTED ($)
2019	0	0	$372,329
2020	0	0	$2,138,031
2021	0	0	$303,028
2022	0	0	$9,924,408
Total	**2**	**0**	**$63,608,809**
HAZARDOUS LIQUID INCIDENTS			
YEAR	INJURIES	FATALITIES	TOTAL COST AS REPORTED ($)
2010	0	0	$101,000
2011	0	0	$1,383,678
2012	0	0	$525,463
2013	0	0	$1,600,967
2014	0	0	$1,555,228
2015	0	0	$637,475
2016	0	0	$2,903,161
2017	0	0	$405,431
2018	0	0	$3,970,219
2019	0	0	$8,003,321
2020	0	0	$125,000
2021	0	0	$651,538
2022	0	0	$170,321
Total	**0**	**0**	**$22,032,802**

4.3.33.4. Future Occurrence

Utility interruptions will continue to occur annually with minimal impact. Widespread utility interruption events usually occur approximately once every five years, usually as a secondary effect of an extreme weather event like a severe winter storm. These interruptions should be anticipated, and first responders should be prepared during severe weather events. Research by the NOAA suggests that climate change may cause more extreme storms, like the March 2018 nor'easters, to occur in Pennsylvania (NOAA, 2018).

Aging infrastructure also adds to the risk of potential utility interruptions. Population growth, urbanization and climate change can put strain on existing assets used to deliver utilities. The boom in natural gas production is a perfect example of this, as new pipeline projects have needed to be started to handle the increased load on the existing system, which over half the transmission pipeline miles are at least 45 years old (ASCE, 2018). In addition to gas transmission lines, electricity infrastructure is also aging. Most of the transmission and distribution infrastructure in the state was built in the 1950s and 60s, with lines dating back as far as the 1920s (ASCE, 2018).

As this equipment ages, it deteriorates from the constant wear and tear of service. And eventually reaches a point at which it will either fail on its own or as a result of outside forces (storms, loads it was designed to handle but no longer can, etc.). These failures cause service interruptions and can require expensive emergency repairs, the timing of which is also impacted

by the age of the infrastructure (DTN, 2021). The wholesale replacement of a system is not a feasible solution for utility companies, as it would require the interruption of services as well as accessing the existing system (which may lay under roads, private property, or other inconvenient places). As a result, there is often a mix of new and old equipment along the line because companies choose repair and not replacement to resolve an issue. However, when the PA Public Utility Commission reported record outage incidents in 2021, they noted that most of the issues were from storm events and not necessarily aging infrastructure (PUC, 2022). As infrastructure continues to age, this may change. The 2022 ASCE Report Card for Pennsylvania Infrastructure listed weatherization and resilience efforts amongst their recommendations for how to raise the grade given to the energy infrastructure, which was a C. (ASCE, 2022).

Discussions on how to develop grid resilience are constantly underway. A more granular, people and experience focused approach has become a focus, including best practices such as micro grids, micro loans, engaging local decision-makers, workforce development, and an equitable distribution of benefits.

4.3.33.5. State Facility Vulnerability Assessment and Loss Estimation

All state facilities are somewhat vulnerable to utility interruptions. Some key indicators of increased vulnerability to utility interruption include the presence of ground- or basement-level utilities, reliance on electronic banking, like the Department of the Treasury, or facilities located in isolated or in wooded areas where a downed tree might cause a utility interruption. According to Carnegie Mellon University's CyLab, locations with publicly accessible or shared computer workstations are more vulnerable to malicious internet outages.

Facilities that have independent generators are less vulnerable to the effects of utility interruption. For example, DGS is responsible for installing generators in DGS-managed buildings. Partner tenants are encouraged to request new or retro-fit generators and budget appropriately.

Additionally, state agencies complete COOP and COG plans to reduce overall state facility/state agency vulnerability to utility interruptions. Plans take into account situations in which an agency might need to move to an alternate location due to a utility outage. Other statewide efforts that will help prepare state entities for utility interruptions include trainings on the Homeland Security Exercise Evaluation Program, trainings for the Office of Administration/IT staff, and trainings with PJM, a regional transmission organization that coordinates the movement of electricity in 13 states and the District of Columbia.

Also, the 634 energy facilities and 635 water facilities in the inventory of state critical facilities may experience greater revenue losses as the Commonwealth's utility providers. There is added vulnerability for state facilities located in jurisdictions that are prone to severe weather events.

4.3.33.6. Jurisdictional Vulnerability Assessment and Loss Estimation

All jurisdictions are vulnerable on some level to utility interruptions, but because this hazard often occurs in conjunction with other hazards, jurisdictions that have been identified as more

vulnerable to winter storms, temperature extremes, tornado, hail events, and lightning strikes may be more vulnerable to a utility interruption.

In the majority of utility interruption events, jurisdictional losses will be minimal. However, long-term and widespread outages can cause significant economic losses stemming from lost income, costs to government and social services agencies, costs to the utility provider, and the cost of spoiled commodities. For example, the Anderson Economic Group estimated that the August 14, 2003 blackout that caused more than 50 million people to lose power for 31 hours had a total economic cost of between $4.5 and $8.2 billion. While this was a regional event that impacted most of the Northeast and parts of Canada, it indicates how significant utility interruptions can be. Additionally, a significant reduction in the supply of any energy resource would impose serious personal and economic hardship on individuals, businesses, and industry. Escalating energy cost compounded with prolonged winter weather conditions could place adequate home heating fuel beyond the reach of elderly and low-income individuals. Also, in more prolonged utility interruption events, there may be illnesses and deaths related to heat or cold exposure.

4.4. Development Trends and Vulnerability

This plan recognizes that vulnerability to hazard events is not static. As development patterns in the Commonwealth evolve, the distribution of at-risk people and property will change, and the magnitude and frequency of certain hazard events will evolve as well. Flooding, for example, is exacerbated by the conversion of fields and forests to roads, roofs, and parking lots. As less rainfall is absorbed and more drainage infrastructure is added, runoff volumes and rates are amplified. This can lead, in turn, to more frequent and extreme flash flooding.

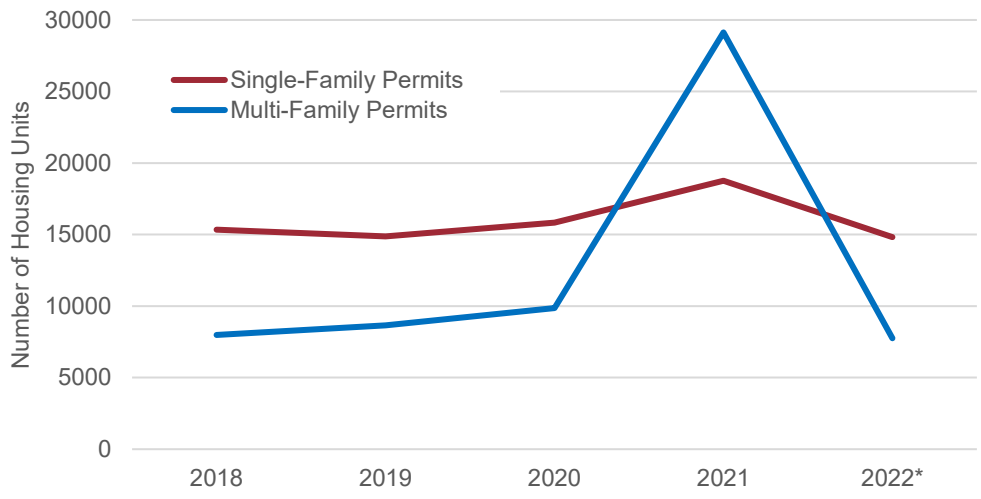
The following sub-sections present data that describes development trends based on Census Bureau's Building Permits Survey, National Land Cover Database, and PA DEP Population Projections. Review shows that permits and land cover trends and population trends do not align throughout the Commonwealth. Areas with projected population decline like Lackawanna, Luzerne, and Lycoming Counties and Allegheny and three of its surrounding counties have an increase in permits and urbanized land. Increases in new housing permits while population is projected to decline can be a result of more land consumption or 'green field' development. This typically leads to more exposure to natural hazards like flooding and wildfire, and in the case of flooding increased impact with less open space to absorb water. The differences in the data can also be linked to the strength of the projections; it is possible that with the 2020 US Census that trends from population will change in these areas so that the population projections 'catch-up' with the more recent permit data. The permit, land use, and population growth trends align in the rest of the Commonwealth such that Southeast and South Central, Lehigh Valley, and the counties of Butler, Centre, Erie, Monroe, and Washington have growth shown across the statistics. The difference between data sources and possible implications will be described in detail in the updated SOG, so that counties will consider how these trends apply to risk and mitigation in their communities.

4.4.1. Development Trends Between 2018 and 2023

Building permit and land cover data provide some of the best information on recent development trends at the state scale. For building permits, the most comprehensive source of data is the Census Bureau's Building Permits Survey, which compiles data on residential construction permits issued by about 21,000 jurisdictions across the nation. According to the data for 2018-2022, the rate of new residential construction in Pennsylvania was relatively stable even through the beginning of the Covid-19 pandemic, but 2021 saw a large spike in multi-family permits and a lesser increase in single family ones. 2022 data shows that permits returned to that relatively stable trend, which was also showcased in the 2013-2017 data from the 2018 SHMP. As shown in Figure 4.4.1-1, single-family units were more stable with around 15,000 issued per year with a jump to almost 19,000 in 2021. This increase resulted in the most single-family permits authorized since the subprime mortgage crisis in 2008. Around 8-10,000 multi-family units were authorized per year, with a large increase to over 29,000 in 2021. This is the largest amount of multi-family permits authorized since the Census Bureau began tracking data in 1995. One of the main drivers of this increase is the 23,704 multi-family units that were authorized in Philadelphia. 9,506 of those were approved in December 2021, which may have been a result of preemptive permits being filed right before the changes to a city program that allow a 10-year tax abatement for new construction (Moselle, 2022). An additional explanation for the large increase in housing permits is the favorable market conditions that resulted from

the Covid-19 pandemic. 2022 numbers show a return to the relatively stable trend observed before this outlier year, but were labeled as preliminary and do not include December.

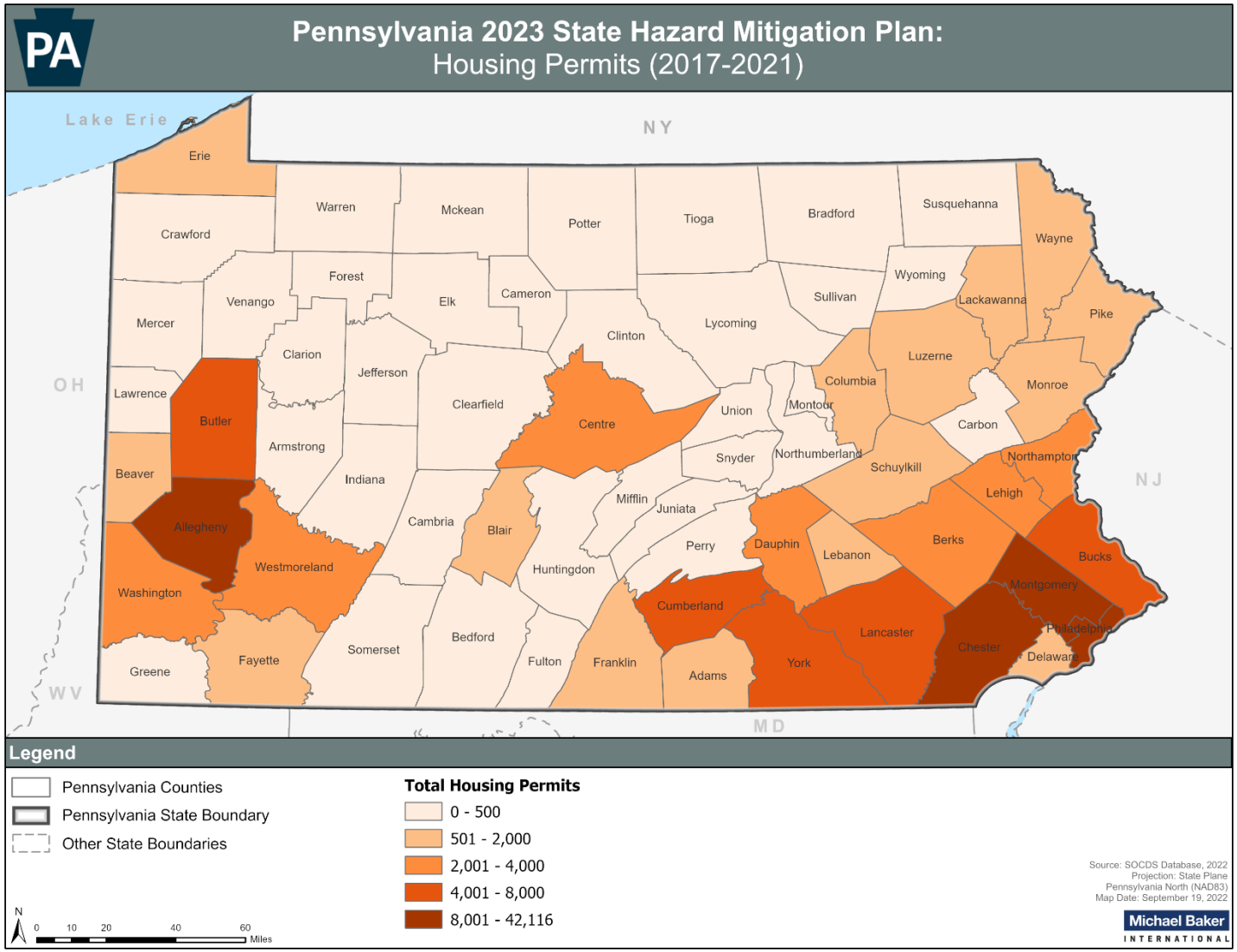
Figure 4.4.1-1 Housing Units Authorized for Construction in Pennsylvania, 2018-2022 (US Census, 2023).



*2022 data does not include December

As highlighted in the 2021 analysis above, the rate of potential new residential construction in Pennsylvania has varied significantly from county to county. As shown in Figure 4.4.1-2, the number of housing units authorized for construction between 2018 and 2022 ranged from less than 700 in some counties to more than 7,000 in others. It is important to note that 2022 data was labeled as preliminary and does not include the month of December. The county experiencing the highest rate of residential development was Philadelphia County with 41,515 total units. This is more than double the next two counties, Allegheny and Chester, combined. Those three counties were the only ones over 9,000 units. Montgomery, Lancaster, York, and Cumberland are the only other counties over 5,000 units, with Butler County barely missing that threshold with 4,820. Lackawanna County had reported over 3,700 units in the 2018 SHMP analysis, but only 1,019 units were recorded between 2018-2022. Once again, development is focused in the Southeastern portion of the state, with additional focal points in Allegheny County and the surrounding counties. Centre County was a hotspot of development compared to the rest of its neighbors.

Figure 4.4.1-2 Housing Units Authorized for Construction by County from 2017 to 2021 (Census, 2022).

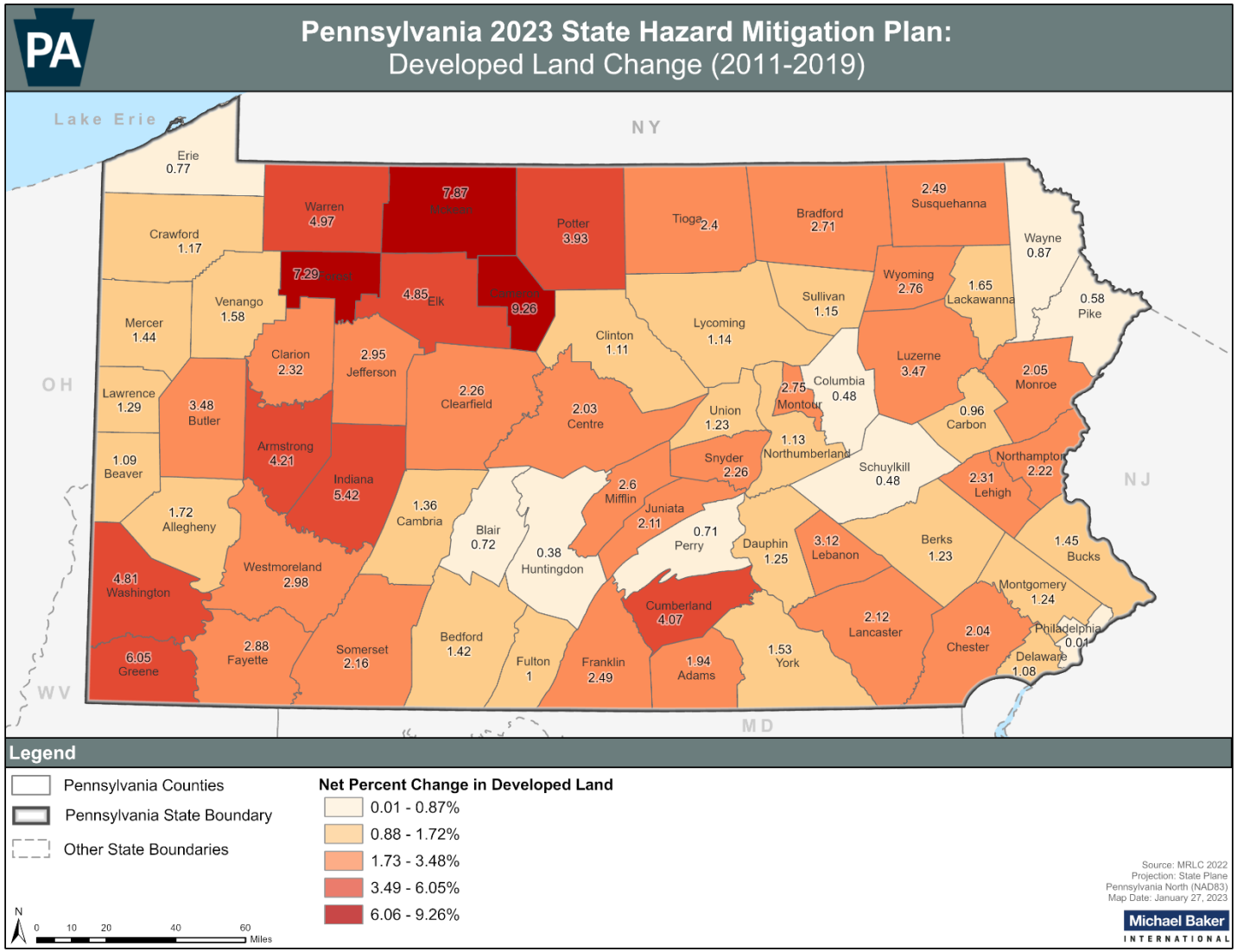


Access to housing is another important part of development trends and vulnerability. Pennsylvania is currently experiencing an affordable housing crisis that coincides with national trends, with a statewide shortage of over 485,000 rental units for low-income households and most low-income households are spending more than 30 percent of their income on housing and utilities. While the total population of individuals experiencing homelessness in Pennsylvania has decreased by 18 percent since 2007, the percentage of the population that is unsheltered and/or chronically experiencing homelessness has increased along with the percentage of students experiencing homelessness. The impacts of the COVID-19 pandemic, namely rising home prices and mortgage rates without relative wage increases and the increase in institutionally owned rental homes, has exacerbated the issue. Low-income populations, when they can rent or own, are more likely to live in homes that are vulnerable to the impacts of disasters due to the poor quality of construction, age, or location of the home. These households are also more likely to have trouble in applying for and receiving aid and therefore the damage suffered is difficult to properly fix. More information on affordable housing in Pennsylvania can be found in Appendix O.

Another important measure of changes in development patterns is land cover data. The most comprehensive source of land cover data at the state scale is the Multi-Resolution Land Characteristics Consortium's National Land Cover Database (NLCD). The NLCD uses satellite data to map land use and land cover across the nation at 30-meter resolution. While permit records indicate where development has been approved to move forward, the NLCD shows were development has occurred. Figure 4.4.1-3 illustrates how the newly developed land area between 2011 and 2019 varied across the state. The three counties that experienced the highest growth in developed area were Cameron, Forest, and McKean in the Northwest. Three counties adjacent to those, Elk, Potter, and Warren, also saw relatively high growth. This contrasts the permit data, but rural counties with low levels of developed land to begin with may not necessarily need a large number of permits to create noticeable changes in developed area. It is more likely that development in these areas is less dense. This phenomenon is reversed in Allegheny, Philadelphia, and other Southeastern counties that experienced small land cover changes but continue to report high permit numbers, as they are most likely building on already built-up land. The same is possible in Erie County. The Southwest saw high growth rates in the counties surrounding Allegheny County, and Cumberland was a somewhat isolated instance of high growth in the South Central region. The far Northeast and a handful of counties in Appalachia saw the lowest growth.

Taken together, building permit and land cover data for the state of Pennsylvania show that the state's **high growth building areas are concentrated in and around Allegheny and Philadelphia Counties, in the Lehigh Valley, and in Cumberland and Centre Counties**. Conversely, these data show that **low growth rates prevail in Central PA, along the Northwest border, and some areas in the Southern Alleghenies.**

Figure 4.4.1-3 Percent of Land Area Newly Developed from 2011 to 2019 (MRLC 2022)).



4.4.2. Projected Population

Population projections extrapolate from past trends to predict how population will change in the future. These projections give an indication of where development is likely to occur in the future, and how the people, property, and infrastructure exposed to hazard events will evolve with time. Table 4.4.1-1 illustrates how the population of the Commonwealth is expected to change through 2040. According to this projection, Pennsylvania is expected to experience a nearly 10 percent increase in population between 2010 and 2040. The population projections are also based on older data from the 2010 US Census which could contribute to the difference between permit and population trends presented in this section. There has not been an updated projection study with new 2020 Census data, but 2020 projections are compared to actual figures to assess the state of these projections after their first milestone year.

Table 4.4.1-1 Population Projections of Pennsylvania Counties (PA DEP, 2012)

COUNTY	2010 CENSUS POPULATION	2020 PROJECTED POPULATION	2030 PROJECTED POPULATION	2040 PROJECTED POPULATION	PERCENT (%) CHANGE BETWEEN 2010 & 2040
Adams	101,407	112,355	122,794	133,523	31.67
Allegheny	1,223,348	1,179,072	1,155,460	1,136,415	-7.11
Armstrong	68,941	67,049	64,823	62,788	-8.93
Beaver	170,539	164,862	157,895	151,666	-11.07
Bedford	49,762	50,857	51,200	51,952	4.40
Berks	411,442	444,991	480,374	514,836	25.13
Blair	127,089	125,409	123,517	121,747	-4.20
Bradford	62,622	63,708	64,319	65,201	4.12
Bucks	625,249	662,439	693,715	728,370	16.49
Butler	183,862	196,325	205,865	217,076	18.06
Cambria	143,679	136,812	131,401	124,494	-13.35
Cameron	5,085	4,762	4,381	4,033	-20.69
Carbon	65,249	67,562	70,987	73,777	13.07
Centre	153,990	166,921	182,921	197,168	28.04
Chester	498,886	552,006	607,694	661,915	32.68
Clarion	39,988	39,396	38,625	37,957	-5.08
Clearfield	81,642	83,541	83,351	84,355	3.32
Clinton	39,238	40,127	41,395	42,447	8.18
Columbia	67,295	69,295	71,986	74,287	10.39
Crawford	88,765	90,493	90,385	91,326	2.89
Cumberland	235,406	254,802	275,462	295,400	25.49
Dauphin	268,100	283,087	298,465	313,620	16.98
Delaware	558,979	562,848	567,327	571,458	2.23
Elk	31,946	30,920	28,953	27,523	-13.85
Erie	280,566	283,031	283,942	285,742	1.84

Table 4.4.1-1 Population Projections of Pennsylvania Counties (PA DEP, 2012)					
COUNTY	2010 CENSUS POPULATION	2020 PROJECTED POPULATION	2030 PROJECTED POPULATION	2040 PROJECTED POPULATION	PERCENT (%) CHANGE BETWEEN 2010 & 2040
Fayette	136,606	133,578	127,240	122,794	-10.11
Forest	7,716	8,665	9,823	10,861	40.76
Franklin	149,618	163,024	180,267	195,318	30.54
Fulton	14,845	15,338	16,123	16,573	11.64
Greene	38,686	38,605	37,858	37,492	-3.09
Huntingdon	45,913	46,905	47,740	48,518	5.67
Indiana	88,880	88,458	87,959	87,504	-1.55
Jefferson	45,200	44850	44,287	43,846	-3.00
Juniata	24,636	26,669	28,577	30,556	24.03
Lackawanna	214,437	211,584	211,150	209,334	-2.38
Lancaster	519,445	567,331	615,323	663,255	27.69
Lawrence	91,108	89,083	87,057	85,032	-6.67
Lebanon	133,568	142,898	154,224	164,409	23.09
Lehigh	349,497	374,744	403,711	430,553	23.19
Luzerne	320,918	316,833	316,271	313,696	-2.25
Lycoming	116,111	115,313	113,437	112,176	-3.39
McKean	43,450	41,801	39,863	38,090	-12.34
Mercer	116,638	115,521	114,429	113,323	-2.84
Mifflin	46,682	46,948	47,224	47,495	1.74
Monroe	169,842	195,103	221,427	247,144	45.51
Montgomery	799,874	851,171	900,477	950,920	18.88
Montour	18,267	18,567	18,713	18,946	3.72
Northampton	297,735	320,507	345,538	369,278	24.03
Northumberland	94,528	93,744	93,513	92,966	-1.65
Perry	45,969	48,372	50,788	53,197	15.72
Philadelphia	1,526,006	1,530,000	1,536,544	1,541,630	1.02
Pike	57,369	66,868	76,604	86,205	50.26
Potter	17,457	17,924	17,798	18,010	3.17
Schuylkill	148,289	146,579	145,376	143,883	-2.97
Snyder	39,702	41,121	42,961	44,560	12.24
Somerset	77,742	77,872	76,855	76,493	-1.61
Sullivan	6,428	6,629	6,654	6,780	5.48
Susquehanna	43,356	44,987	46,389	47,922	10.53
Tioga	41,981	42,361	42,873	43,309	3.16
Union	44,947	48,195	51,486	54,752	21.81
Venango	54,984	53,118	50,963	48,974	-10.93

Table 4.4.1-1 Population Projections of Pennsylvania Counties (PA DEP, 2012)					
COUNTY	2010 CENSUS POPULATION	2020 PROJECTED POPULATION	2030 PROJECTED POPULATION	2040 PROJECTED POPULATION	PERCENT (%) CHANGE BETWEEN 2010 & 2040
Warren	41,815	10,455	38,815	37,335	-10.71
Washington	207,820	209,198	213,722	216,448	4.15
Wayne	52,822	58,386	63,105	68,307	29.32
Westmoreland	365,169	363,665	363,832	361,236	-1.08
Wyoming	28,276	28,423	28,599	28,758	1.70
York	434,972	477,643	523,716	567,845	30.55
PA TOTAL	***12,702,379***	***13,101,704***	***13,536,552***	***13,964,799***	***9.94***

It is also important to note that these population figures are projections derived from birth rates, death rates, and migration information and may not fully anticipate economic and social dynamics. Table 4.4.2-2 below highlights how even projections 10 or less years into the future can be difficult to make, as unexpected events such as the Covid-19 pandemic, which also impacted the collection of census data, can have unforeseen impacts on all three of the variables that go into making the projections. Some counties grew when they were projected to decline, some counties changed at a smaller rate but in the same direction, some grew at a large rate in the same direction. Pennsylvania as a whole grew at a slightly slower rate than was projected, with only twenty-three counties experiencing an increase in population. Allegheny County, the second largest in the state, actually saw over 2% growth yet was projected to see over a 3.5% decline and Philadelphia County, the largest, was expected to grow a modest .26% yet actually saw a 5.1% increase. This seems to point towards urban populations growing at a higher rate than expected. The largest difference was in Warren County, which was projected to see a 75% decline in population but only experienced a 7.72% one. It is unclear why such a large decline was expected.

Table 4.4.1-2 Difference in Projected and Actual Change 2010-2020					
COUNTY	2010 CENSUS POPULATION	2020 PROJECTED POPULATION	2020 CENSUS POPULATION	PROJECTED CHANGE	ACTUAL CHANGE
Adams	101,407	112,355	103,852	10.80%	2.41%
Allegheny	1,223,348	1,179,072	1,250,578	-3.62%	2.23%
Armstrong	68,941	67,049	65,558	-2.74%	-4.91%
Beaver	170,539	164,862	168,215	-3.33%	-1.36%
Bedford	49,762	50,857	47,577	2.20%	-4.39%
Berks	411,442	444,991	428,849	8.15%	4.23%
Blair	127,089	125,409	122,822	-1.32%	-3.36%

Table 4.4.1-2 Difference in Projected and Actual Change 2010-2020					
COUNTY	2010 CENSUS POPULATION	2020 PROJECTED POPULATION	2020 CENSUS POPULATION	PROJECTED CHANGE	ACTUAL CHANGE
Bradford	62,622	63,708	59,967	1.73%	-4.24%
Bucks	625,249	662,439	646,538	5.95%	3.40%
Butler	183,862	196,325	193,763	6.78%	5.39%
Cambria	143,679	136,812	133,472	-4.78%	-7.10%
Cameron	5,085	4,762	4,547	-6.35%	-10.58%
Carbon	65,249	67,562	64,749	3.54%	-0.77%
Centre	153,990	166,921	158,172	8.40%	2.72%
Chester	498,886	552,006	534,413	10.65%	7.12%
Clarion	39,988	39,396	37,241	-1.48%	-6.87%
Clearfield	81,642	83,541	80,562	2.33%	-1.32%
Clinton	39,238	40,127	37,450	2.27%	-4.56%
Columbia	67,295	69,295	64,727	2.97%	-3.82%
Crawford	88,765	90,493	83,938	1.95%	-5.44%
Cumberland	235,406	254,802	259,469	8.24%	10.22%
Dauphin	268,100	283,087	286,401	5.59%	6.83%
Delaware	558,979	562,848	576,830	0.69%	3.19%
Elk	31,946	30,920	30,990	-3.21%	-2.99%
Erie	280,566	283,031	270,876	0.88%	-3.45%
Fayette	136,606	133,578	128,804	-2.22%	-5.71%
Forest	7,716	8,665	6,973	12.30%	-9.63%
Franklin	149,618	163,024	155,932	8.96%	4.22%
Fulton	14,845	15,338	14,556	3.32%	-1.95%
Greene	38,686	38,605	35,954	-0.21%	-7.06%
Huntingdon	45,913	46,905	44,092	2.16%	-3.97%
Indiana	88,880	88,458	83,246	-0.47%	-6.34%
Jefferson	45,200	44850	44,492	-0.77%	-1.57%
Juniata	24,636	26,669	23,509	8.25%	-4.57%
Lackawanna	214,437	211,584	215,896	-1.33%	0.68%
Lancaster	519,445	567,331	552,984	9.22%	6.46%
Lawrence	91,108	89,083	86,070	-2.22%	-5.53%
Lebanon	133,568	142,898	143,257	6.99%	7.25%
Lehigh	349,497	374,744	374,557	7.22%	7.17%
Luzerne	320,918	316,833	325,594	-1.27%	1.46%
Lycoming	116,111	115,313	114,188	-0.69%	-1.66%
McKean	43,450	41,801	40,432	-3.80%	-6.95%
Mercer	116,638	115,521	110,652	-0.96%	-5.13%

Table 4.4.1-2 Difference in Projected and Actual Change 2010-2020					
COUNTY	2010 CENSUS POPULATION	2020 PROJECTED POPULATION	2020 CENSUS POPULATION	PROJECTED CHANGE	ACTUAL CHANGE
Mifflin	46,682	46,948	46,143	0.57%	-1.15%
Monroe	169,842	195,103	168,327	14.87%	-0.89%
Montgomery	799,874	851,171	856,553	6.41%	7.09%
Montour	18,267	18,567	18,136	1.64%	-0.72%
Northampton	297,735	320,507	312,951	7.65%	5.11%
Northumberland	94,528	93,744	91,647	-0.83%	-3.05%
Perry	45,969	48,372	45,842	5.23%	-0.28%
Philadelphia	1,526,006	1,530,000	1,603,797	0.26%	5.10%
Pike	57,369	66,868	58,535	16.56%	2.03%
Potter	17,457	17,924	16,396	2.68%	-6.08%
Schuylkill	148,289	146,579	143,049	-1.15%	-3.53%
Snyder	39,702	41,121	39,736	3.57%	0.09%
Somerset	77,742	77,872	74,129	0.17%	-4.65%
Sullivan	6,428	6,629	5,840	3.13%	-9.15%
Susquehanna	43,356	44,987	38,434	3.76%	-11.35%
Tioga	41,981	42,361	41,045	0.91%	-2.23%
Union	44,947	48,195	42,681	7.23%	-5.04%
Venango	54,984	53,118	50,454	-3.39%	-8.24%
Warren	41,815	10,455	38,587	-75.00%	-7.72%
Washington	207,820	209,198	209,349	0.66%	0.74%
Wayne	52,822	58,386	51,155	10.53%	-3.16%
Westmoreland	365,169	363,665	354,663	-0.41%	-2.88%
Wyoming	28,276	28,423	26,069	0.52%	-7.81%
York	434,972	477,643	456,438	9.81%	4.94%
PA TOTAL	***12,702,379***	***13,101,704***	***13,002,700***	***3.14%***	***2.36%***

As shown in both tables above and Figure 4.4.2-1 below, Pennsylvania's overall growth, both actual and projected, is not evenly spatially distributed. Eight out of ten counties that saw the largest percentage increase in population from 2010-2020 are in the Southeast region, with Cumberland County's regional designation potentially pushing that number to nine. Most of the counties that saw the largest percentage decreases were in either the Northeast or Northwest, with four counties from each region landing in the top ten. It's important to note that most of these counties are among the least populated to begin with, so any changes will have larger impacts on percentage changes.

In general, the Northeast region is expected experience very rapid growth (greater than 40%) from 2010-2040 due to development pressure from the greater New York City metropolitan area. Pike and Monroe Counties are expected to have the highest population growth rates from 2010-2040 in the Commonwealth, with population increases of 50% and 45.5%, respectively. They were also expected to grow 16.5% and 14.8% from 2010-2020, but, their actual growth rates in that time were 2% and -0.9%, respectively. Wayne County is also expected to experience significant growth in both the 2010-2020 and 2010-2040 timelines (29.32%, 10.5%), but actually saw its population decline 3.2% between the census years. Forest County in the Northwest region is also expected to experience very rapid growth (40.8%) across those 30 years and 12.3% from 2010-2020, but had an actual growth rate of -9.6%. The high growth expectations from DEP have not yet materialized in this region, but as stated above the social and economic dynamics that play into population changes can be difficult to predict.

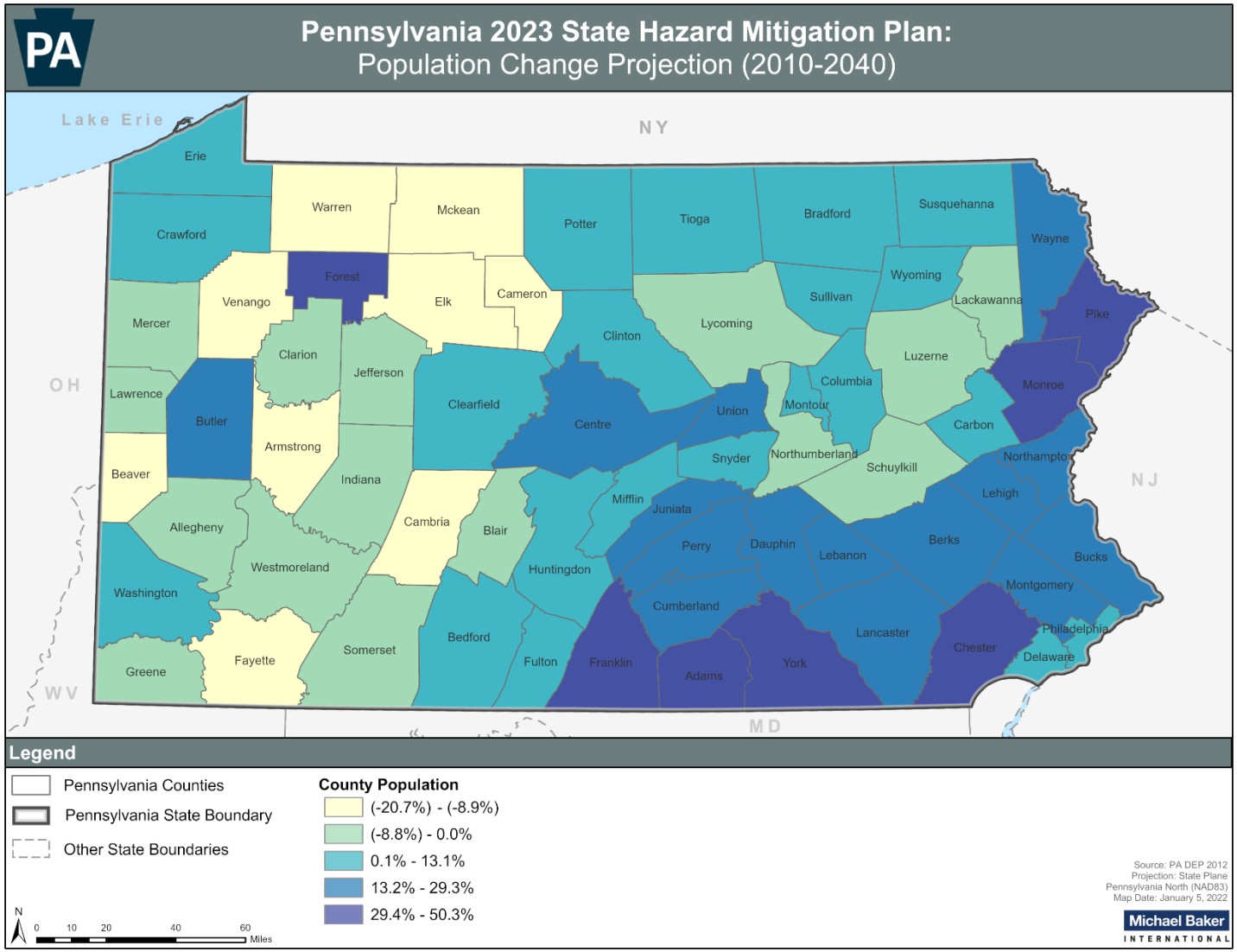
In general, the South Central and Southeast regions are expected to experience rapid growth (greater than 25%) between 2010 and 2040. The nine counties expected to experience growth rates greater 25% and less than 40% are Adams, Berks, Centre, Chester, Cumberland, Franklin, Lancaster, and York. Most of these counties are in the South Central and Southeast regions of the Commonwealth, with the exception of Centre County in the Central region. Every one of those counties ranked in the top seventeen for actual growth rate between 2010-2020. Cumberland led the way with a massive 10.2% growth rate, the rest following with anywhere between 2.4-7.1% growth. These high growth counties were expected to experience a similar phenomenon to Northeast Pennsylvania, with development pressure and exurban sprawl around Baltimore, MD, Washington, DC, and Philadelphia fueling population growth and land conversion from farmland to developed land. DEP's growth expectations for these counties have been fairly accurate so far, with most growing a bit slower than anticipated.

Many counties in Pennsylvania are expected to lose population or experience only slight growth between 2010 and 2040. These declines are typically in rural areas in the Northern Tier region and in the area surrounding Pittsburg with Allegheny and many of its surrounding counties. In Allegheny, Armstrong, Beaver, Cambria, Cameron, Elk, Fayette, McKean, Venango, and Warren counties, population is expected to decline by 7% or more. The rates of decline range from 7.1% in Allegheny County to 20.7% in Cameron County. Cambria, Cameron, Fayette, McKean, Venango, and Warren were in the top fifteen counties with the largest rate of decline from 2010-2020. They all, along with Armstrong County, outpaced the 2010-2020 decline that were projected. Elk County was projected to decline by 3.2% in that time frame, and the actual number came in at -2.99%. Allegheny County was the only one to experience growth (2.23%). In the rural counties, population loss coupled with a strong statewide push to preserve prime agricultural land through the Commonwealth's Agricultural Land Preservation Policy (2003) and the PA Wilds Initiative may decrease or stabilize hazard vulnerability. In the urban to suburban areas around Pittsburgh population decline could have a more mix impact on hazards; for instance, exposure to some natural hazards could decrease while the risk of building and infrastructure collapse increases.

New census data, taken together with building permit, land cover data for the state, and previous population projections for Pennsylvania show that the state's **high growth areas are**

likely to be concentrated in Southeast and South Central, Lehigh Valley, and the counties of Butler, Centre, Erie, and Washington. **Data is mixed in the Southwest for Allegheny, Beaver, Fayette, and Westmoreland. Lackawanna and Luzerne** are two counties where permits and land cover trends have led to growth even though projections believed decreases were coming. Data aligns to show **decline and/or low growth rates are likely to prevail in the Northern Tier, North Central, and Southern Alleghenies regions**. **The Northeast** is on track to see mostly declines or very small population increases even though projections established it as a potential high-growth region.

Figure 4.4.2-1 Projected Population Change by County (PADEP, 2012).



4.4.3. Impacts of Development Trends in High Growth Areas

When a hazard event occurs, the amount of damage and loss is largely determined by the amount of development in harm's way. This section discusses how development in Pennsylvania's high growth areas is likely to increase vulnerability to some of the state's highest-ranked hazards.

- **Flooding**: Flooding is Pennsylvania's most widespread natural hazard and poses a risk to every community in the state. As greenfield development in Pennsylvania's high growth counties converts more forest land and farmland to impervious cover, the amount of runoff generated by a given storm will increase, and the risk of flooding and flash flooding will grow. The high permit growth counties that have historically experienced the most frequent flooding in Pennsylvania (according to the Storm Events Database) are the counties in the Greater Pittsburgh area, the counties in the Greater Philadelphia area, and York and Lancaster counties. These are areas where flood vulnerability is already high and can be expected to increase with further development.

- **Winter Storm**: As sprawling development patterns continue to play out in high-growth suburban and rural areas, people in these areas will become more vulnerable to disruptions to the transportation network caused by winter storms. The closing of secondary roads due to snow and ice can prevent emergency vehicles from reaching people in need and can cause significant economic disruption. Both Centre and Pike Counties are potential high growth counties that has historically experienced a high average annual snowfall. These are the areas where winter storm vulnerability is most likely to increase with further development. Other counties like Monroe or Wayne are projected as high-growth counties and have a high average annual snowfall, but so far that growth has not materialized.

- **Hazardous Materials Release**: Several of Pennsylvania's high growth counties are also home to growing levels of unconventional gas development. These include counties in the Greater Pittsburgh area and Centre County. As new pipeline infrastructure is developed to transport growing volumes of natural gas and natural gas byproducts, the risk of hazard materials release will increase.

- **Wildfires**: Pike County again finds itself in this discussion, as it has shown growth and the potential for more while also being one of the counties with the highest risk of wildfires. Monroe County also has a high risk of wildfires, but again that growth potential has not been realized so far. New construction in previously rural areas is likely to expand the wildland urban interface, increasing exposure to wildfires.

- **Subsidence and Sinkholes**: Several of the high growth counties in Pennsylvania (including the Greater Pittsburgh area, the Lehigh Valley region, and Centre County) are also among the counties with the most karst area and the highest risk of sinkholes and subsidence. If not properly sited, new construction in these areas could be vulnerable to damage from long-term subsidence or abrupt sinkhole formation.

4.4.4. Impacts of Development Trends in Low Growth Areas

When a hazard strikes, the condition of the property and infrastructure in harm's way also affects the amount of damage and loss. This section discusses how conditions in declining areas could increase vulnerability to hazards.

- **Building and Structure Collapse:** Section 4.3.17 shows the distribution of housing units built prior to 1960 and structurally-deficient bridges in Pennsylvania. Based on this data, some of the low-growth counties with the structures and infrastructure that are likely to be in the poorest condition are Cambria, Lawrence, McKean, Northumberland, and Schuylkill. All five counties saw their populations decline at a faster rate between 2010-2020 than was expected by projections. Structures and infrastructure that are in poor condition are more susceptible to collapse when stressed by environmental factors or other hazards.

- **Utility Interruption:** Low growth and declining jurisdictions generally have limited tax revenue to reinvest in aging infrastructure, including utilities such as telecommunication, gas, electric, water, or waste networks. These jurisdictions are therefore more vulnerable to utility interruptions caused by mechanical failures, environmental factors, or other hazards.

4.5. Consequence Analysis

The EMAP standard for a hazard identification and risk assessment (HIRA) requires states to include a consequence analysis for the hazards identified in state HIRAs. The consequence analysis assesses the impact on the Commonwealth's systems after a hypothetical or scenario hazard event. A *consequence* is defined as *something produced by a cause or necessarily following from a set of conditions.* Consequences from hazard events are usually negative, but could be positive.

For this analysis, local, state, and federal agencies and organizations throughout the Commonwealth were asked to identify natural and human-made hazards that would have the largest consequences on their agency or organization and to provide comments regarding the impacts of certain hazards identified as having large consequences. In the survey that they filled out, they were asked to separately rank the natural and human-made disasters by order of their potential consequences to the specific agency or organization. Each response was analyzed individually, and the hazards ranked in the top 5 for each response were recorded. This way, we can see which hazards are seen as the most consequential to which groups. In addition, not every response ranked every hazard, choosing to only focus on ones that directly impacted them. Table 4.5-1 and Table 4.5-2 provide a summary of which natural and human-made hazards each agency or organization determined to be most consequential. While experience with hazards over the past five years will certainly have an impact on how they were ranked this time around compared to 2018, it's also important to note that it is not the exact same list of agencies and organizations, so the experiences and areas of expertise may vary even more.

A total of 26 agencies and organizations participated; only 23 participated in ranking the human-made hazards. There are instances where multiple responses were fielded from the same agency or group, and those are denoted by a "*" in the table. Any agencies or organization that had multiple responses may showcase more than five hazards, as different officials from those groups may have ranked hazards differently. To reduce the size of the tables, all responses from counties were divided into either the County Planning Department/Commission or the County Emergency Service groups. Many different counties are represented, which shows how eager county-level officials were to provide feedback and engage in the planning process. These groups also had the largest variety of hazards landing into the top 5 of individual responses, showcasing the diversity of hazard risk across Pennsylvania. The only natural hazard to not make a single county-level top 5 was coastal erosion. Lightning strikes, radon exposure, and tornadoes were not ranked high enough in any of the Emergency Service responses.

With respect to natural hazards, flooding and severe storms such hurricanes, tropical storms, nor'easters, and other winter storms were most frequently identified as having large consequences by the participating agencies and organizations. Drought, earthquakes, extreme temperatures, pandemics, and tornadoes and earthquakes were also commonly identified. In the previous plan, pandemics were only identified by 6 of 19 (31.5%) agencies or organizations as significantly consequential. It is no surprise that after experiencing the impacts that Covid-19 had and continues to have, 16 of 26 (61.5%) agencies rated its potential consequences as significant in this update. Hailstorms and Landslides were the only hazards to not be identified as ones with the largest consequences in the 2018 SHMP, yet they were identified 5 and 4 times respectively this time. Coastal erosion was the only hazard to see a decrease, even as survey responses increased this update.

Of the 17 human-made hazards, building and structure collapse, cyber-terrorism, hazardous materials release, nuclear incidents, and utility interruption were most commonly identified as most consequential. 17 of 23 (73.9%) agencies and organizations recognized the potential severe consequences of utility interruptions, making it the most frequently identified hazard with the largest consequences. Cyber-terrorism held the top spot in the 2018 plan, but it was noted that several agencies specifically mentioned their interpretation of the term cyber-terrorism included any significant event that posed a threat to cyber security. The five environmental hazards are separated in the table below because they were separated in the survey, and respondents were asked to rank them in a separate grouping. Only 17 participants chose to rank the environmental hazards. The two hazards ranked the highest out of those five were displayed on the table, again for the reasons stated above. Hazardous materials release was viewed as one the most consequential by 15 participants, which is nine more times than the next highest, gas and liquid pipelines. Many of the human-made hazards that were ranked highly were placed there due to potential widespread consequences and the impact on public health and safety, critical resources, and ongoing operations.

Table 4.5-1 Natural Hazards with the Largest Consequences on Local, State, and Federal Agencies and Organization in the Commonwealth

AGENCY	COASTAL EROSION	DROUGHT	EARTHQUAKE	EXTREME TEMPERATURE	FLOOD, FLASH FLOOD, ICE JAM	HAILSTORM	HURRICANE, TROPICAL STORM, NOR'EASTER	INVASIVE SPECIES	LANDSLIDE	LIGHTNING STRIKE	PANDEMIC AND INFECTIOUS DISEASES	RADON EXPOSURE	SUBSIDENCE, SINKHOLE	TORNADO, WINDSTORM	WILDFIRE	WINTER STORM
Commonwealth University - Mansfield					✓						✓				✓	✓
County Dept. of Emergency Services*		✓		✓	✓	✓	✓	✓	✓		✓			✓		✓
County Planning Departments/Commissions*		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DFSD - SDS?					✓					✓	✓			✓		✓
Eastern PA EMS Council			✓	✓							✓			✓		✓
Hospital and Healthsystem Association of PA*			✓	✓	✓						✓					✓
PA Commission on Crime & Delinquency					✓		✓			✓	✓					✓
PA DEP Bureau of Radiation Protection*			✓		✓		✓							✓		✓
PA Dept. of Aging*			✓	✓	✓		✓				✓					✓
PA Dept. of Conservation & Natural Resources		✓			✓		✓	✓							✓	
PA Dept. of Corrections			✓							✓	✓		✓	✓		
PA Dept. of Health				✓	✓			✓			✓	✓				
PA Dept. of Labor & Industry		✓	✓			✓			✓	✓						✓
PA Dept. of Revenue					✓	✓				✓				✓		✓
PA Dept. of State					✓		✓				✓			✓		✓
PA Historical and Museum Commission					✓		✓						✓	✓		
PA Public Utility Commission				✓	✓		✓							✓		✓

Table 4.5-1 Natural Hazards with the Largest Consequences on Local, State, and Federal Agencies and Organization in the Commonwealth

AGENCY	COASTAL EROSION	DROUGHT	EARTHQUAKE	EXTREME TEMPERATURE	FLOOD, FLASH FLOOD, ICE JAM	HAILSTORM	HURRICANE, TROPICAL STORM, NOR'EASTER	INVASIVE SPECIES	LANDSLIDE	LIGHTNING STRIKE	PANDEMIC AND INFECTIOUS DISEASES	RADON EXPOSURE	SUBSIDENCE, SINKHOLE	TORNADO, WINDSTORM	WILDFIRE	WINTER STORM
PA State Police					✓		✓				✓			✓		✓
PASDA		✓		✓	✓		✓				✓					
PEMA*		✓	✓	✓	✓	✓	✓		✓							✓
Penn State University Extension*		✓		✓	✓		✓			✓	✓			✓	✓	
PENNVEST		✓			✓		✓				✓					✓
Susquehanna River Basin Commission				✓	✓			✓								
US Dept. of Health & Human Services		✓			✓					✓	✓					✓
USACE					✓		✓									
USGS PAWSC	✓	✓	✓		✓		✓									

Table 4.5-2 Human-Made Hazards with the Largest Consequences on Local, State, and Federal Agencies and Organization in the Commonwealth

AGENCY	BUILDING AND STRUCTURE COLLAPSE	CIVIL DISTURBANCE	CYBER-TERRORISM	DAM FAILURE	LEVEE FAILURE	MASS FOOD AND ANIMAL FEED	NUCLEAR INCIDENT	SUBSTANCE USE DISORDER	TERRORISM	TRANSPORTATION INCIDENTS	URBAN FIRE AND EXPLOSION	UTILITY INTERRUPTION	EH - COAL MINING	EH - CONVENTIONAL OIL AND GAS WELLS	EH - GAS AND LIQUID PIPELINE	EH - HAZARDOUS MATERIALS RELEASES	EH - UNCONVENTIONAL WELLS
Commonwealth University - Mansfield	✓		✓			✓		✓				✓				✓	✓
County Dept. of Emergency Services*	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
County Planning Departments/Commissions*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Disability Rights Pennsylvania	✓				✓		✓		✓		✓						
Hospital and Healthsystem Association of Pennsylvania*	✓	✓	✓				✓					✓			✓	✓	
PA Commission on Crime & Delinquency	✓		✓							✓	✓	✓			✓	✓	
PA Dept. of Aging*		✓	✓			✓	✓	✓		✓		✓			✓	✓	
PA Dept. of Conservation & Natural Resources	✓			✓		✓				✓		✓					
PA Dept. of Corrections	✓		✓			✓					✓	✓				✓	
PA DPH	✓					✓	✓	✓				✓				✓	✓
PA Dept. of Labor & Industry	✓	✓		✓	✓	✓											
PA Dept. of Revenue		✓	✓						✓	✓		✓				✓	
PA Dept. of State	✓	✓	✓				✓	✓									
PA Historical and Museum Commission	✓	✓	✓				✓					✓					
PA Public Utility Commission			✓	✓			✓		✓			✓			✓	✓	
PA State Police		✓	✓				✓		✓	✓						✓	

Table 4.5-2 Human-Made Hazards with the Largest Consequences on Local, State, and Federal Agencies and Organization in the Commonwealth

AGENCY	BUILDING AND STRUCTURE COLLAPSE	CIVIL DISTURBANCE	CYBER-TERRORISM	DAM FAILURE	LEVEE FAILURE	MASS FOOD AND ANIMAL FEED CONTAMINATION	NUCLEAR INCIDENT	SUBSTANCE USE DISORDER	TERRORISM	TRANSPORTATION INCIDENTS	URBAN FIRE AND EXPLOSION	UTILITY INTERRUPTION		EH - COAL MINING	EH - CONVENTIONAL OIL AND GAS WELLS	EH - GAS AND LIQUID PIPELINE	EH - HAZARDOUS MATERIALS RELEASES	EH - UNCONVENTIONAL WELLS
PASDA				✓		✓	✓					✓		✓	✓			
PEMA				✓	✓	✓	✓					✓			✓		✓	
Penn State University Extension	✓	✓		✓	✓	✓	✓		✓	✓		✓		✓			✓	✓
PENNVEST												✓		✓			✓	
PASDA				✓		✓	✓					✓		✓	✓			
PEMA				✓	✓	✓	✓					✓			✓		✓	
Penn State University Extension	✓	✓		✓	✓	✓	✓		✓	✓		✓		✓			✓	✓

As part of the consequence analysis, local, state, and federal agencies and organizations were also asked to describe how the hazard identified as having the largest consequences impacts the following:

1. Public and Responders
2. Continuity of Operations and Program Operations
3. Property, Facilities, and Infrastructure
4. Delivery of Services
5. Public's Confidence in Jurisdiction's Governance
6. Economic Condition
7. Environment

The following provides a summary of the significance of these impacts, as well as highlights the responses provided by the 19 participating agencies and organizations.

Impact on the Public and Responders

The impact of hazards on the public relates to the geographic extent of a hazard and its impact (minor, limited, critical, catastrophic). Based on the risk assessment and risk factor ranking of hazards in Pennsylvania, there are no hazards whose impact could be considered catastrophic on a statewide level, where there would be a high number of casualties and deaths, more than half the state would be impacted, and where state facilities would be shut down for a month or more. However, flooding hazards along with coastal storms, nuclear incidents, dam failure, utility interruption, pandemic, and cyber-terrorism or terrorism events could have critical impacts in terms of the number of individuals adversely affected. For example, widespread or long-term utility interruption, as well as a pandemic, could jeopardize the continuity of the food supply affecting public health. A consequence of a cyber-terrorism event could be the release of private public data that could lead to identify theft and threaten public safety. Public safety is also a major concern in the event of a nuclear incident where thousands of residents may need to be evacuated. With respect to flooding and severe storms, the widespread halt to the day-to-day lives of Pennsylvanians was most closely seen during Tropical Storms Lee and Irene, when massive areas of the Commonwealth were flooded and people were stuck in their homes or in shelters for many days. Flooding and severe storm events mainly cause transportation issues and closings, utility interruptions, and property damage.

Hazard events in the Commonwealth are unlikely to be catastrophic in nature, so municipalities and counties should be able to enact mutual aid mechanisms in the event of a disaster. As a result, the impact on first responders during hazard events should be fairly low. First responders are specifically trained to reduce negative consequences on their ability to do their jobs. The hazards that can have the highest impact on first responders will most likely be a pandemic disease outbreak or a mass food contamination event. During times of widespread disease or illness, the DOH expects that mutual aid will not be able to be rendered because the event would affect the response capability of most jurisdictions, even across state and county lines. With respect to a cyber-terrorism event, a limited number of OIT staff or other professional staff could influence the timing of response.

Impact on Continuity of Operations and Program Operations

Commonwealth agencies and communities develop Continuity of Operations Plans (COOP) to prepare for events when facilities and agencies are impacted by a hazard event. There will be severe consequences on the continuity of government operations to function in hazard events that strike the heart of the Commonwealth's people and buildings. These hazard events often include civil disturbances, terrorism events, and pandemic disease threats as well as instances of natural disasters that strike areas with a high concentration of government functions, particularly Harrisburg. Closing of roadways and mass transit operations, utility interruption, and housing and facility impacts leading to office disruption or closure can affect continuity of operations during natural disasters, such as flooding or severe storms.

Impact on Property, Facilities, and Infrastructure

The consequences of a given hazard event on Commonwealth property, facilities, and infrastructure will depend on whether the hazard in question is likely to cause structural and/or property damage. Past occurrences indicate that the consequences for property, facilities, and infrastructure are highest for flood and winter storm events. These past events have led to both property damage, leading to relocation or restoration, and utility interruption. However, the Commonwealth has attempted to assess vulnerability and estimate losses for each natural and human-made hazard that has the potential to impact Pennsylvania. In many cases, these vulnerability and loss estimates involve the impact on property, facilities, and infrastructure; please refer to these subsections of Section 4.3 for the potential impacts associated with each hazard. It is important to note that these loss estimates are for comparison purposes in this SHMP; it is unlikely that any single hazard event would inflict the maximum damages estimated in Section 4.3 in all vulnerable jurisdictions.

Impact on Delivery of Services

The consequences of a hazard event on an agency's ability to deliver service corresponds with the severity of the event and the type of agency affected. An event with potential widespread consequences could impact an agency's ability to deliver and perform all its services and non-essential services may be delayed or postponed. For example, in the event of a widespread pandemic, agencies may only be able to deliver essential services. During a cyber-terrorism event, services may be interrupted while responders research the cause and implement mitigation strategies to prevent further losses. Similar to the impact on the continuity of operations, severe storms and flooding can lead to closing of roadways, utility interruption, and office disruption or closure. However, depending on the location and the area impacted, some agencies may operate at a satellite location to ensure delivery of services.

Impact on Public's Confidence in Jurisdiction's Governance

Public confidence in governance is tightly linked to citizens' expectations of government action and response to hazard events. Confidence is higher when the Commonwealth is seen as taking action in the event of a severe hazard event. Therefore, the provision of essential services during these events can be critical in managing public confidence. However, in the case of hazards like severe winter storms where there is a longer-term visible reminder of the event, public confidence can be lower. Public confidence can also be lowered if not all populations, especially any impaired populations, are properly informed or helped. Additionally,

public confidence can be swayed by the characterization of mitigation and response in the popular press. For example, the extensive duration and widespread geographic extent of the opioid epidemic, as well as recent media coverage, will be linked to public perception of and confidence in the state's addiction response efforts. The hazards most likely to have statewide impacts on public confidence are those that also have widespread or statewide impacts, those that have high or even catastrophic impacts, and those that have little warning time. Using these criteria and the results of the Risk Factor Analysis (see Section 4.1), the hazards that can have the most significant consequences for public confidence in governance are drought, winter storms, flooding, severe storms, utility interruption, nuclear incidents, cyber-terrorism events, hazardous materials release, and pandemic disease outbreaks.

Impact on Economic Condition

With the expectation that few hazard events will be catastrophic in nature, the consequences of hazard events on the Commonwealth's economy, while potentially severe in the short-term, should be recoverable. Past occurrences have shown the economic impact to be limited, and federal and state funding helped mitigate consequences. The diversity of Pennsylvania's economy aids in lowering the economic impact of a disaster event; while a hazard event could cripple one sector of the economy, it is unlikely that all sectors will be simultaneously impacted. Geographically, hazards, such as flooding and utility interruptions, that impact greater Philadelphia, the greater Pittsburgh region, and the greater Harrisburg area could have a more significant impact on economic conditions because of the concentration of economic activity in these metropolitan areas. Additionally, some hazards disproportionately affect certain sectors in the Pennsylvania economy. For example, droughts, hailstorms, and invasive species hazards could cause widespread consequences for the Commonwealth's sizeable agricultural sector. Hazard events affecting the Harrisburg area could have severe consequences on economic conditions because of the area's importance in processing government payments and grant programs for the entire Commonwealth. With respect to other state facilities, long-term public closure of state parks or other facilities can impact tourism, leading to economic loss for state agencies and local communities. Finally, cyber-terrorism events can jeopardize the personal information of state agencies and the public, which can lead to identify theft and loss of assets.

Impact on the Environment

As evidenced in this plan's risk assessment (Section 4.3), nearly all hazards identified and profiled have the potential for some kind of environmental impact. For example, drought hazards can cause decreases in air quality and soil productivity as well as adverse impacts on water supplies. Flood events can result in the pollution of streams and rivers due to combined sewer overflows or flooding in SARA Title III facilities. Nuclear incidents can contaminate air and land with unsafe levels of radiation for thousands of years. Wildfire events can reduce biodiversity and increase erosion after a fire event. The hazards with the potential for the highest consequences on the environment are environmental hazards, flooding, and nuclear incident (either intentional or accidental)

5 Capability Assessment

5. Capability Assessment

5.1 Update Process Summary

The purpose of conducting a capability assessment is to determine the ability of the Commonwealth to implement a comprehensive mitigation strategy and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs, or projects. The capability assessment provides an opportunity to highlight the positive mitigation measures already in place or being implemented throughout the Commonwealth, which should continue to be supported and enhanced if possible through future mitigation efforts.

This section provides an assessment of state and local hazard mitigation capabilities and touches on some of the federal hazard mitigation programs most relevant in Pennsylvania. At the state level, a summary of the tools available to the Commonwealth for pre- and post-disaster hazard mitigation efforts is provided as well as development management. Federal, state, local and private funding sources are provided in Section 0. The State Capability Assessment in the 2007 SHMP focused primarily on the presence of the Commonwealth's Emergency Operations Plan. The 2010 SHMP expanded the assessment to comprehensively describe other tools available related to hazard mitigation and development in hazard-prone areas. The 2013 SHMP included the following significant updates and additions:

- Addition of "Legal Context" section
- Addition of "Federal Programs Supporting Hazard Mitigation in Pennsylvania" section
- Updates to the MIRC (BORM at the time) staff text such as job descriptions, trainings, conferences, exercises, etc.
- Updates to the organizational charts for PEMA and MIRC
- Addition of "Other State and Multi-Agency Programs in Pennsylvania" section
- Addition of "Hazard Mitigation Land Use Measures in Pennsylvania" section
- Additions to the "PA Emergency Operations Center" section
- Updates to the "Status of Local Hazard Mitigation Plans" section text and mapping
- Updates to the "Summary & Evaluation of Local Mitigation Capability" section text and mapping
- Addition of a CRS, Firewise, and StormReady information
- Addition of a more robust program and plan integration section

The 2023 update, like the 2018 update, improved and updated information through Section 5. Edits to Section 5.5 were a focus of the update again to improve the information on plan integration and represent how it is accomplished in Pennsylvania. Edits were made throughout Section 5 to confirm the PEMA takeover of NFIP management from DCED, including information on the organizational structure within PEMA and a complete re-write on how DCED contributes to hazard mitigation. One of the most significant hazard events since the 2018 plan is the COVID Pandemic, which resulted in new programs and funding mechanisms to help both public and private stakeholders recover and build resiliency.

This 2023 plan continues and expands upon the issue of Climate Change Adaptation and Resiliency. Formally a problematic topic in the 2007, 2013 and 2018 plans as stakeholders debated the 'reality' of global warming and federal guidance vacillated as administrations changed, the current update reflects the FEMA and legislative mandate to build resilient communities that are adapted to climate change. Climate change adaptation is not only reflected in this plan, but the in the plans of multiple other State Agencies and Organizations. These state agency plans include the Fish and Boat Commission's 2022 Climate Action Plan, PA DEP's 2021 Climate Change Action Plan, and DCNR's 2018 Climate Change Mitigation and Adaptation Plan. In addition to these climate change specific plans, agencies such as PennDOT have included climate change considerations into planning and operating strategies, making adaptation and resilience some of the main goals for the future.

A comprehensive list of existing planning policies, programs, and capabilities which support hazard mitigation activities is included in Section 5.3.2. This assessment was prepared based on information gathered from the SPT and county staff and through coordination with MIRC staff (again, formerly BORM). Opportunities to review draft information were provided to the SPT, county staff, and others who attended the public forums. Section 5.2 below provides additional information on federal, state, and local laws that influence the Commonwealth's hazard mitigation capability.

5.2 Legal Context

The following is a summary of the federal, state, and local disaster mitigation and emergency management laws. Many of these laws are referenced and/or described in more detail throughout this chapter or in other areas of the plan.

5.2.1 Federal Laws

Presidential Policy Directive 8 and Related Requirements

Presidential Policy Directive 8: National Preparedness of 2011 (PPD-8) details the national approach to preparing for threats and hazards posing a national security risk The Department of Homeland Security coordinates interagency cooperation for this directive, which called for the creation of a National Preparedness System (NPS) that is focused on assessing threats and hazards, examining the consequences associated with their impact, and select planning and preparedness activities that build core capabilities among the five mission areas (prevention, protection, mitigation, response, recovery) identified within the National Preparedness Goal (NPG). The NPS consists of an integrated set of guidance, programs, and processes designed to help guide domestic efforts at all levels of government (DHS, 2022).

Robert T. Stafford Disaster Relief and Emergency Assistance Act

The Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 authorizes technical, financial, logistical, and other assistance from the federal government to state and local governments during declared major disasters and emergencies.

The STORM Act was passed in 2021 to grant the federal government the ability to provide capitalization grants to states, eligible tribes, territories, and the District of Columbia so they may create revolving loan funds to provide mitigation assistance to local government and entities.

Disaster Mitigation Act

The Disaster Mitigation Act of 2000 amended the Stafford Act and the Public Works Act, which provides grants for economic development, to require local governments to prepare hazard mitigation plans as a precondition for receipt of Hazard Mitigation Grant Program project funds. The Disaster Mitigation Act encourages communities to reduce preventable, repetitive disaster losses by mitigating natural hazards, vulnerability, and risk.

National Flood Insurance Act

The National Flood Insurance Act of 1968 established the National Flood Insurance Program (NFIP), which allows residents of participating communities to purchase flood insurance in exchange for the implementation and enforcement by state and local communities of floodplain management ordinances. 2,481 jurisdiction in Pennsylvania participate in the NFIP (FEMA, 2022h).

Biggert-Waters Flood Insurance Reform Act and the Homeowner Flood Insurance Affordability Act of 2014

The Biggert-Waters Flood Insurance Reform Act of 2012 made significant changes to the NFIP. This act requires the NFIP to raise subsidized insurance rates to actuarial rates in an effort to make the program more financially stable. The Act implemented rate increases for owners of subsidized policies on non-primary/secondary residences, to owners of subsidized policies on property that has experienced severe or repeated flooding, and on business/non-residential properties in a Special Flood Hazard Area. Primary residences in the SFHA would keep their existing subsidized rates until the property is sold, the policy lapses, a new policy is purchased, or the property suffers severe, repeated flood losses. Grandfathered rates would be phased out at a rate of 20% increase per year for five years when a community adopts a new, updated FIRM.

The Homeowner Flood Insurance Affordability Act of 2014 (HFIAA) addressed criticism of the Biggert-Waters Act by making the transitions to paying more for insurance more gradual. The HFIAA restored aspects of grandfathering by limiting annual rate increases providing time for property owners to mitigate and budget for insurance costs. HFIAA also introduced an annual surcharge to all policyholders to help support the fiscal soundness of the program.

The most recent initiative for adjusting costs is Risk Rating 2.0. Under the Risk Rating 2.0 initiative, FEMA will update insurance policy pricing methodology to deliver rates that are equitable, more accountable to policyholders and taxpayers, and better reflect each property's unique flood risk (FEMA, n.d.b). Phase I of the initiative began on October 1, 2021 when all new policies began being subject to the new methodology and existing policies eligible for renewal could take advantage of decreases. Phase II began on April 1, 2022 when all policies were subject to the new methodology. More on how this impacts Pennsylvania specifically will be discussed later.

FEMA is encouraging communities to consider joining the Community Rating System (CRS) or to increase their CRS activities to lower premiums for residents and also to consider pursuing FEMA grants through the Commonwealth. PEMA MIRC (formerly BORM) staff have been

educating the public about these important changes to the NFIP by addressing flood insurance reform in community trainings.

The NFIP Reauthorization is currently in consideration of the US Congress and additional changes may be made. The bill currently under discussion includes generally prohibiting FEMA from raising premiums, surcharges, and fees more than 9% per year for 5 years, revising coverage limits, creating a program of policy discounts for low-income households, and revising standards and requirements for FIRMs. Additional changes include allowing NFIP operation during a lapse in appropriations and prohibiting the Department of the Treasury from charging FEMA interest for NFIP debt for 5 years. There are also requirements for companies that write and service federal flood policies in their own name. The summary for communities and policy holders is that the cost of insurance is likely to rise and that the investment in mitigation is likely to see additional benefits in both safety and savings.

Pandemic and All-Hazards Preparedness Act

The Pandemic and All-Hazard Preparedness Act of 2006 had broad implications for the Department of Health and Human Service's' preparedness and response activities, including providing new authorities for programs such as development and acquisition of medical countermeasures and the establishment of a quadrennial National Health Security Strategy. The act was reauthorized in March 2013 and June 2019.

Executive Order 14008 on Tackling the Climate Crisis at Home and Abroad (January 2021)

This executive order directs that the climate crisis will be placed at the center of United State foreign policy and national security. It directs the country to move to build resilience against climate change impacts. It states that the federal government must support efforts, from planning to implementation, from every level of government and sector of the economy to assess, disclose, and mitigate climate pollution and climate-related risks in order to develop resiliency. This order also establishes working groups to promote climate action planning, workforce development, and environmental justice advocacy.

Executive Order 14030 on Climate-Related Financial Risk (May 2021)

This executive order prioritizes federal investments and fiscal management towards addressing the impacts that climate change will have on physical assets and investments and the shift away from carbon-intensive energy sources. It establishes that the policy of the current Administration is to advance the disclosure of climate-related financial risk and act to mitigate those risks while accounting for the disparate impacts on disadvantaged communities and communities of color.

FEMA State Mitigation Planning Policy Guide (Effective April 2023)

This guide is FEMA's official policy on, and interpretation of, state hazard mitigation planning requirements. Its purpose is to facilitate consistent evaluation and approval of state plans and provide a resource for the regulations and requirements. Within the guide, it states that states have a responsibility to ensure that the mitigation strategy complies with all applicable legal requirements which help achieve equitable outcomes through the planning process for all communities. The guide also acknowledges that climate change increases the frequency,

duration, and intensity of natural hazards, with these variations creating new risks and posing a unique threat to the country's most at-risk populations. In addition, this guide establishes that hazard mitigation and climate adaptation are complementary efforts.

One plan requirement outlined in the policy guide is ensuring that states coordinate with agencies and organizations with climate change and climate adaptation expertise, along with agencies with programs, policies, and assistance that support underserved communities. In addition, it states that the risk assessment section of state plans must include vulnerability analysis that includes potential impacts from climate change, including how climate change will impact future conditions and occurrences of hazards. It also requires that the capabilities sections must include discussions on state- and local-level policies, programs, and capabilities that serve underserved communities and address the impacts of climate change, including gaps and challenges.

Nationwide Programmatic Environmental Documents

In order to receive federal funding, projects must comply with the National Environmental Policy Act (NEPA) of 1969, which requires federal agencies to consider the effects of proposed projects on the natural and human environment. To eliminate repetitive discussions, nationwide programmatic environmental documents have been developed. If a given project meets the scope, impacts, and mitigation covered in the related programmatic environmental document, then no further NEPA documentation will be required. Programmatic environmental documents relevant to the Commonwealth of Pennsylvania include:

- Programmatic Environmental Impact Statement for the NFIP (Final – September 1976)
- Programmatic Environmental Assessment for Integrated Public Alert and Warning System Construction Projects (Final – June 2010) (radio stations)
- Programmatic Environmental Assessment for the Grant Programs Directorate Programs (Final – July 2010)
- Programmatic Environmental Assessment for Hazard Mitigation Safe Room Construction (Draft – March 2011)

Administrative Directives

Federal guidelines are in place to assist state and local governments with mitigation, preparedness, response, and recovery programs. Relevant federal guidelines include the National Incident Management System, which provides standard procedures for incident command; the National Response Framework, which provides response and recovery guidelines; and the National Disaster Recovery Framework, which provides a recovery framework.

5.2.2 State Laws

Pennsylvania Flood Plain Management Act (PEMA)

The *Pennsylvania Flood Plain Management Act* (Act 166) encourages sound land use practices within the floodplain. The Act requires which municipalities with SFHAs to participate in the

NFIP meeting the minimum standards. The Act establishes higher regulatory standards for hazardous materials and high-risk land uses and designates the state agency responsible for NFIP coordination and oversight. Previously held by DCED, the Flood Plain Management Act was amended in July 2022 to designate PEMA as the State NFIP Coordinator.

PEMA and DCED partnered to transition NFIP coordination responsibilities beginning in 2018. Transition components included responsibilities and budget components. For instance, in the Commonwealth fiscal year (FY) ending June 30, 2019, DCED had $50,000 to support NFIP and mapping related training. By FY 2020, PEMA's budget included $80,000 to support FIRM due process meeting attendance, community outreach, housing and maintenance of the Pennsylvania Flood Zone Map online tool, and training.

In addition to the work PEMA does, there are local floodplain managers that have the training and authority to help enforce regulations. Managers are encouraged to enroll in FEMA training courses and even obtain their CFM certification. PEMA's Orientation Guide describes the job as having four main roles: Coordinator, Regulator, Educator, and Planner (PEMA, 2020). They work continuously with federal, state, and local stakeholders to ensure development in the floodplain is done properly.

Pennsylvania Emergency Management Service Code, Title 35

Pennsylvania's Emergency Management Service Code, Title 35, covers PEMA's overall legal responsibilities for emergency management. PA CS Title 35 Section 7102 defines emergency management as "the judicious planning, assignment and coordination of all available resources in an integrated program of prevention, mitigation, preparedness, response and recovery for emergencies of any kind, whether from attack, manmade or natural sources." Section 7311 establishes that PEMA was created "to assure prompt, proper and effective discharge of basic Commonwealth responsibilities relating to civil defense and disaster preparedness, operations and recovery." Title 35 addresses PEMA's responsibilities before, during, and after disaster.

Pennsylvania Hazardous Material Emergency Planning and Response Act (DEP, PEMA, PA DLI, and Local Emergency Planning Committees, or LEPCs)

The Superfund Amendments and Reauthorization Act 165 of 1986 and amended in 2011 (SARA) combats only one specific type of disaster - hazardous materials. The law has several provisions, including requirements for reporting releases of chemicals and requirements for the protection of responders. However, SARA Title III (i.e. the Federal Emergency Planning and Community Right-to-Know Act), relating to emergency planning and community right-to-know, has the greatest impact on local governments.

SARA Title III requires every facility, public or private, that routinely has on-hand more than a threshold quantity of certain acutely hazardous chemicals to report the name, amount, and location of the chemical to the county, state, and federal environmental protection agencies. This includes many municipal swimming pools, waste treatment plants, and most industrial facilities in the Commonwealth. These facilities must provide an annual report on the state of their chemical inventory through the Pennsylvania Tier II System (PATTS). The threshold for reporting is published in the EPA's List of Lists. Additionally, facilities dealing with large quantities of a specified list of toxic chemicals must provide toxic chemical release forms to the

state annually on chemical activity for the previous year when manufacturing 25,000 pounds or more and have usage of 10,000 pounds or more.

Title III also requires facilities that have one or more extremely hazardous substance at or above an EPA-specified threshold to develop an on-site emergency response plan. The key groups in these emergency response plans are the local emergency planning committees (LEPCs), appointed to receive the information from facilities and develop an off-site emergency plan for every facility which reported having threshold quantities of extremely hazardous substances. These LEPCs must include elected officials; fire, police, civil defense, and public health professionals; environmental, hospital, and transportation officials, as well as representatives of the facilities, community groups, and the media. The LEPC evaluates available resources for preparing for and responding to a potential chemical accident, providing an essential pre-disaster capability to communities that host SARA Title III facilities. According to the 2021 Annual Report from PEMA, there are 67 LEPCs, 3,190 emergency response plans, and 3,615 facilities that require plans as of December 31, 2021 (PEMA, 2022). The number of facilities that require plans fluctuates constantly as more facilities are added and removed based on chemical inventories.

These federal requirements are implemented at the state level through Act 165 (i.e. Pennsylvania Hazardous Material Emergency Planning and Response Act, 1990-165). Act 165 creates a strong working relationship between business and industry, the Commonwealth, counties, and local municipalities to protect citizens from the dangers of hazardous materials.

The history of the program indicates that the interest of elected officials who participate on LEPCs is effective.

Pennsylvania Radiation Protection Act (PEMA and DEP, Bureau of Radiation Protection)

Act 147 (i.e. Pennsylvania Radiation Protection Act, 1984-147) deals specifically with radiation, control of radioactive sources, and accidental releases of radiation from any of the nuclear-powered electric generating facilities in Pennsylvania. The act was most recently amended in 2007 with Act 31. This law empowers the DEP to implement a comprehensive statewide radiation protection program, and also enables PEMA to develop a radiological emergency response program with plans for each fixed nuclear power generating facility. In implementing the radiological emergency response program, PEMA has planned for evacuation or protection of persons in the area immediately surrounding a given facility with a ten-mile radius. Each of the affected municipalities has a plan that addresses accidental releases of radiation at the facility. The law requires periodic exercise of these plans; every two years there is a full-scale exercise involving several hundred people to test the plan and response capabilities.

Act 147 also created a Radiation Emergency Response Fund and a Radiation Transportation Emergency Response Fund, which receives money from nuclear facility operators, spent fuel storage facilities, and spent nuclear fuel shippers. PEMA then distributes this money to affected counties where it is then distributed to municipalities. Funds are distributed based on grant applications submitted by counties to reimburse expenses involved in preparing plans, providing equipment, and involved in training and exercising the radiological emergency response program.

Counterterrorism Planning, Preparedness and Response Act (PEMA, OHS, PSP, and DOH)

Act 227 (i.e. the Counterterrorism Planning, Preparedness and Response Act of December 16, 2002, P.L. 1967, No. 227 35) provides for counterterrorism planning, preparedness, and response; imposing powers and duties on PEMA, DOH, counties, and municipalities; and providing for the organization of various response teams. Act 227 states the responsibilities of regional counter-terrorism task force groups, the urban search and rescue task force, and specialized response teams, and also provides immunity from liability.

Public Safety Emergency Telephone Act (PEMA and PUC)

Act 78 (i.e. the Public Safety Emergency Telephone Act, 1990-78), as amended, is designed to provide a toll-free standard number (911) accessible from both land and cellular phones for any individual in the Commonwealth to gain rapid, direct access to emergency services. The act was amended in 1998 with Act 17. The act places responsibility for developing a 911 system on county government. The act also allows for end-user contributions based on the number of lines of telephone service. Act 78 establishes technical, training, and certification guidelines and minimum standards to be met in developing the county 911 system. Additionally, the act encourages the development of enhanced 911 systems and constant improvement of existing systems.

Currently, there is a project to bring Next Generation 911 (NG911) to Pennsylvania. Comtech Telecommunications Corp. was chosen in the fall of 2020 by PEMA to implement and operate PA's NG911 system. The system will be comprised of a full fiber-based Emergency Services Internet Protocol Network that will bring high data transfer speeds to all areas of the Commonwealth. The project has been broken into 5 phases: Data Collection, Network Design, System Build, Validation/Testing, and Upgrades Complete. As of December 29, 2022, there are 9 counties in Phase 1, 29 in Phase 2, 12 in Phase 3, 7 in Phase 4, and 10 in Phase 5 (complete). 61 counties now have Text-To-911 capabilities. Progress can be tracked at the following link: https://www.pema.pa.gov/911-Program/NG911/Pages/NG911-Progress-Dashboard.aspx

Pennsylvania Construction Code Act (Department of Labor & Industry and Office of the Fire Commissioner)

The Pennsylvania Construction Code Act (Act 45) of 1999 (as amended) establishes the basic requirements for the Uniform Construction Code (UCC), which applies to the construction, alteration, repair, demolition, or change of occupancy of buildings. Enforcement of the UCC began in April 2004. Utilization of the UCC provides for the protection of life, health, property, and the environment on a daily basis as well as during disasters by establishing construction standards. Pennsylvania is protected by the guidelines set forth in the UCC, with over 90% of Pennsylvania's 2,562 municipalities administering compliance locally either through their own staff or third party agencies (DLI, 2018). The Department of Labor & Industry has no code enforcement authority beyond the municipality lacing a certified "Accessibility Inspector/Plans Examiner".

Recent changes to the act include Acts 35 and 36 of 2017. Act 35 provided exclusions for certain agricultural buildings. Act 36 resulted in a lot of changes, including requiring a re-review of the 2015 International Code Council, changing the makeup of the UCC Review and Advisory Council, permitting Philadelphia to pass an ordinance adopting the 2018 commercial ICC codes, changes to permitting fees, creating a local board of appeals, and establishing a six-month statute of limitations for permit submissions after updated building codes go into effect (DLI, 2018). On October 26, 2022, the Commonwealth Court ruled that all enforcement of the 2021 accessibility standards must cease and revert to 2018 requirements.

58 Pennsylvania Code Title 58

Sections of this code (§ 71.6 and § 73.1.) prohibit the possession, transport, or introduction of more than ten invasive species. This includes Zebra Mussels, Quagga Mussels, and all species of crayfish.

Nutrient Management Law (Act 38)

Act 38 was signed into law on July 6, 2005, replacing Act 6 which was Pennsylvania's first nutrient management law. This act deals with local regulation of agricultural operations. It requires that concentrated animal operations develop and maintain a nutrient management plan, which includes best management practices to minimize environmental impact from nutrients on a farm. Act 38 Nutrient Management Plans are required to receive permits for concentrated animal feeding operations can be populated with livestock.

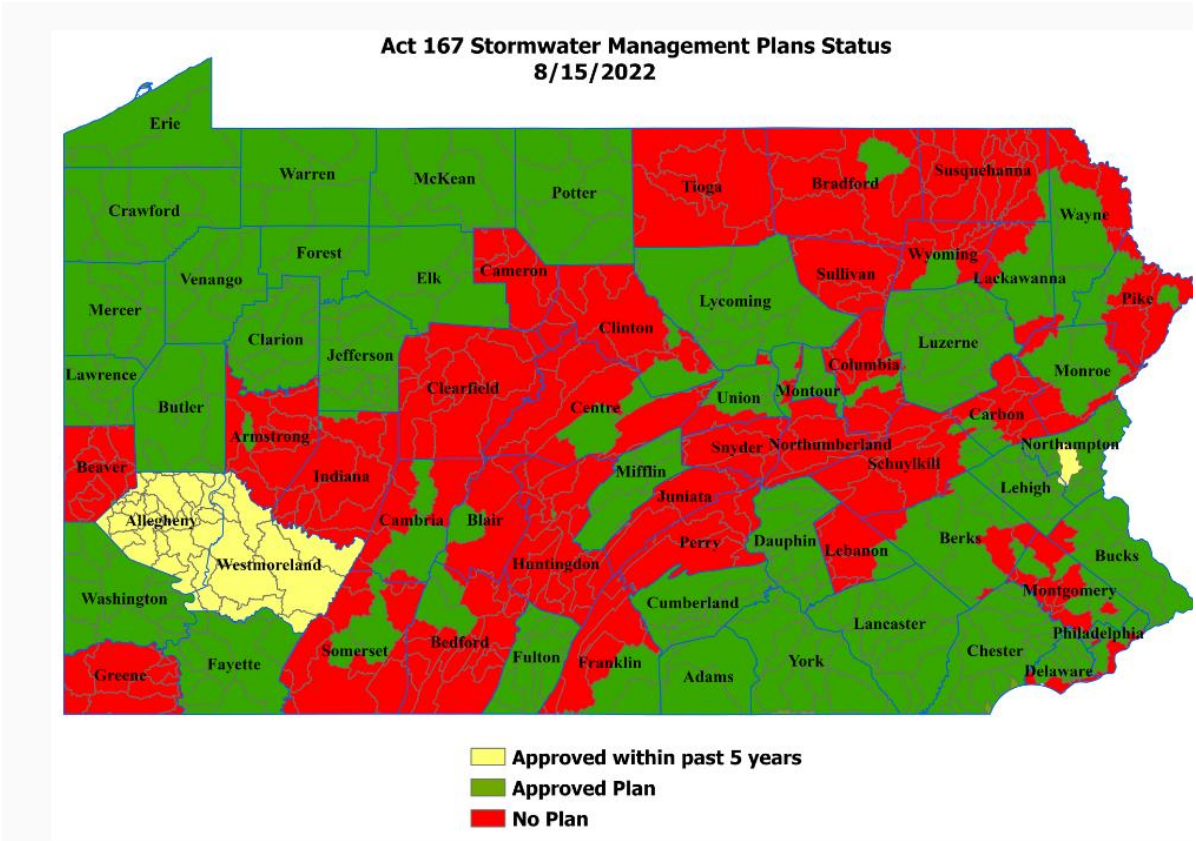
Storm Water Management Act (DEP)

The Storm Water Management Act (Act 167) was enacted in 1978 to counter the effects of land development on storm water runoff. Act 167 requires all counties in Pennsylvania to prepare and adopt watershed-based storm water management plans and requires municipalities to adopt and implement ordinances to regulate development in a way which is consistent with the local Act 167 plan.

DEP has organized a Clean Water Academy that provides guidance on what should be included in the plan. This includes a webinar that walks through all the different components, which consists of 14 short videos. The webinar can be found at https://pacleanwateracademy.remote-learner.net/course/view.php?id=885. It also provides resources such as a sample cover sheet, an SOP document for how reviews are conducted, and legislative references.

Figure 5.2.2-1 below shows the status of Act 167 plans across the Commonwealth as of August 2022. It is unclear why many counties and municipalities do not have Act 167 Plans in place. Counties interested in developing or updating Act 167 Plans should contact their DEP regional office for more information.

Figure 5.2.2-1 Act 167 Plan Status as of August 2022 (DEP, 2022s)



Marcellus Shale Drilling Regulations (DEP, Bureau of Oil and Gas Management)

The Bureau of Oil and Gas Management in the Pennsylvania Department of Environmental Protection along with county conservation districts and the Susquehanna River Basin Commission or the Delaware River Basin Commission, if applicable geographically, have authority to regulate the oil and gas industry in Pennsylvania to protect the environment and citizens of the Commonwealth. Permits and bonds must be provided by drilling companies at various stages including prior to pad construction, pipeline construction, drilling of the well, withdrawal or disposal of water, and impoundment of water. Bonds start at around $4,000, with stipulations for depth and number of wells a company manages. Blanket bonds are possible for large-scale companies, either $250,000 for having 250+ wells under 6,000 feet or $600,000 for 150+ wells over 6,000 feet (DEP, 2021e).

Ongoing Developments

- In September of 2021, a collection of environmental groups had a petition accepted by DEP that would require them to study amending the PA Code to increase bond amounts to $83,000 per well.
- There are discussions of forming an Ohio River Basin Commission with similar regulatory authority over the oil and gas industry.

Oil and gas exploration in Pennsylvania is regulated through the Oil and Gas Act, the Coal and Gas Resource Coordination Act, the Oil and Gas Conservation Law, the Clean Streams Law, the Dam Safety and Encroachments Act, the Solid Waste Management Act, and the Water Resources Planning Act (PA House of Representatives, unknown publication date).

In June of 2020, Pennsylvania's 43rd Grand Jury found that government agencies failed to uphold their responsibility to protect Pennsylvanians from the risks of the unconventional industry and provided recommendations for the future that included expanding no-drill zones, requiring public disclosure of chemicals used, better assessment of air pollution impacts, better transport practices, and responses to health impacts of workers and locals (Office of Attorney General Josh Shapiro, 2020).

The Oil and Gas Act (Act 13 of 2012) presented major changes to the oil and gas industry in Pennsylvania, including the authorization for local governments to adopt an impact fee and the provision of stronger environmental protections. For example, oil and gas well pad setbacks from private water wells, streams, and buildings increased; bond amounts for catastrophic accidents increased; and public accessibility of information related to chemicals used onsite improved (Pittsburg Post-Gazette, 2012). 60% of the revenue stays at the local level, going to counties and municipalities hosting wells. The rest goes to various state agencies involved in regulating drilling and to the Marcellus Legacy Fund, which gets distributed to the state for environmental and infrastructure projects (PA PUC, 2012).

Local governments can use their shares of the funds on various expenses related to natural gas development, including:

- Construction, repair and maintenance of roads, bridges and other public infrastructure
- Water, storm water, and sewer system construction and repair
- Emergency response preparedness, training, equipment, responder recruitment
- Preservation and reclamation of surface and subsurface water supplies
- Records management, geographic information systems and information technology
- Projects which increase the availability of affordable housing to low-income residents
- Delivery of social services, including domestic relations, drug and alcohol treatment, job training and counseling
- Offsetting increased judicial system costs, including training
- Assistance to county conservation districts for inspection, oversight and enforcement of natural gas development
- County or municipal planning

Other statewide initiatives that can be funded with impact fee funds are:

- Acid mine drainage, abatement and cleanup
- Orphaned or abandoned oil and gas well plugging
- Compliance with PA Sewage Facilities Act
- Planning, Acquisition, development and repair of greenways, recreational trails, open space, parks and beautification projects

- Programs to establish baseline water quality data on private water supplies
- Watershed programs and related projects
- Up to 25% of funds for flood control project

PA has significant and dynamic oil and gas industries and in this planning process there were some discussions identifying where conflicts interests may exist between industry leaders and environmental advocates, with state agencies working to regulate between them. Some groups have expressed interest in additional review of these regulations and a more detailed discussion on opportunities to strengthen capabilities even further.

FEMA Technical Bulletins

In addition to the above state laws, FEMA has 11 Technical Bulletins that provide non-statutory guidance on minimum NFIP floodplain management requirements contained in Title 44 CFR, Section 60.3 Floodplain Management Criteria for Flood-Prone Areas.

The NFIP floodplain management regulations outlined in 44 CFR § 60.3, include minimum building performance criteria that apply to (1) new construction, (2) work determined to be Substantial Improvement such as improvements, alterations, and additions, and (3) the repair of buildings determined to have incurred Substantial Damage and that are in Special Flood Hazard Areas (SFHAs).

The Technical Bulletins are intended for use primarily by state and local officials who are responsible for interpreting and enforcing the NFIP floodplain management regulations. The Bulletins may also be used by design professionals (e.g., architects, engineers), contractors, building owners and operators, planners, and other interested stakeholders to help understand and comply with NFIP floodplain management requirements.

Using the information in the Technical Bulletins will improve the design and construction of buildings, including their utility systems, that are in flood prone areas, thereby reducing the potential for damage and increasing building and community resilience. More information on NFIP Technical bulletins can be found at this FEMA link: https://www.fema.gov/emergency-managers/risk-management/building-science/national-flood-insurance-technical-bulletins

5.2.3 Local Ordinances

It is important to note that Pennsylvania adopted Home Rule Law in 1972. Home Rule impacts how municipal governments interact with the county and state government. With Home Rule, municipalities have the authority to exercise governance in any area not specifically limited by state law, rather than in a non-Home Rule state where municipalities act only where specified by state law. An example of where Pennsylvania state law does set requirements for municipalities is the Municipal Planning Code.

Pennsylvania Municipalities Planning Code Act (DCED)

Per the Pennsylvania Municipalities Planning Code Act, P.L. 805, No. 247 (Act 247) of 1968, boroughs, townships, and counties have the authority to individually or jointly prepare zoning, subdivision, land development, floodplain management, and other ordinances, as well as official

zoning maps, all of which can be used as tools to guide growth and minimize development in hazard prone areas. Act 247 also requires counties to create and adopt a comprehensive plan and encourages municipalities to adopt municipal or joint municipal comprehensive plans generally consistent with the county comprehensive plan.

5.3 State Capability Assessment

5.3.1 Pre-disaster Capability

Federal capability for some agencies is listed in the state capability section to illustrate how the Commonwealth is leveraging federal programs to increase state capability.

5.3.1.1 Federal Programs Supporting Hazard Mitigation in Pennsylvania

There are a number of federal programs that support hazard mitigation in Pennsylvania from a variety of agencies and entities. This section provides a summary of the most relevant federal agency programs that directly support PEMA and FEMA's hazard mitigation efforts.

United States Geological Survey

The United States Geological Survey works with the National Weather Service, the USACE, and FEMA through the Flood Inundation Mapping Program (https://water.usgs.gov/osw/flood_inundation/) to help communities understand flood risks and make cost-effective mitigation decisions. The flood inundation library contains a series of maps which illustrate where flooding will occur at various river levels, and during a flood event these maps can be combined with real-time USGS streamflow data and NWS flood forecasts to

provide real-time and forecasted mapping. These maps can be used for preparedness, mitigation, and planning; environmental and ecological assessments; timely response; and recovery.

The USGS provides more flood-related information through the following programs and resources:

- WaterAlert service (http://water.usgs.gov/wateralert)
- WaterWatch (http://waterwatch.usgs.gov)
- WaterNow (http://water.usgs.gov/waternow)
- StreamStats (http://streamstats.usgs.gov)
- USGS Flood Information (http://water.usgs.gov/flood)

USGS provides data to the Department of Environmental Protection for drought determinations, participates in the Emergency Operations Center calls when needed, coordinates with FEMA following an event to document the effects, and has a Continuity of Operations plan in place.

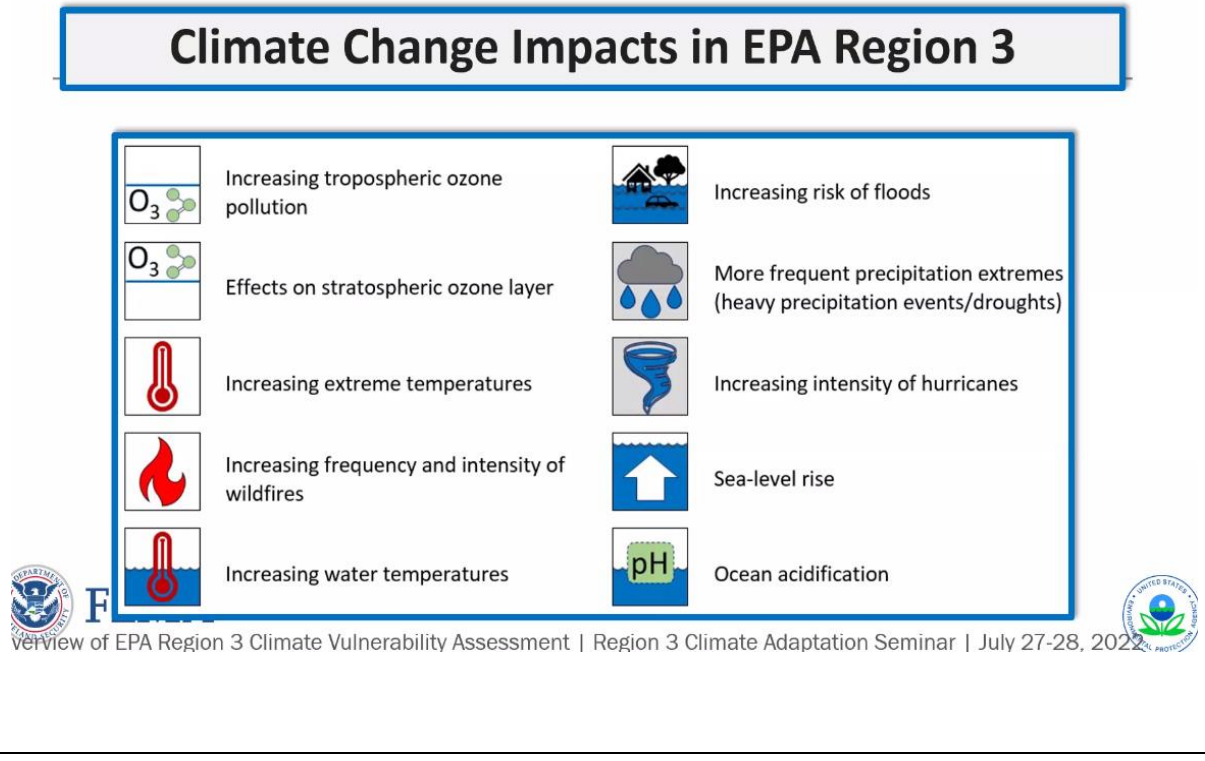
United States Army Corps of Engineers

The USACE, in addition to their leadership role in the Silver Jackets, plays a role in flood risk management as well as dam and levee safety, planning, engineering, and emergency management. The USACE partners with the Department of Environmental Protection for annual levee safety workshops and inspections at federal and state constructed flood protection projects, which includes most of Pennsylvania's levee systems. They also conduct table-top drills with partners.

United States Environmental Protection Agency

The Environmental Protection Agency's (EPA) role in hazard mitigation is varied, as their mission is to protect human health and the environment, The EPA develops and enforces environmental regulations, fund grant programs, study environmental issues, sponsor partnerships, produces training resources, and hosts tools and technical guidance documents for pollution reduction and response. The agency has also developed a workbook for developing risk-based adaptation plans, which guides users through vulnerability assessments and creating an action plan to reduce the most pressing risks. Table 5.1-1Figure 5.3.1-1 presents an example of information shown at an EPA Climate Adaptation Seminar in 2022.

Figure 5.3.1-1 Climate Change Impacts in EPA Region 3 (EPA Region 3 Seminar, 2022)



United States General Services Administration

The United States General Services Administration's (GSA) role in hazard mitigation and disaster response is to support state and local governments in supply and logistics by training users in the use of GSA's e-tools for product and service contracting coverage, pricing, and requests for quotes. Additionally, GSA staff practice table-top drills."

Office of Infrastructure Protection

The DHS Office of Infrastructure Protection serves a key role in hazard mitigation. Protective Security Advisors serve as liaisons among DHS and other federal agencies, state and local governments, and the private sector on security compliance/enforcement matters related to the protection of critical infrastructure and assets. There are three Protective Security Advisors assigned to Pennsylvania in Pittsburgh, Harrisburg, and Philadelphia, and the regional director is also located in Philadelphia. These Protective Security Advisors meet with site security personnel to review protection plans and identify requirements for protection support; monitor information on threats; develop and implement local policies; coordinate requests for federal training and assistance; and conduct workshops, forums, and conferences. This office works to identify and prioritize assets, conduct assessments in support of special events, conduct threat-based outreach, serve in emergency operations centers and joint field offices, and conduct/assist in Office of Bombing Prevention improvised explosive device threat and risk mitigation training. Trainings facilitated by Protective Security Advisors include the IED Awareness/Bomb Threat Management Workshop, the IED Search Procedures Workshop, the

Protective Measures Course, the Surveillance Detection Course for Law Enforcement & Security Professionals, the IED Counterterrorism Workshop, the Counter-IED/Bomb Threat Management Workshop, Active Shooter Training, Workplace Violence Incidents Training, Soft Target Awareness, and the Bomb Making Awareness Program. These trainings serve private sector owners and operators as well as first responders and emergency management personnel.

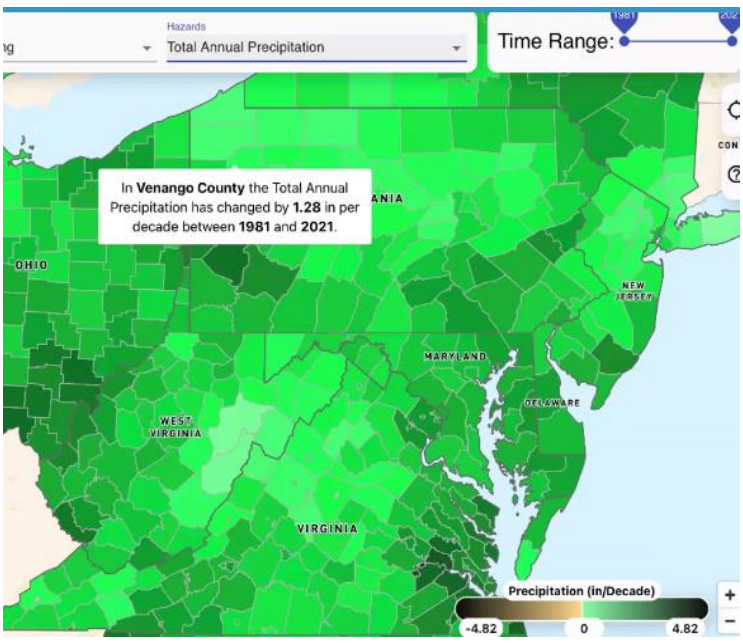
NOAA Search and Rescue Satellite-Aided Tracking (SARSAT)

The SARSAT system helps detect and locate people in distress. Anyone who needs help in an emergency can access the system using a 406 distress beacon. Currently, SARSAT is part of an international search and rescue system that brings together a network of satellites, ground stations, mission control centers, and rescue coordination centers. In 2022, the system helped rescue 397 people in the United States (NOAA, 2023). None occurred in Pennsylvania, but the potential is always there for aviation, maritime, or land emergencies that require SARSAT assistance.

Mid-Atlantic Regional Integrated Sciences and Assessments (MARISA) Program

The MARISA program was established in September 2016 via grant funding from NOAA. MARISA supports integrated, flexible processes for building adaptive capacity to climate variability and change in the Mid-Atlantic region. The program has developed multiple tools for this pursuit. The Climate Hazard and Mitigation Planning (ChaMP) tool is an interactive website focused on communicating vulnerabilities and helping local planners integrate climate information into hazard mitigation planning efforts. Figure 5.3.1-2 below presents an example of how the tool can be used.

Figure 5.3.1-2 Example of ChaMP Tool



Key Regional Products

Federal agencies produce a number of resources to disseminate information to different regions and states.

Quarterly Climate Impacts and Outlook Summaries (NOAA) – NOAA publishes quarterly reports that utilize MARISA data to inform individual regions on important climate data and trends. As an example, the Winter 2022-23 summary for the Mid-Atlantic region included information on significant weather events and impacts, seasonal temperature and precipitation, a Spring 2023 outlook, and historical and projected future average annual number of days with cold low temperatures.

Monthly Webinars – The Northeast Regional Climate Center has partnered with NOAA and Cornell University to host monthly webinars to address timely weather and climate concerns. Webinars are on a variety of topics and various federal agencies present information. Examples from 2023 are Climate Mapping for Resilience and Adaptation, Climate Projections, Spring Flood Outlook 2023, and USDA Northeast Climate Hub.

U.S. Climate Resilience Toolkit – This website was created to be a single, easy-to-use location to access tools, information, and subject matter expertise from federal government agencies to build climate resilience. It was developed by a partnership of agencies led by NOAA and is managed by NOAA's Climate Program Office. It includes information on the built environment, coasts, ecosystems, energy, food, health, transportation, marine life, tribal nations, and water. There are current and historical observations, a variety of mapping tools, socioeconomic and equity resources, and region-specific case studies and other tools.

5.3.1.2 Pennsylvania Emergency Management Agency

PEMA Pre-disaster Capability Overview

Pennsylvania's Emergency Management Service Code, Title 35, addresses PEMA's responsibilities before, during, and after disaster. Mitigation is managed through the Mitigation Insurance and Resilient Communities (MIRC) Office, which capably provides and participates in hazard mitigation and disaster trainings, disaster exercises, and conferences. MIRC staff support the identification and implementation of potential mitigation projects, and provide various tools and technical assistance for local agencies on PEMA's Hazard Mitigation webpage and in-person. RL and SRL property mitigation is consistently prioritized in pre- and post-disaster efforts. The readiness for disaster is maintained by adhering to the Pennsylvania State Emergency Operations Plan and by maintaining EMAP accreditation. Title 35 also mandates that each municipality has a designated Emergency Management Coordinator that is responsible for planning, administration, and operation of local emergency operations. Currently, Pennsylvania is looking into training requirements for EMCs to increase the knowledge base and capabilities of this group without adding undue burden on communities.

PEMA's outreach and citizen engagement efforts are also a key component of the agency's pre-disaster capability. The primary components of these efforts are ReadyPA, Citizen Corps, and the Community Emergency Response Team (CERT) program. As a program, ReadyPA is a tool

used by Citizen Corps and CERT, as well as government and non-profit organizations to assist Pennsylvania citizens in preparing for disaster. Citizen Corps was created to help coordinate volunteer activities that will make our communities safer, stronger, and better prepared to respond to any emergency situation. It provides opportunities for people to participate in a range of measures to make their families, their homes, and their communities safer from the threats of crime, terrorism, and disasters of all kinds. Citizen Corps is coordinated nationally by FEMA. In this capacity, FEMA works closely with other federal entities, state and local governments, first responders, emergency managers, the volunteer community, and the Corporation for National & Community Service.

The overall goal of the various projects undertaken and funded through the Citizen Corps Grant Program is to ensure that the residents of the Commonwealth are prepared at home, school, work, and when they travel throughout the state. In 2008, Pennsylvania kicked off the ReadyPA Campaign urging all Pennsylvanians to “Be Informed. Be Prepared. Be Involved.” The funds spent to date are being used to build private/public partnerships and use those partnerships to reach as many residents as possible as they go about their daily lives. PEMA has leveraged partnerships during National Preparedness Month to distribute information and to hand out materials at PETCO, Home Depot, Lowes, and most recently Target.

PEMA has distributed ReadyPA/Pennsylvania Citizen Corps bookmarks to almost 2,000 Pennsylvania libraries; and preparedness message tent cards and ReadyPA tri-fold brochures to the 131- and 545-member institutions of the Pennsylvania Association of Community Banks and the Pennsylvania Credit Union Association, respectively. The staff has developed a Hispanic Outreach Plan that was implemented in 2011 and translation for the web of ReadyPA materials into Russian, Korean, Chinese, and Vietnamese. Currently, the website can be translated into 133 languages.

PEMA supports the CERT Program, which educates people about disaster preparedness for hazards that may impact their area and trains them in basic disaster response skills such as fire safety, light search and rescue, team organization, and disaster medical operations. Using the training learned in the classroom and during exercises, CERT members can assist others in their neighborhood or workplace following an event when professional responders are not immediately available to help. CERT members also are encouraged to support emergency response agencies by taking a more active role in emergency preparedness projects in their community.

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PEMA has conducted CERT Train-the-Trainer classes as well as CERT Basic classes. The train-the-trainer classes allow those individuals with prior teaching experience the opportunity to

be trained so that they can teach others about Basic CERT in their respective community. PEMA also supports and encourages individual counties with their CERT efforts as well. CERT trained volunteers have been able to help with local response and recovery initiatives throughout the Commonwealth.

Additionally, the Pennsylvania Hazardous Material Emergency Planning and Response Act; the Pennsylvania Radiation Protection Act; and the Counterterrorism Planning, Preparedness and Response Act assist in supporting PEMA's capabilities. Additional funding and staff would be helpful in expanding PEMA's and MIRC's pre-disaster capability. The most prominent emerging policy or program impacting pre-disaster capability is the trend to improve pre-disaster capabilities through partnerships. By partnering with FEMA and Association of State Floodplain Managers (ASFPM), MIRC will be able to provide more training; by partnering with USACE, MIRC will be able to most robustly continue the SPT, and by partnering with counties and communities, more projects will be implemented. PEMA would like to partner with Risk MAP staff and FEMA Region 3's Outreach Staff to increase hazard mitigation outreach within the Commonwealth. Also, the Silver Jackets program has been instrumental in promoting interagency coordination. Strong partnering has significant potential to improve mitigation capabilities in Pennsylvania.

Under Commonwealth HB 336 (Act 70 of 2021), PEMA assumed management the Commonwealth's NFIP responsibilities. MIRC, within PEMA, supports two full-time positions for NFIP program management. These new positions are an NFIP Coordinator and a Deputy Coordinator who, along with support from other staff within MIRC, have contributed to an increased capacity for NFIP management. Additionally, a staff member in each of the PEMA Area Offices is trained in the NFIP to expand the team of staff that can attend meetings and support communities.

PEMA is continuing to grow capacity for NFIP management for the Commonwealth. There are numerous synergies from managing NFIP and hazard mitigation programs in one department. This includes connecting to Cooperating Technical Partners (CTP) program initiatives, funded partners, and coordinating on related project opportunities. The key effort by PEMA is to use the CTP to drive mitigation action. This effort is in line with supporting FEMAs moonshots of increased insurance coverage and mitigation investment.

PEMA is working with Penn State University, using LionPoll and other mechanisms for flood insurance studies and analysis to address why NFIP flood insurance policies are decreasing in Commonwealth and later why there has been an increase in Private Flood Insurance. PEMA will continue to work with Pennsylvania Insurance Department and private insurers to see how much the decrease is captured by alternate policies, understanding that this information may be held as private information. Therefore, PEMA will track progress of other states and FEMA to capture private insurance information even in generalized ways.

Increasing mitigation action and investment is tied to the Risk Reduction Consultation priority communities. These communities have characteristics that represent the full Commonwealth, such that pilots and best practices will be repeatable, and lessons learned will be applicable from one location to another. Priority Communities are those that are Act 47 Distressed

Communities and the ten highest-ranked in the Social Vulnerability Index. These communities will change over time. Please see Table 6.2-5 for more information on the integration of the Risk Reduction and SHMP process.

Additional initiatives for PEMA as they increase NFIP management capability are to build on existing initiatives that intersect with the NFIP. MIRC plans to develop Commonwealth mapping priorities to provide input into FEMA planning process and to develop potential projects for future CTP funding. They are already engaged in a statewide LiDAR project, the State GeoBoard, and with SPT partners and fellow map makers from DEP and DCNR. They will further collaborate to have informed recommendations for future studies that respond to locally and state known problem areas, for instance areas where recent flooding is not reflected on the FIRM. PEMA will continue collaboration with Pennsylvania Historical and Museum Commission for the NFIP. There are opportunities to work together to find suitable pilot projects that protect the historic structures from flooding while also maintaining their historic character. There is also interest in examining how these strategies, such as floodproofing impact flood insurance premiums. Another area for collaboration and growth is the nexus of stormwater management, local floodplain management, and DEP regulation to leverage each other's programs and funding for success. These ideas will build and become additional mitigation actions in the SPT's annual review of the mitigation strategy.

PEMA Staff

PEMA coordinates state agency response, including the Office of the State Fire Commissioner and Governor's Office of Homeland Security, to support county and local governments in the areas of civil defense, disaster mitigation and preparedness, planning, and response to and recovery from human-caused or natural disasters. Figure 5.3.1-3 provides an overview of PEMA's organizational structure and staffing. PEMA's Bureau of Recovery and Mitigation (BORM) was re-organized 2020 to reflect the increased importance of resilience, defined in Presidential Policy Directive (PPD) 8 as "*the ability of a community to adapt to changing conditions, withstand disruption, and rapidly recover from emergencies*."

The PEMA Deputy Director for Recovery supervises three divisions - Mitigation Insurance and Resilient Communities, Disaster Recovery Assistance, and the Individual Assistance Officer. The Deputy has added a Resiliency Program Manager (RPM) and a Disaster Support Administration section. The Resiliency Program Manager is responsible for planning, developing, and implementing a statewide resiliency and risk analysis program. The Resiliency Program Manager acts as a liaison between PEMA and county and municipal emergency management staff to assist with resiliency measures, including preparedness, planning, recovery, mitigation, and grants. Work includes developing, reviewing, analyzing, researching, interpreting, and proposing plans and policies related to Pennsylvania resiliency. The RPM's work is complex and analytical, but must be presented in a manner that is understandable to a varied group of end user. The Disaster Support Administration section provides a greater administrative capacity to apply for and manage grants. The PEMA Deputy for Administration provides funding for the Commonwealth's mitigation program while MIRC performs pre-disaster activities such as administration of Hazard Mitigation Assistance grants and technical

assistance and expertise for mitigation plan development. MIRC's post-disaster responsibilities are summarized in Section 5.3.2.

The State Hazard Mitigation Officer (SHMO) is responsible for hazard mitigation grant administration, state and local hazard mitigation planning, mitigation training and emergency response, and disaster and Joint Field Office support duties. The SHMO was supported by the State Hazard Mitigation Planner and normally has other permanent staff consisting of an engineer and two project officers. However, this level of staffing had proved insufficient for the workload of an enhanced state. In particular, the administration of the National Flood Insurance Program (NFIP) was overseen by a different agency. This obstacle led to many opportunities to fund projects being missed. Along with the creation of the Deputy for Recovery, the MIRC staff was expanded. MIRC added a deputy SHMO to assist with administration. The administration of the NFIP was moved to PEMA from the Department of Community and Economic Development (DCED) and two new NFIP management joined the permanent staff in fiscal year 2019 and 2020. Staff members in the Area Offices were also trained in the NFIP.

The permanent and disaster related staff engage in the following cycle of hazard mitigation activities:

1. Conduct Training and Outreach activities to educate people on best practices and funding opportunities for hazard mitigation and the NFIP.
2. Assist counties, municipalities, agencies, and organizations with identification of potential hazard mitigation projects and preparation of letters of intent and grant applications.
3. Assist municipalities with NFIP management, especially in the FIRM update due process. Work with FEMA to support communities in understanding the importance of providing data and information during Discovery, reviewing and commenting on FIRMs during the Flood Risk Review and Preliminary Release, understanding and submitting data for appeals when needed, and updating ordinances after the Letter of Final Determination.
4. Support technical assistance and development of the Commonwealth's Local Floodplain Managers. Collaborate and support partners in floodplain management from County department, Conservation Districts, insurance and builder associations, and other organizations and agencies to build NFIP capacity in Pennsylvania.
5. Process grant applications and coordinate with FEMA counterparts to ensure effective administration of programs.
6. Serve as project officer during life of grant to ensure compliance with all laws, regulations, and effective stewardship of resources.
7. Prepare briefings for State and other officials on progress of hazard mitigation and NFIP activities.
8. During disasters work in State EOC or Disaster Response Centers.
9. Conduct Preliminary Damage Assessments in conjunction with FEMA.
10. Coordinate with FEMA and other government and private agencies to achieve unity of effort.

In addition, FEMA Region 3 provides personnel and resource support as directed by the Federal Coordinating Officer. Together, PEMA and FEMA have formed a Joint Field Office in Harrisburg to address hazard mitigation and disaster recovery and mitigation activities.

The State Hazard Mitigation Planner, develops, reviews, and evaluates state, county, and local hazard mitigation plans in connection with state and federal laws, regulations, and programs aimed at reducing repetitive losses from natural disasters. The State Hazard Mitigation Planner serves as project officer to administer FEMA hazard mitigation planning grants for development of county hazard mitigation plans. The Division Engineer provides technical support and HM database maintenance.

The State Hazard Mitigation Project Officers administer up to 40 separate hazard mitigation projects and ensure compliance with all state and federal regulations. They are responsible for project quarterly/monthly reports, FEMA reporting, administration, and closeout of Hazard Mitigation Assistance-funded projects. Project officers review and process requests for advances and reimbursements, select and develop research methodology for project development and review, and determine appropriate data sources. Project Officers are encouraged to use new and improved methodologies, techniques, and applications. This will include support necessary to ensure that the SRL strategy is updated annually in the Commonwealth's 322 plan. Project Officers conduct research into physical, economic, social, and demographic phenomena; analyze and interpret data; and prepare graphic and narrative reports of findings of significance and applications of such information to effective hazard mitigation implementation. They also meet with local and regional planning boards or commissions, civic groups and associations, and the general public to render direct technical advice and assistance, explain hazard mitigation and associated topics, and answer questions. The exact location dates and number of attendees for outreach and technical assistance after recent DRs are not available. Please note that a Measure of Success for Action 3-2c is to, "track training and technical assistance location, date, and attendance for next SHMP update," so more complete and detailed statistics will be available in the next plan. Project Officers develop presentations for commissions and boards, civic groups and associations, and the general public, and work closely with state and federal agencies to coordinate hazard mitigation efforts and objectives. Finally, Project Officers assist in the execution of the FEMA Unified Hazard Mitigation Assistance grant program. Two new GIS computers have been purchased for MIRC staff to utilize for tasks including project identification and tracking.

Additionally, cross-attached clerical personnel are temporarily stationed at the Joint Field Office to assist MIRC. The following table contains the phone contacts for PEMA Offices.

Table 5.3.1-1 PEMA Offices Contact Information

TITLE	PHONE NUMBER
Pema Headquarters	717-651-2001
Western Area Office	724-357-2990 or 800-972-7362
Central Area Office	717-651-7060 or 800-272-7362
Eastern Area Office	610-562-3003 or 800-372-7362

While in recovery from the nationwide recession, Pennsylvania state budgets are still impacted. In general, the budget crisis' impact on state agencies, counties, and municipalities has meant less funding to support programs and to fill vacant positions. As a result, PEMA will continue to reach out to federal partners, including FEMA and USACE, to support mitigation efforts as appropriate. PEMA was able to work with FEMA on the Environmental and Historic Preservation Screening Form released by the FEMA Grant Programs Directorate in June 2011 so that the form content fulfills the data needs of both agencies during grant application review. PEMA routinely coordinates with the USACE to use the Silver Jackets initiative as a mechanism to continue holding meetings with the SPT members and to work on implementing mitigation actions. USACE staff can support the Silver Jackets initiative by preparing invitations, materials, presentations, and minutes for meetings. Also, PEMA will build on the success of the SPT to leverage coordination and funding for mitigation efforts between other Commonwealth agencies when appropriate. MIRC's goal is to increase staff capacity by adding two permanent project managers in the near future. The agency has already implemented a program to bring reservists to Joint Field Offices during disaster events in order to save about one million dollars per month while increasing assistance availability throughout the Commonwealth.

MIRC also coordinates with other departments within PEMA for technical expertise during shared missions and non-emergent activities. Commonly, MIRC coordinates with the Bureau of Strategic and Operational Plans (Bureau of Plans). The Bureau of Plans staff has access to data sources and information that is valuable in making the SHMP stronger. The analysis in the complete SHMP will also be shared with the Bureau of Plans to assist in integrating the SHMP into other Commonwealth planning mechanisms.

Figure 5.3.1-3 **Organizational Structure for the Pennsylvania Emergency Management Agency (updated October 27, 2020).**

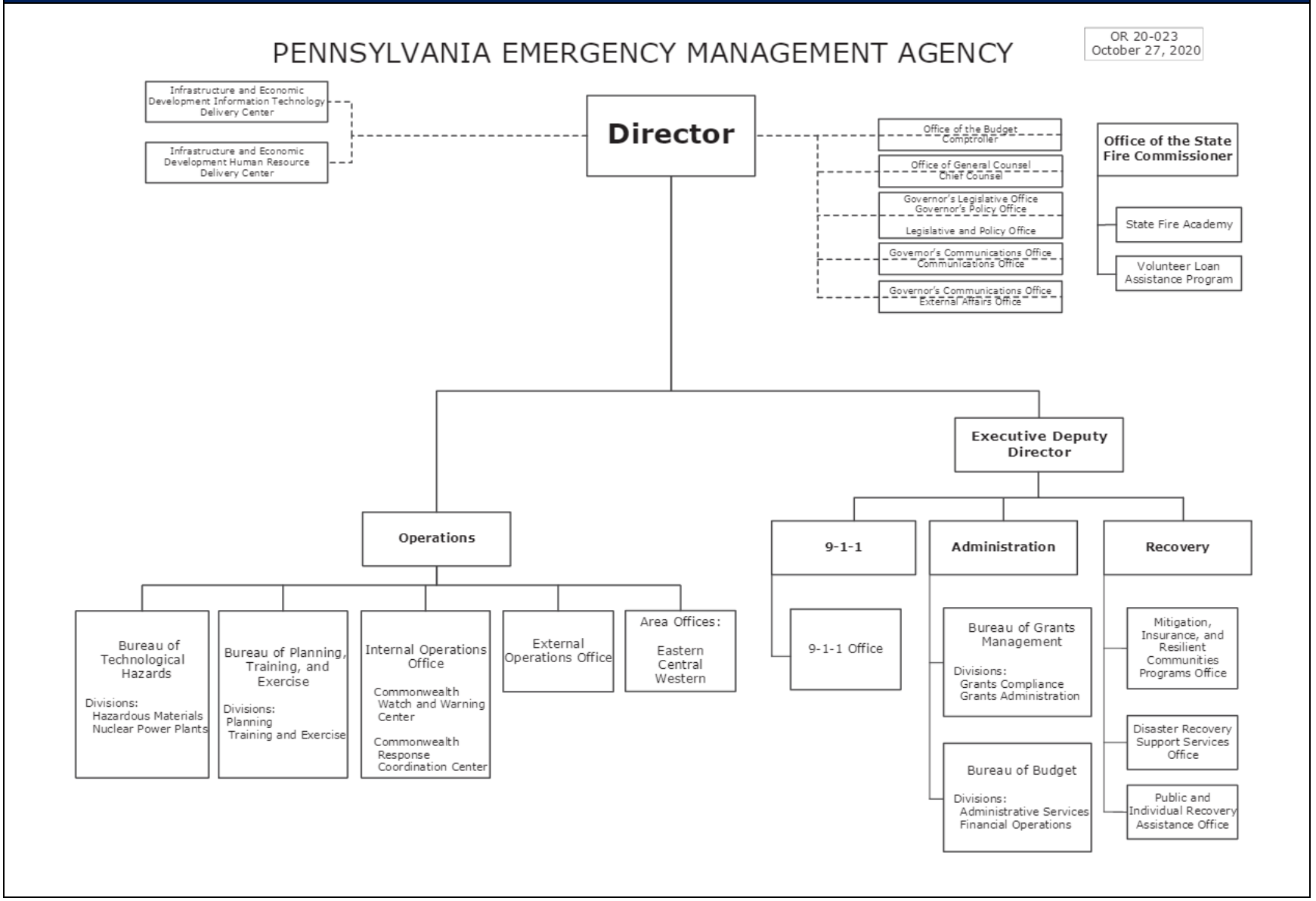
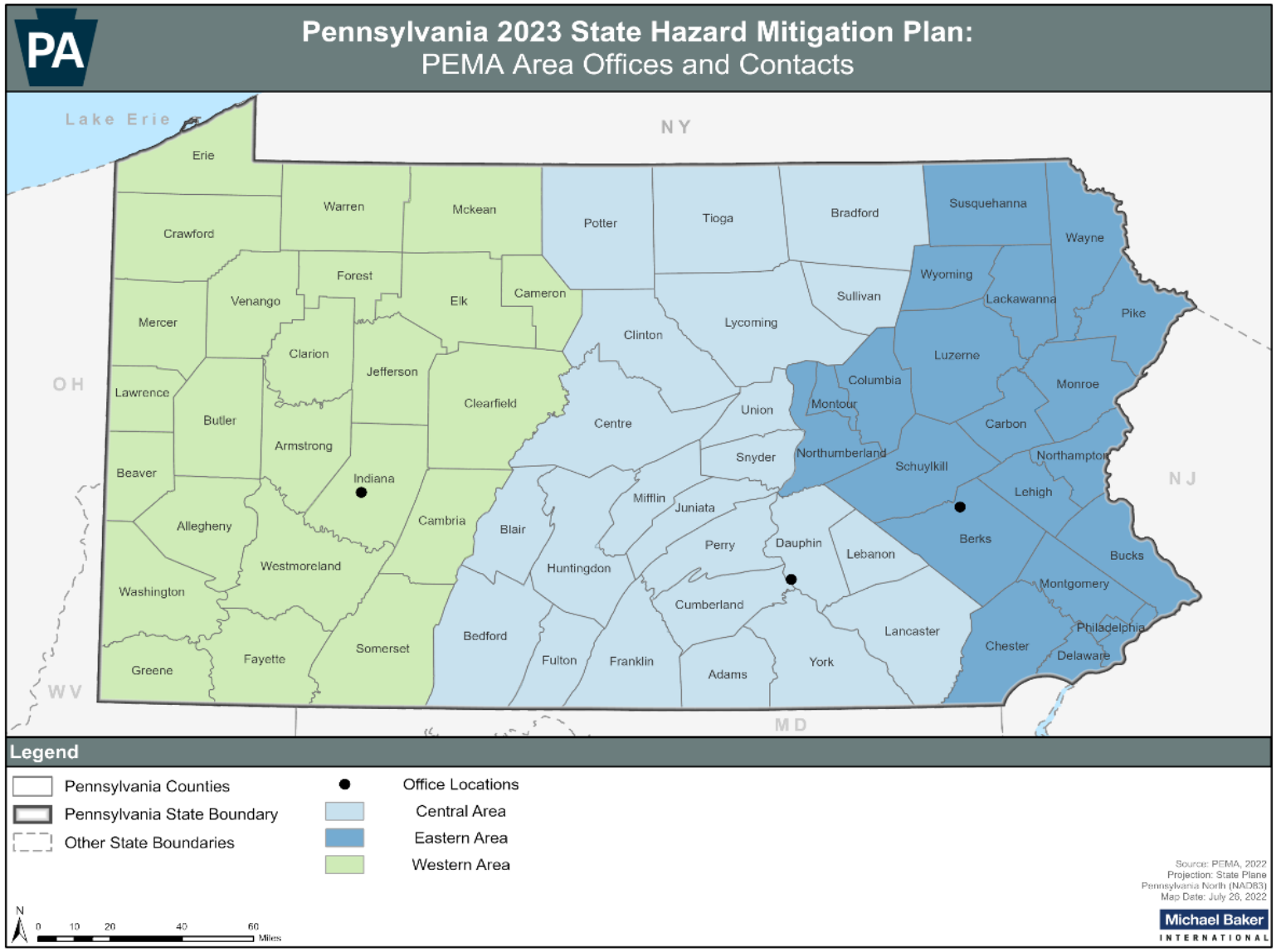


Figure 5.3.1-4 PEMA Area Offices with Hazard Mitigation Points of Contact (2022).



PEMA Hazard Mitigation, NFIP Management, and Disaster Trainings

PEMA provides various trainings and presentations to community officials and local emergency management staff in support of local hazard mitigation, NFIP management, and disaster preparedness. Many of the training events that PEMA supports are courses developed by the Emergency Management Institute (EMI) in Emmitsburg, MD. PEMA sends its own personnel and facilitates the attendance of county and municipal emergency management personnel to courses in Emmitsburg, MD and hosts courses locally following EMI guides and tailoring training as appropriate to local needs. PEMA holds three two-day trainings each quarter in the east, west, and central regions of Pennsylvania, which are typically attended by county emergency managers. Other attendees include local emergency managers, other emergency management staff, and related planners. There has also been an increase in virtual training opportunities.

PEMA is responsible for monitoring, supervising, and facilitating the management of federal and state hazard mitigation grants by local and county governments. Therefore, Hazard Mitigation Project Officers should be very knowledgeable about FEMA's grant programs. FEMA offers in person trainings available at the Emergency Management Institute (EMI). While not specific to EMI, the HMPO should also consider learning more about FEMA's grant application and management software. To apply for a FEMA grant, you must use the FEMA Grants Outcomes (FEMA GO) system (previously eGrants). This new system allows users to apply, track, and manage all disaster and non-disaster grants. It also improves oversight and monitoring. Courses offered focus on topics that include:

- Fundamentals of Grants Management
- Hazard Mitigation Assistance Grant Program Courses
    1. Developing Quality Application Elements
    2. Application Review and Evaluation
    3. Project Implementation and Closeout
- Managing Floodplain Development through the NFIP
- NFIP/Community Rating System
- Retrofitting Floodprone Residential Buildings
- State Public Assistance Operations
- State Individual Assistance Operations
- State Voluntary Organizations Active in Disaster (VOAD) Operations

The following is a list of trainings hosted locally or promoted for Pennsylvania municipal, county, and state staff to attend at EMI. Please note that a Measure of Success for Action 3-2c is to, "Track training and technical assistance location, date, and attendance for next SHMP update", so more complete and detailed training statistics will be available in the next plan. NFIP focused training has been added to the list since the last plan update based on PEMA's new role in NFIP management. Training for local floodplain managers is particularly important in Pennsylvania due to the large number of municipalities. The large number of municipalities means communities tend to be smaller and have staff and volunteers that hold multiple positions and are often new to floodplain management. Targeting NFIP training across the Commonwealth will help build capacity and ultimately more Certified Floodplain Managers.

- **Annual State Training and Exercise Planning Workshop:** Workshop for state representatives to update the Multiyear Training and Exercise Plan for the Commonwealth of Pennsylvania 2017-2022. The workshop was led and coordinated by PEMA.
- **EMI EO212: Hazard Mitigation Assistance Program: Developing Quality Application Elements:** Training is geared towards local government agencies along with PEMA and FEMA representatives. The four-day workshop focuses on project management and provides an overview of the process for Hazard Mitigation Assistance (HMA) applications and the overall HMA Grant program.
- **EMI EO213: Hazard Mitigation Assistance: Application Review and Evaluation:** Training is provided to PEMA, FEMA, or other support staff responsible for assisting with HMA supplicants. The two-day workshop focuses on grant application and sub application review. An overview of the grant award process is also included.
- **EMI EO214: Hazard Mitigation Assistance: Project Implementation and Closeout:** Training is provided to PEMA, FEMA, or other support staff responsible for assisting with HMA supplicants. The two-day workshop focuses on implementation and closeout of a project.
- **EMI GO318: Mitigation Planning for Local Governments:** Training is provided to local communities. This two-day workshop covers the fundamentals of the mitigation planning requirements for communities to develop new or updated Local Mitigation Plans that address community priorities and needs and meet requirements established in 44 CFR 201.6. This workshop describes the planning process, the requirements for stakeholder involvement, and the relationship between multi-hazard mitigation planning requirements and elements of the Community Rating System (CRS) to assess risks and develop effective mitigation strategies. Finally, the basic elements of the plan review, approval, and update cycle are discussed, including tips for implementing and maintaining an approved plan, tracking performance, keeping stakeholders involved, and preventing plans from lapsing or expiring.
- **EMI ISO318: Mitigation Planning for Local and Tribal Communities:** Training is designed for plan writers and reviewers. The twelve-hour long course provides an overview of the regulations governing hazard mitigation plans and the plan development process required to write them.
- **EMI Independent Study:** PEMA encourages Independent Study course through EMI. The following list shows the titles of several mitigation related Independent Study courses:
  - IS0030.b: Mitigation eGrants for the Subgrant Applicant
  - IS0031.b: Mitigation eGrants for the Grant Applicant
  - IS0032.a: Mitigation eGrants Internal System
  - IS0212.B: Introduction to Unified Hazard Mitigation Assistance
  - IS0318: Mitigation Planning for Local and Tribal Communities
  - IS0323: Earthquake Mitigation Basics for Mitigation Staff
  - IS0328: Plan Review for Local Mitigation Plans
  - IS0393.b: Introduction to Hazard Mitigation
- **FEMA R3 NFIP/SHMO Conference***:* Provides the opportunity for SHMO and NFIP officers from each state in Region 3 meet to share best practices, resources, and success stories.

- **Hazus:** Training is provided for individuals seeking to gain better knowledge of the Hazus program. Completion certificates are available for “Hazus Professional” or “Hazus Practitioner”. Courses are available for focus on hurricane, flood, or earthquake modeling in Hazus as well as focused courses for emergency managers or floodplain managers. Each course is four days in length.
- **E0190: ArcGIS for Emergency Managers:** Training is designed to train emergency management professionals in basic skills in ArcGIS necessary for utilizing the HAZUS loss estimation program. The workshop is four days in length and is intended for staff members who currently use or plan to use GIS and Hazus.
- **E0276: Benefit-Cost Analysis: Entry-Level:** Taught PEMA and local HM planners the basic of the benefits/cost Analysis process and use of FEMA software.
- **E0273: Managing Floodplain Development through the National Flood Insurance Program:** This course provides 4-days of training geared towards local floodplain manager and officials involved in floodplain management, covering the NFIP, FIRM and related mapping products, ordinance and other floodplain management concepts.
- **Best Practices of the NFIP**: This Region 3 designed training covers the concepts in the EO273 course in 4-6 hours. The abbreviated course increases the reach of the information since more people have time for a half to one-day training and provides resources for attendees to access additional information.
- **Advanced Floodplain Management Training**: Advanced floodplain management training offerings include E0282: Advanced Floodplain Management Concepts II, E0284: Advanced Floodplain Management Concepts III, and E0291: Community Dam Safety, Preparedness and Mitigation.
- **Natural Hazard Mitigation Association (NHMA) Legal Workshop for Mitigators:** training is for local emergency managers, legal experts, floodplain managers and anyone else involved in community development. The length of the workshop is two days.
- **PEMA HMA Application Development Workshop:** This training assists floodprone communities in developing successful applications for HMA grant funding.
- **PEMA Area Quarterly Training:** This training targeted at County Emergency management staff provides an opportunity for MIRC to brief on hazard mitigation. For example in Spring 2018 MIRC (BORM at the time) presented on the State Hazard Mitigation Plan, State Pre-Disaster Recovery Plan and the Integration between the two planning topics.
  Silver Jackets Non-Structural Flood Proofing Workshops: This workshop for public officials and municipal representatives. The workshops provided an overview of non-structural options and examples for flood proofing properties.

Recommended courses that are offered in person at EMI are listed on FEMA’s Mitigation Curriculum webpage:
https://training.fema.gov/is/searchisbycurriculum.aspx?eqid=9cbf3ef400000b18000000035a916718&keywords=mitigation&=wd&all=true

PEMA also promotes training from other organizations and agencies easily when it addresses a topical hazard mitigation issue. PEMA will be promoting US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety (US DOT PHMSA OPS) training webinars as appropriate

(http://primis.phmsa.dot.gov/comm/pipa/pipa_webinars.htm). The webinars are available on demand and address the following topics of relevance to Pennsylvania:

- Energy Pipelines 101
- Energy Pipelines in Pennsylvania
- Why are pipelines important?
- Who regulates pipeline safety?
- Roles local governments can play in pipeline safety?
  - Land planning near pipelines
  - Emergency response
  - Excavation damage prevention
  - Hazard mitigation planning
- PIPA recommended practice examples
- Pipeline resources for local governments

In addition, there are numerous trainings which PEMA staff attends. Examples of some of the trainings MIRC staff participate in are provided below. While these trainings apply only to MIRC staff, PEMA as a whole serves the Commonwealth both pre- and post-disaster. Other departments within PEMA have similar training exercises. Organization of the trainings is flexible and works effectively in both pre- and post-disaster operations:

- Each MIRC staff member is required to have two hours of Emergency Operations Center training each quarter
- Professional courses including one Emergency Management Institute course per year and optional ASFPM courses offered once per quarter;
- CPR-AED certifications maintained
- Human resources courses (i.e. equal opportunities, bio-hazard, etc.) are required once a month

MIRC would like to increase both internal and external staff trainings in the future, as staff availability and budget allow. Accordingly, MIRC established three training goals in 2013. The first goal is to improve coordination between MIRC and the PEMA Training Department. The second goal is to have all staff attend trainings for unified hazard mitigation assistance (E212), project development and implementation (E213), and project closeout (E214). The third goal is to provide the revamped Hazard Mitigation Handbook to all MIRC staff in conjunction with an internal mentoring program.

PEMA Disaster Exercises

MIRC and other PEMA staff participate in numerous exercises to prepare for more effective disaster response. Exercises may be conducted as table-top exercises or as field drills. All exercises serve to have staff practice response-related responsibilities. Issues identified during the exercises as needing improvement may direct planning, preparedness, and other activities in order to improve response during actual disaster events. Exercises are regularly held for

weather emergencies and nuclear power plants, and additional exercises will be organized as disasters are closed out and staff have more availability.

PEMA Identification and Implementation of Potential Mitigation Projects

Mitigation projects are identified at the local level and rolled up to the Commonwealth's Mitigation Project Inventory. This inventory is tracked by PEMA and contains a variety of projects including proposed property acquisition, elevation of buildings, storm water management (i.e. culvert or sewer repairs), stream channel restorations, etc. MIRC staff members conduct joint field surveys with municipalities to assist with Benefit-Cost Analyses (BCAs). MIRC's in-house survey equipment saves time in determining whether a property will meet the BCA by checking first floor elevations quickly and allowing MIRC and municipalities to focus efforts on properties that will match grant requirements. In some cases, inventorying and assessing the condition of structures both before and after a disaster event provides the flexibility to promote improved conditions either through a mitigation grant or through a disaster recovery grant.

DCED and PEMA, acting under their respective responsibilities to coordinate hazard mitigation planning at the county level, discuss with counties the Commonwealth's preference for the counties and their local jurisdictions to address RL properties as projects under the hazard mitigation planning process.

The identification and/or implementation of potential projects are critical to mitigation efforts in Pennsylvania. More information on the inventory and support provided to local communities in implementing mitigation projects is provided in Section 6.3. Project prioritization practices are also discussed in Section 6.3. In addition, Section 5.3.3 discusses federal, state, local, private, and nonprofit sources of funding and technical assistance for local mitigation projects.

PEMA Repetitive Loss and Severe Repetitive Loss Capability

RL and SRL property mitigation is addressed in Hazard Mitigation Assistance (HMA) funding streams available both before and after disaster. MIRC staff support RL and SRL mitigation using a continuous 12-month approach to increase grant applications and the mitigation of RL and SRL properties. This continuous approach includes outreach, technical assistance, grant support, and tracking. The activities that support pre- and post- disaster RL and SRL capabilities are primarily explained in Section 6.4.

The MIRC staff serves as a repository of information for counties and municipalities regarding RL and SRL properties. PEMA routinely distributes information about the HMGP to provide insight into the program regarding RL and SRL property mitigation. PEMA also created a supplemental packet which contains FEMA guidance materials. This packet is sent out to all interested applicants. The MIRC staff has updated the PEMA website to include information on the SRL and RFC grant programs. PEMA will also hold seminars at the request of a county and/or municipality to provide guidance for the application and the HMGP process as a whole. With MIRC's expanded role in NFIP management there will be additional opportunities for integration planning and communications for RL and SRL properties within the map update meetings, floodplain management training and technical assistance, CAVs, and hazard mitigation. The link of risk identification and reduction in one department with assist with moving forward on mitigating these properties.

The Director of PEMA provides yearly notifications to emergency management officials and planners about the fiscal availability of HMA Funds. The Circular may be found in Appendix C and the full RL/SRL inventory is in Appendix F. HMA funding is described in more detail in 5Table 5.3.3-1. The MIRC staff also provides an information session at their quarterly trainings. In addition to the annual notification and quarterly trainings, PEMA provides the counties a list of RL and SRL properties and will disseminate additional information to those counties which are interested in either the SRL or RFC program. PEMA staff work with counties and municipalities to identify RL and SRL properties for mitigation; identification criteria include identifying projects that are likely to be cost-effective, environmentally sound, and technically feasible.

PEMA is the State Applicant and essentially functions as a clearinghouse for all the non-disaster grant applications. PEMA also provides technical assistance and quality control for the sub-applicants. For example, once a sub-applicant submits their application, PEMA will review the application to ensure that it meets all requirements established by FEMA. PEMA's review evaluates and prioritizes RL and SRL projects that are cost-effective, environmentally sound, and technically feasible. If an application for an RL or SRL property is submitted that does not meet FEMA criteria, PEMA staff will provide technical assistance to the community to re-envision the project and re-submit an application. If the application cannot meet FEMA criteria, it will not be submitted to FEMA. Once the application meets all criteria and is complete, it is sent to FEMA for review.

MIRC also monitors and tracks projects that are underway and those which have been completed. In order to maintain accurate records of all projects that have received FEMA mitigation grants, FEMA requires the submission of Form AW-501, NFIP Repetitive Loss

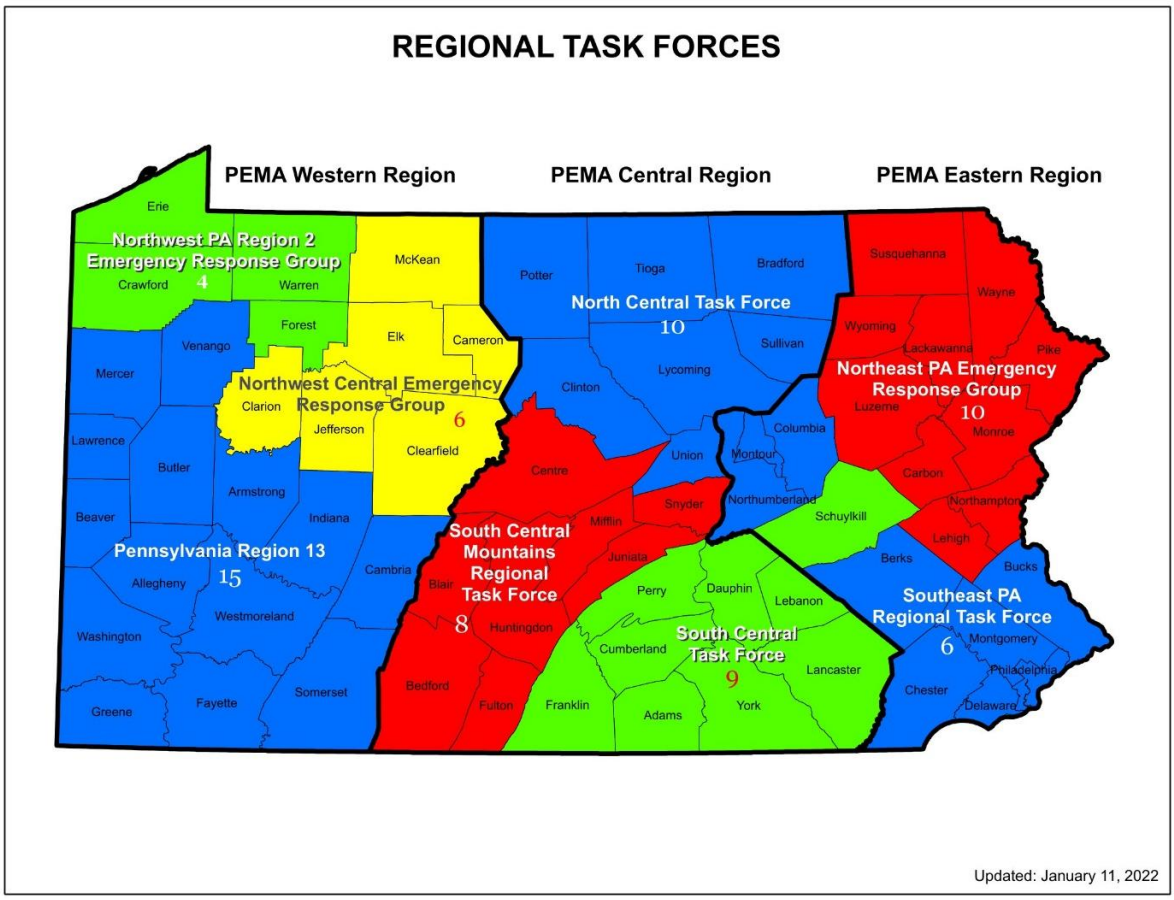
Update Worksheet (OMB #1660-0022). It is a local responsibility to complete the AW-501 form with appropriate documentation to shows any changes in the status of a property (e.g., elevation certificate). This form, along with the transmittal sheet or other document signed by an authorized community official, must be submitted for each property mitigated with HMA funds prior to project closeout. Sometimes, PEMA is able to support the completion of AW-501 forms, particularly with the staff available after a Disaster Declaration; however, AW-501 form completion remains a locally responsibility.

Regional Task Forces

PEMA regularly coordinates with the 8 Regional Task Forces across Pennsylvania, shown in Figure 5.3.1-4 below. These task forces are regional entities that assist in regional planning, maintain shared equipment, and provide trainings and exercises to bolster the region's ability to respond to hazards. Many of the task forces began as units working within the counterterrorism and critical infrastructure protection space, but since evolved into an all-hazards mindset. Task Forces may consist of various capabilities such as Hazmat Teams, Bomb Disposal Teams, Water Response Teams, Search and Rescue, Dive Teams, SWAT Teams, and more. They play an important role in ensuring regional public safety communications infrastructure is maintained, improved, and effective when needed. Funding is partly provided via the Homeland Security Grant Program (HSGP). PEMA no longer has a programmatic role in the HSGP, but still shares all necessary info on its website

PEMA Plans no longer has a programmatic role in the HSGP, and so PEMA Grants would be the Point of Contact (POC) for any HSGP-related projects for the task forces. This was transitioned to the Bureau of Grants Management as it was a more appropriate fit to handle grant-related initiatives.

Figure 5.3.1-5 Regional Task Forces in Pennsylvania as of January 2022 (PEMA, 2022)



PEMA Hazard Mitigation Webpage

www.pema.pa.gov is maintained by PEMA and provides timely information to local community officials and citizens throughout the Commonwealth. Information provided through the webpage includes but is not limited to: advisories and alerts, upcoming meeting and training announcements, guidance on mitigation grant programs, forms and documents, risk assessment information (i.e. Hazus reports), and program and service information.

The guidance provided for grant programs is very robust. There are separate web pages dedicated to 15 different grant programs, with pages including vital background information, important deadlines, application instructions, contact information, and other resources that allow applicants to be as informed as possible on the entire process. There is a table on the main page that provides the best contact for each grant type, which ensures questions are answered by the most knowledgeable option from the start.

PEMA also regularly uses project-based websites to promote hazard mitigation planning. These websites are tailored to projects and offer information on hazard mitigation with links to partner agencies including FEMA, calendars for meetings, meeting materials, surveys, and draft plans for review; people may sign up for alerts to be notified when the page is updated.

Pennsylvania Floodplain Management and Flood Insurance Webpage

The management of the Pennsylvania Flood Map Tool online moved to PEMA and a new set of webpages was launched on PEMA's website to address the NFIP, flood maps, determining your risk, local government resources, business and resident resources, and frequently asked questions. The webpages may be seen here: https://www.pema.pa.gov/planningandpreparedness/floodplainmanagement/Pages/default.aspx The initial move is complete and it is expected that as the new MIRC NFIP Administrative Officers are working with communities they will likely identify improvements and additions to the Pennsylvania Flood Map Tool for following fiscal years.

Pennsylvania State Emergency Operations Plan

The Pennsylvania Emergency Management Council, acting through the PEMA, develops and maintains the SEOP and implements the plan during incident response. The Pennsylvania SEOP describes the procedures to be followed in disaster response and assigns responsibilities to various departments and agencies of the Commonwealth government. It incorporates the principles of the National Incident Management System (NIMS), including the Incident Command System (ICS). NIMS provides standards that ensure compatible equipment, training, and procedures for all Pennsylvania responders. All government departments and agencies of Pennsylvania are directed by the Governor to use NIMS and the associated ICS for all emergency responses within Pennsylvania.

5.3.1.3 Other State and Multi-Agency Programs in Pennsylvania

The following provides a description of commonly engaged agencies. Complementary information is also available in Section 5.5.1.

Silver Jackets

The Silver Jackets program is a volunteer-based organization, which is focused on promoting interagency collaboration to combine resources such as funding, programs, and technical expertise. Members of the Silver Jackets represent local, state, and federal agencies, as well as other non-governmental groups with an interest in hazard mitigation, response, and recovery. The Pennsylvania Silver Jackets are led by the USACE and are focused primarily on flooding. The Pennsylvania Silver Jackets hold two webinars and one live meeting each quarter and invite participants from non-member organizations when the program may align with their interests. The Silver Jackets also assist FEMA with the High-Water Mark Initiative, which helps communities to remind residents of past flooding in the area and to encourage residents to take steps to mitigate against future flood losses. The SHMO, Tom Hughes, is an active member of the Silver Jackets.

ReadyPA

ReadyPA is an outreach program, which was launched in September 2008. ReadyPA is a statewide campaign supported by PEMA, Pennsylvania Citizen Corps, DOH, and volunteer organizations aiming to motivate Pennsylvanians to take action to prepare for a disaster. This program encourages all Pennsylvanians to "Be Informed, Be Prepared, and Be Involved." ReadyPA is coordinated between the Citizen Corps and the PEMA Press Office, which in turn coordinate with the counties, local government, state agencies, DHS, and other

organizations and agencies. The website, www.readypa.org, provides the latest guidance on disaster and emergency preparedness for the general public, children, individuals with disabilities, older residents, pet owners, etc. To reach those communities that speak other languages, the site is available in 133 different languages. It disseminates risk information and tools such as an emergency preparedness guide that includes supply kit checklists, emergency contact forms, and other printable information which can be used to reduce the risk of damage, injury, and death during a disaster event. The site also provides valuable information about making emergency plans and how people can become involved with their local Citizen Corps Councils or register to assist during a disaster through the State Emergency Registry of Volunteers in Pennsylvania. The ReadyPA website, www.readypa.org, went live at the end of December 2012.

Pennsylvania Insurance Department

The Pennsylvania Insurance Department's role in hazard mitigation is to educate the public on resources that may be available for hazard mitigation such as insurance and FEMA grants. In pursuit of this goal, the Pennsylvania Insurance Department posts fact sheets and press releases on their website on how to prepare and respond to disasters.

Pennsylvania Department of Community & Economic Development (DCED)

DCED's role in hazard mitigation is centered around funding mitigation and recovery activities. The most important funding mechanism DCED manages is the Community Development Block Grant – Disaster Recovery (CDBG) from HUD. CDBG-DR makes funding available to prevent further damage to an impacted area after a federally designated disaster with a focus on assisting communities in low-income areas. The goals of the program align with those in the SHMP, especially regarding Pennsylvanians most at-risk.

DCED also administers Act 13 Marcellus Legacy Fund grants that can support flood mitigation projects authorized by a flood protection authority, watershed restoration and protection, and orphaned or abandoned well plugging efforts. DCED was charged with administering several grant programs associated with funding various aspects of the response to and aftermath of the COVID-19 pandemic, including hazard pay programs, vaccines, public outreach, small business recovery efforts, and more.

The Land Use Planning & Technical Assistance Program (LUPTAP) provides grants for comprehensive plans and for the preparation of local zoning or subdivision. The leading mitigation technique associated with this program is Local Plans and Regulations as it provides funding to amend or develop comprehensive plans to include an assessment of hazard vulnerability and take appropriate mitigation measures. The Municipal Assistance Program (MAP) provides funding to assist local governments to plan for and efficiently implement a variety of services and improvements. Funding is available for three groups of activities: shared services, community planning, and floodplain management. The Keystone Communities Program (KCP) is another funding pathway for local initiatives that are focused on developing neighborhoods through social and economic diversity and revitalization. Communities can obtain a designation that opens them up for targeted investment for specific needs or development.

Pennsylvania Department of General Services

The Pennsylvania Department of General Services attempts to provide built-in hazard mitigation for new or retrofit construction via the Bureau of Engineering and Architecture and attempts to avoid leasing facilities in hazardous areas via the Bureau of Real Estate.

Pennsylvania Housing Finance Agency

The Pennsylvania Housing Finance Agency staffs the Joint Field Office, serves on the statewide disaster planning committee, and partners with PEMA, DCED, and DPW on an apartment locator service.

Pennsylvania State System of Higher Education

Each university in the Pennsylvania State System of Higher Education has a university-specific hazard mitigation plan, and Millersville University includes a Center for Disaster Research and Education.

Pennsylvania Treasury

The Pennsylvania Treasury evaluates the financial risk and consequences that can occur after a major disaster. The department also considers hazards that could put essential functions, such as payment processing, at risk. Also, staff members attend and practice table-top drills and exercises and train employees on emergency roles and home preparedness.

Pennsylvania Department of Transportation

The Pennsylvania Department of Transportation (PennDOT) coordinates transportation projects and maintains state-owned infrastructure across the Commonwealth. Their role in hazard mitigation is to promote safety and implement plans, procedures, and projects that mitigate transportation accidents. PennDOT maintains the Pennsylvania Mobility Plan, EV Mobility Plan, PA Transportation Security Plan, Winter Services Strategic Plan, and more. They are also engaged in the Federal Highway Administration's Alternative Fuels Corridor Program, which focuses on providing access to electric vehicle charging and hydrogen, propane, and natural gas fueling stations. Currently, I-78, I-80, and I-81 are engaged in efforts to create these corridors.

Pennsylvania Department of Health

The mission of the Pennsylvania Department of Health (PA DOH) is to promote healthy behaviors, prevent injury and disease, and to assure the safe delivery of quality health care for all people in Pennsylvania. PA DOH is home to several bureaus that provide pre-disaster capabilities. The Bureau of Communicable Diseases' mission is to reduce the incidence and prevalence of communicable diseases in the Commonwealth of Pennsylvania by providing a wide range of prevention and intervention strategies that incorporate all aspects of government and community partnerships. The Bureau of Emergency Medical Services Lead the commonwealth in preventing, responding to and reducing the public health and medical consequences of emergencies and disasters. The Bureau of Health Promotion and Risk Reduction supports community partners in implementing evidence-based prevention strategies, using current data and research for chronic disease, injury, and violence to foster healthy and

resilient communities across the Commonwealth of PA. The department also contributes to the Lyme and Other Tickborne Diseases Interagency Workgroup, which consists of members from the Department of Agriculture, Education, Environmental Protection, Conservation of Natural Resources, the Fish and Boat Commission, and the Game Commission that help coordinate the commonwealth's response.

There is interest in developing stockpiles of essential medical equipment such as PPE, but challenges regarding funding, storage capacity, and determining what equipment to stockpile and how to properly source it exist. Hospitals may experience difficulty managing and maintaining stockpiles as they are navigating the care and treatment of patients and potentially dealing with staff shortages. There is potential for regional stockpiling, but similar challenges apply. PA agencies have expressed interest in discussing national and statewide stockpiles and protecting them from disasters through various mitigation actions. At the time of this plan drafting, these conversations were nascent.

Pennsylvania DLI/Bureau of Occupational & Industrial Safety

The Pennsylvania DLI's Bureau of Occupational & Industrial Safety serves as the data repository for the Pennsylvania Tier II System (PATTS) Hazardous Chemical Reports available to PEMA and the county LEPC's that participate in the online PATTS Enterprise Program. Numerous facilities also upload their emergency response plans to this system.

Pennsylvania Construction Codes Academy

The Pennsylvania Construction Codes Academy offers training tailored to becoming certified as a Building Code Official (BCO). The program provides interactive education focused on the practical application of the Uniform Construction Code (UCC) regulations. Courses are held both in-person and online and address a number of building related topics.

Pennsylvania Department of Environmental Protection

The Department of Environmental Protection's mission is to protect Pennsylvania's air, land and water from pollution and to provide for the health and safety of its citizens through a cleaner environment. The DEP partners with individuals, organizations, governments, and businesses to prevent pollution and restore our natural resources. The DEP's mission is integral to hazard mitigation in Pennsylvania as it implements flood control projects, monitors and conducts outreach for radon, participates in emergency response, and regulates safe practices for several industries.

The DEP Bureau of Waterways, Engineering, and Wetlands plans, designs, and manages the construction of flood control projects. Completed projects are inspected annually by either DEP or USACE, while DEP reviews H20 and flood mitigation grant applications. DEP also has numerous fact sheets on their programs and hosts annual flood protection workshops for municipal sponsors. DEP provides project sponsors with the Emergency Action Plan Guidelines for flood protection projects, and the Division of Dam Safety within the Bureau approves dam emergency action plans, completes design and construction review, inspects dams for safety, and requires dams to be upgraded or repaired when warranted, under the authority of the Dam Safety and Encroachments Act and the Pennsylvania Code. The bureau is also involved in

levee safety, even though FEMA and USACE are known for levee monitoring and certification. As noted above, USACE partners with the DEP for annual levee safety workshops and inspections at federal and state constructed flood protection projects, which includes most of Pennsylvania's levee systems.

Stormwater management is an important aspect of DEP's authority. The Bureau of Clean Water administers NPDES permitting and compliance programs for commercial and municipal stormwater in PA. In general, permit coverage is five years. For commercial activities, permits are focused on industrial waste and large-scale earthmoving activities from construction. Municipalities and other public institutions like universities must maintain their own storm sewer systems according to their permits, ensuring that any water discharged into public waterways meets standards. DEP is also charged with the implementation of Act 167 stormwater management programs, which were discussed earlier in this section. Proper stormwater management not only impacts water quality across the Commonwealth, but also impacts the severity of flooding in areas.

DEP also protects waterways by requiring agricultural operations where over 5,000 square feet are used for plowing, tilling, or heavy animal use develop Agricultural Erosion and Sediment Control Plans. Agricultural runoff is a major cause of the growth of algae blooms in Pennsylvania. Currently, the Mid-Atlantic region leads the nation in cover crops and no-till practices, which allows rains to enter soil more quickly and both reduce runoff and increase organic matter in the soil, reducing carbon dioxide in the atmosphere.

The DEP Emergency Response Program helps achieve the Department's overall mission by providing timely responses to incidents which require the immediate presence of Department personnel to ensure the health and safety of the environment and the public. Responses typically include gathering critical evidence or information which may be transient, perishable, or otherwise unobtainable if a timely response is not made. The Emergency Response Program maintains the Department's Emergency Operations Plan, sends representatives to the PEMA Commonwealth Response Coordination Center (CRCC), participates in PEMA/FEMA trainings, drills, and conferences, shares incident notifications, has partnerships with neighboring states, and provides public information, as needed.

The DEP Bureau of Radiation Protection provides expertise in radiation protection and nuclear safety and possesses the equipment and personnel for radiation monitoring. Hazard mitigation is integrated into the Bureau's plans and procedures. This Bureau also participates in training programs, drills, and exercises, and has a public outreach program regarding radon.

DEP's partnerships with individuals, organizations, governments, and businesses often comes in the form of training and providing technical assistance in the process of monitoring and inspection. During monitoring and inspection, DEP provides information on safe practices and what partners can do to meet and exceed regulations that will keep employees, residents, and the environment safe now and into the future. The inspections and plan reviews that DEP conducts mitigate dam failure, hazardous materials release, mine collapse, and radon exposure. It also mitigates pollution from impacting individuals' health.

The following is a list of additional DEP programs:

- **Natural Gas Safety**: DEP conducts unconventional well inspections.
- **Mine Safety**: DEP conducts a mine safety program which inspects mines and equipment to ensure compliance with laws and safety standards.
- **Energy Technology**: DEP provides incentive and rebate opportunities for fleet conversions and alternative fuel generation. Improving use of alternative energy can reduce both pollution and climate change.
- **Air Quality**: DEP's monitoring aids in reducing hazardous air pollutants.
- **Brownfields**: DEP supports cleanups under the Environmental Cleanup and Brownfield's Voluntary Cleanup Program.

Beyond all the monitoring, inspecting, and training, DEP also manages an open GIS data portal for all of their public published, non-sensitive data. It has over 300 data layers, including geospatial information on abandoned mines, coal mining, municipal waste, radiation, stormwater, and more. It also includes several applications that allow you to search for various NPDES permit requirements, oil and gas operations, water quality networks, and more. The portal is available at https://newdata-padep-1.opendata.arcgis.com/.

Pennsylvania State Geospatial Coordinating Board

The Pennsylvania State Geospatial Coordinating Board (PSGCB) was established within the Office of Administration by Act 178 of 2014 to: "Provide advice and recommendations to the Governor and the citizens of this commonwealth on geospatial issues and provide uniform data standards, coordination and efficiency in geospatial policy and technology issues among Federal, State and local government agencies, academic institutions and the private sector." In June 2020, the operations of the GeoBoard were re-authorized through the enactment of Act 37 of 2020 (OA, 2023). The PSGCB includes data access and sharing resources as well as a variety of reports in the Geoboard Library.

Hazard Mitigation Land Use Measures in Pennsylvania

Local comprehensive plans provide a vision for the physical design and development of a community, and the principles in comprehensive plans are typically implemented via zoning ordinances, subdivision regulations, and capital improvement programs. Therefore, integrating hazard mitigation into the comprehensive plan helps to guide the community's development in a way that does not lead to increased hazard vulnerability. For instance, future development can be guided away from areas with known hazards, and design standards to withstand potential hazards can be created for new or improved construction.

There are several programs in place in Pennsylvania to promote land use controls as a means of hazard mitigation. For example, the Land Use Planning and Technical Assistance Program (LUPTAP) available through the DCED provides grants and technical assistance for preparation of community comprehensive plans, zoning ordinances, and subdivision regulations. The Community Assistance Program (CAP) is funded by FEMA and implemented through PEMA to provide technical assistance to local governments for ordinance updates and administration as well as floodplain map interpretation and enhancement. Similarly, the Local Floodplain

Management Reimbursement Program and the Risk MAP program help PEMA fund ordinance compliance updates when new FEMA flood maps are issued. Additionally, the DCNR Community Conservation Partnership Program is in place to provide technical assistance and funding for land acquisition, park rehabilitation and development, and small community development projects.

Pennsylvania Spatial Data Access (PASDA)

PASDA is the Commonwealth's official public access open geospatial data portal, developed in 1995 by Pennsylvania State University. It is currently run as a cooperative project between Penn State's Institution of Energy and the Environment, the Governor's Office of Administration, and the Office for Information Technology. Penn State contributes system administration support and infrastructure while the Office for Information Technology provides funding.

The keystones of PASDA are collaboration, cooperation, continuity, active engagement, efficiency, and free access. The data is provided by federal, state, local and regional government agencies, non-profit organizations, and academic institutions. Current online applications and tools include:

- **Pennsylvania Imagery Navigator:** A one stop portal for all imagery and raster data
- **Pennsylvania Atlas:** Online mapping interface that allows for enhanced visualization and data downloads
- **Pennsylvania Mine Map Atlas:** A preservation project utilizing data from DEP's Office of Active and Abandoned Mine Operations
- **Pennsylvania LiDAR Navigator:** A one stop portal for all LiDAR data
- **PA Flood Risk:** Provides vital information on the degree of flood risk for specific areas or properties
- **Penn Pilot:** Online library of digital historical aerial photography
- **Landscape Indicators for Mapped Wetlands in Pennsylvania:** Characterization of all mapped wetlands from the National Wetland Inventory in PA

In addition to providing this data, PASDA delivers presentations and has published papers on spatial data infrastructure. The PASDA website (https://www.pasda.psu.edu/) has an archive of all past presentations, reports, papers, articles, and more.

5.3.2 Post-Disaster Capability

As discussed in Section 5.2.2, Title 35 addresses PEMA's responsibilities before, during, and after a disaster.

PEMA's post-disaster capability is also built on staff and the training they receive to know and practice their post-disaster responsibilities. PEMA and MIRC staff has access to multiple technical and communication tools, including the Pennsylvania Emergency Operations Center, that support their ability to respond effectively in post-disaster situations. The Public Safety Emergency Telephone Act supports identification of disaster needs to emergency responders and managers. The Hazard Mitigation Grant Program Administrative Plans play a large part in identifying and implementing processes that will effectively target and access post-disaster funding for the Commonwealth. The Hazard Mitigation Grant Program Community Outreach is effective in starting the dialogue with potential local grantees about how to access funding. MIRC staff members are cross-trained to fulfill multiple roles in the post-disaster environment. RL and SRL property mitigation is prioritized in the HMGP state application review. As stated in Section 5.3.1, in any time period of limited budgets and staffing, additional funding and staff would be helpful in expanding PEMA and MIRC's post-disaster capability. The most prominent emerging policy or program impacting post-disaster capability is the program to regularly host training and exercises of post-disaster capability. Participation in two hours of EOC training per quarter and participation in exercises allow MIRC staff to be ready when they need to respond. MIRC is developing a second version of the HMPO Handbook that was completed in September of 2013; the second version will improve and standardize training of HMPOs in the Joint Field Office (JFO).

PEMA has hosted substantial damage trainings for local municipalities in 2023 that were funded by the 2023 CAP-SSE grant, as instructed by FEMA Region 3. On April 13th, there was an in-person training which was attended by FEMA Region 3. In addition to this in-person offering, virtual trainings were provided on April 24th and 27th.

In addition to these trainings, PEMA hosted the DRRA Section 1206 Workshop (both in-person and virtual options were available) on April 26th and 27th at PEMA HQ alongside FEMA Region 3, with attendance from FEMA HQ Public Assistance, Building Science/Code Enforcement, Mitigation, Recovery and local FPM/FPA and Building Code officials. PEMA later ran the Substantial Damage Estimation Training Pilot at PEMA HQ on June 21st and a field exercise at Ft. Indiantown Gap on June 22nd that both local and state officials attended.

PEMA has consistently provided Just-In-Time Substantial Damage/Substantial Improvement classes after a disaster and have provided Substantial Damage Estimator (SDE) Trainings along with Just-In-Time Duties and Responsibilities for Floodplain Managers, Floodplain Administrators, and Code Enforcement Officials trainings.

PEMA continues to encourage these efforts and has posted all associated documents on pa.gov here.

Technical and Communication Tools

PEMA is capable of assisting all levels of government in post-disaster situations. The agency has technical expertise and communication tools to provide disaster-related coordination and support. Hazus (http://water.usgs.gov/osw/flood_inundation/toolbox/HAZUS.html), Geographic Information Systems, a 24-hour call center, WebEx, and video telecommunication are all used in post-disaster situations. Within MIRC, all staff members are cross-trained and capable of performing multiple tasks depending on the status of the Emergency Operations Center. In addition to pre-disaster responsibilities discussed in Section 5.3.1.3, the MIRC staff also performs several post-disaster activities:

- Commonwealth Response and Coordination Center (CRCC) duties – MIRC staff provide infrastructure and human services support in the event the CRCC is activated.
- Field duties – MIRC staff are trained and have safety equipment to perform field work after a disaster. They often assess locations that were heavily impacted by a disaster and identify opportunities for mitigation. MIRC staff also may be called upon to staff disaster assistance centers in the field.
- Field briefings – MIRC staff conduct field briefings to municipalities on Pennsylvania disaster funding, how it may be used, and how municipalities can fund eligible projects.
- Continuity of Operations duties – MIRC staff maintains their regular pre-disaster duties during a disaster to maintain continuity of operations.
- Post Flood Recovery - Damage Checklist -This Region 3 developed tool is distributed by PEMA is coordination with FEMA post-disaster. It reminds municipalities what they should be doing and concerned about after a disaster for floodplain management, floodplain insurance, grants, and individual and public assistance.
- Preliminary damage assessment – MIRC PA and IA project officers and FEMA staff help counties and municipalities to document preliminary damage assessments in order to quickly determine whether or not the event qualifies as a disaster meriting financial assistance.
- Lessons learned briefings – MIRC compiles a list of “lessons learned” following each disaster.

Additional coordination mechanisms for outreach exist between the PSATS, Pennsylvania State Association of Boroughs, the Pennsylvania League of Cities and Municipalities, Keystone Emergency Management Agency (KEMA), the American Planning Association, Greenway Associations, and borough and township officials. These organizations also help PEMA distribute public information after disasters, as well as before disasters.

Pennsylvania Commonwealth Response and Coordination Center (CRCC)

The CRCC is a technologically-advanced facility staffed and operated 24-hours a day by highly-trained personnel. Representatives from each of the 15 Emergency Support Functions (ESF) are required to staff the CRCC during declared emergencies or disasters and exercises, and non-governmental organizations may also send representatives. The ESF include transportation; communications; public works and engineering; firefighting; emergency management; mass care, housing, and human services; resources support; public health and medical services; urban search and rescue; oil and hazardous materials response; agriculture and natural resources; energy; public safety and security; long-term community recovery and mitigation; and external affairs (U.S. Department of Health and Human Services, 2012). As of February 2015, the state agencies coordinating the 15 ESFs include: Pennsylvania Department of Administration, Pennsylvania Department of Transportation, Pennsylvania Department of Aging, Pennsylvania Department of General Services, Pennsylvania Department of Health, Pennsylvania Emergency Management Agency, Pennsylvania Department of Health, Pennsylvania Department of Environmental Protection, Pennsylvania State Police, Pennsylvania Department of Agriculture, Governor's Office of Communication and Press, and the Pennsylvania Department of Human Services,

At the county and local levels, other Emergency Operations Centers are also the central coordination point for response and recovery efforts. These county and local facilities range from large and highly-sophisticated to small and simple.

Hazard Mitigation Grant Program Administrative Plans

In the event of a Presidential Disaster Declaration, the Hazard Mitigation Grant Program Administrative Plan is edited and updated. Edits may be extensive and may require new sections to be developed depending on the regulatory changes between disaster declarations. Administrative Plans document the process for the administration of HMGP and the project management of the mitigation measures to be funded under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988. The revised Administrative Plan establishes agency guidance for HMPOs on the eligibility, development, submission, review, and recommendation of IA, PA and HMGP applications relative to federal disaster declarations. Topics including responsibilities and staffing, identification and evaluation of mitigation projects, application procedures, and financial management are addressed.

Repetitive Loss and Severe Repetitive Loss Capability

MIRC staff has a continuous 12-month approach to mitigating RL and SRL properties. This continuous approach supports both pre- and post-disaster grant funding streams. RL structures are structures covered by a contract for flood insurance that have incurred flood-related damage on two occasions during a ten-year period in which the cost of repair on average equaled or

exceeded 25% of the value of the structure at the time of the flood event. SRL is defined as properties which are single-family properties covered under NFIP flood insurance that: have at least four flood-related damages claims payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or for which at least two separate claim payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. For both instances, at least two of the reference claims must have occurred within any ten-year period and must be greater than ten days apart.

The HMGP program selects mitigation projects that are cost-effective, environmentally sound, and technically feasible. Following a disaster, the mitigation of RL and SRL properties is a priority for the State Review Team when reviewing HMGP applications. The State Review Team is comprised of Commonwealth employees from various agencies and offices that are tasked with reviewing HMGP applications and assigning a numeric ranking to the mitigation projects based on the projects being cost-effective, environmentally sound, and technically feasible.

Pennsylvania Voluntary Organizations Active in Disaster (PaVOAD)

The PaVOAD supports disaster preparedness, response and recovery by linking needs to available resources from independent member organizations. PEMA serves as the coordinating office and monitor for the PaVOAD. PaVOAD member organizations act independently during a disaster to provide services in line with their organization's mission. They collaborate to decrease duplication of services and to reduce un-met needs. Like the national VOAD, the PaVOAD works for the principles of cooperation, coordination, communication and collaboration. The services provided during VOAD members typically fall in the category of mass care and include food and water, shelter, and blankets. Member organizations often have volunteers training in first aid and disaster mental health; religious organization members may also provide spiritual care during disaster events. Many of the member organizations provide services and care on a daily basis; this ongoing support in communities also supports the long-term recovery process.

Pennsylvania State Animal Response Team (PASART)

PASART works to coordinate between a network of organizations, businesses, federal, state, county and local government agencies, and individuals that supports the prevention, preparedness, response, and recovery for emergencies affecting animals. PASART also supports County Animal Response Teams (CARTs) across the Commonwealth. The services provided by the PASART and CARTs includes recruiting and training volunteers to care for animals during disasters; coordinating locations that are appropriate to shelter pets with and near family members; coordinating locations to shelter larger animals and livestock; coordinating the purchase and donation of food, water, and supplies needed to care for animals; preventing the spread of diseases that affect animals during disasters; and supporting the long-term recovery of individuals and the local economy by protecting animals during disaster.

5.3.3 Funding and Technical Assistance Capability

Each local hazard mitigation plan includes mitigation actions and projects. This section includes an identification and discussion of current and potential sources of federal, state, local, or

private funding and technical assistance available to implement these mitigation activities identified in local hazard mitigation plans.

5.3.3.1 Federal-Level Funding and Technical Assistance

FEMA Hazard Mitigation Assistance Program

FEMA administers three hazard mitigation grant programs, known collectively as the Hazard Mitigation Assistance (HMA) programs. FEMA's *Hazard Mitigation Assistance Program and Policy Guide* (April 2023) provides specific guidance for these different programs. The HMA guidance replaces previous guidance and more efficiently manages hazard mitigation grants under one umbrella. Three FEMA hazard mitigation grants of the HMA program include:

Flood Mitigation Assistance (FMA) Program

As stated in the April 2023 policy guide, "FMA funding is available through the National Flood Insurance Fund for flood hazard mitigation activities and plan development and is appropriated by Congress on a yearly basis. States, territories and federally recognized tribes are eligible to apply for FMA assistance. NFIP participation is required to be eligible for funding; sub applicants must also be in "good standing" with the NFIP. Local governments and non-federally recognized tribes are considered sub applicants and must apply to their applicant state, territory or federally recognized tribe."

Funds can be used for projects that reduce or eliminate the risk of flood damage to structures insured by the National Flood Insurance Program (NFIP). All applicants and sub applicants must have a FEMA-approved mitigation plan that has been adopted in accordance with 44 CFR Part 201 and applicable mitigation planning policies to apply for and receive funding.

Building Resilient Infrastructure and Communities (BRIC) Program

The BRIC Program replaced the Pre-Disaster Mitigation (PDM) Program after The Disaster Recovery Reform Act of 2018 (DRRA) amended Section 203 of the Stafford

Act. According the FEMA, “The BRIC program seeks to fund effective and innovative projects that will reduce risk and increase resilience and serve as a catalyst to encourage the whole community to invest in and adopt policies related to mitigation”.(FEMA, n.d.c) Principles of the program include capability- and capacity-building, innovation, partnerships, future loss reduction, equity through EO 14008, and supporting building code adoption.

Hazard Mitigation Grant Program (HMGP)

As stated in the April 2023 policy guide, “HMGP is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) and implemented in regulations at 44 Code of Federal Regulations (CFR) §§ 206.430-440. The HMGP ensures that state, local, tribal and territorial governments have the financial opportunity to plan for and implement mitigation measures that reduce the risk of loss of life and property from future natural disasters during the reconstruction process following a disaster. HMGP is available when authorized through a major disaster declaration and either a governor, tribal chief executive, or equivalent, may request that funding be available to the state or territory that was affected by the declared disaster. The amount of HMGP funding available to the applicant is based on the estimated total federal assistance, subject to the sliding scale formula that FEMA provides for disaster recovery for each disaster declaration.”

A number of the above HMA programs require a match component. For selected HMGP, the Commonwealth has provided the local match. This is not a guarantee that the Commonwealth will provide the local match for all HMGP in the future. For FMA and BRIC, the local government (or sub-applicant) or the homeowner has provided the matching funds. Sometimes, funding is appropriated to PEMA by the Commonwealth for the purpose of providing the 25% match on mitigation projects that apply to a specific disaster. Other agencies also have funding streams that may support matches for the FEMA grant programs. Table 5.3.3-1 summarizes the mitigation activities for which FEMA HMA funds have been made available.

There are certain situations where the programs will provide more funding than is typical. The 2022 Bipartisan Infrastructure Bill allowed FMA to provide up to 90% of funding, instead of the typical 75%. The BRIC Program may provide up to 90% of the cost for eligible mitigation activities for small, impoverished communities, which are classified as those with less than 3,000 people and an average per capita annual income no more than 80% the national average. The Department of Homeland Security Appropriations Act (2022) included a provision that HGMP cost-share will increase to no less than 90% for disaster declarations between 1/1/2020 and 12/31/2021.

Table 5.3.3-1 FEMA Grant Program Eligible Activities (FEMA Hazard Mitigation Assistance Guidance, March 2023c).			
MITIGATION ACTIVITY	HMA PROGRAM[1]		
	HMGP[1]	BRIC	FMA[1]
1. Mitigation Projects	✓	✓	✓
Property Acquisition and Structure Demolition	✓	✓	✓
Property Acquisition and Structure Relocation	✓	✓	✓
Structure Elevation	✓	✓	✓
Mitigation Reconstruction	✓	✓	✓
Dry Floodproofing of Historic Residential Structures	✓	✓	✓
Dry Floodproofing of Non-Residential Structures	✓	✓	✓
Minor Localized Flood Reduction Projects	✓	✓	✓
Structural Retrofitting of Existing Buildings	✓	✓	✓
Non-structural Retrofitting of Existing Buildings and Facilities	✓	✓	✓
Safe Room Construction	✓	✓	
Infrastructure Retrofit	✓	✓	✓
Soil Stabilization	✓	✓	✓
Wildfire Mitigation	✓	✓	
Post-Disaster Code Enforcement	✓		
5% Initiative Projects (including Advanced Assistance)	✓		
2. Hazard Mitigation Planning	✓	✓	✓

Other FEMA Programs

National Flood Insurance Program (NFIP) – As discussed in other sections, the NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the NFIP. Flood insurance protects two types of insurable property – building and contents. The program is administered in Pennsylvania by PEMA. There is language in the NFIP pertaining to substantial damage, wherein if the insured structure in the floodplain is more than 50% damaged (or modified) the structure must be brought into compliance with the NFIP. Structures in the floodplain that are substantially damaged, may be eligible for the Increased Cost of Compliance (ICC) coverage, new and renewed Standard Flood Insurance Policies. Substantial Damage Determinations and ICC coverage have been found to be effective in communities working to mitigate RL and SRL properties and may be considered in combination with other funding streams.

Community Rating System (CRS) – The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS.

Public Assistance (PA) Program – According to the FEMA website, “Through the PA Program, FEMA provides assistance for the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain PNP organizations. Section 406 of the Stafford Act provides a funding source for cost-effective hazard mitigation measures that would reduce or eliminate the threat of future damage to a facility damaged during the disaster. The measures must apply only to the damaged elements of a facility rather than to other, undamaged parts of the facility or to the entire system. Section 406 mitigation measures are considered part of the total eligible cost of repair, restoration, reconstruction, or replacement of a facility. They are limited to measures of permanent work, and the Applicant may not apply mitigation funding to alternate projects or improved projects if a new replacement facility is involved. Upgrades required to meet applicable codes and standards are not ‘mitigation measures’ because these measures are part of eligible restoration work.”

FEMA Regional Catastrophic Preparedness Grant Program (RCPGP) – The RCPGP is intended to support coordination of regional all-hazard planning for catastrophic events, including the development of integrated planning communities, plans, protocols, and procedures to manage a catastrophic event in high-risk urban areas and their surrounding regions.

Emergency Management Performance Grants (EMPG) – According to the FEMA website, “Emergency Management Performance Grants (EMPG) provides funding to assist State and local governments with sustaining and enhancing all-hazards emergency management capabilities. Emergency management must be able to coordinate in the context of natural and human-made hazards, as well as technological events, that threaten the security of the homeland and the safety and well-being of citizens. An all-hazards approach to preparedness, including the development of a comprehensive program of planning, training, and exercises, sets the stage for an effective and consistent response to any threatened or actual disaster or emergency, regardless of the cause.” EMPG has a 50% federal and 50% state cost-share requirement.

Community Assistance Program – State Support Services Element (CAP-SSSE)
According to the FEMA website, “[the CAP-SSSE] program provides funding to States to provide technical assistance to communities in the National Flood Insurance Program (NFIP) and to evaluate community performance in implementing NFIP floodplain management activities. In this way, CAP-SSSE helps to:

- Ensure that the flood loss reduction goals of the NFIP are met,
- Build State and community floodplain management expertise and capability, and
- Leverage State knowledge and expertise in working with their communities.”

In Pennsylvania, FEMA Region 3, PEMA, and DCED negotiate a CAP-SSSE Agreement that specifies activities and products to be completed by the Commonwealth in return for CAP-SSSE funds. In addition, since Federal Fiscal Year 2005, the Commonwealth is required to develop a Five-Year Floodplain Management Plan describing the activities to be completed using CAP-SSSE funding as well as how the required performance metrics will be met. Performance standards that address quality of service are to be developed and measured. There is a 25% non-federal match for all states receiving CAP-SSSE funds. The CAP-SSSE funding will contribute to the new NFIP management positions planned for MIRC.

Community Disaster Loan Program - The program provides direct loans to local governments to offset the loss of tax or other revenues as a result of a major disaster. The loans are to be directly used to maintain local governmental functions such as police and fire protection, or water and sewer services.

Individuals and Households Program (IHAP) – The Individuals and Households Program is a combined FEMA and state program. When a major disaster occurs, this program provides funds and services to people in the declared area whose property has been damaged or destroyed and whose losses are not covered by insurance. In every case, the disaster victim must register for assistance and establish eligibility.

Environmental Planning and Historic Preservation Program (EHP) – FEMA's EHP integrates the protection and enhancement of environmental, historic, and cultural resources into FEMA's mission, programs and activities; ensures that FEMA's activities and programs related to disaster response and recovery, hazard mitigation, and emergency preparedness comply with federal environmental and historic preservation laws such as the National Historic Preservation Act and executive orders; and provides environmental and historic preservation technical assistance to FEMA staff, local, State and Federal partners, and grantees and subgrantees.

Fire Management Assistance Grant (FMAG). The FMAG Program is authorized by section 420 of the Stafford Act (42 U.S.C. 5187), which (1) authorizes the President to provide Fire Management Assistance to state, tribal, and local governments; (2) requires coordination with the State and Tribal Departments of Forestry; (3) allows the President to provide Essential Assistance under Section 403 of the Stafford Act; (4) allows section 420 to provide assistance to 404 Hazard Mitigation Assistance; and (5) requires the establishment of rules and regulations to carry out the program. When an uncontrolled fire on public or private forest or grassland is such a threat that, in the opinion of the on-scene commanders or other government officials, the fire threatens such destruction that would constitute a major disaster, the Governor may request assistance from the FMAG Program. The Governor of a state or the Governor's Authorized Representative (GAR) submits a request for a Fire Management Assistance Grant declaration. In addition to the declaration request, the Governor may also designate the GAR to execute, on behalf of the state, all necessary documents for requesting fire management assistance.

While all four of the following criteria from 44 CFR § 204.21 are considered when evaluating a request for an FMAG declaration, the criteria are considered in order of descending priority during the evaluation process of a threat of a fire or fire complex:

Threat to lives and improved property, including threats to critical facilities/infrastructure and critical watershed areas;

- Availability of state and local firefighting resources;
- High fire danger conditions, as indicated by nationally accepted indices such as the National Fire Danger Ratings System (NFDRS); and
- Potential major economic impact.

Before a grant can be awarded, a state must demonstrate that total eligible costs for the declared fire meet or exceed the fire cost thresholds. According to FEMA's calendar year (CY) 2022 cost thresholds, Pennsylvania's individual and cumulative fire event cost thresholds are $1,059,720 and $3,179,160, respectively (FEMA, 2022m).

Risk MAP (Mapping, Assessment, and Planning) – According to the FEMA website, "The vision for Risk MAP is to deliver quality data that increases public awareness and leads to action that reduces risk to life and property. Risk MAP builds on flood hazard data and maps produced during the Flood Map Modernization (Map Mod) program." Risk MAP combines flood hazard mapping, risk assessment tools and mitigation planning into one seamless program. The intent of this integrated program is to encourage beneficial partnerships and innovative uses of flood hazard and risk assessment data to maximize flood loss reduction. FEMA will collaborate with federal, state, and local stakeholders to achieve the following goals under Risk MAP:

- Flood Hazard Data. Address gaps in flood hazard data to form a solid foundation for risk assessment, floodplain management, and actuarial soundness of the National Flood Insurance Program (NFIP).
- Public Awareness/Outreach. Ensure that a measurable increase of the public's awareness and understanding of risk results in a measurable reduction of current and future vulnerability.
- Hazard Mitigation Planning. Lead and support States, local, and Tribal communities to effectively engage in risk-based mitigation planning resulting in sustainable actions that reduce or eliminate risks to life and property from natural hazards.
- Enhanced Digital Platform. Provide an enhanced digital platform that improves management of Risk MAP, stewards information produced by Risk MAP, and improves communication and sharing of risk data and related products to all levels of government and the public.
- Alignment and Synergies. Align Risk Analysis programs and develop synergies to enhance decision-making capabilities through effective risk communication and management.

National Dam Safety Program (NDSP) – The NDSP, led by FEMA, is a partnership of the states, federal agencies, and other stakeholders that encourages individual and community

responsibility for dam safety. The NDSP, which was formally established by the Water Resources and Development Act of 1996, includes:

- Grant assistance to the states, which provides vital support for the improvement of the state dam safety programs that regulate most of the 79,500 dams in the United States.
- Dam Safety Research, which is a program of technical and archival research.
- Dam safety training for state dam safety staff and inspectors.

The Dam Safety and Security Act of 2002, signed into law on December 2, 2002, reauthorized the NDSP for four more years and added enhancements to the 1996 Act that are designed to safeguard dams against terrorist attacks. In 2016 the President signed the "Water Infrastructure Improvements for the Nation Act" or the "WIIN Act" to provide a new grant program for the rehabilitation of High Hazard Potential Dams (HHPD). The Rehabilitation of High Hazard Potential Dams (HHPD) Grant Program provides technical, planning, design, and construction assistance for eligible HHPDs and was funded at $10 million dollars for FY 2019 with funding projected to increase in coming years. Pennsylvania has actively pursued the HHPD program with one grant awarded in the first year and 5 in its second. in addition, PEMA has secured funding to include FEMA required HHPD analysis in County Hazard Mitigation Plan Updates for 34 counties.

Safeguarding Tomorrow Revolving Loan Fund (RLF) Program - An amendment to the Robert T. Stafford Disaster Relief and Emergency Assistance Act authorized FEMA to provide funding to states, eligible tribes, territories, and the District of Columbia to create revolving loan funds that will provide mitigation assistance to reduce risks from natural hazards and disasters. The loans from this revolving fund are low interest and need to be used for reducing vulnerabilities, fostering resilience, and reducing disaster damages. The funds can be used as the non-federal matches required by other HMA programs. One of the program priorities is to deliver equitable investments and increased access to funding, with 40% of overall benefits generated occurring in underserved communities.

U.S. Army Corps of Engineers Programs

Planning Assistance to States (PAS) Program – Section 22 of the 1974 Water Resources Development Act provides authority for the US Army Corps of Engineers Planning Assistance to the States (PAS) and Indian Nations. Under this program, the USACE assists the States, local governments, Native American Tribes and other non-federal entities in the preparation of comprehensive plans for the development and conservation of water and related land resources. Types of work that can be done include: Water Quality Studies, Wetland Evaluation Studies, Flood Plain Management Studies, Coastal Zone Management/Protection Studies, Harbor/Port Studies, or other water resource planning investigations. The needed planning assistance is determined by the individual non-federal sponsors.

Flood Plain Management Services Program (FPMS) – Section 206 of the 1960 Flood Control Act (PL 86-645), as amended, provides the authority for the USACE to provide assistance and guidance on all aspects of flood plain management planning. The program develops or

interprets site-specific data on obstructions to flood flows, flood formation, and timing and the extent, duration, and frequency of flooding. Upon request, program services are provided to the state, regional, and local governments, Native American Tribes, and other non-federal public agencies without charge.

Continuing Authorities Program (CAP) – Congress has provided USACE with a number of standing authorities to study and build water resource projects for various purposes without additional project specific congressional authorization. The types of projects addressed by the CAP include emergency streambank and shoreline erosion, flood control projects, snagging and clearing for flood control, and small beach erosion control projects.

Inspection of Completed Works (ICW) Program – Civil works structures whose failure or partial failure could jeopardize the operational integrity of the project, endanger the lives and safety of the public, or cause substantial property damage, are periodically inspected and evaluated to ensure their structural stability, safety, and operational adequacy. For those structures constructed by the USACE and turned over to others for operation and maintenance, the operating entity is responsible for periodic inspection and evaluation. The USACE may conduct the inspection on behalf of the project sponsor provided appropriate reimbursement to the USACE is made. However, the USACE may participate in the inspection with the operating entity at the government's expense.

Rehabilitation and Inspection Program (RIP) – The Rehabilitation and Inspection Program is a USACE program that provides for inspection of flood control projects, the rehabilitation of damaged flood control projects, and the rehabilitation of federally-authorized and constructed hurricane or shore protection projects.

National Levee Safety Program – The National Levee Safety Program assesses the integrity and viability of levees and recommends actions to assure that levee systems do no present unacceptable risk to the public, property, and the environment.

Beach Restoration and Shoreline Protection Program – This program authorizes USACE under Section 103 of the 1962 River and Harbor Act, as amended, to develop and construct small projects for the purpose of shore protection and beach restoration on Great Lakes and coastal areas. In Pennsylvania, this program is applicable in Erie County.

General Investigation (GI) – These are congressionally authorized studies under USACE's Civil Works program. Congress can authorize USACE to study, design, and construct major flood risk management projects. The feasibility study is cost-shared 50/50 and construction is cost shared 65/35 between the federal government and non-federal sponsor. These are generally large-scale projects that cost more than $10 million. Congress can also authorize USACE to conduct other water-related studies/projects such as watershed assessments, ecosystem restoration, and navigation improvements.

Other Federal Programs

Climate and Economic Justice Screening Tool (CEJST) – The Council on Environmental Quality (CEQ) was directed by Executive Order 14008 to develop this tool, an interactive map to identify communities that are overburdened or underserved. It is a resource for federal agencies to ensure programs and projects adhere to the requirements of the Justice40 initiative. The tool uses eight indicators to determine the level of burden, which are:

- Climate Change
- Energy
- Health
- Housing
- Legacy Pollution
- Transportation
- Water and Wastewater
- Workforce Development

Community Development Block Grant (CDBG) – The Community Development Block Grant (CDBG) Program is authorized under Title 1 of the Housing and Community Development Act of 1974, Public Law 93-383, as amended 42 U.S.C. 5301 et seq. The CDBG program provides grants and technical assistance to federally designated and non-designated municipalities for any type of community development. There is an Entitlement component that provides funding for designated communities via a set formula. The Competitive component provides funding of up to $500,000 to non-federally designated communities. These grants may be used for infrastructure improvement, public services, or development and planning. 70% of the project must benefit low- and moderate-income persons. CDBG money can be used as matching funds for the FEMA HMA grant programs.

There are a couple of different types of CDBG funds, including CDBG Mitigation Funds (CDBG-MIT) or CDBG Disaster Recover Funds (CDBG-DR). CDBG-MIT funding provides an opportunity for grantees to use assistance in areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risk and reduce future losses.CDBG-DR funds are targeted at helping cities, counties and states recover from Presidentially-declared disasters.

Eligible grantees are:

- Principal cities of Metropolitan Statistical Areas (MSAs)
- Other metropolitan cities with populations of at least 50,000
- Qualified urban counties with populations of at least 20,000 (excluding the population of entitled cities)
- States and insular areas

CDBG funds may be used for activities including, but not limited to:

- Acquisition of real property
- Relocation and demolition

- Rehabilitation of residential and non-residential structures
- Construction of public facilities and improvements, such as water and sewer facilities, streets, neighborhood centers, and the conversion of school buildings for eligible purposes
- Public services, within certain limits
- Activities relating to energy conservation and renewable energy resources
- Provision of assistance to profit-motivated businesses to carry out economic development and job creation/retention activities

Department of Homeland Security Grant Program (HSGP) – The Homeland Security Grant Program consists of three sub-programs: the State Homeland Security Program (SHSP), Urban Areas Security Initiative (UASI), and Operation Stonegarden (OPSG). The SHSP is the core assistance program in this suite; it provides funds to build capabilities at the state and local levels and to implement the goals and objectives included in state homeland security strategies and initiatives in their State Preparedness Reports. At least 25% of these funds are dedicated toward anti-terrorism activities. UASI focuses on enhancing regional preparedness in metropolitan areas, while OPSG is intended to enhance cooperation and coordination among law enforcement agencies in a joint mission to secure the US border. This program currently helps fund Regional Task Forces across the Commonwealth.

Small Business Administration Disaster Loan Programs – The SBA Disaster Loan Program provides low-interest, long-term loans to businesses and most private nonprofit organizations to repair or replace damaged property owned by the business, including real property, machinery and equipment, fixtures, inventory, and supplies. Homeowners may also qualify for low-interest loans to help rebuild or repair their primary homes or repair or replace uninsured or underinsured flood damaged personal property. Renters may qualify for loans to repair or replace personal property such as clothing, furniture, cars and appliances. Economic Injury Disaster Loans provide working capital to small businesses, small agricultural cooperatives and most private nonprofit organizations to assist them through the recovery period.

Natural Resources Conservation Service (NRCS) provides financial and technical assistance that supports mitigation before and after a disaster. The programs are unique in that they will support improvements to both private and public lands. Prior to a disaster, the NRCS's easement programs promote Natural System Protection mitigation. The Wetlands Reserve Program is the easement program most closely linked to flood mitigation by providing a place for flood waters to appropriately flow. Though the remaining easement program also could provide a role for Natural System Protection mitigation depending on where they are implemented: Farm and Ranch Land Protection Program, Grasslands Reserve Program, and Healthy Forests Reserve Program.

In response to disasters, the NRCS provides the Emergency Watershed Protection Program (EWP) for Recovery and Floodplain Easement (FPE). The EWP-Recovery program supports improvement for watersheds including projects to address debris-clogged stream channels, unstable streambanks, jeopardized water control structures and public infrastructures, wind-borne debris removal, and damaged upland sites stripped of protective vegetation by fire or

drought. The EWP-FPE program targets floodplain restoration by purchasing permanent easements on floodplain lands. The purpose of these easements is to restore, protect, manage, maintain, and enhance the functional values of floodplains and other lands, and for the conservation of natural values including fish and wildlife and their habitat, water quality improvement, flood water retention, groundwater recharge, open space, aesthetic values, and environmental education.

Silver Jackets Flood Mitigation Program Guide – A comprehensive list of all federal programs and funding mechanisms that support flood risk management activities. The latest guide was published in March 2022 and can be found at: https://www.iwr.usace.army.mil/Portals/70/docs/silverjackets/PA%20Mitigation%20Program%20Guide%20Final%20Mar2022.pdf?ver=kNeAzcLUleg6jx6uwkX_Vg%3D%3D The guide also includes information on state-level and non-profit opportunities, which are covered in greater depth below.

5.3.3.2 State-Level Funding and Technical Assistance

The Commonwealth uses a variety of funding sources to meet the match requirements of the various HMA grant programs. In addition, the Commonwealth has a variety of technical assistance programs available to aid communities with hazard mitigation. Funding sources are listed by agency and program. The following list is not exhaustive of all mitigation assistance opportunities. Some programs, such as The Office of the Budget's Redevelopment Assistance Capital Program, do not focus on hazard mitigation specifically but may still have an impact. For example, during the national infant formula shortage of 2022, this program helped fund the construction of a formula manufacturer in PA. The manufacturer was the first new infant formula manufacturer to be registered by the FDA in 15 years (Druga, 2022). This will increase the state's ability to mitigate risks associated with food contaminations or food supply issues.

Department of Community and Economic Development (DCED)

DCED offers assistance through a number of programs. Applicants can apply via a Single Application for Assistance online. The Single Application is a streamlined application process for financial assistance for the following programs:

Municipal Assistance Program (MAP) – The program provides funding to assist local governments to plan for and efficiently implement a variety of services and improvements, and soundly manage development with an emphasis on intergovernmental approaches. Funding is available for three groups of activities: shared services, community planning, and floodplain management.

- Shared service activities: consolidating or regionalizing shared services among multiple counties and municipalities boundary change studies, shared personnel, and shared equipment. New or expanded intergovernmental initiatives that promote local governmental efficiencies and effectiveness.
- Community planning: comprehensive plans and parts thereof, land use ordinances, Transit Revitalization Investment District planning studies and entrepreneurial/innovative

plans that support community and economic development improvements with an emphasis on multi-municipal plans.

- Floodplain management: reimbursement for costs of preparation, enactment, administration and enforcement of floodplain management regulations pursuant to the Flood Plain Management Act.

Grants of up to 50% eligible costs are available; the program is administered by the Governor's Center for Local Government Services within the DCED.

CDBG-DR – As discussed above, the CDBG-DR program provides grants for any type of community development. In Pennsylvania, state law governs how the Commonwealth distributes the annual HUD Non-Entitlement allocation. The law provides for two ways of distributing these funds: as Entitlement funds (applicable to non-urban counties, non-urban third class cities, urban boroughs and townships) and as Competitive funds (applicable to non-urban boroughs and townships and other restricted municipalities).

Business Financing – Several programs under this general program category could be used to help businesses finance a mitigation-related activity. All projects must demonstrate that a certain number of jobs will either be retained or created. These programs have not been itemized for this plan because of the wide variety of state programs in existence. Each application for these state funds must be customized and/or tailored to fit the economic development criteria. Therefore, it is recommended that each applicant meet with the central office or field economic development staff specialists of the department before completing online applications.

Local Municipal Resources and Development Program (LMRDP) – The program provides grants from a minimum of $5,000 up to $25,000 for infrastructure rehabilitation, acquisition and demolition of structures, and revitalization of community facilities.

Urban Development Program (UDP) - The program provides grants from a minimum of $5,000 up to $25,000 for construction or rehabilitation of infrastructure, acquisition and demolition of structures, rehabilitation of structures, planning of community assets, and public safety training (i.e. first responder training). However, this program is currently inactive.

H2O PA Program – This program provides single-year or multi-year grants to the Commonwealth, independent agencies, municipalities, or municipal authorities for the construction, improvement, repair, or rehabilitation of all or part of a flood control system. Funding is for a minimum of $500,000 or more and a maximum amount of $20 million for any project. Types of flood control projects may include channel improvements, compacted earth levees, concrete channels, concrete floodwalls, detention dams, non-structural measures, or any combination of these project types. Major repairs or rehabilitation of an existing flood protection project would also be eligible.

PENNVEST

PENNVEST provides low-interest loans to communities to fund sewer, stormwater, and drinking water projects throughout the Commonwealth. PENNVEST is responsible for administering the Clean Water State Revolving Fund, the Drinking Water State Revolving Fund, and the American Recovery and Reinvestment Act of 2009 funds. Stormwater improvement projects by PENNVEST represent significant funding for Pennsylvania. The total funding from 1993-2022 is $211,776,165.00. The following table provides details on the location, title, and funding for each stormwater project.

Table 5.3.3-2 PENNVEST Stormwater Projects 1993-2022 (PENNVEST, 2022).

COUNTY	PROJECT NAME	APPROVAL DATE	AMOUNT
Bradford	Sayre Boro.-stormwater project in the borough	11/10/1993	$1,435,000
Philadelphia	PAID-stormwater drainage system for spectrum II arena	11/10/1993	$2,341,467
Allegheny	Scott Twp -Lincoln Ave storm line	3/23/1994	$364,300
Beaver	Monaca Boro -phase I storm water	3/23/1994	$501,218
Delaware	Brookhaven Boro-storm water inlets & piping	3/23/1994	$195,460
Delaware	Eddystone Boro-storm sewers	3/23/1994	$1,402,625
Jefferson	Reynoldsville Boro. -storm sewers on Mabel St.	3/23/1994	$230,000
Lancaster	E Hempfield Twp- storm sewers in cherry hill, wheatland &running pump	3/23/1994	$1,229,000
Delaware	Prospect park boro-new storm water drainage system	11/30/1994	$128,374
Delaware	Ridley Park boro-stormwater dam project	11/30/1994	$650,000
Delaware	Ridley Park boro-stormwater improvement project	11/30/1994	$650,000
Delaware	Ridley Twp-upgrade & extend stormwater drainage system	11/30/1994	$1,242,500
Lawrence	Shenango Twp. -storm sewers Brookshire Area	11/30/1994	$224,971
Luzerne	LAFLIN BORO 94-s; storm	11/30/1994	$153,790
Schuylkill	Pottsville City stormwater 94	11/30/1994	$331,775
Erie	Lake Cty. Boro. -stormwater drainage system Martin Ave.	3/22/1995	$85,000
Tioga	Mansfield Boro. MA -install storm sewer lines, manholes, etc.	3/22/1995	$461,100
Tioga	Wellsboro Boro -Storm sewer project along Charleston St. and East Ave.	3/22/1995	$291,178
Westmoreland	Hempfield Twp -Zellers street storm sewers	3/22/1995	$908,969
Allegheny	Dravosburg Boro -storm water mine water	7/12/1995	$186,019
Blair	Newry boro-storm sewers & 4 catch basins	7/12/1995	$40,000
Bucks	Sellersville boro-storm drainage improvements	7/12/1995	$150,000
Dauphin	Hbg auth-improve stormwater inlets @ 5 locations	7/12/1995	$85,133
Mifflin	Burnham boro-stormwater system walnut st to hungry run	7/12/1995	$247,000
Northumberland	Mount Carmel MA -replace combined sewer box culvert	7/12/1995	$609,000

Table 5.3.3-2	PENNVEST Stormwater Projects 1993-2022 (PENNVEST, 2022).		
COUNTY	PROJECT NAME	APPROVAL DATE	AMOUNT
Westmoreland	Hempfield Twp -high park storm sewers	7/12/1995	$269,101
Carbon	LANSFORD BORO 95 stormwater/sinkhole	11/29/1995	$604,290
Clearfield	Dubois City -storm sewer along New St.	3/20/1996	$126,010
Erie	Lawrence Park Twp.-replace storm sewer pipe	3/20/1996	$94,182
Erie	Millcreek Twp. -replace storm sewer lines dredge Beaver Run	3/20/1996	$615,098
Erie	Wesleyville Boro.-replace storm sewer along Bird Drive	3/20/1996	$81,436
Washington	California Boro -sewer separation project	7/17/1996	$703,620
Delaware	Lower Chichester Twp-stormwater drainage improvements Marshall terrace	11/13/1996	$695,000
Washington	Washington City -hall Ave storm sewer	3/26/1997	$2,484,149
Berks	Colebrookdale Twp-stormwater drainage improvements	7/16/1997	$157,187
Columbia	Mifflin Twp. -storm sewer to connect to PENNDOT system	7/16/1997	$407,419
Delaware	Ridley Twp-stormwater drainage improvements in 12 areas	7/16/1997	$1,250,000
Somerset	Paint Boro -stormwater improvements	7/16/1997	$335,650
Luzerne	Wright Twp Yorktown rd.	11/19/1997	$236,200
Delaware	Upper Chichester Twp-storm sewer improvements in 9 locations	3/25/1998	$706,700
Luzerne	EDWARDSVILLE BORO 98-storm; Larkmont Manor	7/15/1998	$101,342
Luzerne	FREELAND BORO 98-storm separation	7/15/1998	$1,786,826
Westmoreland	Penn Twp -level green	7/15/1998	$597,570
Delaware	Upland boro-storm sewer improvements	11/18/1998	$236,950
Fayette	Connellsville City -stormwater extensions	11/18/1998	$125,197
McKean	Bradford City -stormwater pipe and storm inlets	11/18/1998	$2,575,017
Allegheny	Pleasant Hills Boro -east Bruceton phase 1	3/24/1999	$561,195
Bucks	Middletown Twp-stormwater drainage improvements	3/24/1999	$674,475
Lycoming	Picture Rocks Boro. -stormwater drainage system Taylor Hill	7/14/1999	$62,734
Delaware	Upper Chichester Twp-storm sewers @ Johnson, hillside & roger Aves	3/22/2000	$559,000
Delaware	Lansdowne boro-storm sewer improvements	7/12/2000	$1,538,741
Mercer	Sharon City -storm sewer along Mesabi St.	7/12/2000	$272,518
Westmoreland	Penn Twp -berlin stream	7/12/2000	$238,000
Crawford	Titusville City -stormwater pipe and catch basins	10/4/2000	$3,522,045
Allegheny	Mt Oliver Boro -Anthony street phase 1 storm	11/15/2000	$856,370
Allegheny	Pittsburgh WSA -Overbrook Blvd.	11/15/2000	$991,115
Cambria	Westmont Boro -spear Ave storm sewers	11/15/2000	$163,382
Clinton	Avis Boro.-storm sewer system	3/21/2001	$438,350

Table 5.3.3-2	PENNVEST Stormwater Projects 1993-2022 (PENNVEST, 2022).		
COUNTY	PROJECT NAME	APPROVAL DATE	AMOUNT
Allegheny	Baldwin Boro -storm sewer phase 1	7/18/2001	$205,050
Allegheny	Mt. Oliver Boro -Anthony street phase 2 storm	7/18/2001	$1,164,050
Clinton	Wayne Twp.- stormwater drainage system	7/18/2001	$360,519
Northumberland	Northumberland Boro. -new storm sewer collection system	11/14/2001	$1,113,715
Westmoreland	Penn Twp -berlin dam project	11/14/2001	$806,920
Cambria	Cambria Twp -mylo park storm water project	3/20/2002	$349,561
Erie	Lawrence Park Twp. - replace storm sewer pipe	3/20/2002	$271,000
Fayette	Uniontown City -stormwater separation project	3/20/2002	$1,664,000
Westmoreland	Penn Twp -Cortina Marie project	3/20/2002	$1,325,000
Allegheny	Edgewood Boro -race street storm	7/17/2002	$158,520
Luzerne	HAZLE TWP 02-storm	7/17/2002	$1,274,040
Washington	Charleroi Boro -stormwater system	7/17/2002	$7,900,000
Lawrence	South New Castle Boro. -stormwater pipe along Morris St.	11/20/2002	$97,091
Montgomery	Schwenksville Boro - Third Street Improvements	5/7/2003	$80,000
Luzerne	Freeland Boro -Northside Storm Water Project	3/24/2004	$1,149,848
Westmoreland	Unity Twp - Lawson Heights Storm Sewer Project	3/24/2004	$960,000
Berks	Colebrookdale Twp - Mill Street	7/7/2004	$630,000
Berks	Exeter Twp - East Neversink Storm Sewer	7/7/2004	$299,193
Bedford	Everett Boro - West Street Improvements	11/17/2004	$346,400
Washington	North Franklin Twp - Stormwater Construction on eight (8) streets	11/17/2004	$306,927
Union	Lewisburg Area Rec Auth - Saint Mary Street Park Improvements	3/23/2005	$298,909
Berks	Sinking Spring Boro - Mountain Home Road Stormwater Project	7/6/2005	$603,094
Dauphin	Steelton Boro - Pine & Jefferson Streets Stormwater Facilities	11/9/2005	$1,259,000
Luzerne	Bear Creek Vlg Boro - Beaupland Road Storm Sewers	5/24/2006	$199,000
Westmoreland	Derry Boro (Westmoreland Cty) Storm Sewer Improvements	5/24/2006	$1,900,938
Westmoreland	Unity Twp - Lawson Heights Storm Sewer Replacement - Phase 2	5/24/2006	$386,135
Luzerne	Greater Hazelton Jt SA - Terrace Stormwater Improvement Project	10/23/2007	$726,534
Luzerne	Freeland Boro - East-West Storm Water Project	4/14/2008	$651,100
Philadelphia	Philadelphia City - Green Infrastructure for Stormwater Management	4/20/2009	$30,000,000
Allegheny	Friends of the Pittsburgh Urban Forest - City of Pbgh Parking Lot Landscaping Initiative	7/21/2009	$274,393
Allegheny	Pittsburgh Botanic Garden - Botanic Garden Irrigation Ponds	7/21/2009	$1,368,894
Allegheny	Western Pennsylvania Conservancy--TreeVitalize	7/21/2009	$2,400,000

Table 5.3.3-2	PENNVEST Stormwater Projects 1993-2022 (PENNVEST, 2022).		
COUNTY	PROJECT NAME	APPROVAL DATE	AMOUNT
Armstrong	Armstrong Conserv District - Water Improvement	7/21/2009	$1,552,007
Bedford	Broad top Twp (Six Mile Run Area Vltr Fire Co) - Station 36 Innovative Stormwater Reuse	7/21/2009	$35,070
Bedford	Everett Boro (Everett Hardwood Bsnss Pk) - Boro Brownfield Stormwater Mgnt	7/21/2009	$137,802
Bradford	Standing Stone Twp - Slope Stabilization Mosier Road Slide 1 into Rummerfield Creek	7/21/2009	$128,653
Bradford	Standing Stone Twp - Slope Stabilization Mosier Road Slide 2 into Rummerfield Creek	7/21/2009	$101,462
Bucks	Tinicum Twp - Dirt Road/storm water management	7/21/2009	$600,000
Bucks	West Rockhill Twp - Jesmont Road	7/21/2009	$49,343
Cambria, Centre, Clearfield, Snyder, Union	Snyder CCD - Riparian Stream Buffer Tree Planting Project	7/21/2009	$119,833
Chester	Chester Cty Conserv District - Brandywine Christina Stormwater BMPs - Agriculture and Urban	7/21/2009	$1,832,839
Chester	Chester Cty Conserv District - Octoraro/Elks/Northeast AG BMPs	7/21/2009	$339,245
Chester	Tredyffrin Twp - Maude-Lisa-Vincent Drainage Improvement Project	7/21/2009	$523,974
Clearfield	Ferguson Twp - Dirt & Gravel Road Environmental Innovative	7/21/2009	$142,380
Crawford	Sadsbury - Clean Water - Foust Rd. Project	7/21/2009	$98,000
Cumberland	Upper Mifflin Twp - Bridgewater Rd and Parkhill Rd Improvements	7/21/2009	$205,291
Dauphin	Chesapeake Bay Foundation, Inc. - Riparian Forest Buffers & Ag BMPs to Improve Water Quality	7/21/2009	$14,966,444
Delaware	Villanova Univ - Down Spout Disconnection Program	7/21/2009	$55,912
Erie	Erie County Conserv District - rural road stormwater improvements	7/21/2009	$1,191,201
Fayette	PA Environmental Council – Ohio Pyle Green Infrastructure Projects	7/21/2009	$1,312,718
Lackawanna, Luzerne, Wyoming	PA Urban & Community Forestry Council - Green Stormwater Management	7/21/2009	$300,000
Lehigh	Lehigh Cty - County Environmental Center	7/21/2009	$40,000
Lehigh, Northampton	Lehigh Cty Conserv District - Lehigh/Northampton Stormwater BMP Demo Project	7/21/2009	$100,000
Luzerne	Lake Twp: Wesley Road and Bear Hollow Road Project	7/21/2009	$131,044
Montgomery	Towamencin Twp - Fischer's Park Pervious Pavement Project	7/21/2009	$281,964
Montgomery	Whitemarsh Twp - McCarthy Park Stormwater Basin Retrofits	7/21/2009	$618,485

Table 5.3.3-2	PENNVEST Stormwater Projects 1993-2022 (PENNVEST, 2022).		
COUNTY	PROJECT NAME	APPROVAL DATE	AMOUNT
Philadelphia	PA Cleanways - The Cobbs Creek, West Philadelphia- Storm Water Mitigation Project	7/21/2009	$136,429
Philadelphia	PA Horticultural Society - Green Infrastructure Tree Plantings	7/21/2009	$1,655,249
Pike	Shohola Twp - Rosa Road Stormwater and Landslide Corrections	7/21/2009	$494,417
Sullivan	Sullivan Cty Conserv District - Sullivan Dirt and Gravel Headwater Protection	7/21/2009	$820,482
Wyoming	Factoryville Boro - Factoryville and Clinton Township Municipal Park Green Parking Lot Project	7/21/2009	$85,600
York	North Hopewell Twp - Dirt & Gravel Road Water Quality Improvements	7/21/2009	$749,976
York	York Twp - Stump Park Green Infrastructure Improvements	7/21/2009	$460,673
Franklin	Waynesboro Boro -South Potomac Street Storm Water Drainage Network	7/20/2010	$5,737,812
Luzerne	Yatesville Boro - Storm Sewer Improvements	7/20/2010	$400,000
Northumberland	Mt Carmel MA - Butternut Box Culvert Replacement	7/20/2010	$1,350,458
Westmoreland	Unity Township Phase 3 Storm Water Project	4/19/2017	$1,741,047
Snyder	Middleburg Storm Water Improvements	7/19/2017	$978,500
Northampton	Bangor Borough Messinger Stormwater Culvert Replacement	10/18/2017	$1,986,826
Cumberland	Mount Holly Springs - Hill Street Drainage Improvement Project	10/18/2017	$1,640,650
Wayne	Hawley Borough Storm Water Repair	1/31/2018	$277,911
Clarion	Clarion Borough - Center Place Storm Sewer	7/18/2018	$1,560,675.00
Clarion	Hawthorn Borough - Storm Sewer Project - Phase I	7/18/2018	$1,330,450.00
Dauphin	MA of Lower Swatara Township, Dauphin County, Pennsylvania – Rosedale Drainage Improvements	7/18/2018	$4,598,000.00
Indiana	Ernest Borough Storm Water Authority – Storm Sewers	7/18/2018	$790,000.00
Armstrong	West Kittanning Borough - Pine Hill Road Storm Sewer Replacement	1/30/2019	$470,000.00
Dauphin	Halifax Borough Stormwater Authority - Strawberry Alley and Division Street Drainage Improvement	1/30/2019	$1,922,000.00
Delaware	Prospect Park Borough - Stormwater Improvements	1/30/2019	$975,632.00
Allegheny	Bethel Park Stormwater Phase 1	4/17/2019	$1,049,834.00
Westmoreland	Penn Township Stormwater Improvements Project	4/17/2019	$1,454,866.00
York	Delta Borough MA - Stormwater Improvements	4/17/2019	$650,000.00
Delaware	Chester City SW Auth - Comprehensive Infrastructure Project - Phase 1	7/17/2019	$9,980,156.00

Table 5.3.3-2	PENNVEST Stormwater Projects 1993-2022 (PENNVEST, 2022).		
COUNTY	PROJECT NAME	APPROVAL DATE	AMOUNT
Schuylkill	Auburn Borough - 2019 Storm Sewer Replacement Project	7/17/2019	$326,098.00
Delaware	Ridley Township-Wide Stormwater Improvements	10/16/2019	$3,266,864.00
Crawford	Jamestown School District - Storm Water Project	4/22/2020	$190,932.00
Northampton	North Catasauqua Borough Stormwater Improvements	7/22/2020	$782,867.00
Westmoreland	Penn Township - Hyland Road - Chris Drive Storm Water Project	7/22/2020	$1,509,294.00
Allegheny	(Small Project Initiative) Glen Osborne - Sycamore Road	11/20/2020	$500,000.00
Clarion	Hawthorn Borough - Stormwater Project -Phase I	1/20/2021	$925,701.00
Delaware	Chester Stormwater Authority - Comprehensive Infrastructure Stormwater Project - Phase 3	1/20/2021	$9,963,539.00
Lackawanna	Lace Village in Scranton - Stormwater	1/20/2021	$1,639,541.00
Philadelphia	Philadelphia City Lawncrest Southwest - Stormwater	1/20/2021	$5,794,470.00
Erie	Girard Township - Westgate Drive Storm Sewer Improvements - Phase 2 (Small Project)	3/4/2021	$441,000.00
Allegheny	Bethel Park - Phase II - Thunderwood	7/23/2021	$1,052,679.00
Philadelphia	GSI in Packer Park, South Philly, Overbrook, Lawndale, and Holmesburg	1/19/2022	$8,221,985.00
Philadelphia	Philadelphia City GSI in Saunders Park, Fairmount, South Philly, and Harrowgate	1/19/2022	$7,545,605.00
Westmoreland	Penn Township- Harrison Park/ Dolly Drive	4/20/2022	$1,909,625.00
Beaver	Midland Borough Railroad Storm Sewer Improvements	7/20/2022	$944,400.00
Lancaster	Stehli Mill, LLC. - Stormwater Project	10/19/2022	$1,859,676.00
Total Funding:			**$211,776,165.00**

Department of Environmental Protection (DEP)

Stream Improvement Program – DEP administers this program, which offers assistance by designing and constructing small projects to reduce flooding, protect structures from streambank erosion, and to restore degraded stream channels.

Dam Safety Program – DEP, in collaboration with FEMA, federal agencies, and other stakeholders, oversees the regulation and safety of dams and reservoirs in the Commonwealth.

Flood Protection Program – According to the DEP website, “This program responds to requests from municipalities, state and federal legislators, county and state government officials, and private residents to investigate flood problems within the Commonwealth of Pennsylvania and determine the feasibility of providing a solution to these flood problems. The program considers long term structural solutions to a community's flood problem by evaluating the magnitude and frequency of flooding, performing a hydrologic and hydraulic analysis, evaluating flood protection alternatives, estimating construction costs, assessing environmental impacts,

performing an economic analysis, determining local sponsor responsibilities, and designing and constructing the project."

Nonpoint Source Implementation Program (Section 319) – This program provides funding to assist in implementing PA's Nonpoint Source Management Program. This includes funding for abandoned mine drainage, agricultural and urban run-off, and natural channel design/stream bank stabilization projects, as well as for development of watershed-based restoration plans.

Act 13 Impact Fee (Oil and Gas Act 13 of 2012) – Impact fees support county conservation districts, the Pennsylvania Fish and Boat Commission, PUC, DEP, PEMA, the Pennsylvania Office of State Fire Commissioner, and PennDOT to address statewide issues and local municipalities to address water, wastewater, and road infrastructure maintenance and improvements; emergency preparedness; environmental programs; tax reductions; increased safe/affordable housing; employee training; or planning initiatives.

Mine Subsidence Insurance (MSI) **-** In 1961, the Commonwealth of Pennsylvania established the Mine Subsidence Insurance Fund to provide a reliable source of insurance against losses caused by underground coal and clay mine subsidence. The Mine Subsidence Insurance Board, through the Pennsylvania Department of Environmental Protection (DEP), administers this non-profit insurance fund, which is sustained by its policyholders' premiums. MSI provides property owners with insurance coverage if they are located within coal mining regions of Pennsylvania. Property owners can use a website at https://gis.dep.pa.gov/pamsi/index.html to check for local mine conditions, submit MSI coverage applications or they can call 1-800-922-1678 to speak to a program representative.

Department of Conservation and Natural Resources (DNCR)

Community Conservation Partnership Program – DCNR provides a wide range of technical assistance and grants for land acquisition, park rehabilitation and development, and small community development projects.

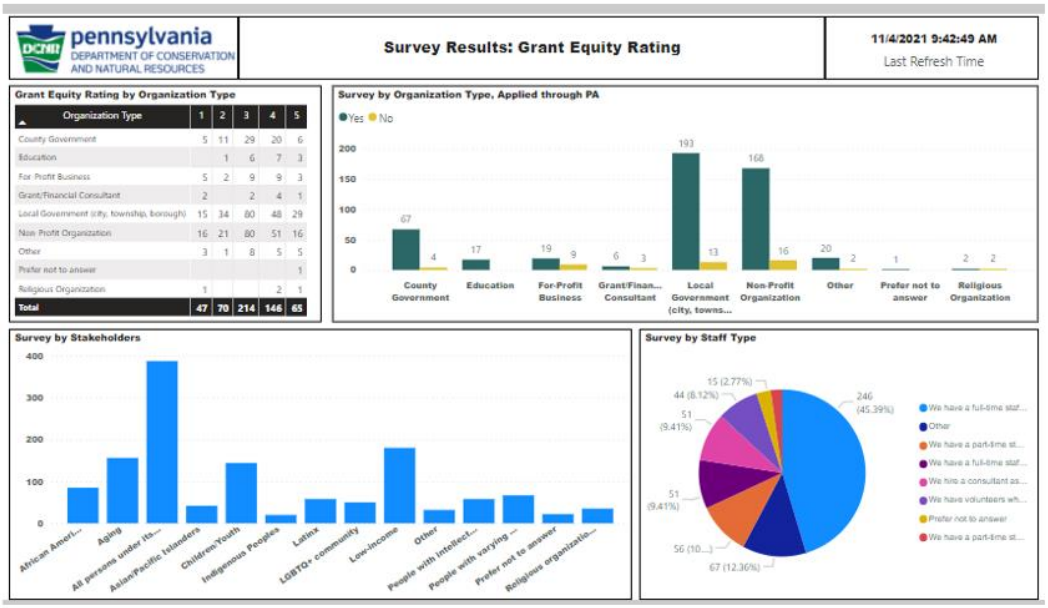
Pennsylvania Rivers Conservation Program – DCNR administers this program to provide technical and financial assistance to municipalities and river support groups to carry out planning, implementation, acquisition, and development activities to preserve and enhance river resources. Grants can be used for planning, implementation, development, and acquisition.

Community & Watershed Forestry Program – DCNR provides financial assistance to riparian forest buffer installations, lawn conversions, community tree-planting, and other projects that produce buffers in an effort to protect water resources. Grants can be used for research, development, design, and implementation.

Grant Equity Workgroup– DCNR chairs a statewide grant equity workgroup, primarily working with state agencies on terminology and opportunities to increase in the grant administration and implementation process. In the Fall of 2021, DCNR surveyed 541 agencies including County and Local governments, For- Profit and Non-Profit agencies, Religious organizations, Grant and

Financial Consultants, Education Institutions, and other agencies. The survey included questions about what populations the entities serve, how, and then a number of questions about the Commonwealth's grant process. Respondents noted challenges with securing matching funds, obtaining cost estimates, and obtaining supplemental documentation (maps, construction drawings, resolutions). Many of the respondents scored determining eligibility and obtaining letters of support as very easy. For the Commonwealth to make finding grants easier, participants recommended clear grant listings and a central site/ unified system to house funding opportunities by category, workforce development, vocational training, women in the workplace, etc. Those surveyed also requested getting reimbursed within 30 days, increasing the limit of allowable expenditures on personnel, and decreasing the reporting requirements for awards under $5,000. There was also a request to designate funds for smaller projects.

Figure 5.3.3-1 Figure Grant Equity Workgroup Survey Results



State Conservation Commission (SCC)

Dirt and Gravel Road Maintenance Program – The SCC receives an annual apportionment from the Commonwealth to administer this program, which provides funding for the maintenance and improvement of dirt and gravel roads. The SCC allocates monies to county conservation districts to assist with implementing the program at the local level. Grants are awarded to municipalities and state agencies that maintain dirt and gravel roads to carry out environmentally sound maintenance practices to correct pollution problems related to the roadway.

Resource Enhancement & Protection Program – The SCC provides tax credits to Clean Stream-compliant farming operations that implement Best Management Practices (BMPs) to reduce nitrogen, phosphorus, and sediment pollution, including the installation of forested riparian buffers along streams.

Conservation Excellence Grant Program – Created by Act 39 of 2019, this program provides financial and technical assistance for BMPs in priority locations, including those identified in the DEP Chesapeake Bay Phase 3 Watershed Implementation Plan. The qualifying BMPs include streambank restoration, stream-side buffers, and conservation/agricultural erosion and sedimentation plans.

Department of Health (DOH)

Pennsylvania Substance Use Navigation (PA-SUN) Program – An initiative started in 2021 to enhance treatment options for patients with substance use disorder by increasing access to medication-assisted treatment. The program offers Emergency Departments free technical

assistance, consultation, and support from expert opioid medical consultant clinicians to increase the overall preparedness of these departments in initiating and facilitating treatment.

Health Assessment Program – This program begun in 1989 to publish reports on toxic waste sites and other environmental hazards in Pennsylvania. It is funded by the Agency for Toxic Substances and Disease Registry (ATSDR). Community members, health care professionals, private organizations, and other government agencies may request an assessment or health consultation to better understand the public health impact of an environmental issue. The three types of documents it produces range from short letters to comprehensive and lengthy reports, depending on the issue.

Environmental Health Capacity (EHC) Program – This program is funded by the CDC and aims to detect, prevent, and control environmental health hazards by partnering with state agencies, universities, non-profit partners, and community-based advocates and stakeholders. Current initiatives and focuses include:

- Environmental Health Indicators (EHI) Map
- Harmful Algal Blooms
- Families with Young Children
- Private Well Water

Department of Human Services (DHS)

Human Services Block Grant Program – Created by Act 180 of 2012, this program allocates funds to county governments for locally identified human services. These funds provide a significant portion of total funds allocated to counties for human services. The different funds within the Block Grant Program are:

- Mental Health Community Base Funded Services
- Behavioral Health Services Initiative
- Intellectual Disabilities Community Base Funded Services
- Act 152 Drug and Alcohol Services
- Homeless Assistance Program Funding
- Human Services Development Fund

Heating Assistance/Low-Income Home Energy Assistance Program (LIHEAP) – This program helps low-income families, both renters and owners, pay heating bills through cash grants, a one-time payment sent directly to utility companies or fuel providers. Households in immediate danger of being without heat can also qualify for crisis grants; instances include broken heating equipment, lack of fuel, and imminent service termination.

Emergency Rental Assistance Program (ERAP) – This program was created in order to allocate the approximately $1.3 billion in funding received from the Consolidated Appropriations Act of 2021 and the American Rescue Plan Act to assist renters affected by the COVID-19 pandemic and economic insecurity. The initial phase of the program, ERAP1, ran from March 8, 2021 to September 30, 2022. ERAP2, an expanded version that allowed more funding for administration and housing stability services along with direct to tenant payments, was actively taking applications during the development of this plan. As of September 30, 2022, counties had processed hundreds of thousands of applications, kept more than 182,000 households in their homes, and granted over $1 billion in funds. DHS provided trainings and presentations on how counties could utilize funds and ways to create synergies with other existing housing programs, especially for those that focus on vulnerable populations like veterans, those with disabilities, and the elderly.

Department of Drug and Alcohol Programs (DDAP)

Services to BIPOC Communities Grant Program – This program provides funding for organization to establish or expand substance use disorder services, community outreach, and education to BIPOC communities to reduce racial inequalities in outcomes. Eligible activities include harm reduction services, promoting access to treatment and recovery support, and offender reentry support. Funds can be used for construction, infrastructure, staffing, and evidence-based programming.

Pennsylvania's Recovery Housing Program – This program supports demolition, debris removal, rehabilitation improvements, environmental remediation costs, construction, and inspections needed for existing or new recovery housing facilities to meet Pennsylvania's Recovery Housing licensure requirements. Also, financial assistance is available for those seeking recovery housing program licensure.

Regional Recovery Hubs Grant Program – Nine Regional Recovery Hubs will be established to work in partnership with recovery community leaders to conduct ongoing needs assessment through surveys and focus groups and provide technical assistance to organizations providing recovery supports that will enhance and promote recovery within each region. There are nine grants available, one for each region.

Pennsylvania Broadband Development Authority (PBDA)

The Pennsylvania Broadband Development Authority (PBDA) was signed into law in 2021 as an independent agency of DCED.

Affordable Connectivity Program – This program, through the Federal Communications Commission, provides eligible households $30 each month off their internet bills and a one-time discount of up to $100 to purchase a laptop, desktop computer, or tablet. To be eligible for the program, a household must meet one of the following criteria:

- A household income at or below 200% of Federal Poverty Guidelines;
- A member of the household is eligible for a participating provider's existing low-income internet program;
- A member of the household participants in an eligible federal assistance program such as Medicaid or Public Housing; OR
- A member of the household received a Federal Pell Grant during the current award year.

The current income limits by household size and qualifying federal assistance programs can be found at: https://dced.pa.gov/programs-funding/broadband-in-pennsylvania/affordable-connectivity-program/. In addition to funding service and device discounts, the program also provides outreach grants so that eligible households may be notified to apply.

COVID-19 ARPA PA Broadband Infrastructure Program – This program utilizes funds from the Coronavirus Capital Project Fund established under the American Rescue Plan Act of 2021 to target locations across Pennsylvania that do not currently have access to 25/3 Mbps reliable service. Examples of activities the program will fund include extension of existing cable modems and fiber-to-the-premise broadband networks along with large-scale regional projects to increase availability. The program will prioritize projects that involved networks owned, operated, or affiliated with local governments, non-profits, cooperatives, and those with commitments to serving entire communities. The program begins in May 2023.

Local

Several of the programs under the HMA program as well as several of the other above state programs require a local match component. If funding is not obtained through other state or federal grant programs, often local municipalities use their own funds to provide the match. Mitigation resources from the local level are limited to funds generated from local taxes permitted by state enabling legislation and/or proceeds from the issuance or floating of local municipal bonds. Political and economic constraints have strongly discouraged local officials from seriously consider this financing alternative for mitigation activities in the past. It will also

likely continue to be a deterrent in the future. Consequently, most, if not all, local entities rely on funding available from the Federal and/or state government. However, if local communities cannot provide direct funds for hazard mitigation, they often will provide staff time for projects or plan development.

Penn State Extension and County Conservation Districts are also valuable local resources. 66 of the 67 Pennsylvania counties have County Conservation Districts, which provide technical assistance to municipalities and residents and administer laws and regulations for PA DEP, PA Department of Agriculture, and the State Conservation Commission.

Private Sector and Non-Profit

Private sector and non-profit sector financing of mitigation activity typically occurs through land trusts, conservancy groups, and certain foundations whose focus is preserving natural areas such as floodplains, wetlands, farmland, viewsheds, and other valuable land areas. Important groups that provide technical assistance to counties and municipalities include:

- County Commissioners Association of Pennsylvania
- League of Cities and Municipalities
- Pennsylvania State Association of Township Supervisors (PSATS)
- Pennsylvania State Association of Boroughs (PSAB)
- Pennsylvania Association of Conservation Districts (PACD)

There are numerous other land conservancies, watershed organizations, and foundations that provide technical assistance and assist municipalities with mitigation projects. Because these funding sources have a wide array of eligibility requirements and project specifications, they are not all enumerated individually in this plan.

There are several other state programs that provide funding and technical assistance; these additional programs are described in Section 5.5 integration worksheet and in Appendix N.

In addition, there are potential sources of state funding including the Growing Greener program which in the past has provided millions of dollars in grants to fund various environmental projects to clean up rivers and streams; protect natural areas, open spaces and working farms; and shore up key programs to improve quality of life and revitalize communities across the Commonwealth. The Act 167 program funding, *when available*, has been used to reimburse counties up to 75% of the costs to prepare storm water management plans. Greenway Planning is an additional way to implement projects that improve natural resources and accommodate flooding.

5.3.4 Development and Construction Management Capability

In Pennsylvania, local municipalities regulate development and construction. They do this by adopting zoning ordinances, floodplain ordinances, and subdivision and land development ordinances and by granting building permits only after verifying that development proposals are consistent with these documents. Local municipalities have several effective tools at their

disposal to address development and construction in hazard prone areas. These tools are discussed below.

Regarding regulation of development, in 1968, Pennsylvania passed the Pennsylvania Municipalities Planning Code Act, P.L. 805, No. 247 (Act 247) which granted authority to boroughs, townships, and counties to individually or jointly prepare zoning, subdivision, land development, floodplain management and other ordinances, and official zoning maps. Through local ordinances, municipalities can guide growth and minimize development in hazard prone areas. However, municipalities often grant variances, waivers, or special exceptions to regulations and ordinances on a case by case basis if requested by a permit or development applicant. The opportunity for improvement is to increase the number of municipalities that effectively implement the regulations and choose to adopt regulations that exceed minimum standards.

Zoning ordinances allow for local communities to regulate the use of land in order to protect the interest and safety of the general public. Zoning ordinances can be designed to address unique conditions or concerns within a given community. They may be used to create buffers between structures and high-risk areas, limit the type or density of development, and/or require land development to consider specific hazard vulnerabilities.

Subdivision and land development ordinances are intended to regulate the development of housing, commercial, industrial or other uses, including associated public infrastructure, as land is subdivided into buildable lots for sale or future development. Within these ordinances, guidelines on how land will be divided, the placement and size of roads and the location of infrastructure can reduce exposure of development to hazard events.

Act 247 also requires counties to create and adopt a comprehensive plan and encourages municipalities to adopt municipal or joint municipal comprehensive plans generally consistent with the county comprehensive plan. Comprehensive plans promote sound land use and regional cooperation among local governments to address planning issues. These plans serve as the official policy guide for influencing the location, type, and extent of future development by establishing the basis for decision-making and review processes on zoning matters, subdivision and land development, land uses, public facilities, and housing needs over time.

To protect people and structures from flood hazards, FEMA administers the NFIP that has an objective to guide development away from high-flood risk areas. Local municipalities participate through ordinance adoption and floodplain regulation and, as a condition of community participation in the NFIP structures built within the Special Flood Hazard Area must adhere to the floodplain management regulations. FEMA Region 3 provides an ordinance review checklist to local communities listing 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.

Through administration of floodplain ordinances, municipalities can ensure that all new construction or substantial improvements to existing structures located in the floodplain are

flood-proofed, dry-proofed, or built above anticipated flood elevations. Floodplain ordinances may also prohibit development in certain areas altogether.

The responsibility for supporting municipalities with ordinance technical assistance and updates has transitioned from DCED to PEMA. The transition was assisted by PEMA choosing to continue with the same contractor Leslie Rhoads, CFM supporting municipalities with ordinance updates. PEMA has model floodplain ordinances posted on their website related to the CFR, Title 44, Section 60.3 level of regulations that are typical in Pennsylvania. The document used to be present on DCED's site. However, adoption of level D regulations is encouraged throughout Pennsylvania communities to provide communities with the highest level of regulation typical in Pennsylvania and to facilitate future ordinance updates if maps change. The models 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 also contain provisions that exceed minimum federal requirements.

Additionally, the Delaware River Basin Commission (DRBC) Flood Advisory Committee (FAC) issued Recommendations of the DRBC Flood Advisory Committee (FAC) for More Effective Floodplain Regulations in the Delaware River Basin. These recommendations apply to all communities within Pennsylvania, New Jersey, and New York that make up the Delaware River Basin. These recommendations were made by reviewing and evaluating existing floodplain regulations in the Delaware River Basin and proposing more effective floodplain management requirements. The floodplain regulation recommendations are available on DRBC's website at http://www.state.nj.us/drbc/programs/flood/floodplainregs.html for local municipalities to utilize when drafting or updating existing floodplain management ordinances. In general, the recommendations are more restrictive than the NFIP requirements and DCED's suggested ordinance. Examples of recommendations include but are not limited to the following:

- Defining the floodplain as the 1% annual chance flood PLUS an additional 25% in flow
- Defining floodway in the Delaware River Basin as a 0.2-foot rise standard
- Requiring critical facilities to be kept outside of the 0.2% annual chance (500 year) floodplain
- Prohibiting any and all new development in the floodway
- Adopting a minimum 100' vegetated buffer along all waterways in the Delaware River Basin
- Requiring new or substantially improved residential, institutional, and commercial structures to be constructed with a two-foot freeboard above the 1% annual chance base flood elevation

Act 166 mandates municipal participation in and compliance with the NFIP for communities with SFHAs. It also establishes higher regulatory standards for hazardous materials and high-risk land uses. As new FIRMs are published, the MIRC and the State NFIP Coordinator will work 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.

The duties of Community Assistance Contacts (CAC) and Community Assistance Visits (CAV) are planned to transfer from DCED to PEMA. In the last five years, PEMA has conducted 15 CAV and 33 CACs, closing 7 CAVs and 44 CACs, and provided general technical assistance 29,075 times including CRS, Disaster Assistance, Floodplain Management, and mapping support. These statistics are planned to increase with the added capacity of NFIP management planned for MIRC; CAVs are targeted at 5-10 annually and CACs and general technical assistance is also anticipated to increase. FEMA completed 7 CAVs, 14 CACs, and provided general technical assistance 1,422 times in Pennsylvania during the same period of time. Twenty-six additional CACs were completed by an agency other than PEMA and FEMA. The following table provides detail on the location and number of CACs and CAVs during the 5-year period between SHMP updates.

Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from January 1, 2018 to December 30, 2022 (PEMA, 2023).

COMMUNITY	CAC	TOTAL
ALEXANDRIA, BOROUGH OF	1	1
ANTHONY, TOWNSHIP OF	1	1
AVOCA, BOROUGH OF	2	2
BEAR CREEK, TOWNSHIP OF	2	2
BENTON, BOROUGH OF	2	1
BRADY'S BEND, TOWNSHIP OF	1	1
BULLSKIN, TOWNSHIP OF	1	1
BURGETTSTOWN, BOROUGH OF	1	1
CHESTER HILL, BOROUGH OF	1	1
COLLEGEVILLE, BOROUGH OF	1	1
COLUMBIA COUNTY*	1	1
CONNELLSVILLE, CITY OF	1	1
DEER LAKE, BOROUGH OF	1	1
DOVER, TOWNSHIP OF	2	2
EMMAUS, BOROUGH OF	1	1
ETNA, BOROUGH OF	1	1
FRANKSTOWN, TOWNSHIP OF	1	1
HEMLOCK TOWNSHIP OF	1	1
LACKAWANNA COUNTY*	1	1
LEECHBURG, BOROUGH OF	1	1
LEWISBURG, BOROUGH OF	1	1
MANCHESTER, TOWNSHIP OF	1	1
MURRYSVILLE, MUNICIPALITY OF	1	1
NEW CASTLE, CITY OF	1	1
OAKDALE, BOROUGH OF	3	3
ORANGE, TOWNSHIP OF	1	1
PHILADELPHIA COUNTY*	1	1
SELLERSVILLE, BOROUGH OF	1	1
SMITH, TOWNSHIP OF	1	1
SOUTH FAYETTE, TOWNSHIP OF	1	1
SOUTH HANOVER, TOWNSHIP OF	1	1
SOUTH HUNTINGDON, TOWNSHIP OF	1	1
TERRY, TOWNSHIP OF	1	1
UPPER MAHANTONGO, TOWNSHIP OF	1	1
UPPER PROVIDENCE, TOWNSHIP OF	1	1

Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from January 1, 2018 to December 30, 2022 (PEMA, 2023).		
COMMUNITY	CAC	TOTAL
WARRINGTON, TOWNSHIP OF	1	1
WELLSBORO, BOROUGH OF	1	1
WEST MANCHESTER, TOWNSHIP OF	1	1
WHITPAIN, TOWNSHIP OF	1	1
WILLIAMSPORT, CITY OF	1	1
YARDLEY, BOROUGH OF	1	1
YORK, CITY OF	2	2
TOTAL	**49**	**49**

Municipalities can also participate in the NFIP's CRS program. Community participation in this program can provide premium reductions for properties located outside of Special Flood Hazard Areas of up to 10% and reductions for properties located in Special Flood Hazard Areas of up to 45%. These discounts can be obtained by undertaking public information, mapping and regulations, flood damage reduction, and flood preparedness activities.

Beyond programs from state agencies and support from non-profits, Pennsylvania's building code is another way to develop resilient, affordable housing. It was recently updated to include the majority of the 2018 International Code Council (ICC) building codes and 2021 ICC accessibility standards, which are expected to provide public safety improvements through better building technologies, energy conservation and efficiency, and supporting efforts to mitigate flooding and other storms effects. However, enforcement of building codes has proven difficult historically, and some buildings may require extensive upgrades that may decrease their affordability. Public subsidy programs may need to be considered to offset these initial costs, but long-term enforcement of building codes will improve housing resiliency while maintaining affordability. Additional measures that can be instituted and enforced at the local level include inclusionary zoning policies to encourage higher-density development, local risk assessments and vulnerability studies, community benefit agreements to potentially decrease displacement and provide employment opportunities, and community land trusts to help preserve affordable housing or community assets. Strategies like these are just some ways to address 2023 Mitigation Actions 1-6d and 3-4f, found in 6 in Section 6. More information on housing affordability and resilience can also be found in Appendix O.

5.3.5 State Capability Obstacles and Solutions

Devolved Authorities

A significant obstacle to effective hazard mitigation planning is the fragmented structure of local government. Land Use Authority in the Commonwealth is vested with the 2,560 separate municipalities. The majority of these are small townships or boroughs of less than 2,500 persons. These small communities lack the capability or capacity to conduct effective Hazard Mitigation on their own. The boundaries of these municipalities may or may not align with the 500 school districts, 3,393 Fire Departments and over 2,600 sewer, water, municipal and other authorities. The 67 Counties do not have any legal basis to compel Hazard Mitigation activities such as enforcing flood plain regulations or HM planning by the municipalities and other

authorities. Hazard Mitigation Plans are most often prepared by County Emergency Management Agencies (EMAs). While this nests with PEMA and FEMA, County EMAs often do not have the capacity to prepare and update HMPs. County EMA personnel who are not full-time planners may also lack visibility of other plans within the county.

PEMA has implemented a number of policies to help support the Counties in their Hazard Mitigation Mission. PEMA strongly encourages municipal participation in County HMP updates. PEMA actively encourages municipalities and non-governmental authorities to participate in their county HMP. PEMA screens all Hazard Mitigation Project applications to ensure that the municipality has participated in the county HMP update, adopted the HMP and received FEMA approval. Second, PEMA ensures that the requested project is included in the approved HMP as a mitigation action for that municipality. PEMA refuses to consider HM Projects for municipalities or authorities who have not integrated their project within the county planning efforts. Where appropriate, PEMA encourages counties to manage HM projects for smaller municipalities and by using management costs to hire planning consultants to provide required project management expertise. PEMA coordinates with colleges and universities to link local governments needed help with students needed internships and faculty who have grant writing and management expertise. PEMA technical assistance to counties and municipalities such as the Plan Implementation and Grant Development (PIGD) workshops. PEMA encourages County governments to assign the HMP to the planning commission vs the EMA. The planning commission has more capacity for planning, it has visibility on all the other plans within the county, and its labor is fully reimbursable since they are not federally funded. Finally, PEMA takes an active role in assisting and tracking municipal participating and adoption of county HMPs.

Limited Funding

Funding for Hazard Mitigation Planning can be a significant obstacle. PEMA pursues funding for the State and County HMP updates via Disaster or Non-Disaster grants from FEMA. At the state level, PEMA successfully applied for a PDM 19 grant and negotiated with the PA Department of Community and Economic Development (DCED) to provide the local match. PEMA and DCED closely integrate their community resiliency efforts. For County HMP updates, PEMA needs to coordinate an average of $750,000 per year to update an average of 13 plans per year. The primary source of funding since 2018 has been the BRIC (Building Resilient Communities and Infrastructure) program. While this annual program provides a predictable source of funding, it has shortcomings. The state set asides for planning are always less than $500,000. This means some counties must apply in the competitive side, which is problematic. Second, the local match of 25% is a difficult bar for less wealthy counties. While county commissioners are willing to support HMP if someone else pays for it, it can be difficult to write a $15,000 - $25,000 check from the county treasury to cover the local match.

PEMA works with counties to help them identify noncash sources of local match and encourages them to have the county planning department be the project manager using the county Geographic Information Systems (GIS) to develop the maps vs paying a consultant to do so. A third issue with non-disaster grants are the long timelines. PEMA will begin recommending counties apply for planning funds three years before their plan expires. It

normally takes 18 months from sub-application submission to a sub-grant award being fully executed.

PEMA took advantage of the large amounts of funding for hazard mitigation planning as a result of COVID 19. A total of 36 counties applied for a won HMPG sub-grants under DR-4506 and DR-4618. In this case, the state of Pennsylvania contributed the 25% local match so that there was no cost to the counties. In addition, PEMA negotiated and expanded Statement of Work with FEMA and added additional funding so that all 36 of the counties could bring their HMPs up to High Hazard Potential Dam (HHPD) standards. While not a requirement under the FEMA Local Mitigation Planning Policy Guide of April 2022, HMPs must meet HHPD standards if they wish to apply for HHPD project grants. Since Pennsylvania has over 700 High Hazard Potential Dams, we felt this was a good investment.

Lack of Personnel

Shortage of personnel is a significant obstacle. In 2018 PEMA Hazard Mitigation Division was authorized only five personnel, which as the SHMO, one hazard mitigation planner, one engineer, and two project officers. They were supported by a single administrative person. The NFIP was administered by DCED, and coordination had proven difficult.

As part of the effort to gain and maintain enhanced state status, PEMA has reorganized Hazard Mitigation efforts into a Bureau with a SHMO, Deputy SHMO, HM Planner, Engineer, and four project officers. The Bureau of Mitigation Insurance and Resilient Communities (MIRC) shares a larger administrative staff of four persons with the rest of the Deputy for Recovery. The State Assembly passed legislation to move the NFIP from DCED to PEMA. MIRC added two additional positions as the State NFIP Administrator and Deputy.

Underserved and Disadvantaged Communities

Providing hazard mitigation and resiliency support to underserved and disadvantaged communities present several challenges, including identifying such groups within communities, finding leaders or advocates who can give a voice to group and articulate what they actually need vs society's perception of their needs, and providing grant application and project management support to these groups.

The Grant Equity Interagency Workgroup was formed in 2021 from DEP's Environmental Justice Interagency Workgroup with a specific focus on identifying best practices to support a more equitable distribution of Commonwealth funding, increasing access, and reducing barriers to Commonwealth funding opportunities, reaching a more diverse pool of applicants, and identifying opportunities to better serve communities that have been historically marginalized. In the spirit of continuous improvement, the Workgroup looked for opportunities to find ways in which state agencies can advance equitable policies, practices, and procedures in grantmaking.

The following principles embody the Commonwealth's commitment to upholding equity, inclusion, diversity, and transparency and are consistent with current management directives and executive orders, including:

- Executive Order 2016-04 affirms "the Commonwealth of Pennsylvania and its agencies should continue to be vigilant in assuring a continued commitment to treat all Pennsylvanians, including the Commonwealth's employees and officials, without regard

to race, color, religious creed, ancestry, union membership, age, gender, sexual orientation, gender identity or expression, national origin, AIDS or HIV status, or disability."

- Executive Order 2021-07 states "all Pennsylvanians are entitled to fair and equitable treatment and meaningful involvement in decision-making that affects their environment, communities, homes, livelihoods, and health."

5.4 Local Capability Assessment

5.4.1 Status of Local Hazard Mitigation Plans

All 67 of PA's counties have or are working on CFR 44 Compliant Hazard Mitigation Plans (HMPs) using a Standard Operating Guide (SOG) mandated by PEMA. The SOG contains a process for updating local plans along with a mandatory format and use of FEMA standard hazard descriptions. The purpose is to foster plan integration and cooperation across the commonwealth. Counties are encouraged but not required to nest their mitigation strategies within Pennsylvania's mitigation strategy. This nesting of strategies allows for more efficient use of funding. Likewise, the Commonwealth Mitigation Strategy, like the HIRA, is an amalgamation of the 67 County Mitigation Strategies and HIRAs.

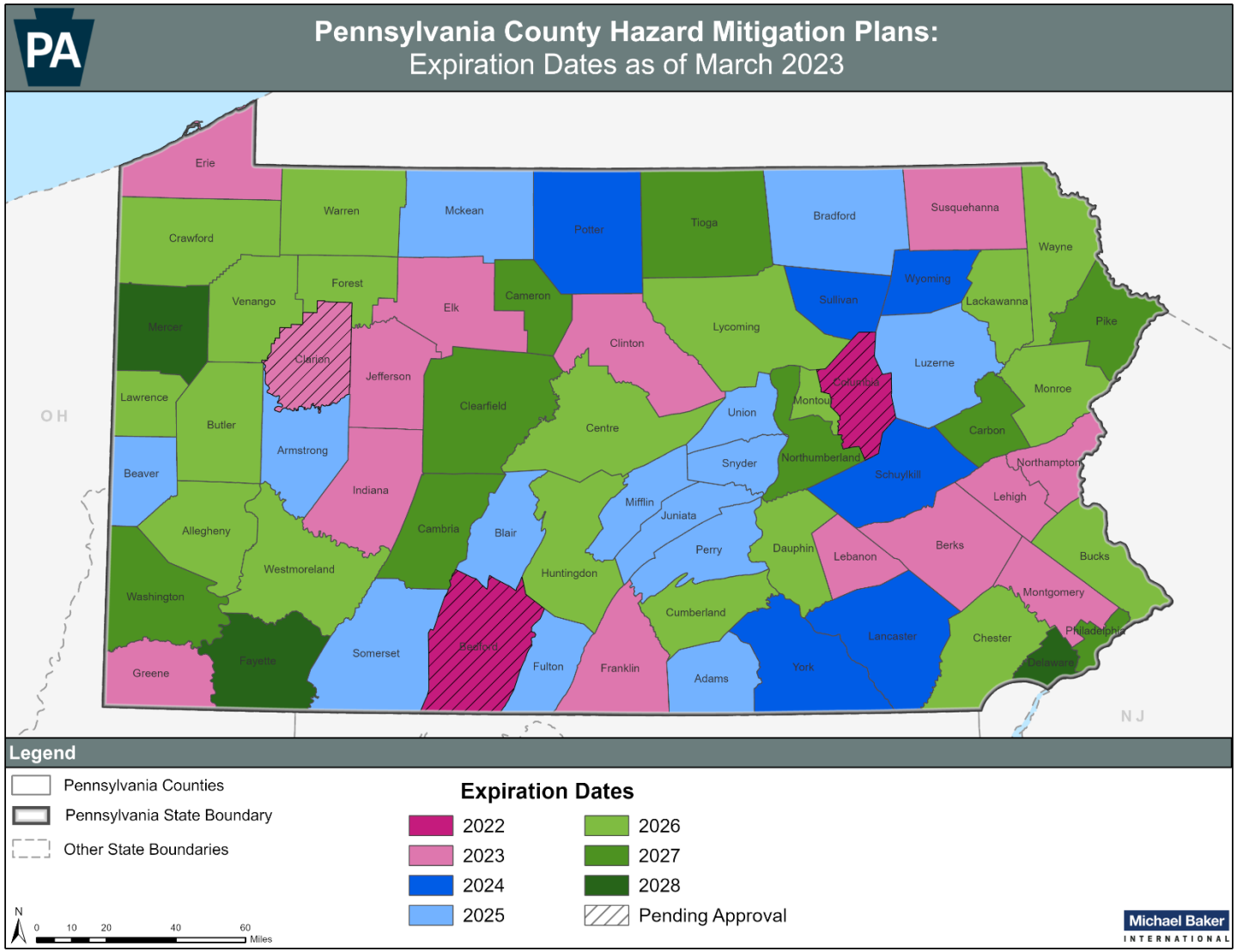
Land use authority rests with 2,560 separate municipalities in the Commonwealth. These municipalities range in size from the City of Philadelphia with over two million people to the Borough of Centralia with 7 people. Since federal guidance requires that HMPs be adopted by the level of government with land use authority, local HMPs are developed by the counties in conjunction with their municipalities and coordinated with other major stakeholders, such as employers, educational and health institutions, adjacent counties, and state and federal agencies. Municipal participation is vital because municipalities without a current plan are ineligible for HMGP funds and other forms of disaster assistance. Townships and boroughs are required to participate in the county planning process and adopt the approved county plan into be eligible for HMGP funds and other aid. The plans expire every five years and there an average of 13 county plans under revision at any one time. The planning process normally takes 18 – 24 months from grant submission to FEMA approval. Most counties do not have the capacity to update their HMP without assistance. Shortages of county planning personnel and the extensive coordination requirements lead to some plans expiring before the update process is complete.

PEMA closely tracks plan expiration dates and works with counties throughout the life cycle of their plan, encouraging annual County HMP reviews and forwarding them to FEMA. Currently 10 of the 67 counties are conducting these voluntary reviews. PEMA coordinates HMP update funding beginning 36 months from plan expiration date. Normally PEMA coordinates funding via the BRIC and HMGP programs. Since the inception of the BRIC program, PEMA has used 100% of the available state set aside for County HMP updates, however that has proven insufficient. Pennsylvania took advantage of the large amount of HMP funding received during the DR-4506 COVID Pandemic to address the chronic underfunding of HMPs. PEMA encouraged 37 counties to apply for funding under DR 4506 to update their plans. The state elected to pick up the 10% local match so that this funding was 100% free to the counties. PEMA negotiated a bespoke Statement of Work (SOW – see Appendix C) for these HMP

updates with FEMA. They provided for analysis of High Hazard Potential Dams, greater outreach to underserved communities, and other previously unfunded risk analysis to include climate change adaptation. Some counties are developing climate mitigation and adaptation plans of their own.

5Figure 5.4.1-1 shows the expiration years and status of each county's HMP according to FEMA's records as of March 29, 2023. Note that this information summarizes the FEMA Region 3 322 plan status table combined with contracting and Adoption Pending Approval data tracked by PEMA. This data is constantly changing as communities adopt plans and plans gain FEMA approval, but it is generally representative of the state of county-level hazard mitigation planning.

Figure 5.4.1-1 Pennsylvania County HMP Expiration Dates (FEMA, 2023).



PEMA no longer supports the creation of separate University HMPs. The funding of separate HMPs for college campus is inefficient and does not encourage integration of HM activities across the community. Universities and other higher education campuses are encouraged to participate in and support the County HMP in which they reside. In addition, they are encouraged to adopt the County HMP once it receives FEMA APA. Both public and private universities have been participating in County HMPs. Staff from Millersville University participated in the 2018 SHMP, while staff from Bloomsburg University, Cheyney University, Indiana University of Pennsylvania, Mansfield University, Millersville University, Pennsylvania State University, Pennsylvania Western University, Slippery Rock University, and Temple University participated in this plan update. University participation in hazard mitigation planning efforts will continue to be important moving forward, especially as universities have a greater role in community emergency response. For instance, East Stroudsburg and West Chester Universities were shelters during Hurricane Sandy.

5.4.2 Summary & Evaluation of Local Mitigation Capability

Pennsylvania continues to strive to improve hazard mitigation capabilities and the ability to evaluate the effectiveness of local mitigation policies, programs, and capabilities. Local mitigation capabilities include not only the traditional execution of hazard mitigation projects, but also hazard mitigation planning (as discussed in Section 5.4.1), participation in the NFIP and CRS, Act 167 Plans, and county-level greenway and open space planning.

Historically, the evaluation of local mitigation capabilities has been challenging due to inconsistent planning methods and the lack of standard tracking and reporting processes. Local mitigation project information is often missing or incomplete and information regarding local policies and programs pertaining to mitigation has not always been well documented.

The most effective way to obtain these improvements has been realized through the development of the SOG. The SOG, described in much greater detail in Section 6.3.1.2, contains a Capability Assessment Survey along with a Model Plan Outline. These two tools, when used together, ensure that appropriate information pertaining to local capabilities is collected and reported completely and consistently.

The Capability Assessment Survey is to be completed by county and municipal officials and contains questions about specific information pertaining to planning, regulatory, administrative, technical, fiscal, and political capabilities. The Model Plan Outline prompts users to enter the information into the plan regarding the following areas of hazard mitigation capability:

- Emergency Management
- Participation in the NFIP
- Planning and Regulatory Capability
- Administrative and Technical Capability
- Fiscal Capability
- Political Capability
- Self-Assessment
- Existing Limitations

This information is then input into the local HMP, which not only improves Pennsylvania's ability to evaluate the effectiveness of local mitigation capabilities, it greatly increases local planning capabilities by simplifying, streamlining, and standardizing the hazard mitigation planning process.

There have been a number of successful mitigation projects in Pennsylvania. These include efforts to mitigate the extensive damages caused by flooding throughout the Commonwealth. Flooding is by far the most extensive hazard in Pennsylvania. PEMA is very active in mitigation efforts, especially those concerning flooding. A majority of these efforts have been through the acquisition and demolition of structures in floodplains. This effort is considered the most advantageous flood mitigation project as it completely removes the potential for flooding of homes or property. Additionally, there have been other significant mitigation efforts to reduce the vulnerability to flooding.

Currently, local capability information that is tracked on a federal or state level can be evaluated and reported most effectively. Since flooding poses the highest risk to Pennsylvania communities, flood-related capabilities are of the utmost importance. Participation in the NFIP provides one mechanism for assessing flood hazard mitigation capabilities.

National Flood Insurance Program (NFIP)

All 67 Pennsylvania counties have most of their municipalities participating in the NFIP, with a total of 96.6% of all municipalities participating. 5Table 5.4.2-1 below provides a list of counties with the corresponding number of jurisdictions and the percentage participating in the NFIP. Of Pennsylvania's 67 counties, 26 have 100% jurisdictional participation in the NFIP. This is an increase from the 25 reported in the last plan, as Lebanon County has reached 100% since. Only two counties have less than 90% participation in the NFIP; Clarion and Armstrong Counties with 88 and 89 percent participation, respectively. Armstrong added a new NFIP community since 2018 when it only had 40/46 or 87%. The total number of communities that participate has increased by 13 since the 2018 plan, with 8 communities moving from the "non-participating" list and 5 having their suspensions lifted. It is important to note that many communities in Pennsylvania do not participate in the NFIP program because they have no designated Special Flood Hazard Areas (SFHAs) in their jurisdictions.

The NFIP is managed by local municipalities participating in the program through ordinance adoption and floodplain regulation, and often the county planning and/or zoning department provides an oversight and coordination role.

Table 5.4.2-1 Community Participation in the NFIP (FEMA, 2022h).

COUNTY	TOTAL NO. OF JURISDICTIONS	NO. OF JURISDICTIONS PARTICIPATING IN NFIP	PERCENT OF JURISDICTIONS PARTICIPATING IN NFIP	NO. OF NON-PARTICIPATING JURISDICTIONS	NO. OF SUSPENDED JURISDICTIONS
Adams	34	33	97.1%	1	0
Allegheny	130	129	99.2%	1	0
Armstrong	46	41	89.1%	5	0

Table 5.4.2-1 Community Participation in the NFIP (FEMA, 2022h).

COUNTY	TOTAL NO. OF JURISDICTIONS	NO. OF JURISDICTIONS PARTICIPATING IN NFIP	PERCENT OF JURISDICTIONS PARTICIPATING IN NFIP	NO. OF NON-PARTICIPATING JURISDICTIONS	NO. OF SUSPENDED JURISDICTIONS
Beaver	54	53	98.1%	0	1
Bedford	38	38	100.0%	0	0
Berks	75	73	97.3%	2	0
Blair	24	24	100.0%	0	0
Bradford	51	49	96.1%	1	1
Bucks	53	49	92.5%	4	0
Butler	57	52	91.2%	5	0
Cambria	63	58	92.1%	5	0
Cameron	7	7	100.0%	0	0
Carbon	23	23	100.0%	0	0
Centre	35	34	97.1%	0	1
Chester	74	73	98.6%	1	0
Clarion	34	30	88.2%	4	0
Clearfield	50	48	96.0%	2	0
Clinton	29	29	100.0%	0	0
Columbia	33	33	100.0%	0	0
Crawford	51	51	100.0%	0	0
Cumberland	32	32	100.0%	0	0
Dauphin	40	39	97.5%	1	0
Delaware	49	48	98.0%	0	1
Elk	12	12	100.0%	0	0
Erie	38	36	94.7%	1	1
Fayette	43	40	93.0%	3	0
Forest	9	9	100.0%	0	0
Franklin	22	21	95.5%	1	0
Fulton	13	12	92.3%	1	0
Greene	26	25	96.2%	1	0
Huntingdon	48	46	95.8%	2	0
Indiana	38	36	94.7%	2	0
Jefferson	34	33	97.1%	1	0
Juniata	17	17	100.0%	0	0
Lackawanna	40	40	100.0%	0	0
Lancaster	60	58	96.7%	2	0
Lawrence	26	25	96.2%	1	0
Lebanon	26	26	100.0%	0	0

Table 5.4.2-1 Community Participation in the NFIP (FEMA, 2022h).					
COUNTY	TOTAL NO. OF JURISDICTIONS	NO. OF JURISDICTIONS PARTICIPATING IN NFIP	PERCENT OF JURISDICTIONS PARTICIPATING IN NFIP	NO. OF NON-PARTICIPATING JURISDICTIONS	NO. OF SUSPENDED JURISDICTIONS
Lehigh	25	25	100.0%	0	0
Luzerne	76	75	98.7%	1	0
Lycoming	52	52	100.0%	0	0
Mckean	22	21	95.5%	1	0
Mercer	48	46	95.8%	2	0
Mifflin	16	15	93.8%	1	0
Monroe	20	20	100.0%	0	0
Montgomery	62	61	98.4%	1	0
Montour	11	11	100.0%	0	0
Northampton	37	37	100.0%	0	0
Northumberland	36	33	91.7%	2	1
Perry	30	29	96.7%	1	0
Philadelphia	1	1	100.0%	0	0
Pike	13	13	100.0%	0	0
Potter	31	31	100.0%	0	0
Schuylkill	67	67	100.0%	0	0
Snyder	21	21	100.0%	0	0
Somerset	49	45	91.8%	4	0
Sullivan	13	13	100.0%	0	0
Susquehanna	40	38	95.0%	0	2
Tioga	39	39	100.0%	0	0
Union	14	13	92.9%	1	0
Venango	31	29	93.5%	2	0
Warren	27	26	96.3%	1	0
Washington	65	61	93.8%	2	2
Wayne	28	27	96.4%	0	1
Westmoreland	64	60	93.8%	4	0
Wyoming	23	23	100.0%	0	0
York	72	67	93.1%	5	0
TOTAL	**2,567**	**2,481**	**96.6%**	**75**	**11**

FEMA Region 3 has documented and tracked communities that adopt floodplain management ordinances that contain provisions which exceed the minimum requirements through the Mitigation Action Tracker (MAT) since 2013. The MAT lists 160 communities in nine counties that have adopted higher standards. The nine counties are Beaver, Berks, Bradford, Chester,

Lancaster, Lycoming, Montgomery, Schuylkill, and York. It is important to note that the MAT has not captured all communities with higher standards; there are likely hundreds of other communities that have adopted higher standards as recommended in DCED's model floodplain management ordinance. Higher standards documented in the model ordinances that are provided to communities are described below. The majority of municipalities have incorporated a freeboard requirement and prohibit any new construction or development within the area measured 50 feet landward from the top-of-bank of any watercourse.

1. **Community Identified Flood Hazard Areas:** shall be those areas that the municipality identified local flood hazard or ponding areas, as delineated and adopted on a "Local Flood Hazard Map" using best available topographic data and locally derived information such as flood of record, historic high water marks, soils or approximate study methodologies.

2. **Conservation District Review**: A copy of all applications and plans for any proposed construction or development in any identified floodplain area to be considered for approval shall be submitted by the Floodplain Administrator to the County Conservation District for review and comment prior to the issuance of a Permit. The recommendations of the Conservation District shall be considered by the Floodplain Administrator for possible incorporation into the proposed plan.

3. **Fill Prohibited**: Within any Identified Floodplain Area the use of fill shall be prohibited.

4. **Freeboard:** Establishes a freeboard safety factor (usually 1.5 feet) in addition to the requirement to elevate and floodproof to the regulatory base flood elevation (BFE).

5. **Manufactured Homes Prohibited in the Floodway.**

6. **Manufactured Homes Prohibited in any SFHA.**

7. **Manufactured Homes Prohibited – 50 ft. Buffer:** Within any Identified Floodplain Areas, manufactured homes shall be prohibited within the area measured 50 feet landward from the top-of-bank of any watercourse.

8. **New Construction Prohibited in the Floodway.**

9. **New Construction – 50 ft. Buffer:** Within any SFHA, no new construction or development shall be located within the area measured 50 feet landward from the top-of-bank of any watercourse.

10. **No Enclosures:** Prohibits fully enclosed spaces (excluding basements) below the base flood elevation with any new and substantially improved structures.

11. **Recreational Vehicles Prohibited in the Floodway.**

12. **Recreational Vehicles Prohibited in any SFHA.**

13. **Repetitive Loss Review:** In the case of existing structures, prior to the issuance of any Development/Permit, the Floodplain Administrator shall review the history of repairs to

the subject building, so that any repetitive loss issues can be addressed before the permit is issued.

14. **Less than 50%:** Any modification, alteration, reconstruction, or improvement of any kind to an existing structure, to an extent or amount of less than 50% of its market value, shall be elevated and/or floodproofed to the greatest extent possible.

15. **Special Permits Prohibited:** Activities within the SFHA requiring special permits are prohibited including the construction or expansion of hospitals, nursing homes, jails/prisons, or manufactured home parks/subdivisions.

16. **Substances Prohibited:** Any new or substantially improved structure which will be used for the production, or storage, or will require the maintenance of a supply of more than 550 gallons of any of the substances identified as dangerous to human life, are prohibited in the SFHA.

17. **Substances Prohibited – 50 ft. Buffer:** Any new or substantially improved structure which will be used for the production, or storage, or will require the maintenance of a supply of more than 550 gallons of any of the substances identified as dangerous to human life, are prohibited within the area measured 50 feet landward from the top-of-bank of any watercourse.

18. **Smaller Subdivisions:** Subdivision proposals and development proposals containing at least 50 lots or at least five acres, whichever is the lesser, within the SFHA where elevation data are not available, shall be supported by hydrologic and hydraulic engineering analyses that determine the BFE and floodway.

19. **Prohibitive:** Prohibits new development and substantial improvements except by variance.

Currently there are a total of 11 jurisdictions in the Commonwealth which have been suspended from the NFIP, which is down from 16 in the previous update. These communities are listed in Table 5.4.2-2. The five that are no longer suspended are Georgetown Borough, Lawrence Park Township, Carmichaels Borough, Morris Township, and Youngstown Borough. Suspension results after a community has been found to no longer be in compliance with NFIP requirements. Suspended communities are subject to sanctions for non-participating communities and flood insurance is not available to residents. A probation period precedes suspension during which time the community is formally notified that its floodplain management program is non-compliant. Sanctions during the probationary period include increased flood insurance premiums for property owners. There are no communities on probation as of December 2022. All 16 community suspensions were due to a failure to adopt a compliant floodplain management ordinance.

Table 5.4.2-2 Communities Suspended from the NFIP.

COUNTY	COMMUNITY NAME	SUSPENSION DATE
Beaver	GEORGETOWN, BOROUGHS OF	08/17/2015
Bradford	ROME, TOWNSHIP OF	10/17/2014

Table 5.4.2-2 Communities Suspended from the NFIP.		
COUNTY	COMMUNITY NAME	SUSPENSION DATE
Centre	SNOW SHOE, BOROUGH OF	05/07/2009
Delaware	RUTLEDGE, BOROUGH OF	11/25/2009
Erie	WESLEYVILLE, BOROUGH OF	02/20/2014
Northumberland	WEST CAMERON, TOWNSHIP OF	07/17/2008
Susquehanna	JACKSON, TOWNSHIP OF	04/03/2013
Susquehanna	UNIONDALE, BOROUGH OF	07/05/1993
Washington	LONG BRANCH, BOROUGH OF	10/01/2015
Washington	NORTH BETHLEHEM, TOWNSHIP OF	10/01/2015
Wayne	PROMPTON, BOROUGH OF	05/17/2013

Community participation in the NFIP allows property owners to obtain flood insurance. Flood insurance provides a means for homeowners, renters, and business owners to financially protect themselves. This capability greatly improves resilience after a flood hazard event by allowing residents to repair and rebuild. The table below provides a list of counties with the number of flood insurance policies that exist in that county. Since the last HMP update, the number of flood insurance policies in Pennsylvania has decreased by 24% from 56,822 to 43,082. This follows another 24% decline between 2013 and 2018, where the number of policies fell from 74,665 to 56,822. Every county in the Commonwealth had a percentage decrease in the double-digits besides Lackawanna, which only saw a 4% decrease. Armstrong County had the largest decrease at 49%. The 2018 plan had two counties, Armstrong and Erie, that had increases; they were 7% and 1%, respectively.

In general, a decrease in the number of flood insurance policies in Pennsylvania suggests decreased recovery capabilities and an increase in flood vulnerability. The total policy coverage also decreased, with 17% less coverage than was reported in 2018. This represents over $2 billion. The largest decreases were the 38% decline reported for Armstrong and Mercer Counties. Lackawanna County was the only one with an increase in coverage, which was 15%.

Table 5.4.2-3 NFIP Policies and Total Dollar Amount of Coverage per County and Percent Change in the Number of Policies since 2013 (FEMA, December 2022).				
COUNTY	NUMBER OF NFIP POLICIES	% CHANGE IN NUMBER OF NFIP POLICIES SINCE 2018	TOTAL COVERAGE ($)	% CHANGE IN TOTAL COVERAGE SINCE 2018
Adams	375	-23%	$80,370,100	-21%
Allegheny	2,974	-18%	$781,177,100	-12%
Armstrong	306	-49%	$48,542,800	-38%
Beaver	326	-19%	$63,419,100	-18%
Bedford	298	-32%	$39,626,000	-25%

Table 5.4.2-3	NFIP Policies and Total Dollar Amount of Coverage per County and Percent Change in the Number of Policies since 2013 (FEMA, December 2022).			
COUNTY	NUMBER OF NFIP POLICIES	% CHANGE IN NUMBER OF NFIP POLICIES SINCE 2018	TOTAL COVERAGE ($)	% CHANGE IN TOTAL COVERAGE SINCE 2018
Berks	830	-20%	$206,148,700	-19%
Blair	623	-31%	$102,872,000	-27%
Bradford	557	-13%	$115,498,500	-8%
Bucks	3,063	-21%	$863,767,500	-17%
Butler	416	-23%	$85,527,100	-16%
Cambria	555	-30%	$108,290,900	-20%
Cameron	104	-22%	$9,958,700	-28%
Carbon	158	-33%	$30,406,500	-22%
Centre	280	-23%	$56,868,800	-12%
Chester	1,114	-25%	$302,259,800	-20%
Clarion	74	-34%	$18,042,800	-16%
Clearfield	264	-35%	$38,551,300	-28%
Clinton	351	-33%	$44,753,800	-28%
Columbia	613	-29%	$111,565,500	-19%
Crawford	371	-31%	$71,216,200	-24%
Cumberland	707	-33%	$152,005,000	-28%
Dauphin	1,605	-33%	$368,588,200	-26%
Delaware	1,445	-24%	$388,667,400	-16%
Elk	136	-26%	$21,253,300	-24%
Erie	402	-24%	$104,120,200	-16%
Fayette	332	-27%	$65,433,700	-16%
Forest	25	-31%	$3,879,500	-22%
Franklin	235	-29%	$50,919,700	-26%
Fulton	23	-36%	$3,566,600	-31%
Greene	111	-25%	$17,754,000	-24%
Huntingdon	270	-34%	$34,680,100	-29%
Indiana	227	-33%	$35,614,000	-28%
Jefferson	230	-22%	$41,862,100	-15%
Juniata	102	-41%	$12,974,600	-32%
Lackawanna	944	-4%	$193,831,200	15%
Lancaster	931	-22%	$226,021,300	-13%
Lawrence	189	-25%	$30,156,500	-29%
Lebanon	316	-29%	$76,387,000	-20%
Lehigh	572	-19%	$144,381,700	-10%

Table 5.4.2-3	NFIP Policies and Total Dollar Amount of Coverage per County and Percent Change in the Number of Policies since 2013 (FEMA, December 2022).			
COUNTY	NUMBER OF NFIP POLICIES	% CHANGE IN NUMBER OF NFIP POLICIES SINCE 2018	TOTAL COVERAGE ($)	% CHANGE IN TOTAL COVERAGE SINCE 2018
Luzerne	4,953	-25%	$1,355,858,800	-20%
Lycoming	844	-33%	$131,092,600	-27%
Mckean	226	-15%	$32,752,800	-14%
Mercer	85	-41%	$19,271,100	-38%
Mifflin	307	-36%	$39,845,400	-22%
Monroe	425	-21%	$118,570,600	-16%
Montgomery	2,937	-21%	$849,378,900	-14%
Montour	131	-20%	$27,532,400	-16%
Northampton	742	-22%	$172,927,700	-18%
Northumberland	560	-35%	$108,741,700	-26%
Perry	221	-37%	$37,168,700	-24%
Philadelphia	3,415	-11%	$871,717,900	-7%
Pike	247	-18%	$68,065,600	-12%
Potter	159	-33%	$18,210,400	-30%
Schuylkill	635	-30%	$92,581,400	-20%
Snyder	263	-24%	$43,149,000	-17%
Somerset	331	-28%	$47,818,900	-29%
Sullivan	64	-15%	$11,349,200	-12%
Susquehanna	282	-17%	$44,821,900	-15%
Tioga	234	-18%	$39,044,600	-7%
Union	303	-38%	$49,597,400	-28%
Venango	166	-28%	$31,682,900	-15%
Warren	209	-23%	$37,289,700	-11%
Washington	657	-23%	$130,820,500	-15%
Wayne	188	-29%	$46,760,200	-25%
Westmoreland	883	-24%	$173,873,300	-19%
Wyoming	259	-24%	$58,668,300	-14%
York	902	-24%	$204,518,500	-18%
TOTAL	**43,082**	**-24%**	**$10,014,069,700**	**-17%**

Appendix K includes policies and coverage by municipality. There are 7 municipalities in Pennsylvania that have over 100 million dollars in coverage shown in the table below. There were 10 such municipalities in the 2018 plan, but Lower Merion Township, Hanover Township, and Swoyersville Borough all dipped below the threshold. Every municipality saw a drop in the number of policies and total coverage. By percentage, Harrisburg experienced the largest drop

in both. These 7 municipalities represent nearly 21% of the NFIP coverage in the Commonwealth.

Table 5.4.2-4 NFIP Policies and Total Dollar Amount of Coverage for Municipalities with Greater Than $100 Million in Coverage (FEMA, 2022h).

COUNTY	MUNICIPALITY	NUMBER OF NFIP POLICIES	% CHANGE FROM 2018	TOTAL COVERAGE ($)	% CHANGE FROM 2018
Allegheny	PITTSBURGH, CITY OF	436	-3%	$155,753,100	-11%
Bucks	BRISTOL, TOWNSHIP OF	572	-32%	$100,841,500	-25%
Dauphin	HARRISBURG, CITY OF	514	-39%	$133,810,600	-35%
Luzerne	FORTY FORT, BOROUGH OF	536	-22%	$154,824,900	-17%
Luzerne	KINGSTON, BOROUGH OF	1,369	-31%	$405,122,800	-28%
Luzerne	WILKES-BARRE, CITY OF	907	-31%	$244,663,700	-26%
Philadelphia	PHILADELPHIA, CITY OF	3,149	-18%	$824,055,800	-12%
	Total	**4,518**		**$2,019,062,400**	

The NFIP's CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Participation in this program results in discounted flood insurance premium rates that reflect the reduced flood risk resulting from the additional actions taken. Table 5.4.2-5 summarizes the number of credit points associated with each corresponding CRS class.

Table 5.4.2-5 CRS Classes and Associated Credit Points.

CRS CLASS	CREDIT POINTS	PREMIUM REDUCTION SFHA	PREMIUM REDUCTION NON-SFHA
1	4500+	45%	10%
2	4,000-4,499	40%	10%
3	3,500-3,999	35%	10%
4	3,000-3,499	30%	10%
5	2,500-2,999	25%	10%
6	2,000-2,499	20%	10%
7	1,500-1,999	15%	5%
8	1,000-1,499	10%	5%
9	500-999	5%	5%
10	0-499	0	0

Currently, 38 of Pennsylvania's 2,576 municipalities are participating in CRS, up from 23 in 2018. It is important to note that while a small number of Pennsylvania municipalities participate in CRS, participation in the program nationwide is generally low. Nationwide there are only 1,740 communities participating in CRS with an average of 30 communities per state. Within FEMA Region 3, there are a total of 110 communities participating in CRS, or an average of 22 communities per state. Table 5.4.2-6 below provides additional details about the community participation in the CRS program and average savings for property owners.

Table 5.4.2-6 Jurisdictional Participation in FEMA's CRS program (FEMA, 2022n)

COMMUNITY	COUNTY	CRS RATING	TOTAL PREMIUM ($)	SHFA POLICIES	NON-SHFA POLICIES	TOTAL POLICIES
ETNA, BOROUGH OF	Allegheny	7	$181,762	120	14	134
SHALER, TOWNSHIP OF	Allegheny	8	$159,197	59	46	105
UPPER ST. CLAIR, TOWNSHIP OF	Allegheny	7	$81,816	15	53	68
BEDFORD, TOWNSHIP OF	Bedford	10	$44,119	26	9	35
ALTOONA, CITY OF	Blair	8	$72,304	64	20	84
LOWER MAKEFIELD, TOWNSHIP OF	Bucks	7	$274,679	88	165	253
UPPER MAKEFIELD, TOWNSHIP OF	Bucks	8	$165,743	67	70	137
WARWICK, TOWNSHIP OF	Bucks	7	$26,800	3	40	43
YARDLEY, BOROUGH OF	Bucks	8	$236,529	121	26	147
BLOOMSBURG, TOWN OF	Columbia	7	$219,582	121	58	179
UPPER ALLEN, TOWNSHIP OF	Cumberland	10	$28,115	12	15	27
HARRISBURG,CITY OF	Dauphin	8	$1,289,660	384	130	514
ROYALTON, BOROUGH OF	Dauphin	9	$42,342	38	11	49
BROOKHAVEN, BOROUGH OF	Delaware	9	$27,161	7	11	18
HANOVER, TOWNSHIP OF	Luzerne	8	$303,884	52	274	326
KINGSTON, BOROUGH OF	Luzerne	8	$959,801	0	1,369	1,369
WEST PITTSTON, BOROUGH OF	Luzerne	7	$262,718	43	208	251
WILKES-BARRE, CITY OF	Luzerne	6	$837,695	163	744	907
JERSEY SHORE, BOROUGH OF	Lycoming	8	$99,439	97	1	98
LOYALSOCK, TOWNSHIP OF	Lycoming	10	$62,613	36	19	55
GRANVILLE, TOWNSHIP OF	Mifflin	10	$43,040	20	21	41
LEWISTOWN, BOROUGH OF	Mifflin	8	$117,484	66	36	102
DANVILLE, BOROUGH OF	Montour	8	$76,143	53	46	99
HERNDON, BOROUGH OF	Northumberland	7	$13,703	9	4	13
MILTON, BOROUGH OF	Northumberland	7	$153,629	99	14	113
NORTHUMBERLAND, BOROUGH OF	Northumberland	10	$16,482	2	15	17
POINT, TOWNSHIP OF	Northumberland	10	$38,295	16	8	24
SUNBURY, CITY OF	Northumberland	8	$102,887	4	117	121
UPPER AUGUSTA, TOWNSHIP OF	Northumberland	10	$31,879	16	16	32
NEWPORT, BOROUGH OF	Perry	9	$37,229	29	1	30
CHAPMAN, TOWNSHIP OF	Snyder	10	$9,364	9	1	10
MONROE, TOWNSHIP OF	Snyder	9	$39,000	35	12	47
PENN, TOWNSHIP OF	Snyder	8	$21,493	18	2	20
SELINSGROVE, BOROUGH OF	Snyder	7	$129,465	104	11	115
LEWISBURG, BOROUGH OF	Union	8	$138,159	68	29	97
LIMESTONE, TOWNSHIP OF	Union	10	$14,621	12	0	12
UNION, TOWNSHIP OF	Union	10	$16,643	7	3	10

Table 5.4.2-7 provides estimates for 10 of the non-CRS participating communities with the highest savings potential on annual flood insurance premiums should they join the program with a rating of 9, which would provide for a 5 percent discount on all policies. Given the number of flood insurance policies in Philadelphia, the city has the highest total savings potential for property owners while the City of Reading in Berks County could have the highest average savings per policy at $265.64. 7 of the 10 communities are the same from the 2018 plan's analysis. Yardley Borough, as shown in the table above, is now a Class 8 CRS community. Upper Darby & Abington Townships are the other 2 communities that were replaced, as they dropped to around $10,000 in total savings. The number of total policies in each township decreased by around 100. The 3 new communities are Mckees Rocks Borough and the cities of Scranton and Reading. The 10th highest potential savings in the 2018 analysis was $18,339, while its only $11,422 for this update. This follows the theme of decreasing numbers of policy and coverage across the Commonwealth.

Table 5.4.2-7 Non-CRS Communities with the Highest Potential Savings (FEMA, 2022n).

COMMUNITY	COUNTY	TOTAL PREMIUM	TOTAL POTENTIAL SAVINGS	TOTAL POLICIES	AVERAGE POTENTIAL SAVINGS PER POLICY ($)
City of Philadelphia	Philadelphia	$1,962,153	$98,107.65	3149	$31.16
City of Pittsburgh	Allegheny	$861,360	$43,068.00	422	$102.06
City of Johnstown	Cambria	$589,731	$29,486.55	246	$119.86
Forty Fort Borough	Luzerne	$361,830	$18,091.50	536	$33.75
Bristol Township	Bucks	$353,280	$17,664.00	389	$45.41
Mckees Rocks Borough	Allegheny	$299,145	$14,957.25	61	$245.20
City of Scranton	Lackawanna	$282,259	$14,112.95	338	$41.75
Susquehanna Township	Dauphin	$268,807	$13,440.35	138	$97.39
New Hope Borough	Bucks	$252,914	$12,645.70	176	$71.85
City of Reading	Berks	$228,449	$11,422.45	43	$265.64

The following table showcases which communities would see the greatest average savings per policy if they joined CRS and obtained a Class 9 rating, while having at least 10 total policies. This filtered out some communities that only have a handful of policies with high premiums in an attempted to find communities with many such instances. It's also possible that a small number of policies in the communities chosen have very high premiums and are skewing the data, but less likely than those who only have 1 or 2 policies total. Communities like this include Port Vue Borough, which has 1 policy with a $55,616 premium in which a Class 9 rating would result in $2,781 saved. Reading & Mckees Rocks Borough make an additional appearance in this table. A common theme for most of these communities is they directly abut either the Susquehanna, Monongahela, or Ohio Rivers, which may explain why they have policies with such high premiums.

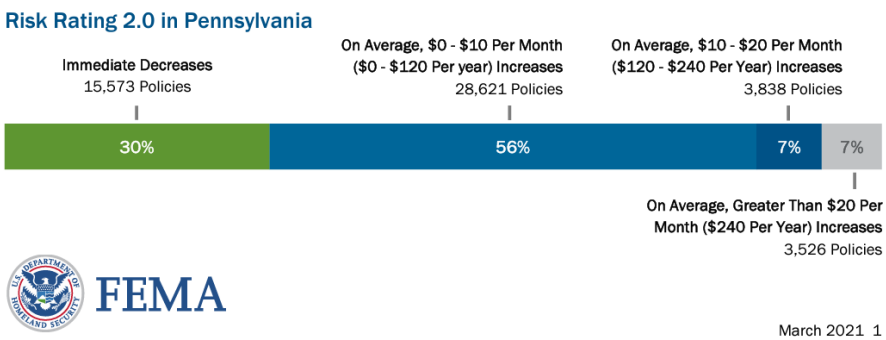
Table 5.4.2-8 Non-CRS Communities with the Highest Potential Savings per Policy (FEMA, 2022n).					
COMMUNITY	COUNTY	TOTAL PREMIUM	TOTAL POTENTIAL SAVINGS	TOTAL POLICIES	AVERAGE POTENTIAL SAVINGS PER POLICY ($)
Sewickley Borough	Allegheny	$107,071	$5,354.55	12	$446
Jenkins Township	Luzerne	$148,115	$7,406.75	20	$370
Hopewell Township	Beaver	$134,278	$6,714.90	23	$292
City of Reading	Berks	$228,449	$11,422.45	43	$266
Mckees Rocks Borough	Allegheny	$299,145	$14,957.25	61	$245
Canton Township	Washington	$81,885	$4,094.25	17	$241
Charleroi Borough	Washington	$50,942	$2,547.10	12	$212
Speers Borough	Washington	$45,613	$2,281.65	11	$207
New Bethlehem Borough	Clarion	$102,927	$5,146.35	25	$206
Tunkhannock Borough	Wyoming	$69,222	$3,461.10	17	$204

An additional way that insurance premiums can change is through FEMA's Risk Rating 2.0 initiative. This will change insurance premiums by attempting to provide a more accurate reflection of a property's risk by taking into consideration the following factors:

- Elevation
- Location with the flood zone
- Distance from a source of potential flooding
- Dynamics of the watershed drainage area
- Flood history
- Design and type of foundation
- Cost of repair
- Mitigation efforts

The figure below shows what FEMA's estimated changes are for Pennsylvania specifically. The agency claims that 93% of current policyholders' premiums will either decrease or increase by $20 or less per month. Despite potential increases, communities can still earn rate discounts by participating in the CRS program. The discount will be uniformly applied to all policies throughout the participating community, regardless of SFHA status.

Figure 5.4.2-1 **Projected Savings from Risk Rating 2.0 in Pennsylvania (FEMA, 2022o).**



Stormwater Management

Aside from NFIP and CRS capabilities, counties have two strong planning capabilities that relate closely to hazard mitigation planning and projects. Since many floods in Pennsylvania are caused by or exacerbated by increased storm water flow during excessive rainfall events, Act 167 Storm Water Management Plans can be an effective tool in evaluating and mitigating storm water-related flooding. Act 167 was enacted in 1978 to address storm water runoff resulting from land development which results in water pollution, soil erosion, and an increase in flooding frequency. It requires counties to develop storm water management plans for its watersheds and requires municipalities to adopt the plans and adopt or amend storm water management ordinances necessary to meet the requirements of their Act 167 Plan. These plans typically focus on design and construction measures that are intended to reduce the impact of more frequently occurring minor urban flooding. Counties must submit the plans to DEP for approval, and municipalities must enact ordinances or regulations consistent with the plans. After adoption and approval of a plan, the location, design and construction of storm water management systems, obstructions, flood control projects, subdivisions and major land developments, highways and transportation facilities, public utility services, and facilities owned or financed in whole or in part by funds from the commonwealth within the watershed must be conducted in a manner consistent with the watershed storm water plan (DEP Act 167, 2018).

StormReady

As of June 2023, there are 100 StormReady sites in Pennsylvania. StormReady is a NWS program to help communities with the communication and safety skills needed to save lives and property--before and during the event. Pennsylvania became the sixth state with full county participation in 2019 and is the largest state other than Florida with all counties participating.

Table 5.4.2-9 Pennsylvania StormReady communities (NOAA NWS, 2023).

STORMREADY COUNTIES			
• Adams • Allegheny • Armstrong • Beaver • Bedford • Berks • Blair • Bradford • Bucks • Butler • Cambria • Cameron • Carbon • Centre • Chester • Clarion • Clearfield	• Clinton • Columbia • Crawford • Cumberland • Dauphin • Delaware • Elk • Erie • Fayette • Forest • Franklin • Fulton • Greene • Huntingdon • Indiana • Jefferson • Juniata	• Lackawanna • Lancaster • Lebanon • Lehigh • Luzerne • Lycoming • McKean • Mercer • Mifflin • Monroe • Montgomery • Montour • Northampton • Northumberland • Perry • Philadelphia • Pike	• Potter • Schuylkill • Snyder • Somerset • Sullivan • Susquehanna • Tioga • Union • Venango • Warren • Washington • Wayne • Westmoreland • Wyoming • York
COMMUNITIES	**UNIVERSITIES**	**COMMERCIAL**	
• Charleroi • Chippewa • Cogan House • Daughtery Township • Hamilton • Hempfield Township • Millcreek • Milton Hershey School • Monaca • New Brighton • Paradise • Pittsburgh	• California University of Pennsylvania • Carnegie Mellon University • Edinboro University • Millersville University • Penn State University • University of Pittsburgh • University of Pittsburgh, Greensburg	• The Boeing Company • Duquense Light Company • Evangelical Community Hospital • Hershey Entertainment Complex • Main Line Health System	• Penn State Health • Pennsylvania Turnpike Commission • York Hospital
SUPPORTERS			

Table 5.4.2-9 Pennsylvania StormReady communities (NOAA NWS, 2023).

- Pulaski Township
- Tunkhannock
- West Lebanon
- Westfall Township
- York
- Bridgestone Allentown
- Bridgestone, Fredericksburg
- Dickinson College
- Dormont Borough
- Hempfield Township
- Longwood Gardens
- Mountain Productions Inc
- Mt. Lebanon
- North Strabane Township
- PA Emergency Management Agency
- Peters Township
- Salem Township
- St. Christopher's Hospital for Children
- Stockdale Borough
- Univ. of Pittsburgh, Bradford
- Univ. of Pittsburgh, Johnstown
- Univ. of Pittsburgh, Titusville Campus
- Warren State Hospital
- Williamsport

Shopping Centers:

- The Crossings Premium Outlets
- Grove City Premium Outlets
- King of Prussia Mall
- Lehigh Valley Mall
- Montgomery Mall
- Oxford Valley Mall
- Philadelphia Mills
- Philadelphia Premium Outlets
- Ross Park Mall
- South Hills Village
- Tanger Outlets

Firewise

Wildfires are another hazard that a number of Pennsylvania communities have taken steps to reduce their vulnerability at the community level by joining the Firewise, a program of the National Fire Protection Association. Firewise encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is typically done on the level of the homeowners' association, not at the municipal level. Pennsylvania has 3 Firewise communities, most of which are located in the Pocono Mountains area.

Table 5.4.2-10 Pennsylvania Firewise communities.

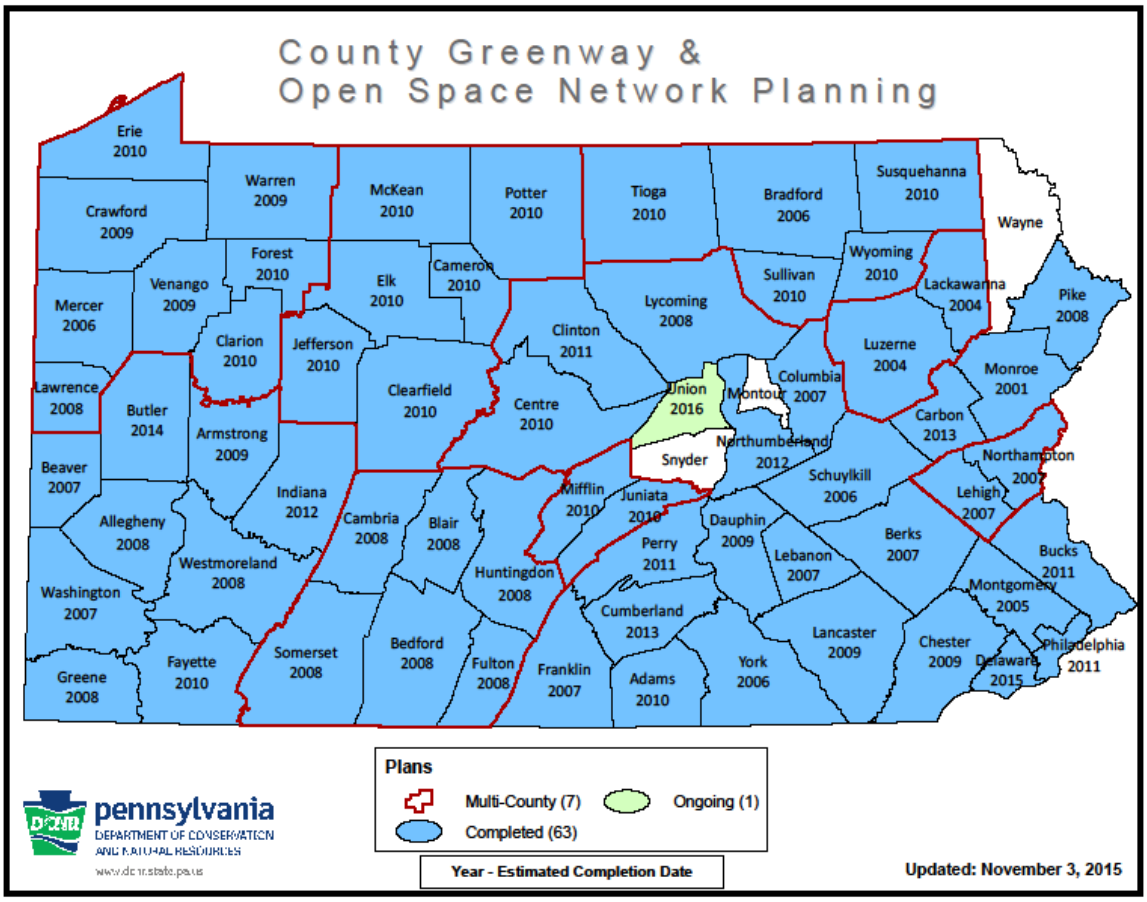
FIREWISE COMMUNITY	CITY	POPULATION	YEAR JOINED	INVESTMENT IN REDUCING WILDFIRE RISK
Big Bass Lake	Thornhurst	2,240	2012	$46,695
Hemlock Farms Community Association	Hawley	8,000	2006	$704,471
Penn Forest Estates Neighborhood Group	Jim Thorpe	1,136	2003	$218,697
Treasure Lake	DuBois	4,418	2018	N/A

Greenway and Open-Space Planning

Another key local planning mechanism that can assist with reducing vulnerability to hazards, especially natural hazards, is greenway and open space planning. Frequently, open space and greenway plans are used to preserve land in sensitive environmental areas, such as stream banks and steep slopes. While frequently focused on the recreational uses of open space and

greenways, these plans also assist in hazard mitigation planning by directing development away from areas that are more hazard-prone. These plans may also work hand-in-hand with existing hazard mitigation and flood protection projects. For example, Monroe County's greenways plan helped spur the development of a trail loop along their levee system, thus ensuring that the levee system stays clear of obstructions and is properly maintained. Since properties that are acquired through HMA grants must be kept as open space in perpetuity. Figure 5.4.2-2 shows the status of greenway and open space planning in counties across Pennsylvania since the information was last updated in 2015, which is the latest available information.

Figure 5.4.2-2 County Greenway and Open Space Planning Efforts (DCNR, 2015).



High Hazard Potential Dam (HHPD) Program

The National Dam Safety Program Act (Pub. L. 92–367), as amended, 33 U.S.C. § 467f-2, authorizes FEMA to provide High Hazard Potential Dam (HHPD) Rehabilitation Grant Program assistance to eligible states for pass through to non-federal governmental organizations or nonprofit organizations for the rehabilitation of dams that fail to meet minimum dam safety standards and pose unacceptable risk to life and property. This program has great potential to improve the resiliency of communities throughout Pennsylvania. There are many HHPDs which are owned by local communities or other owners who do not have the resources to mitigate them without assistance. The diverse ownership of HHPDs contributes to a great disparity in

planning for the hazards they pose. Some do not have Emergency Action Plans (EAPs). Others lack inundation maps and data on downstream populations; most owners lack information on incremental, residual, and non-breach risk posed by their dams. Most county HMPs do not currently meet FEMA HHPD standards. PEMA and DEP are working numerous actions to integrate HHPD planning across agencies and throughout the Commonwealth. These include adding HHPD analysis to 35 county HMP updates, which was assisted by winning a DR-4618 grant to amend county HMPs not currently in the HMP update window. PEMA and DEP have coordinated with FEMA and USACE to clarify definitions and have a consistent classification system for HHPDs within the Commonwealth.

Evaluation of Local Capabilities

The following general improvements in local capability are apparent statewide:

- Improved administration resulting in better tracking, data collection and reporting, including tracking of mitigated RL and SRL properties.
- An increase in the awareness of the availability of non-disaster grants for hazard mitigation, which allows for a broader range of mitigation actions and larger project budgets.
- An increase in the use of the PEMA hazard mitigation website.
- Creation of a Projects data base.
- Plans are improving in quality and depth.

General weaknesses in local hazard mitigation capability include:

- While implementation is improving, there is still room for increased growth in implementation activities.
- Lack of local funds for cost sharing and awareness of soft match.
- Integration of hazard mitigation planning into other planning mechanisms is at cursory level in local plans.
- Lack of awareness of the ability to contract SRL administration.
- Insufficient staffing.
- Lack of awareness of substantial damage in floodplain management ordinances and little or no enforcement.
- Only 15%of property owners that should have flood insurance obtain it.
- Institutional memory.

5.4.3 Local Mitigation Plan Integration

Counties have been working to integrate their hazard mitigation plans into other existing plans and documents to create more connections between land use, development, and hazard mitigation. Integration does not simply mean using other plans and documents in the development of the local mitigation plan; instead, it means that communities consistently consider hazard risk and mitigation legal and development management framework (see Section 5.2). According to FEMA's Integrating Hazard Mitigation into Local Planning, local integration is specific to each community. Since, in Pennsylvania, much of the land use,

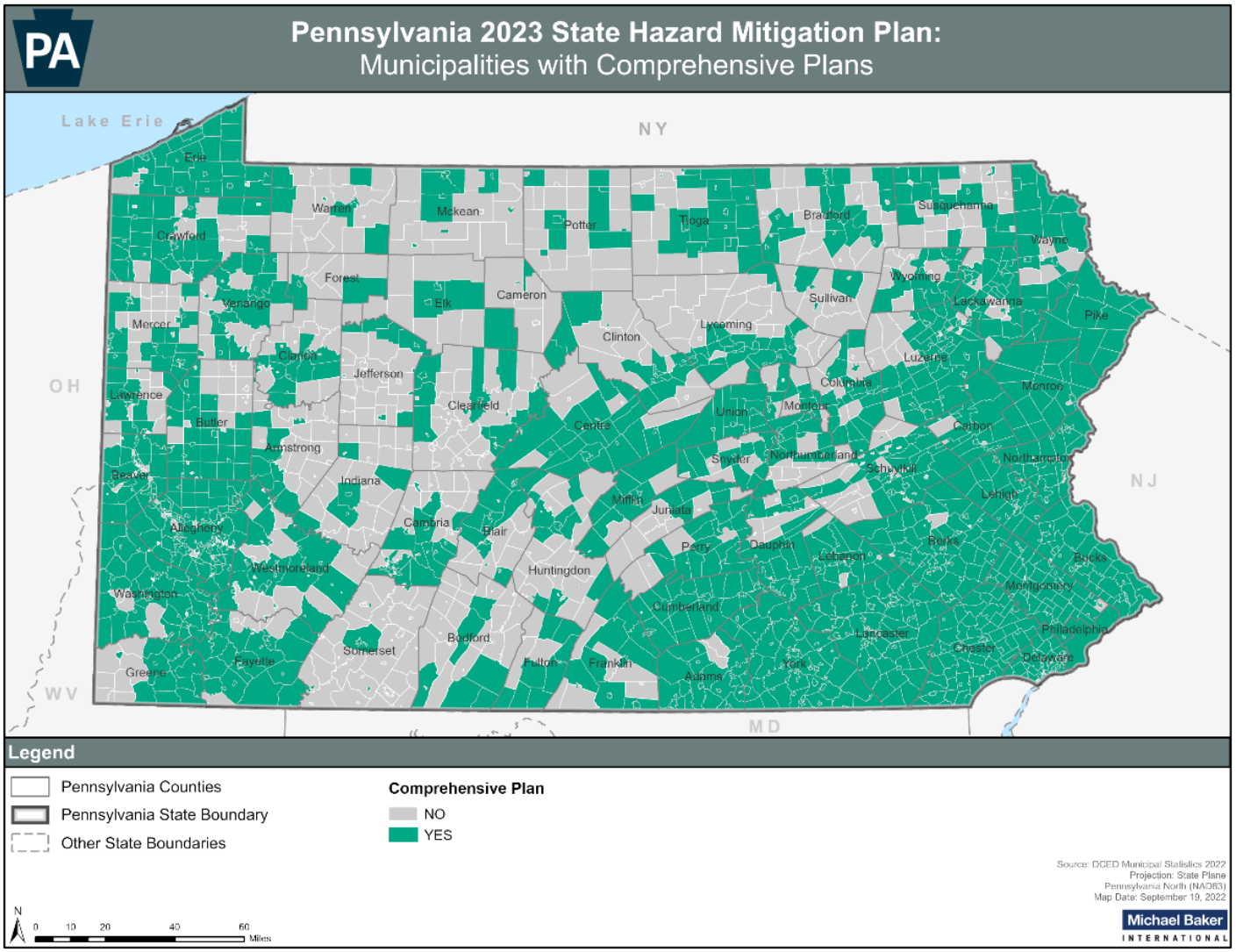
environmental, and development planning occurs at the local and county level; local mitigation plan integration is essential at the municipal and county level. Plans are now required to have enhanced HAZUS analysis with building attribute data, and the highest priority mitigation actions from county hazard mitigation plans have been identified and recorded.

One of the most important local planning mechanisms is the comprehensive plan. A community's comprehensive plan establishes the framework for future growth and serves as the official policy guide for decisions about how development will be managed, where and how it will occur, and what capital improvements and public services will support it. Act 247 requires Pennsylvania counties to create and adopt a comprehensive plan and encourages municipalities to adopt municipal or joint municipal comprehensive plans generally consistent with the county comprehensive plan. As shown in Figure 5.4.3-1, Pennsylvania has a strong foundation of local comprehensive plans, with 1,740 of the state's 2,570 municipalities having adopted comprehensive plans (DCED, 2020). The Pennsylvania SOG includes a discussion of how each county can encourage the integration of hazard mitigation principles into local comprehensive plans and other local planning mechanisms.

The Standard Operating Guide also addresses how the hazard mitigation plan will strengthen and support local planning mechanisms. Additionally, the Pennsylvania Model Plan Outline establishes integration between local planning mechanisms as a key part of local hazard mitigation plans.

There are ongoing conversations between state, county, and municipality officials on how to address barriers to developing, updating, adopting, and implementing these local hazard mitigation plans. Pennsylvania is committed to increasing its capacity to provide local support where needed to help overcome issues that counties and municipalities may encounter during the hazard mitigation planning process. PEMA and other Commonwealth agencies reach out frequently to counties to discuss challenges and opportunities. When there are funding options available, the Commonwealth works within its Mitigation Strategy Management Plan to fund projects and encourage integrated project applications. Two of the biggest barriers for local mitigation activities are capacity and funding. The Commonwealth has also looked into statewide projects to increase capacity and decrease the lift needed for local mitigation projects. As stated above, counties have identified their highest priority mitigation actions within their plans, but certain levels of developmental, technical, and operational capacity along with potentially significant funding mechanisms are needed to ensure these actions are undertaken and successful.

Figure 5.4.3-1 Municipalities with Comprehensive Plans (PA DCED, 2022).



5.5 State-Level Program and Plan Integration

Plan integration at the state level means that the policies, codes, plans, and programs directed from federal and Commonwealth agencies consider hazard mitigation and strive for synchronicity between and among planning efforts. This kind of plan integration will increase the success rate of hazard mitigation at the local, regional, and state levels improving the overall resilience of the Commonwealth. Pennsylvania currently has a pre-disaster recovery plan, which may be updated to build towards a resilience plan and/or integrated into this SHMP.

It is understood by all levels of government that the success of the Commonwealth's mitigation program depends on the degree to which everyone works together toward the common goal of reducing loss of life and property in Pennsylvania. The agencies and organizations that integrate hazard mitigation activities in the Commonwealth have mitigation capabilities within their own organizations, leverage partnership with each other to accomplish more and reach more stakeholders, and work towards the goals set forth in the mitigation strategy. Pennsylvania has several key coordinating structures that bring stakeholders together to identify and implement effective, long-term mitigation solutions. These key coordinating structures are:

- **Annual Plan Review Meetings:** Theses meetings are held with the State Planning Team annually in October between SHMP approval years to review how hazards are changing in the Commonwealth and what steps partners want to take to mitigate new and evolving conditions. The mitigation strategy is reviewed in detail to capture accomplishments and consider whether

Integration Highlights

FEDERAL

- Nearly $831 million was provided to PA to reimburse costs associated with emergency protective measures undertaken in response to and during recovery from the COVID-19 pandemic.
- The LiDAR Working Group continues to map every county in Pennsylvania
- The latest round of funding from the Assistance to Firefighter Grant Program provided $31.7 million to 226 stations

STATE

- DEP assisted in creating the second Climate Leadership Program in the country, which produced 150 graduates in 2021.
- In an effort to make it easier for Pennsylvanians to get vital information and stay informed before, during, and after a flood, the PA Silver Jackets team created a flood risk management website and the PA Flood Mitigation Programs Guide.
- Act 13 Funding has provided over $180 million to 1,233 projects since its inception.
- NFIP responbilities were successfully transferred from DCED to PEMA.

NGO/LOCAL/OTHER

- Delaware River Basin Commission voted in December 2022 to prohibit the discharge of wasterwater from high volume hydraulic fracturing to water or land in the basin.
- The PA SHMO is now the President of the NHMA and contributed to NHMA's publication *Building Your Roadmap to a Disaster Resilient Future.* This publication helps navigate through an array of pre- and post-disaster resources and programs available for risk reduction and is a resource for mitigation implementation throughout the country.

actions without progress need to be revised to match current priorities or can have more resources devoted to them.

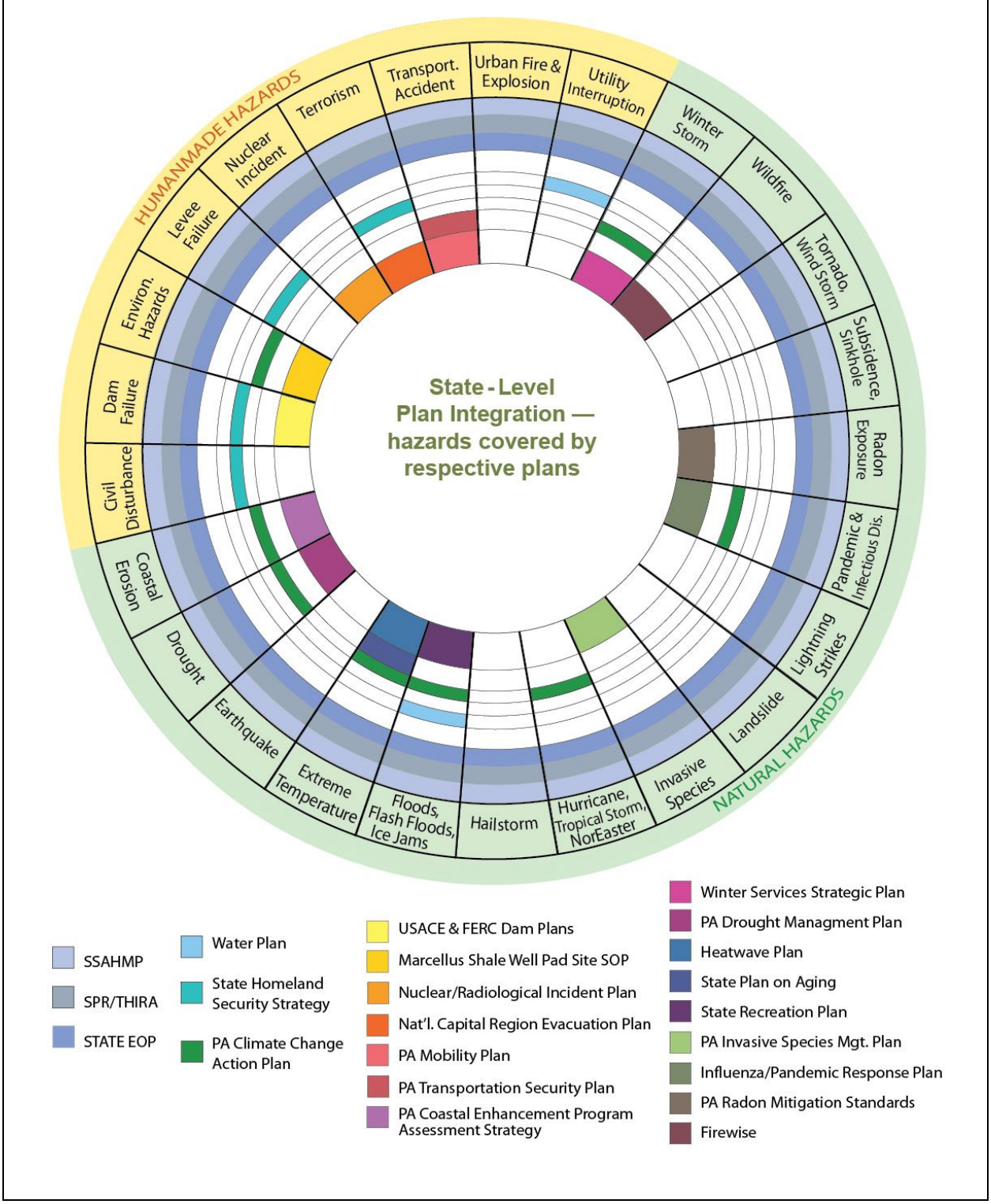
- **Annual Risk Reduction Consultations:** These meetings are held in partnership with state agency leaders and FEMA to review the Commonwealth's annual priorities for risk reduction and plan for implementation. The Risk Reduction priorities are captured within the 2022 mitigation strategy as described in Table 6.2-5.
- **Silver Jackets:** This USACE-led coordination effort focuses on flood mitigation and has been successful in bringing together multiple agencies and organizations on projects for outreach, training, mapping, and funding resource collection. The organizations active in Pennsylvania's Silver Jackets include: American Rivers Organization (ARO), DCED, DCNR, DEP, DRBC, EDA, FEMA Region 3, HUD, Interstate Commission on the Potomac River Basin (ICPRB), KEMA, NOAA/NWS, NRCS, PA Association of Floodplain Managers (PAFPM), PA Department of Agriculture, PA Insurance Department, PA SHPO, PEMA, PennDOT, SRBC, USACE, and USGS.
- **Recovery Resources Team (RRT) Meetings**: Pennsylvania is in the process of developing a Pre-Disaster Recovery Plan. Recovery can be a key time to accomplish mitigation as funding is available and communities want to re-build stronger and more resilient. Coordination and implementation of the recovery plan supports mitigation though it addresses additional topics. The plan includes DCED, DCNR, PA Department of Human Services, PEMA, PENNVEST, and PHFA as leads for Recovery Support Functions. The majority of the Commonwealth's agencies from the PA Department of Military and Veterans Affairs to PA Human Relations Commission have a role in supporting the recovery plan depending on their applicable resources.

Hazard mitigation in the Commonwealth is led and supported by a cross-section of state partners that host mitigation programs and activities within their organizations, as well as work collaboratively to implement mitigation solutions. Though PEMA is a catalyst for mitigation in the Commonwealth, partners abound that support mitigation in collaborative projects and through the missions of their own organizations. Federal leaders like FEMA are strong partners in planning and furthering the Risk Reduction Consultations, while the USACE leads the Silver Jackets initiative. DEP oversees dams, levees, and flood permitting within its own agency and collaborates on projects through the SHMP. Strong non-profit organizations like Nurture Nature Center have led training for the public and professionals in the field on risk communication. Universities support research through centers like Millersville University's Center for Disaster Research and Education and mitigation such as generator grants for East Stroudsburg University. No single agency or organization has all the answers, but the Commonwealth's stakeholders come together to leverage better mitigation solutions.

Part of successful hazard mitigation integration is knowing the status of hazard planning. Figure 5.5-1 shows how hazards are addressed by a range of state-level plans, with many hazards addressed across a range of plans. The graphic is from the 2018 plan, but it highlights how plans can address multiple hazards and the variety of plans across the state. In some instances, hazards remain unaddressed by the separate plans listed. This may be because the hazard risk is low in Pennsylvania, such as earthquake. In other cases, a lack of separate plan coverage may suggest that the hazard is typically addressed through other planning mechanisms, such

as building codes for wind and lightning. This diagram also serves as a resource for local plans and partners that work to address a hazard using multiple resources.

Figure 5.5-1 State-Level Plan Integration – Hazards Covered by Respective Plans.



5 CAPABILITY ASSESSMENT

Everyone in Pennsylvania is eligible to complete a mitigation project. Projects would be integrated with other partners in most cases, whether it be learning about individual mitigation from a FEMA brochure, understanding the requirements for radon mitigation when buying or selling a home from a property inspector, to attending a floodproofing workshop with USACE, PEMA, and local Emergency Management representatives. Though the opportunity to mitigate is available to residents, business, organizations and all levels of government, there are several entities that led the implementation of integrated mitigation activities in the Commonwealth. The following mitigation integration worksheets were created for key agencies. Additional integration worksheets will be added as part of future updates to the SHMP as more partners take stake in mitigation across the Commonwealth.

The worksheets discuss integrated mitigation programs and projects that make up the Pennsylvania's overall mitigation capacity and contribute to the mitigation program. Ongoing activities, sectors of activity, available funding, integrated partners, and highlights of integration accomplishments are summarized. Mitigation actions detailed in Table 6.2-6 that are connected to those activities and accomplishments at the federal, state, and local level or through non-governmental organizations are also noted to illustrate that integration is not static and is planned into the future.

There are numerous federal, state, and local planning mechanisms that contribute to hazard mitigation integration in the Commonwealth captured in the following worksheets. These programs along with some additional resources are provided in Appendix N as an additional reference for mitigation implementation.

Federal Emergency Management Agency Integration Worksheet

Ongoing Activities

FEMA is the Federal agency that sponsors and regulates hazard mitigation planning, related HMA funding opportunities, the NFIP, and risk MAP. This worksheet summarizes highlights of integration efforts in Pennsylvania.

FEMA supports hazard mitigation planning with guidance, technical assistance, training, funding, and review. Pennsylvania counties have applied for and received funding for a growing number of plan updates, with 24 plans funding through the PDM program in 2018 and 2019, 1 each in 2019 and 2020 through the FMA program, 7 through the BRIC program in 2020, and 37 through the HGMP. FEMA shared guidance on local and state hazard mitigation plans nationally and Region II developed state specific guidance on how to address future conditions. FEMA Region 3 staff participated in the SPT update meetings, annual review meetings, and in the plan review as well. Projects identified by the hazard mitigation plans are funded through HMA grants for implementation.

FEMA works with DCED, PEMA, and local partners to update and provide technical assistance related to FIRMs throughout Pennsylvania through CAP-SSSE and Risk MAP. Currently 39 studies are ongoing in Pennsylvania at various stages in the due process. Sixteen of the 39 studies are related to levees. FEMA, DEP, USACE, PEMA, DCED and local communities regularly meet and work towards options to improve levee maintenance and to better reflect flood risk on FIRMs. Risk MAP data was used to update the flood profile in the SHMP.

FEMA is an agency of DHS, which means that some of the directives from FEMA and DHS serve related efforts. THIRA analysis is a DHS initiative that assesses all-hazards capability and has informed this SHMP update and hazard selection. Funding streams from DHS and Urban Area Security Initiative (UASI) line up with some of the mitigation actions identified in state and local plans in Pennsylvania.

FEMA often convenes federal, state and local partners to work towards integrating their work for hazard mitigation. Annually, FEMA Region 3 works with PEMA to host the Risk Reduction Consultation that links partners to furthering priorities for reducing risk in the Commonwealth. They also host State NFIP Coordinator/ SHMO conferences bi-annually to share ideas across the Region. They have hosted NFIP and mitigation related training throughout the state annually and participated as members of the SPT and Silver Jackets.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• HMA (FMA, BRIC, and HMGP) • NFIP with related ICC, CRS, CAP-SSSE and Risk MAP • Public and Individual Assistance • RCPGP, EMPG, Community Disaster Loan Program, EHP, and NDSP • All for the above described in more detail in section 5.3.3	• DCED, DEP, Department of Human Services, DOH, Insurance Department, PASSHE, PEMA, PennDOT, PHMC, US DHS, USACE, and USGS. • FEMA often partners with Metropolitan Planning Organizations like DVRPC on outreach.

Integration Accomplishments

- Host annual Risk Reduction Consultations with PEMA, the most recent of which was in April 2023. The priorities were integrated into the SHMP update.
- FEMA Region 3 developed Addressing Future Conditions memo that references data from US Census, NOAA, USDA, EPA, and the National Climate Assessment.
- FEMA Region 3 partnered with Delaware Valley Regional Planning Commission (DVRPC) on a series of brainstorming sessions and other collaborations including the Game of Floods.
- Nearly $831 million was provided to Pennsylvania to reimburse costs associated with emergency protective measures undertaken in response and during recovery from the COVID-19 pandemic, including $41.4

million to Philadelphia for alternate care sites, emergency operations centers, mortuary services, vaccines, and more.

- FEMA's Cooperating Technical Partners program provided grant funding for a partnership of Penn State University and PEMA to develop the PA Flood Risk Tool that consolidates flood data from FEMA and state sources to provide easy access to anyone in PA.
- FEMA awarded Philadelphia $25 million via a BRIC grant for the Cohocksink Flood Mitigation Project in 2021, while FMA grants awarded $1.2 million for technical & managerial assistance, land acquisition, and a levee project.
- The most recent funding cycle for the Assistance to Firefighters Grant Program awarded $31.7 million to 226 fire departments across the Commonwealth, helping to provide new equipment, vehicles, training, and more.
- FEMA conducted the Biennial Radiological Emergency Preparedness Exercise at the Susquehanna Steam Electric Station in October of 2022.
- The *Resilience Report* reaches 3,895 recipients with 54% of the subscribers in Pennsylvania.
- Lackawanna County Flood Risk Coalition is an innovative partnership between local, state and federal agencies initiated by FEMA.
- Additional accomplishments are listed in Table 6.2-4 Evaluation of 2018 mitigation actions.

United States Army Corp of Engineers Integration Worksheet

Ongoing Activities

The Pennsylvania Silver Jackets was established in 2010 as the State Hazard Mitigation Plan was being updated. The USACE provides administrative capacity, expertise, and resources to host regular meeting and develop comprehensive local flood mitigation strategies. The Pennsylvania Silver Jackets was recognized as the Silver Jackets Team of the year in 2013. The team brings together federal and state agencies and non-governmental organizations regularly for coordination and to work towards completing specific projects.

The team has been successful in hosting regular ice jam training in the winter and floodproofing workshops in the summer. They have created and maintained online tools for communicating steps for people to take before, during, and after a flood and for inundation mapping in the Harrisburg area. In March 2022, they published the PA Mitigation Program Guide to help identify programs, services, and tools available to support flood risk management activities. The document is broken down by assistance type (preparation, response, recovery, or mitigation) and source (federal, state, regional, or non-governmental). They plan to continue their work to coordinate and work together on projects that inform both the general public and risk management professionals on mitigation opportunities and methods.

The USACE has technical assistance and funding grants that support flood mitigation. USACE staff sit on the State Planning Team and participate in the prioritization of projects that may be eligible for assistance under these programs.

Twenty-six dams in Pennsylvania fall under the jurisdiction of USACE; these dams each have safety plans. Since dam failure has been identified as a hazard of significant concern, these plans are crucial in mitigating the risk associated with dam failure.

Congress authorized the USACE to develop the National Levee Database (NLD) in 2007 to organize levee inspection, flood plain management, risk assessment, and flood risk communication information. The NLD is undergoing redevelopment as of 2018 and there are plans in place to make it a levee data repository for USACE and FEMA data.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• PAS, FPMS, CAP, ICW, RIP, National Levee Safety Program, and GI are described in more detail in section 5.3.3	• ARO, DCED, DCNR, DEP, DRBC, EDA, FEMA, HUD, ICPRB, KEMA, NOAA/NWS, NRCS, PAFPM, PA Department of Agriculture, PA Insurance Department, PA SHPO, PEMA, PennDOT, SRBC, USACE, and USGS

Integration Accomplishments

- Created before, during, and after flood risk management website, which was launched in February 2013.
- Created the PA Flood Mitigation Programs Guide to assist local governments, communities, businesses, and individuals in identify the resources available to them for flood risk management.
- Developed a library of inundation maps tied to an existing stream gage to inform the general public, local officials, and emergency managers of flooding for a 20-mile reach of the Susquehanna River near Harrisburg.
- Held the “Filling Flood-Related Outreach Gaps” webinar series in March 2022.
- Assisted in developing The Flood Risk Communication Initiative with federal, state, and local agencies to host 5 flood education workshops in the summer of 2021 on flooding basics, how to prepare property, available resources and contacts, and more.

- Completed 2016 study for Lycoming County that compared the benefits of flood proofing measures to the reduction in flood damages and reduction in flood insurance costs for 20 prototype structures.
- Held ice jam training Bloomsburg and Oil City in December 2021 with presenters from USACE; NWS from State College, Binghamton, and Pittsburgh; and SRBC. The Oil City training included a site visit to the ice boom on the Allegheny River, which is one of only three ice booms in the country.
- Held annual floodproofing workshops across the state; with the 2022 ones being held in Lebanon 2018. The workshops consisted of an afternoon meeting directed towards public officials and an evening meeting for the general public.
- Additional accomplishments are listed in Table 6.2-4 Evaluation of 2013 mitigation actions.

United States Department of Agriculture Integration Worksheet

Ongoing Activities

USDA data and information are integrated into the SHMP hazard profiles for drought, hailstorm, invasive species, and mass food and animal feed contamination. Agriculture is an economic driver that is vulnerable to hazards and in the case of mass food and animal feed, agricultural contamination is a hazard. USDA collects data and shares information for farmers on the impact of climate change and climate extremes on a 'Climate Hubs' website.

The Natural Resources Conservation Service (NRCS) within USDA has programs and funding that integrates with hazard mitigation, particularly the Emergency Watershed Protection (EWP) program. These funds help communities address watershed impairments that pose threats to lives and property, which may include debris-clogged stream channels, undermined and unstable streambanks, jeopardized public infrastructure, wind-borne debris removal, and damaged upland sites stripped of protective vegetation by fire or drought. The NRCS will pay up to 75% of the construction costs for these emergency measures. Floodplain easements are also available.

The USDA announced in August 2022 that they were investing an additional $5 million in the Wetland Mitigation Banking Program, with a focus on states that have large amounts of wetlands and agricultural producers with wetland determination requests, like Pennsylvania. This program can be used for site identification, site restoration, permitting, market research, and more.

An additional grant program is the Regional Conservation Partnership Program (RCPP) which targets projects that address climate change and enhance water quality. In August 2022, NRCS announced $17.8 million in funding through the RCPP for a stream restoration project in Central PA and a statewide preservation and climate change mitigation project.

NRCS provides technical assistance and guidance on stream corridor restoration that takes the impact of flooding into account and serves the purpose of providing a suitable place to manage the floodplain, protect agriculture, and restore the functions of natural systems.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• NRCS has several funding streams that could support mitigation including for conservation, easements, and wetlands. The EWP and Recovery and Floodplain Easement (FPE) programs are particularly applicable to mitigation efforts.	• PEMA, PA Department of Agriculture, DEP, County Conversation Districts

United States Geological Survey Integration Worksheet

Ongoing Activities

The USGS works with the National Weather Service, the USACE, and FEMA through the Flood Inundation Mapping Program to help communities understand flood risks and make cost-effective mitigation decisions.

The USGS Pennsylvania Water Science Center (PAWSC) operates 361 continuous-record stream gages offering real-time stage and discharge information for streams throughout and boarding the Commonwealth. The gages are operated and maintained in cooperation with 53 federal, state, and local partners. Stream gages can act as a warning system by alerting residents when stream flows are above or below normal. Not only can these gages be integrated into flood hazard planning, they can also determine periods of drought that could impact the Commonwealth's ability to meet its water needs. Additionally, gage data informs statistics and modeling used by FEMA to update FIRMs. The center also publishes a seasonal newsletter and periodic research studies about water resources in PA.

USGS' flood inundation library contains a series of maps which illustrate where flooding will occur at various river levels, and during a flood event these maps can be combined with real-time USGS streamflow data and NWS flood forecasts to provide real-time and forecasted risk information. These maps can be used for preparedness, mitigation, and planning, environmental and ecological assessment, timely response, and recovery.

USGS is a leader and partner in the PA LiDAR Working Group that is working on gaining improved coverage across the Commonwealth. Their 3D Elevation Program (3DEP) has supported initial data collection and the working group is collaborating for additional funding streams including funding in state budgets.

USGS also provides vital information for studying and planning for risks associated with wildfires, landslides, earthquakes, droughts, acid mine drainage, radon contamination, and coastal erosion through various databases, research programs, and technical expertise.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• USGS has multiple funding opportunities that tend to fall in the category of research and analysis. The funding stream that is in active use currently in Pennsylvania is the 3D Elevation Program (3DEP).	• LiDAR Working Group partners include: PEMA, DCNR, PennDOT, DEP, DCED, PA Game Commission, USGS, NRCS, USFS, PASDA, Shippensburg University, PA Magic, PA Management Association for Private Photogrammetric Surveyors (PA MAPPS), SRBC

Integration Accomplishments

- USGS data is used throughout the Risk Assessment section of the SHMP.
- Through 3DEP, LiDAR data for 25 counties spanning from southeastern Pennsylvania to Lycoming County was collected between 2014 and 2018.
- The LiDAR Working Group is continuing the collection effort through 3DEP, to work towards acquiring updated statewide coverage. Throughout 2019 and 2020, 16 more counties will be collected in central and northeastern Pennsylvania.
- Several studies have been conducted alongside DEP and local partners to assess the impacts of mining, natural gas production, agriculture, and sewage systems on local water supplies, some which have detected high levels of radon contamination.
- PAWSC, DEP, and the Susquehanna River Basin Commission collaborated to publish a first-of-its-kind Per- and Plyfluorinated Alkyl Substances (PFAS) dataset in 2021.

- PAWSC updated StreamStats, the national web-based application that provides access to information on streams throughout the Commonwealth, for the first time since 2003. The tool is used by water-resource managers to manage withdrawals and can also be used to find information on historic flows.
- The seasonal “Pennsylvania Waters” newsletter was started in Summer 2020 by PAWSC.

PA Department of Community and Economic Development Integration Worksheet

Ongoing Activities

DCED integrates risk mitigation planning efforts through various techniques and programs. DCED and PEMA established a partnership to transition the management of the Commonwealth's duties for the NFIP starting in 2018. The State NFIP Coordinator remained at DCED while additional NFIP-focused staff joined PEMA-MIRC in 2019 and 2020, but as of September 7, 2021 DCED no longer house or has responsibility for any aspect of NFIP.

The Community Development Block Grant – Disaster Recovery (CDBG) from HUD is managed by DCED for Pennsylvania. CDBG-DR makes funding available to prevent further damage to an impacted area after a federally designated disaster with a focus on assisting communities in low-income areas. The goals of the program align with those in the SHMP, especially regarding Pennsylvanians most at-risk.

The DCED Land Use Planning & Technical Assistance Program (LUPTAP) provides grants for comprehensive plans and for the preparation of local zoning or subdivision. The leading mitigation technique associated with this program is Local Plans and Regulations as it provides funding to amend or develop comprehensive plans to include an assessment of hazard vulnerability and take appropriate mitigation measures. Similarly, DCED's Municipal Assistance Program (MAP) provides funding to assist local governments to plan for and efficiently implement a variety of services and improvements. Funding is available for three groups of activities: shared services, community planning, and floodplain management.

DCED administers the Act 13 Marcellus Legacy Fund grants that can support flood mitigation projects authorized by a flood protection authority, watershed restoration and protection, and orphaned or abandoned well plugging efforts. The H2O PA Act provides additional funding for flood mitigation and water resources, with single- or multi-year grants for flood control, High Hazard Unsafe Dam projects, and infrastructure upgrades. For smaller projects ($30,000-500,000), the Small Water and Sewer program provides funding for water, sewer, stormwater, and flood infrastructure projects.

DCED is also charged with administering several grant programs associated with funding various aspects of the response to and aftermath of the COVID-19 pandemic, including hazard pay programs, vaccines, public outreach, small business recovery efforts, and more.

The 2022 DCED Action Plan is utilizing $58 million in CDBG, HOME, HOWPA, ESG, and HTF allocations to address affordable housing issues by increasing the supply of affordable housing opportunities, providing direct assistance to homebuyers, individuals experiencing or at risk of experiencing homelessness, and providing housing services, supports, and counseling.

Other DCED programs that can be leveraged to support hazard mitigation principles include:

- Municipal Assistance Program: provides funding for planning and implementing public services, improvements, and development. The focus is on multi-municipal partnerships and the categories are Shared Service Activities and Community Planning.
- Unserved High-Speed Broadband Funding Program: grants for nongovernmental entities to deploy middle-mile and last-mile high-speed broadband to underserved areas.
- Community Development Block Grants: funding and technical assistance for housing rehabilitation, public services, community facilities, infrastructure improvement, and planning efforts.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing	• Act 13 Marcellus Legacy Fund • CDBG-DR • LUPTAP Municipal Assistance Program • Business Financing • Local Municipal Resources and Development Program	• Local municipalities, DEP, FEMA, HUD, NRCS, PEMA, and USACE

Health & Social Services Infrastructure Natural & Cultural Resources	• Urban Development Program • H2O PA Program • Small Water and Sewer Program • Municipal Assistance Program • Un-served High-Speed Broadband Funding Program	

Integration Accomplishments

- DCED, PEMA and FEMA Region 3 worked together on a new agreement to improve the capacity of NFIP support from the Commonwealth.
- PEMA and DCED issued a Joint Letter to municipalities with Suspended or Non-Participating NFIP designation in FEMA's CIS Systems. This resulted in several communities re-engaging in the NFIP.
- DCED supported the update and adoption of approximately 718 local floodplain management ordinances between 2013 and 2017.
- NFIP 101 session conducted in 2016 for PA legislative delegation by FEMA, PEMA, and DCED staff.
- DCED and PEMA secured funding and collaborated on the contracting of the Pre-Disaster Recovery Plan due to be completed in 2019.
- CDBG-DR funds have been used for flood wall construction and storm sewer restoration in Bloomsburg, property buy-outs in Harrisburg, multifamily housing construction in Wyoming County, bridge demolition in Luzerne County, and wetland restoration in Schuylkill County.
- CDBG funding has also been utilized for projects involving water and sewer infrastructure, stormwater management, affordable housing, and roadway safety across the Commonwealth.
- An investment of $125 million in the Whole Home Repair Program.
- In 2022, Municipal Assistance Program funding was approved for projects that included updating comprehensive plans to better reflect social, environmental, and economic realities, updating Subdivision and Land Development Ordinances, and updating zoning codes. Bridgeville Borough's updated plan will account for recent flooding events and the Congress of Neighboring Communities will use funds to improve the partnerships between volunteer fire departments in and around Pittsburgh.
- Act 13 funding has supported 1,233 projects with $181,430,682 in grant funding since its inception (as of September 2022):
  - Watershed Restoration and Protection: 161 projects, $22.6 million
  - Sewage Facilities: 32 projects, $1 million
  - Orphan or Abandoned Wells: 10 projects, $1.8 million
  - Greenways, Trails and Recreation: 879 projects, $108 million
  - Flood Mitigation & H20 PA: 124 projects, $38.4 million
  - Baseline Water Quality Data: 5 projects, $1.1 million
  - Abandoned Mine Drainage Abatement & Treatment: 22 projects, $8.4 million
- Additional accomplishments are listed in Table 6.2-4 Evaluation of 2013 mitigation actions.

PA Department of Conservation and Natural Resources Integration Worksheet

Ongoing Activities
Pennsylvania Department of Conservation and Natural Resources (DCNR) works to maintain and protect rivers, greenways, open space, and other natural areas. Many programs funded by DCNR integrate hazard mitigation actions outlined throughout the SHMP. For example, the Pennsylvania Greenways Action Plan is meant to preserve the highest priority undeveloped floodplain areas via fee, simple acquisition, and/or easement, and retain as public open space for passive recreational uses. The Pennsylvania Statewide Comprehensive Outdoor Recreation Plan presents 28 programmatic and five funding recommendations to enhance the delivery of outdoor recreation facilities and services, organized under four major goals: strengthen connections between outdoor recreation, healthy lifestyles, and economic benefits in communities; reconnect people to the outdoors and develop a stewardship ethic through outdoor recreation; develop a statewide land and water trail network to facilitate recreation, transportation, and healthy lifestyles; and enhance outdoor recreation through better state agency cooperation. This plan aligns with standards of the Land and Water Conservation Fund works to provide education and awareness programs aimed at better informing residents of their role in environmental conservation. Penn Parks For All is a plan that assess how DCNR can provide greater access and opportunity for recreation while minimizing impacts on natural and cultural resources. The planning process was heavily impacted by public input and addressing climate change impacts. DCNR's Climate Change and Mitigation Plan looks at climate change impacts and adaptation from the lens of public lands by identifying vulnerabilities and recommending specific actions. The overall goal is to promote resiliency for public resources so they can continue to provide ecological, social, and economic benefits to Pennsylvania. FireWise is a multi-organizational initiative designed to include not only fire safety professionals, but also homeowners, community leaders, developers, and others in localized efforts to reduce susceptibility of homes, communities, and structures to wildfire through cooperative education and mitigation techniques. This program aims to teach homeowners how to prepare their homes for wildfires as well as hold safety committee meetings and other fire and safety educational training programs to better educate residents and first responders.] The Land and Water Conservation Fund State Assistance Program provides grant funding for the acquisition and development of public outdoor recreation areas. All projects funded through the LWCF are permanently protected for public benefit. The Pennsylvania Invasive Species Management Plan establishes strategic goals in combating invasive species threats and establishes a robust statewide risk assessment of invasive species hazards. Residents are encouraged to select native plants for landscaping, manage existing on-site invasive species to prevent their spread, and conduct annual inspections for invasive species outbreaks. The recently formed Recreation Engagement Coalition is an advisory group formed by stakeholders across the Commonwealth to help build the Office of Outdoor Recreation, an office that will be responsible for coordinating initiatives, partnerships, policies, and resources that will enhance access to outdoor recreation, support local businesses, and promote sustainability.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure	• DCNR Community Conservation Partnerships Program Grants • Pennsylvania Rivers Conservation Program • Land and Water Conservation Fund (LWCF)	• National Fire Protection Association, Bureau of Forestry, DEP, Office of the State Fire Commissioner, PEMA

Natural & Cultural Resources

Integration Accomplishments

- The DCNR Bureau of Forestry (BOF) contributed to the wildfire risk assessment for 2010 SHMP update.
- DCNR Educational Series #9 Booklet on Landslides in Pennsylvania contributed to the landslide risk assessment in the 2023 SHMP update.
- Data from the PA Invasive Species Management Plan was used in the 2013, 2018, and 2023 SHMP updates.
- DCNR has committed to produce or purchase 100% of its electricity from renewable sources by 2030. There have been 23 solar installations completed,18 currently in design or under construction, 41 state parks or forests with electric vehicle charging stations, and continued investment into battery operated maintenance equipment and electrifying the agency's fleet.
- DCNR Bureau of Forestry (BOF) established FireWise Medal Communities to reward communities for their efforts to prepare for and reduce the risk of wildfire emergencies. Gold, Silver, and Bronze Medals are given to communities based on their level of preparedness. There are four FireWise Medal Communities in the Commonwealth: Treasure Lake, Big Bass Lake, Penn Forest Streams, and Hemlock Farms.

Pennsylvania Department of Environmental Protection Integration Worksheet

Ongoing Activities

The Department of Environmental Protection (DEP) is a major partner in hazard mitigation planning with its work spanning across all sectors. Many aspects of the SHMP integrate DEP programs in a collaborative effort to protect Pennsylvania's land, water, and air such as the State Water Plan and the Commonwealth Nuclear/Radiological Plan, both of which were included in SHMP updates. Other integrations include:

- The Pennsylvania Drought Management Plan outlines the public water supplier's sources of water and identifies watch, warning, and emergency conditions within the water supply system.
- The Pennsylvania Water Plan reports on regional resources and statewide priorities, helping to inform decision-making and establish effective and collaborative management.
- DEP provides technical and financial assistance to support municipalities in implementing the Act 537 Program to improve sewage disposal problems and prevent the siting of sewage treatment facilities in sensitive areas like floodplains, areas susceptible to landslides, and on certain kinds of soils.
- The Flood Protection Program plans long-term structural solutions through evaluation, hydrologic, and hydraulic analysis, environmental impacts analysis, and cost benefit analysis.
- PA Chapter 106 outlines the permit process and regulations for development within the floodplain with the goal for future reduction of losses by restoration of the natural floodplain.
- The Coastal Zone Enhancement Grants Program Assessment and Strategy is a self-assessment of nine NOAA priority areas followed by a five-year strategy to enhance the PA coastal program.
- DEP participates in Chesapeake Bay Watershed Management through the Phase 3 Implementation Plan, which describes ways the state can work with local governments and the private sector to address nutrient and sediment loads along with climate change impacts to waterways.
- The Dam Safety Program has statutory authority for permitting and monitoring dams and levees. The Bureau of Waterways Engineering, managers of this program, are active participants on the SPT.
- PA Radon Mitigation Standards provides standards to be referred to by certified mitigation contractors for installation of radon mitigation systems.
- The Pennsylvania Climate Change Act and Climate Change Action Plan report on potential climate change impacts and economic opportunities for the Commonwealth.
- The Local Climate Action Program provides free technical and personnel assistance to local governments to reduce GHG emissions and address climate change.
- The Clean Energy Program Plan outlines clean energy policies that will build capacity, efficiency, and resilience for the growing infrastructure sector.
- DEP Surface Subsidence Agent Program monitors and documents conditions in areas impacted by longwall mining and offers mine subsidence insurance for potential losses caused by the collapse of underground coal and clay mines in PA.
- The Acid Mine Drainage Set-Aside Program outlines the process for identifying abandoned mines, priorities, cost/benefit analysis and more to help remediate and restore watersheds and achieve higher water quality.
- The Liquid Fuels Shortage Planning Guidebook for Pennsylvania Local Governments provides assistance to county planners and emergency managers to anticipate, prepare for, and respond to fuel supply challenges resulting from hazards.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure	• Stream Improvement Program • Dam Safety Program • Flood Protection Program • Coastal Zone Grants • Section 319 Nonpoint Source Management Grants • Growing Greener • Act 13 Impact Fee	• DCNR, DCED, USACE, PUC, PEMA, PHMSA

Natural & Cultural Resources	• Infrastructure Investment and Jobs Act	

Integration Accomplishments

- Shared data and information for dam failure profile for 2010, 2013, 2018, and 2023 plan updates.
- Total distribution of Act 13 Impact Fees for year 2017 to cover local impacts of drilling such as water and wastewater management, road infrastructure maintenance and improvements, emergency preparedness, environmental programs, and planning initiatives: $209,557,300.00.
- Steps taken for the approved “Building Capacity to Facilitate Climate Adaptation Planning and Community Resiliency” strategy in the 2016 Coastal Zone Enhancement Assessment document include DVRPC facilitating community outreach, developing informational resources for coastal communities in DECZ, updating regulatory programs to focus on climate resiliency, and additions to the Coastal Zone Advisory Committee (CZAC).
- Begun the 2nd Climate Leadership Academy in the country in 2021, educating around 150 participants on the impacts of climate change on communities and policy-driven solutions to mitigate them.
- The Climate Change Advisory Committee’s (CCAC) 2021 Climate Action Plan provides strategies to cut the state’s greenhouse gas emissions by 26 percent by 2025 and 80 percent by 2050 from 2005 levels.
- The Local Climate Action Program has trained 53 cities, townships, boroughs, counties, and regional organizations for their efforts to reduce GHG emissions and address climate change.
- DEP’s Open Data Portal provides access to all publicly published GIS data, which includes over 300 data layers with info on abandoned mines, coal mining, hazardous waste, radiation, stormwater, and more.
- Applied FEMA’s High Hazard Potential dam (HHPD) definition appropriately to Pennsylvania base analysis and inspections, gathering 8 applications to new HHPD grant program for quick 2019 deadline.
- Additional accomplishments are listed in Table 6.2-4 Evaluation of 2018 mitigation actions.

Pennsylvania Department of Health Integration Worksheet

Ongoing Activities

The Pennsylvania Department of Health (DOH) integrates The Pennsylvania Pandemic Influenza Outbreak Plan establishes response protocol for a pandemic event. Mitigation activities for influenza focus on minimizing exposure and treating patients. The Pennsylvania Department of Agriculture leads the nation in its ability to monitor poultry flocks for avian influenza and contain outbreaks. The Pennsylvania DOH has extensive experience responding to many types of disease outbreaks and uses an award-winning disease surveillance system to immediately spot outbreaks and monitor their spread. Local officials, hospitals, and community organizations continue to plan for the impact of a pandemic on local services by integrating hazard mitigation plans.

The Pandemic and All-Hazard Preparedness Act of 2006 had broad implications for the Department of Health and Human Service's' preparedness and response activities, including providing new authorities for programs such as development and acquisition of medical countermeasures and the establishment of a quadrennial National Health Security Strategy. The act was reauthorized in March 2013.

At least fourteen Pennsylvanians die every day from a drug overdose, with over 5,000 overdose deaths in Pennsylvania in 2021 alone. The numbers reported in the previous plan update were ten and 3,500 respectively. In January 2018, Governor Tom Wolf declared Pennsylvania's opioid addiction epidemic a disaster emergency. Since this declaration, there have been several programs and initiatives started the help combat the issue. One such program is the Pennsylvania Substance Use Navigation (PA-SUN) Program, which increases access to medication-assisted treatment by supplying emergency departments with the proper medication and training.

In March of 2018, the Opioid Data Dashboard was launched to give easy access to data and resources. The Department also collects information on all filled prescriptions for controlled substances, and in collaboration with the Department of Drug and Alcohol Problems and the University of Pittsburgh Program Evaluation and Research Unit, has developed educational curriculum for drug prescribers on best practices and evidence-based prescribing. In addition, naloxone, a medication to reverse opioid overdoses, has been granted a standing order by the Secretary of Health and Physician General so that access is easier for both the public and first responders. Lastly, the Warm Hand-off Care Map was created to help care providers direct patients in emergency departments to substance use disorder treatment programs.

CURE Grants supported more than $35.5 million in research by Pennsylvania institutes in fiscal year 2020-2021. The funding supports a variety of research for health conditions covered and not covered in the SHMP. CURE supported research on viruses and opioids could help mitigate pandemic and assist in opioid addiction response long term.

Sector	Funding Available	Integrated Partners
Emergency Management	• CURE Grants	• PEMA, Universities and research institutions
Economic Development		
Land Use & Development		
Housing		
Health & Social Services		
Infrastructure		
Natural & Cultural Resources		

Integration Accomplishments

- Information from the Pennsylvania Pandemic Influenza Outbreak Plan was used in the 2023 SHMP.
- Pandemic Preparedness Flyers were released by the Governor's Office of Administration and the PADOH to provide accurate information to prepare in case of a pandemic situation and was encouraged to be included in the emergency preparedness planning for the agencies and facilities receiving the flyers.

- In response to Governor Tom Wolf declaring Heroin and Opioid Epidemic a Statewide Disaster Emergency, a new Opioid Coordination Group housed within PEMA will meet weekly during the disaster declaration to monitor implementation and progress of the initiatives in the declaration.

Pennsylvania Department of Transportation Integration Worksheet

Ongoing Activities
The Pennsylvania Department of Transportation (PennDOT) coordinates transportation projects and maintains state-owned infrastructure across the Commonwealth. Their role in hazard mitigation is to promote safety and implement plans, procedures, and projects that mitigate transportation accidents. PennDOT has several active plans in order to fulfill this role for the myriad of transportation sectors The PA Active Transportation Plan (2019) focused on improving conditions for walking and bicycling by routinely making active transportation a focus area in all elements of operation. The plan focuses on safety, equity, creating connections within existing networks, leveraging partnerships, improving public health, and increasing economic mobility. The Strategic Highway Safety Plan (2022) is a plan that focuses on reducing fatalities and serious injuries on state roadways. Data collection and analysis are a cornerstone of the plan along with integration with the Highway Safety Improvement Program by prioritizing funding for projects that align with the strategies recommended in the plan. It also integrates into the PA Transportation Security Plan, which outlines goals to mitigate both transportation accidents and terrorist threats or attacks through improving security to high-risk facilities and creating coordinated plans and procedures for emergency response and recovery. The 2045 Long-Range Transportation Plan (2021) discusses existing trends for transportation modes, demographics, bridges, operations, and environmental features. The goals discussed in the plan fall into 6 categories: Safety, Mobility, Equity, Resilience, Performance, and Resources. The plan allows PennDOT to deal with short-term trends and issues by creating a vision and direction to base decision-making off of. The Freight Movement Plan was developed in parallel, with the important concepts being logistics & supply chains, intermodal connectivity, land use, system conditions, climate change, equity, economics, IT, EVs & AVs, and front door distribution. The Electric Vehicle Mobility Plan (2022) outlines a 5-year timeline for adding 2,000 new EV charging ports at 800 sites across PA. The primary goals of the plan are growing the EV market providing safe charging, increasing range of EVs, fighting climate change, and locating stations equitably. As the EV market grows, it will be important that the infrastructure created to support it grows along with it and has built-in resilience. The PA Mobility Plan outlines a vision for direction and investment into transportation across the Commonwealth from 2006 to 2030 with goals for safety that aim to mitigate transportation accidents. The Winter Services Strategic Plan is PennDOT's plan to guide response and customer service for winter storms. While PennDOT cannot prevent winter storms, they are able to mitigate the impact of the storm and transportation accidents. Key mitigation techniques included in the plan are web-conferencing with other state agencies to review real-time weather forecasts, current conditions, and the status of statewide forces, pro-active speed-reduction restrictions, and snow routes across the state using transportation-focused management software. PennDOT has a multi-phase Extreme Weather Vulnerability Study that is underway. Phase 1 reached out to transportation stakeholder, compiled the historic impacts of extreme weather, identified how the future floodplain could impact transportation assets, and developed strategies to improve resiliency. PennDOT is also actively engaged in the Federal Highway Administration's Alternative Fuels Corridor Program, which aims to assist transportation agencies with planning for alternative vehicle fueling and charging facilities. Currently, I-78 & I-81 are part of 2 FHA projects, with I-80 also involved in a multi-state project led by Illinois DOT.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing	• PennDOT funding streams focus on transportation planning and infrastructure, though appropriate mitigation can be woven into a project as was	• PSP, PEMA, local transit agencies, Metropolitan Planning Organizations

Health & Social Services Infrastructure Natural & Cultural Resources	done for the *Paxton Creek Master Plan* in Harrisburg. • 2021 Bipartisan Infrastructure Law	

Integration Accomplishments

- PennDOT Connects provides 6 on-site training modules that can be presented by a technical expert. They are Improving Safety, Maintaining or Improving Community Character, Funding the Maintenance of the Existing Transportation System, Improving Mobility and Efficiency, Encouraging Multimodal Transportation, and Accommodating Growth within the Transportation and Natural Environments. They also offer training on Major Development Stages in Transportation Planning, Local Safety Road Plans, and Planning for Bicycle, Trails, and Greenways.
- All of the more than 2,200 PennDOT-owned and rented plow trucks are equipped with Automated Vehicle Location (AVL) technology, which uses in-truck technology to log and share data in real-time for that truck.
- Two studies that are important examples of hazard mitigation plan integration are the *Extreme Weather Vulnerability Study* from April 2017 and the *Paxton Creek Master Plan* from February 2018.
- Mobility Plan defined an illustrative Core PA Transportation System, a concept proposed as a planning tool to improve the performance of Pennsylvania's multimodal transportation system. The PA Mobility Plan also included the development of new analytical tools such as a statewide travel demand model and freight model. PennDOT designed these tools to evaluate infrastructure projects and policy options that span regions and estimate the impacts on the transportation system by simulating traffic patterns.
- The 2045 Long Range Plan identified continued coordination with county planning agencies, regional & local planning, and strengthening the transportation system's resiliency to climate change as important concepts for both short- and long-term operations. Part of this effort includes developing a Transportation Planning Data Repository that will allow organized data sharing through easy-to-use products.
- A Stormwater Control Measure Maintenance Manual was published in November 2021.
- The 2022 Strategic Highway Safety Plan identified integration with existing plans as one of its eight essential elements.
- An annual Pennsylvania Traffic Safety Conference began in April 2022.
- PennDOT continues to advance Active Transportation Plan priorities to improve opportunities for walking and biking, including rewriting design guidance for on-road bicycle facilities and continuing outreach to all partners for educational awareness and to provide support for local planning needs.

Pennsylvania Emergency Management Agency Integration Worksheet

Ongoing Activities

PEMA is the state agency that supports and implements hazard mitigation planning and related HMA funding opportunities in Pennsylvania. Since the last update, PEMA took over from DCED with coordinating the NFIP. PEMA also aids with floodplain management through CAVs, CACs, mapping and technical assistance, and trainings. Their website provides resources that allow businesses and homeowners to determine their own flood risk and inform them of their insurance options.

PEMA conducts outreach by attending local tours, inviting legislators to local tours, and by presenting at conferences. Examples of outreach in the last 5 years have included DEP/PEMA Flood Protection Conference, PAFPM Conference, Villanova University Tour, DRBC/Silver Jackets Tour in conjunction with Nurture Nature Center, 'A Workshop for Resiliency' in the Borough of Muncy, County Commissioners Association of Pennsylvania (CCAP) Conference, American Planning Association Pennsylvania Chapter (APA-PA) Conference, and Pennsylvania State Association of Township Supervisors (PSATS) Conference. PEMA also keeps an Integrated Preparedness Calendar which lists trainings, workshops, and meetings across the Commonwealth. In addition to the calendar, the Integrated Preparedness Plan (formerly known as the Multiyear Training and Exercise Plan) helps the agency continually develop preparedness exercises, trainings, activities, and reviews for itself and partners.

PEMA works to bring stakeholders that work on mitigation together to leverage ideas and implementation strategies. PEMA supports the regular convening of integration partners in Annual Plan Review Meetings, Annual Risk Reduction Consultations, PA Silver Jackets, and RRT Meetings. Initiatives that have come out of these meetings include the Ice Jam training, Floodproofing Workshops, and PEMA has updated the PA SOG to include information on historic preservation analysis.

PEMA also operates the Private Sector Integration Program, which fosters relationships that drive information sharing in the periods before, during, and after disasters by holding private sector driven planning discussions and running the Pennsylvania Business Emergency Operations Center (PABEOC). These planning discussions are held under a group titled PA Endeavor, where the private sector leads, and government partners engage. The PABEOC gives out information like travel restrictions, hours-of-service waivers, weather conditions, power outages, and a chat function.

The following is a non-comprehensive list of the hazard mitigation programs that PEMA is involved with:

- Building Resilient Infrastructure and Communities (BRIC)
- Emergency Management Performance Grant (EMPG)
- Cybersecurity Grant Program
- Flood Mitigation Assistance (FMA)
- Hazard Mitigation Grant Program (HMGP)
- Hazardous Materials Response Fund
- Hazardous Materials Emergency Preparedness (HMEP) Planning and Training Grants
- Homeland Security Grant Program (HSGP)
- Individual Assistance Program
- Nonprofit Security Grant Program (NSGP)
- Operation Stonegarden Grant Program (OPSG)
- Public Assistance Program
- Radiological Emergency Response Fund (RERF)

The Commonwealth prioritized hazard mitigation by matching more that $20 million dollars in federal HMGP funding since 2011, typically covering between 22% and 25% of the non-federal match to assist local communities and property owners.

The ReadyPA website and newsletter, operated by PEMA, is a great resource for Pennsylvanians to find timely and helpful on information and resources about emergency and disaster preparedness, recovery, and more. It

houses information on topics such as wildfire safety, winter weather warnings, national preparedness months, holiday advisories, power outages, developing personal emergency plans, and much more.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• FEMA HMA and DHS Grant Program funding flow to and through PEMA for the Commonwealth • PA has matched through PEMA more that $20 million dollars in federal HMGP funding since 2011	• SPT members (see Table 3.2-2), HMA grant recipients throughout PA, and other partners

- DCED, PEMA and FEMA Region 3 successfully worked together to transition NFIP responsibilities.
- The SHMO regularly shares information with state and local partners, for example HMA guidance was shared with American Planning Association - PA Chapter.
- An annual Integrated Preparedness Plan Workshop is held where stakeholders meet and collaborate to enhance the Commonwealth's preparedness.
- DCED and PEMA secured funding and collaborated on the contracting of the Pre-Disaster Recovery Plan due to be completed in 2019.
- PEMA collaborated with FEMA and DCED to create a Floodplain Post Damage Checklist to help communities after flooding particularly with NFIP compliance.
- Additional accomplishments are listed in Table 6.2-4 Evaluation of 2013 mitigation actions.

Pennsylvania Governor's Office of Homeland Security Integration Worksheet

Ongoing Activities

The Pennsylvania Governor's Office of Homeland Security (GOHS) supports, schools, the private sector, and other state and local agencies with training, security assessments, exercises, and other technical assistance that supports mitigation of civil disturbances, cyber-terrorism, terrorism, and other criminal activity.

GOHS leads the Critical Infrastructure Protection Program for all critical infrastructure and key resources that are deemed critical to the Commonwealth. The purpose of this program is to ensure the overall preparedness of critical infrastructure and key resources by helping set security goals, identify assets, assess vulnerabilities, prioritize investments, and implement outreach programs. The critical infrastructure information from GOHS is protected, therefore publicly available DHS HIFLD and FEMA CDMS data was used to analyze critical facilities. The publicly available data was compared to the tallies of GOHS categories to confirm the data sets were complementary.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• Though the GOHS does not provide grants, they are a partner in supporting and applying for US DHS Grant Program funding and UASI Grants	• PA Attorney General, PEMA, PSP, DHS, FBI, FEMA, local school districts and emergency management agencies

Integration Accomplishments

- GOHS hosts exercises and trainings multiple times each month in locations across the Commonwealth.
- The governor's School Safety Task Force visited schools and completed a report on school safety in 2018 in an effort to prevent and mitigate school violence and active shooter incidents. Active shooter incidents are profiled under terrorism in the SHMP.
- GOHS was a partner in producing the Pennsylvania Protecting Yourself Online guidance to mitigate cybercrime and potentially the impact of cyber-terrorism.
- There are trainings offered by the Homeland Security Exercise Evaluation Program, trainings for the Office of Administration/IT staff, and trainings with PJM, a regional energy transmission organization that coordinates the movement of electricity in 13 states and the District of Columbia.

Pennsylvania Historical and Museum Commission (PHMC) Integration Worksheet

Ongoing Activities

Pennsylvania's 2018-2023 Statewide Historic Preservation Plan, #PreservationHappensHere!, was released in May 2018 and integrated hazard mitigation throughout. The plan identifies that "Pennsylvania's historic communities are increasingly vulnerable to flooding, which threatens resources and community character." Two subsequent implementation actions established in the plan incorporated mitigation: "Establish a collaboration between PA SHPO, PEMA, and FEMA, to prioritize cross-training and education on hazard mitigation and historic preservation to historic preservation and emergency management professionals, agencies, and organizations" and "Explore dedicating a percentage of annual grants or other funding to fund hazard mitigation projects that will enable communities to sensitively retrofit historic resources or develop hazard mitigation plans for their historic resources."

PHMC secured funding after Hurricane Sandy for a Disaster Planning for Historic Properties Initiative. This initiative led to the development of a Historic Resource Survey for Bedford, Cameron, Monroe and Philadelphia Counties, Pennsylvania in 2016-2017 to identify a methodology to analyze at-risk Pennsylvania river towns from a historic resource perspective. The first phase identified hundreds of historic resources in these four counties. The second phase saw the completion of the Pennsylvania River Town Historic District Survey and Assessment in 2017 to evaluate and prioritize historic districts in the SFHA when preparing hazard mitigation plan updates.

PHMC staff participate in the PA Cultural Resilience Network and are available to provide technical assistance to the regional Alliances for Response, local EMA personnel, and PEMA staff. The PHMC website also provides links to the National Trust for Historic Preservation website, which hosts various resources for historic preservation in pre- and post-disaster disaster contexts.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development **Land Use & Development** Housing Health & Social Services Infrastructure Natural & Cultural Resources	• Keystone Historic Preservation Grant Program, projects must meet the goals and objectives of Pennsylvania Historic Preservation Plan which includes mitigation as noted above	• DCNR, DCED, PEMA, Preservation Pennsylvania, and local historic preservation boards

Integration Accomplishments

- The Disaster Planning for Historic Properties Initiative integrates historic preservation and hazard mitigation.
- #PreservationHappensHere! & the 2020 PEMA All-Hazard Mitigation Planning Standard Operating Guide integrates hazard mitigation throughout.
- The 2020 update to the PA SOG integrates historic preservation analysis throughout.
- This SHMP integrated PHMC's data for historic property into the vulnerability analysis for the flood, hurricane, wildfire, and building collapse profiles.
- Surveys were completed in 2020 to document historic properties in flood-prone communities in Dauphin, Cumberland, Perry, and Juniata County in conjunction with the Commonwealth Heritage Group, ASC Group, and Johnson, Mirmiram & Thompson.
- The Manayunk Main Street Historic District Flood Guide was published in 2020 and utilized data from an earlier city-wide survey project and an USACE Historic Resource Flood Hazard Vulnerability Study to create a document that provides an overview of flood risk, specific agencies involved in flood response, basic improvements to mitigate flooding, and more.

Natural Hazard Mitigation Association Integration Worksheet

Ongoing Activities

The Natural Hazard Mitigation Association (NHMA) promotes natural hazard risk reduction & climate adaptation through planning, adaptation, and mitigation. NHMA is working to create more equitable, safe and sustainable hazard mitigation programs so that those foreseeable natural events do not become disasters. Their program "Resilient Neighbors Networks" links together grassroots communities working to become safer, disaster-resilient, and sustainable. Through Resilient Neighbors Networks, NHMA is working with ten pilot communities around the USA to create a peer-to-peer sharing network, so grassroots communities can work together directly to strengthen and expand local hazard-mitigation programs.

The SHMO, Thomas Hughes, is the current President of NHMA. Through his board role he shares NHMA resources with federal, state, and local partners in the Commonwealth and alternatively shares state and Region 3 resources with NHMA. Some examples of cross-fertilization of information include the Region 3 Mitigation Coffee Breaks being shared with NHMA's national membership and NHMA newsletters and announcements like the NHMA Planning Committee webinar featuring French Wetmore on CRS and Mitigation Planning have been shared with state and local partners.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• Not Applicable	• Institutional and corporate membership is complemented by individual members throughout the local, state and federal agencies that work on mitigation. Membership and partnership are open to all groups pursuing mitigation.

Integration Accomplishments

- NHMA and PEMA co-hosted the *Disaster Risk Reduction Ambassador Curriculum Workshop* in April of 2017.
- The SHMO is the President of NHMA and able to collaborate on ideas about hazard mitigation from national peers.

Nurture Nature Center Integration Worksheet

Ongoing Activities

Nurture Nature Center (NNC) has been working actively with government agencies and other non-profit organizations to increase understanding of weather and hazard risks and has offered professional development and risk communication training to officials and community leaders throughout the state. NNC maintains an ongoing website and outreach effort, *Focus on Floods*, which provides an overview of flood education and safety information for Pennsylvania and the other states in the Delaware River Basin. This website contains a variety of multi-media materials designed for flood outreach and education that have been distributed widely digitally and in print form.

Many of the educational materials developed for NNC programs are now used by governmental bodies and other organizations throughout the country. NNC has completed several research studies related to the use of flood forecast and warning tools, in collaboration with the Middle Atlantic River Forecast Center (MARFC).

NNC provides a variety of resources and trainings to community leaders, residents, students, and more. They run science and art programs that create fun and interactive ways to understand environmental challenges. In addition to running these programs, NNC also collaborates on research to help them evolve. There are multiple ongoing projects, funded by the National Science Foundation, that will do just this.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• Not Applicable	• Citizens Corps of Schuylkill County, City of Easton, FEMA Region 3, MARFC, NOAA, NWS

Integration Accomplishments

- The NNC welcomed 5 new grant-funded projects in 2021 that focus on social science research, environmental education through art and science, and community outreach.
- In 2015, NNC completed and published the findings from a research study, *Flood Risk and Uncertainty: Assessing and Improving National Weather Service Flood Forecast Products*. Products in this study included the hurricane cone, Significant Flood Outlook, flood watches and warnings, and the regional meteorological mode-based ensemble river forecasts (MMEFS) ensemble forecast system. Recommendations from *Flood Risk and Uncertainty* have been operationalized by NWS offices since publication.
- The City of Easton Vulnerability Assessment was a 2018 Lehigh Valley Award Honoree under the category of Plan, Planning Policy or Ordinance.
- NNC assisted the City of Easton with its commitments to the Global Covenant of Mayors for Climate & Energy, an international coalition of cities and local governments supporting voluntary action to combat climate change. NNC was awarded a contract to help the City update, develop and adopt a Climate Plan that included a greenhouse gas emissions reduction target, vulnerability assessment, and greenhouse gas emissions inventory. Dr. Kathryn Semmens updated emissions data and completed the inventory. Following recommendations from NNC, the City of Easton Council adopted an emissions reduction target of 80% by 2050 with an interim goal of 30% by 2030.

Pennsylvania Association of Floodplain Managers Integration Worksheet

Ongoing Activities

The Pennsylvania Association of Floodplain Managers (PAFPM), PEMA, and DCED have an integrated approach to strengthening floodplain management and reducing flood risk in Pennsylvania. PEMA and DCED have supported the organization by promoting membership, training, and strategic planning. PEMA, DCED and PAFPM share a common goal to increase the number of Certified Floodplain Managers (CFMs) in Pennsylvania as identified in the 2018 Pennsylvania Risk Reduction Consultation, thereby strengthening and increasing local floodplain management capabilities.

PEMA, DCED and PAFPM have and will continue to collaborate on training to improve the capabilities of floodplain managers in Pennsylvania and to increase the number of CFMs. Trainings integrate instruction from PAFPM members and DCED, PEMA and FEMA instructors. PEMA and PAFPM coordinate additional NFIP Training for local officials and have begun to offer additional opportunities to take ASFPM's CFM exam. PEMA utilizes the PAFPM membership and audience by providing training and other beneficial opportunity information to PAFPM for dissemination through email and/or website posting, in order to reach the largest group of flood risk related stakeholders possible. PAFPM is also a member of the Silver Jackets Team and contributes to educational projects that integrate input and expertise from federal, state, and non-profit partners. PAFPM board member Kerry Wilson received a PEMA coin to recognize PAFPM's consistent involvement in floodplain management and hazard mitigation related meetings and projects in the Commonwealth.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• Not Applicable	• ASFPM, DCED, and PEMA are core partners • Additional partners include DCNR, FEMA Region 3, Nurture Nature Center, Penn State Law, PHMC, Private Businesses, SEDA-COG, and Silver Jackets

Integration Accomplishments

- PAFPM became official ASFPM State Chapter in June 2018.
- PAFPM has held annual conferences since 2009, alternating locations each year besides Harrisburg's repeat in 2018 & 2019. There was no conference held in 2020 and the 2021 conference was virtual. The 2022 conference returned to Harrisburg and hosted educational presentations by a diverse mix of government, business, and non-profit organizations: AECOM, Arcadis, Drexel University, FEMA Region 3, Floodproofing.com, JMT, LandStudies, Inc., PEMA, Penn State, Philadelphia Water Department, Silver Jackets, Stantec, Taylor Wiseman & Taylor, and Wyoming Valley Sanitary Authority.
- PAFRPM regularly hosts webinars and discussions on topics related to Floodplain Management and disseminates educational resources from ASFPM and FEMA for its members. It also provides resources to prepare for the CFM exam.

River Basin Commissions Integration Worksheet – Focusing on DRBC and SRBC

Ongoing Activities

The DEP is the lead state agency for coordination with the river basin commissions in Pennsylvania: Delaware River Basin Commission (DRBC), Susquehanna River Basin Commission (SRBC), Partnership for the Delaware Estuary, Great Lakes Commission, Interstate Commission on the Potomac River Basin, and Ohio River Valley Water Sanitation Commission. Integration of hazard mitigation activities with river basin commissions has focused on DRBC and SRBC thus far.

DRBC has a standing Flood Advisory Committee (FAC) the includes members from NFIP and SHMO offices from DE, NJ, NY, and PA, FEMA Region II and III, USDA - NRCS, USGS, NWS, USACE, National Park Service, and the Delaware River Joint Toll Bridge Commission. The committee reviews and coordinates on river conditions, shares information on projects impacting the basin, and completes projects like recommendations for higher standards in floodplain management regulations.

SRBC has a permitting arm that reviews applications for withdrawals and water use, a Planning & Operations Program that focuses on flood risk management and drought planning, and a Monitoring & Protection Program that collects data on water quality in relation to things like stormwater and abandoned mine drainage. There are various portals on the Commission's website that detail the various projects and programs that are active across the Commonwealth. The Commission and several partners are currently in the design phase for an active abandoned mine drainage treatment plant on Morris Run to help restore over 20 miles of the Tioga River. The SRBC is also a member of the State Planning Team, ensuring non-profit integration in the SHMP.

DRBC, SRBC, DEP and others collaborate on the inter-related hazards of environmental hazards-conventional and unconventional gas drilling, hazardous materials release, and flooding. Both DRBC and SRBC have authority to regulate the oil and gas industry in Pennsylvania to protect the environment and citizens. DRBC's 2023-25 Water Resources Program identified pipelines and climate change as emergent issues to plan for, with institutional coordination and cooperation being listed as a key component of the management program. SRBC has a Comprehensive Plan (2021-2041) that identifies flooding, adequate water supply, impaired streams, and stormwater runoff as some of the most important challenges the Commission will face in the next two decades.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• Not Applicable	• American Rivers, Bucknell University, DRBC, Delaware River Joint Toll Bridge Commission, DEP, FEMA, PEMA, PA Fish and Boat Commission, National Park Service, NWS, SRBC, USACE USDA, and USGS.

Integration Accomplishments

- SRBC, PEMA, DEP, Pennsylvania Fish and Boat Commission, NWS, American Rivers, and Bucknell University were among the collaborating participants in the 2018 Susquehanna River Symposium. The conference tackled topics including monitoring, mapping, flooding and climate change which promotes the interdisciplinary education of students and professional on topics that mitigate hazards.
- DRBC Flood Mitigation Task Force delivered a final report to four basin state governors with 45 mitigation recommendations to address six management areas: flood warning, reservoir operations, floodplain regulation, floodplain mapping, structural and non-structural mitigation, and stormwater management.

- In December 2022, DRBC voted to prohibit the discharge of wastewater from high volume hydraulic fracturing to water or land in the basin.
- SRBC has hosted various workshops and trainings on water supply such as “Water Resource Management Considerations for Public Water Supply Manager” and a series on Water Loss Management in partnership with DEP.
- SRBC has begun using an eDNA monitoring tool to track aquatic invasive species throughout the basin.

Susquehanna River Heartland Coalition for Environmental Studies Integration Worksheet

Ongoing Activities

The Susquehanna River Heartland Coalition for Environmental Studies (SRHCES) is a unique collaboration of colleges and universities, research partners, and community partners working together on ecological research projects in the Susquehanna River watershed including its West Branch. This collaborative is working to collect, share, and interpret data on ecological conditions and processes in the watershed as well as disasters such as flooding. Since 2007, over 480 interns have helped to provide more information about the Susquehanna River with many going on to work for PA DEP, Pennsylvania Fish and Boat Commission, and various Conservation Districts.

Sector	Funding Available	Integrated Partners
Emergency Management Economic Development Land Use & Development Housing Health & Social Services Infrastructure Natural & Cultural Resources	• SRHCES	• Pennsylvania Fish and Boat Commission, Pennsylvania SeaGrant, various local colleges and universities, WVIA Public Media, Northcentral Pennsylvania Conservancy, Greater Susquehanna Valley Chamber of Commerce

Integration Accomplishments

- SRHCES organized the Fishing Creek Hydro Watch Project with monitored stream discharge throughout the Fishing Creek watershed in an effort to better understand and predict flooding impacts to the Town of Bloomsburg and the surrounding area.
- Faculty from Bucknell University have conducted research related to the Susquehanna Watershed and presented their findings in peer-reviewed publications, professional conferences, and at SRHCES meetings related to flooding, stormwater management, flood policy, river town resilience, economic impact of shale gas extraction, the price of water in Pennsylvania, stream restoration, invasive species, etc.
- Lycoming College has provided over 110 undergraduate interns with field experience such as storm water assessments, which have ultimately played a critical role in collecting information on the Susquehanna River Watershed.
- Researchers from Susquehanna University, Bucknell University, and Lycoming College are working to evaluate the beneficial effects of stream restoration projects on sediment-impaired streams in north central Pennsylvania, led by PADEP.

6 Mitigation Strategy

6. Mitigation Strategy

6.1. Update Process Summary

The mitigation strategy for the 2023 State HMP serves as a blueprint for reducing or avoiding Pennsylvania's long-term vulnerabilities to hazards identified in the Risk Assessment (see Chapter 4). The mitigation strategy meets requirements of the Stafford Act per FEMA's State Mitigation Planning Policy Guide (FP 302-094-2; Released April 19, 2022, Effective April 19, 2023; OMB Collection #1660-0062), and identifies goals, objectives, and prioritized actions designed to reduce risk.

In addition, the mitigation strategy reflects PEMA's enhanced efforts to engage state agency partners that have not participated in past State HMP updates. These efforts ensure the mitigation strategy reflects an all-agency approach to hazard mitigation.

This chapter includes the following sections:

- 6.1 Update Process Summary
  An overview of the process used to develop the mitigation strategy and review of the goals, objectives, and actions from the 2018 State HMP.

- 6.2 Mitigation Goals and Objectives
  Identification of goals and objectives for the 2023 State HMP.

- 6.3 Identification and Analysis of Mitigation Techniques
  Review of the mitigation techniques that will be utilized to reduce hazard risk via actions in the 2023 State HMP.

- 6.4 Mitigation Action Plan
  Identification of actions for the 2023 State HMP including action prioritization and an analysis of Pennsylvania Risk Reduction Consultation priorities.

- 6.5 Local Mitigation Strategy
  Review of local hazard mitigation planning efforts through funding and technical assistance provided to Pennsylvania's 67 counties.

- 6.6 Pennsylvania Repetitive Loss and Severe Repetitive Loss Mitigation Strategy
  Update on the statewide strategy to reduce the number of Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties across Pennsylvania.

- 6.7 High-Hazard Potential Dams (HHPDs)
  Update on the statewide strategy to reduce the risk associated with HHPDs across Pennsylvania.

- 6.8 Mitigation Success

Summary of mitigation successes completed throughout the hazard mitigation planning period, including PEMA's leadership through concurrent activations during the COVID-19 pandemic.

The mitigation strategy includes a series of goals, objectives, and actions developed to mitigate statewide risks and reduce loss of life and property. Goals are broad policy statements representing desired long-term results. Objectives describe strategies or implementation steps to attain the identified goals. Actions are more specific than objectives, and have identified responsible parties, timeframes, potential funding sources, and measures of success.

Developing the 2023 mitigation strategy began with evaluation of the 2018 mitigation strategy through a continual process beginning in 2019 with the SPT's annual review of the State HMP. An annual review was conducted in November 2019 and due to the disruption from the COVID-19 pandemic, the annual review conducted in January 2021 covered both 2020 and 2021. The review team included personnel from PEMA, FEMA, EPLOs from state agencies, County Emergency Management Agency personnel, industry, and non-governmental organizations. During each annual review, goals, objectives, and actions were assessed with progress made towards implementing actions identified.

The process for reviewing the 2018 mitigation strategy as part of 2023 State HMP update began in June 2022. At each in person or virtual meeting beginning in June 2022 through January 2023, participants were provided with a link to a '2018 State Hazard Mitigation Plan Comments Form'. The form included a separate worksheet to review 2018 goals and objectives including the opportunity to suggest new objectives. A worksheet to suggest and describe new mitigation actions was also included. The review worksheets documented progress made towards achieving, suggesting changes to, or incorporating new goals, objectives, and actions into the mitigation strategy. See Chapter 3 for a detailed accounting of meetings conducted as part of the Planning Process for the 2023 State HMP update.

Input on 2018 goals, objectives, and actions was also obtained during individual outreach conducted with state agency and organization representatives as part of developing the 2023 mitigation strategy.

- A total of 109 individuals representing 65 agencies or organizations provided input on either the 2018 mitigation strategy and/or the 2023 mitigation strategy.
- Input was obtained through 37 individual meetings conducted via Teams, Zoom, conference call, or in person between September 2022 and January 2023.
- Over 700 emails during that time were either sent to SPT members from PEMA's contractor team or sent to PEMA's contractor team from SPT members to evaluate the existing and develop the new mitigation strategy.

6.1.1 Review of 2018 Goals and Objectives

The 2018 mitigation strategy included the following five (5) goals. The wording for Goals 1 and 4 was modified slightly from the 2013 State HMP, and Goals 2, 3, and 5 were carried over from the 2013 State HMP.

- Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including high risk properties.
- Goal 2: Enhance consistent coordination, collaboration, and communications among stakeholders.
- Goal 3: Provide a framework for active hazard mitigation planning and implementation.
- Goal 4: Build legislative and other organizational support and leverage funding for mitigation efforts.
- Goal 5: Increase awareness, understanding, and preparedness across all sectors.

The goals were supported by twenty-nine (29) objectives. 1 summarizes the review of the 2018 goals and objectives based on input by the SPT as described above. Strikeout and underline text formatting shows modifications to the wording of several objectives as suggested by SPT members and the 'Evaluation' column reflects input provided by SPT members. Objectives receiving no comments from the SPT will continue to the 2023 HMP.

Table 6.1.1-1 2018 Goals and Objectives Review	Evaluation
Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including high-risk properties.	Continue
Objective 1-1: ~~By 2021, reduce~~ <u>Continue reduction of</u> flood-related losses (with an emphasis on reducing NFIP identified repetitive loss and severe repetitive loss properties by 5%) through promotion of the Commonwealth's flood protection program through local, county, state, and federal partners.	Modify objective to replace specific timeframe.
Objective 1-2: ~~Increase by 5% the number of projects implemented~~ <u>Continue implementation of projects prepared for design</u> by the Commonwealth that will mitigate the most vulnerable structures against hazards by 2023.	Modify objective to replace specific percentage increase.
Objective 1-3: Identify and work toward implementation of five feasible and cost-effective projects related to the mitigation of critical buildings, state facilities, and infrastructure.	Continue. Suggest increasing the number of projects above five.
Objective 1-4: Identify projects related to advanced warning within the Commonwealth by 2023.	Continue
Objective 1-5: Minimize risk to communities posed by levee structures by increasing participation with Federal standards developed by the Federal Emergency Management Agency and the United States Army Corps of Engineers, focusing on planning and certification if feasible.	Continue
Objective 1-6: Continue to provide outreach and training opportunities for local building code enforcers throughout the Commonwealth.	Continue

Table 6.1.1-1 2018 Goals and Objectives Review	Evaluation
Objective 1-7: Increase coordination, prioritization, and funding availability to address community needs for dam hazards.	Continue
Objective 1-8: Encourage aggressive enforcement of floodplain and storm water management ordinances and other all-hazards regulations within the Commonwealth to reduce losses in high risk areas.	Continue. PEMA's hiring a State NFIP Coordinator will improve enforcement.
Objective 1-9: Promote increased implementation of urban-wild land interface (wildfire) mitigation projects by local communities by 2023.	Continue
Objective 1-10: Enhance Commonwealth efforts to address mine/quarry related hazards by increasing inter-agency cooperation.	Continue
Objective 1-11: Support the Department of Environmental Protection in addressing hazards associated with shale gas formation extraction and distribution.	Continue
Objective 1-12: Ensure reports and databases are updated annually to reflect Repetitive Loss and Severe Repetitive Loss mitigation.	Continue. FEMA PIVOT will enhance tracking.
Objective 1-13: Promote Natural Systems Protection mitigation in the Commonwealth between 2019 and 2023.	Continue
Objective 1-14: ~~Encourage measures to protect Pennsylvanian's from cyber-terrorism attacks.~~ Promote public and private sector CI/KR physical and cyber security.	Modify objective as suggested by GOHS.
Objective 1-15: Increase the capacity and effectiveness of Commonwealth NFIP management.	Continue
Suggested Objective: Increase the funding available to communities for rehabilitation of existing flood protection projects that will mitigate the aging infrastructure and protect at risk structures against hazards by 2028.	New objective suggested by DEP.
Goal 2: Enhance consistent coordination, collaboration, and communications among stakeholders.	Continue
Objective 2-1: Promote development of COOP and COG plans for critical infrastructure within the Commonwealth, focusing on water treatment, water supply, and critical goods and services suppliers.	Continue
Objective 2-2: Promote integration of mitigation goals, objectives, and actions where appropriate in other federal, state and local planning initiatives by 2023.	Continue
Objective 2-3: Support the collection, update, and dissemination of datasets useful for hazard mitigation planning and implementation.	Continue
Objective 2-4: Identify local Hazard Mitigation Officers and increase participation by local community representatives in the Commonwealth's Mitigation Planning Team by 50% between 2019 and	Continue

Table 6.1.1-1 2018 Goals and Objectives Review	Evaluation
2023.	
Objective 2-5: Continue to support coordination between mitigation, planning, preparedness, recovery, and response personnel throughout the Commonwealth to ensure effectiveness in all-hazard mitigation planning.	Modify. Include recovery in objective.
Objective 2-6: Support and prioritize collaborative efforts toward recovery and resiliency planning across the Commonwealth.	Modify. Prioritize collaboration in objective.
Goal 3: Provide a framework for active hazard mitigation planning and implementation.	Continue
Objective 3-1: Identify opportunities for regional organizations, businesses, and academia to be engaged in hazard mitigation planning.	Continue
Objective 3-2: Enable the Pennsylvania Emergency Management Agency to encourage each participating jurisdiction to secure funding and initiate one mitigation action by 2023.	Continue
Goal 4: Build legislative and other organizational support and leverage funding for mitigation efforts.	Continue
Objective 4-1: Provide opportunities for Pennsylvania Emergency Management Agency and County Emergency Management Agencies to educate State, county and local government officials, and legislators about hazard risk and mitigation by 2023.	Continue
Objective 4-2: Expand working relationships with at least two volunteer and professional organizations to improve mitigation efforts within the Commonwealth.	Continue
Objective 4-3: Identify statutory, regulatory, or other barriers to completing mitigation efforts within the Commonwealth, and leverage support against these barriers to implement mitigation actions by 2023.	Continue
Objective 4-4: Encourage the use of state funding for hazard mitigation for projects and plans.	Continue
Goal 5: Increase awareness, understanding, and preparedness across all sectors.	Continue
Objective 5-1: Support all-hazards mitigation and preparedness programs to educate private and public stakeholders, academia, government employees and elected officials on the hazards pertinent to the Commonwealth.	Continue
Objective 5-2: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications between 2019 and 2023.	Continue

Additional SPT member comments pertaining to the goals and objectives including how each is addressed in the mitigation strategy are summarized below.

- A comment for Goal 2 noted that if the PDRP is to be integrated into the State HMP, consideration should be given to the PDRP framework and how the RSFs identified can help to support coordination, communication, and communications for mitigation efforts/initiatives. A similar comment for Goal 3 noted that the framework mentioned in the

goal, can be taken, and enhanced from the PDRP. It was further stated that using the RSFs from the PDRP can help with the identification and coordination of mitigation planning, strategies, actions, and particularly implementation. Similar comments were provided for Goals 4 and 5.
    - The mitigation strategy addresses this comment through the multitude of objectives and actions that facilitate data sharing and planning collaboration between various agencies, organizations, and communities.
- Reducing impacts from disasters/incidents, making for a speedier recovery was identified as a consideration for all goals/objectives.
    - The mitigation strategy addresses this comment through the multitude of objectives and actions focused on developing and implementing mitigation projects and increasing the state's capabilities to prepare for and response to all hazards.
- A consistent comment identified for Goals 3, 4, and 5 included developing a clearing house of success stories and ongoing projects which would benefit potential applicants to have a background of successful work. This could include unique projects, project testimonials, and additional information that could benefit future applicants.
    - Documenting mitigation successes is woven throughout the mitigation strategy. The following actions address identifying and cataloging mitigation success: Action 1-2b, Action1-4b, Action 1-12a, Action 3-2e, Action 4-1c, Action 4-3a, Action 5-2c.
- An SPT member suggested including an objective for each of the five (5) goals pertaining to code enforcement. Codes should be enforced to ban building in risk areas in an effort to stop future development in flood plains and reduce the potential for recurrent damage.
    - Objective 1-6 in the mitigation strategy addresses outreach and training to improve building code enforcement. Objective 1-8 addresses aggressive enforcement of floodplain and stormwater management ordinances. A new action was added to promote the use of Model Floodplain Ordinances which prohibit and redevelopment in floodplains (Action 1-8f.)
- Overlaying food production zones with major processors and distribution centers to ensure routes are in place for supply chain reinforcement under adverse conditions was identified as a consideration in developing new actions.
    - Objective 1-1 in the mitigation strategy addresses continuing activities which reduce flood-related losses. Action 1-1b is an ongoing action that brings together PEMA, PDA (Agriculture), DCED, USDA Farm Service Agency, Penn State Extension, and county conservation districts to identify policies and potential legislation to prioritize crop and livestock infrastructure during hazard incidents.

The SPT input summarized in this section was used along with review of the risk and capability assessments to develop the goals and objectives for the 2023 mitigation strategy as presented in Section 6.2. Appendix C includes worksheets received from SPT members documenting comments.

6.1.2 Review of 2018 Actions

A total of 129 actions were developed to support the 2018 State HMP goals and objectives. Actions were reviewed with many SPT members identified as 'Lead/Support Agency' in the mitigation action plan. SPT members provided the status of each action assigned to their organization (complete, ongoing, modify, defer into new plan, remove from plan), and evaluation

comments including suggested modifications to the action description, lead/support agency, funding source, target completion date, and measure of success. Not all entities identified as lead and support agency responded. Review of 2018 mitigation actions was conducted through meetings and emails as discussed in Section 6.1.

Review comments from the 2018 mitigation strategy are documented in 6. The table duplicates Table 6.2-6 from the 2018 State HMP and replaces the ‘Priority’ column with an ‘Evaluation’ column., summarizing input received. Modifications to existing actions are noted using strikeout and underline text formatting. The Table of Contents section includes the List of Acronyms which will help provide definitions for those referenced in the table. Target Completion Dates were updated as part of the 2023 mitigation strategy (see Table 6.4-2).

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including high-risk properties.						
Objective 1-1: By 2021, reduce flood-related losses (with an emphasis on reducing NFIP identified repetitive loss and severe repetitive loss properties by 5%) through promotion of the Commonwealth's flood protection program through local, county, state, and federal partners.						
Action 1-1a. Support the maintenance of existing flood protection projects and construction.	Flood	DEP; DCED; DGS; USACE; USDA; NRCS; Local Communities	DCED/CFA Act 13 Flood Mitigation Program; DEP Growing Greener Watershed Protection Grants; PENNVEST; Capital Budget; Clean Water Fund; USACE; USDA NRCS	Ongoing	Ensure existing flood protection projects are operated and maintained to ensure a state of readiness. Provide ~~annual~~ workshops for Project Sponsors to discuss maintenance tips and latest technology.	Complete and continue. DEP suggested revision to measure of success. PEMA funded three (3) CDPM grants in 2021 for 1) City of Williamsport, 2) Town of Bloomsburg (Stage 1,2, & 3), 3) Mayfield Borough Levee Enhancement. PENNVEST funded two (2) dam projects as part of a drinking water system. 1) City of Lock Haven: Modification to the Warren Ohl Dam, approved 04/20/2020, in construction status. 2) Altoona Water Authority: Bellwood Dam Upgrade/Rehabilitation, approved 01/20/2021, in construction status.
Action 1-1b. Participate in discussions about potential solutions/policy changes regarding farmland flooding due	Flood	PEMA; PDA (Agriculture); DCED; USDA Farm Service Agency; Penn State Extension: County Conservation Districts	Agency Legislative Liaisons staff time; Legislative Officials staff time; FEMA Cooperating	Oct-23	Determine feasibility of developing supporting legislation. Develop policies to prioritize crop	In progress. Add County conservation districts to Support Agency. Specify Farm Service Agency after USDA. PEMA and partners have been working to identify solutions to farmland flooding through workshops. PEMA, FEMA, and partners DRBC and SRBC have hosted three (3) Plan

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
to stream impediments.			Technical Partners (CTP) Program		and livestock support infrastructure during hazard incidents, flagging farm risks as a priority.	Implementation and Grant Development Workshops (PIGD) per year for county and municipal planners. Details of the PIGD events and additional events conducted with DRBC and SRBC are highlighted under mitigation successes included in Table 6.7-1.
Action 1-1c. Target SRL and RL properties for mitigation (including demolition, acquisition, and elevation) during annual HMA project review and prioritization process.	Flood	PEMA; Counties; DCED; PAFPM; Local Floodplain Managers	FEMA Hazard Mitigation Assistance Programs; Staff time	Dec-19	Mitigate five or more SRL properties per year. Use the list of 'shovel ready' projects from recent DRs to facilitate mitigation project application process for future funding opportunities.	Complete and continue. Add PAFPM and Local Floodplain Managers as support agencies. Refer to Section 6.5.
Objective 1-2: Increase by 5% the number of projects implemented by the Commonwealth that will mitigate the most vulnerable structures against hazards by 2023.						
Action 1-2a. Maximize use of FEMA HMA grant and other programs	Flood, All Natural Hazards	PEMA; Local jurisdictions	FEMA Hazard Mitigation Assistance Programs;	Oct-23	Identify at least 100 structures to be acquired/ demolished/	Complete and continue. Refer to Section 6.5.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
to support all- hazard mitigation as well as acquisition/ demolition, elevation, and relocation of flood- prone residences along with flood-proofing of non-residential structures.			CDBG-DR; USACE;		elevated/ relocated with FEMA HMA grant support.	
Action 1-2b. Increase FEMA HMGP Section 404 funding and identify Public Assistance Program Section 406 projects.	All Hazards	PEMA	FEMA Section 404 -b. Hazard Mitigation Grant Program; FEMA Section 406 - Public Assistance Program	Oct-23	Identify at least five projects to be funded by FEMA HMGP Section 404 and Public Assistance Program Section 406.Track and share success stories.	Continuing to work with FEMA to secure funding.
Action 1-2c. Mitigate buildings and structures, including historic structures, at risk from the impacts of natural and	Building and Structure Collapse	PEMA; PA SHPO	FEMA Hazard Mitigation Assistance Programs; CDBG-DR; PHMC Keystone Historic	Oct-23	Mitigate at least five buildings and/or historic structures.	Complete and continue. PA SHPO provided guidance and/or led many mitigation efforts during the planning period. A detailed accounting of the mitigation successes associated with this action are included in Table 6.7-1. PA SHPO recommends the action be

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
human- made hazards.			Preservation Construction Grant Program; NPS Federal Rehabilitation Investment Tax Credit Program.			included in every state and county hazard mitigation plan.
Objective 1-3: Identify and work toward implementation of five feasible and cost-effective projects related to the mitigation of critical buildings, state facilities, and infrastructure.						
Action 1-3a. Define critical infrastructure/key resources (CI/KR) in terms of mitigation.	All Hazards	PEMA; GOHS: FEMA Region 3 PSA Office	Staff time	Oct-18	Update the definition of critical infrastructure /key resources (CI/KR) in the Standard Operating Guide.	Defer. Add FEMA Region 3 PSA Office as a support agency.
Action 1-3b. Establish and sustain a business, industry, and infrastructure subcommittee on the regional task force level. ~~to advance the identification of CI/KR and~~	All Hazards	PEMA; DLI; DCED; OHS; DHS; GOHS; PSP; OA; PUC; DOS; ~~COC's~~	Staff time; Agency Operating Budget; PSP	~~6/1/2021~~ Ongoing	~~Coordinate with local Chambers of Commerce and businesses to bridge information.~~ Coordinate with Regional Task Forces and key	Complete and continue. Modify the action description to reference regional taskforces. Add OA, PUC, and DOS as support agencies. Change target completion date to ongoing. Modify measure of success to include coordination with Regional Task Forces and private industry sectors. PEMA completed the full stand-up of

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
~~interdependencies of CI/KR providing essential services.~~					private industry sectors to bridge information.	the Commonwealth Response Coordination Center of the PA Business Emergency Operations Center (PA BEOC) which encourages multi-sector coordination between private and State agencies. Additional details are included in Table 6.7-1. DOS notes that election infrastructure was added to the list of CI/KR in 2019.
Action 1-3c. Leverage support of the ~~nine~~ eight Regional Task Forces to support critical infrastructure mitigation.	All Hazards	PEMA; Regional Tasks Forces	DHS Hardening/Protection related funding; Homeland Security Grant Program.	Oct-23	Complete one project through each Regional Task Force.	Complete and continue. Change nine (9) regional task forces to eight (8).
Action 1-3d. Identify insurable state-owned flood-prone buildings and appropriate mitigation methods if located in the special flood hazard area (SFHA).	Flood	DGS; PEMA ~~BORM~~ MIRC Office	FEMA Hazard Mitigation Assistance Programs; USACE	Dec-18	Continue to coordinate with DGS to see progress of DGS database for use in ~~SHMP work.~~ State Enhanced HMP Support.	In progress. DGS is working with partners to ensure all Owned and Leased structures are added to a GIS layer. Once complete, the GIS layer will overlay with the SFHA layer. Modify BORM to MIRC Office. Change measure of success to reflect use of database for State Enhanced HMP Support.
Action 1-3e. Evaluate state-owned	All Hazards	PEMA; Identified state agencies	Homeland Security Grant	Dec-21	Conduct a workshop with	Complete and continue. The Department of General Services led

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
structures for mitigation options for non-flood related high-priority hazards.			Programs 20% Portion		state agencies to identify state- owned structures vulnerable to high priority hazards.	several meetings to identify and classify state-owned critical facilities and non-critical structures that led to the improved list used for the 2023 plan update.
Action 1-3f. Provide emergency electrical backup generation to key state, county, and municipal critical infrastructure.	All Hazards	PEMA, FEMA; DHS	FEMA Hazard Mitigation Assistance Programs; HMGP 5% initiative	Dec-22	Continue to identify and prioritize emergency backup generation projects, including pad and patch panel installation. Submit five projects.	Complete. Continue ongoing coordination with USACE. Add DHS as a support agency.
Action 1-3g. Add internet interruption to the list of reportable incidents in Knowledge Center.	Utility interruption	PEMA, Counties; PUC; DEP	Staff time	Dec-22	Data tracking in place for utility interruption incidences that can be used for HM planning.	In progress. Add PUC and DEP as support agencies.
Objective 1-4: Identify projects related to advanced warning within the Commonwealth by 2023.						

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 1-4a. Support the sustainment and enhancement of Commonwealth fusion centers.	Terrorism, Civil Disturbance	PSP; OHS; OAG	Department of Homeland Security (DHS) Grant Funding	Ongoing	Continue to support the operation of Commonwealth fusion centers.	Complete and ongoing. PSP has added CyberCom and Overdose Identification Network (ODIN) Sections to the Pennsylvania Criminal Intelligence Center (PaCIC). Continue to build operations in PaCIC and onboard contributing partners. ODIN was established through Act 158 of 2022 which requires PSP to collect overdose information for all police agencies within the Commonwealth. Add PA Office of Attorney General as a support agency.
Action 1-4b. Promote reverse notification systems in high-hazard areas.	All Hazards	Counties (911 Operations)	DHS Grant Funding; Act 78 of 1990 (Public Safety Emergency Telephone Act) Funding	Ongoing	Identify and catalog success stories of jurisdictions utilizing reverse notification systems.	Complete and ongoing. Specify county 911 Operations as Lead Agency. Act 78 of 1990 (the Public Safety Emergency Telephone Act) facilitated the implementation of Pennsylvania's statewide emergency telephone 911 system. Several success stories of jurisdictions utilizing reverse notification systems are highlighted under mitigation successes included in Table 6.7-1.
Action 1-4c. Increase participation in ~~PA Alert~~ Alert PA.	All Hazards	OA	~~DHS Grant Funding~~ Agency	Ongoing	~~Increase participation in PA Alert by 25%.~~ Continue to increase	Complete and ongoing. Alert PA has approximately 200,000 subscribers as of 2022. Change PA Alert to Alert PA and replace DHS Grant Funding with

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
			Operating Funds		participation in Alert PA.	Agency Operating Funds. Per OA, modify measure of success.
Action 1-4d. Establish Water Monitoring Council Action to improve stream gauge coordination in Commonwealth.	Flood	USGS; River Basin Commissions; PEMA; DEP; NWS; USACE; Water Authorities; Municipalities; FEMA; PaWARN	USGS; USACE; DEP; Water Authorities; Municipalities	Oct-23	A consistently meeting Council and an updated dashboard of monitoring/weather data.	Complete and ongoing. Add PaWARN as a support agency.
Action 1-4e. Complete flood inundation mapping for high risk and high population centers.	Flood	SJ Initiative including USGS; USACE; NWS; PEMA; River Basin Commissions; FEMA	USGS; USACE; FEMA CTP	Jul-21	Complete one flood inundation mapping project and related outreach per year based on funding availability.	Complete and ongoing. PA Sliver Jackets completed Susquehanna River Flood Inundation Mapping Wyoming Valley Flood in 2019. The project included 101 miles along the main stem of the Susquehanna River in Columbia, Luzerne, Montour, Northumberland, and Snyder counties.PA Silver Jackets conducts regular outreach as highlighted under mitigation successes included in Table 6.7-1. Add FEMA CTP as a funding source.
Objective 1-5: Minimize risk to communities posed by levee structures by increasing participation with Federal standards developed by the Federal Emergency Management Agency and the United States Army Corps of Engineers, focusing on planning and certification if feasible.						

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 1-5a. Re-examine impacts of federal levee guidance and identify necessary actions.	Flood; Levee Failure	DEP; USACE; FEMA; PEMA-~~BORM~~ MIRC; DCED; DCNR; PFBC	Act 13 Flood Mitigation Grants; Staff time	Ongoing	Support USACE in efforts to conduct inspections and risk assessments of non-Program levees.	Complete and ongoing. Add DCNR and PFBC as support agencies.
Action 1-5b. Support non-state and non-federal levee owners, identified in the National Levee Inventory, with information on compliance with the National Levee Safety Program and appropriate funding streams.	Flood; Levee Failure	DEP; PEMA; USACE; FEMA	Act 13 Flood Mitigation Program; FEMA BRIC; Staff time	Ongoing	Support USACE outreach activities with levee owners.	Complete and ongoing. Add PEMA as a support agency and FEMA BRIC as a funding source.
Action 1-5c. ~~Update emergency action plan guidelines for flood protection projects to~~ Assist flood protection project sponsors with developing project	Flood; Levee Failure	DEP; USACE; PEMA; levee owners; County EMAs	Staff time; FEMA BRIC	~~12/1/2019~~ Ongoing	~~When guidance is published.~~ Increasing percentage of completed and updated EAPs.	Complete. Per DEP, modify action description, target completion date, and measure of success. Add FEMA BRIC as a funding source.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
specific EAPs including inundation maps.						
Action 1-5d. Identify and work with local sponsors of state levee systems, given an unacceptable or minimally acceptable rating, to bring them back up to acceptable rating.	Flood; Levee Failure	DEP; DCED; USACE	Staff time; Capital Budget; Act 13 Flood Mitigation Program; FEMA BRIC	Ongoing	Explore funding opportunities to provide support for levee project improvements.	Complete and ongoing. Add FEMA BRIC as a funding source.
Action 1-5e. Encourage local, state, and federal levee system sponsors to develop Emergency Action Plans.	Flood; Levee Failure	USACE; DEP; Counties; Local Municipalities	Staff time	Ongoing	Obtain Emergency Action Plans for all ~~29% of~~ state levee systems.	Complete and ongoing. Per DEP, modify measure of success to obtaining Emergency Action Plans for all state levee systems.
Objective 1-6: Continue to provide outreach and training opportunities for local building code enforcers throughout the Commonwealth.						
Action 1-6a. Continue to conduct statewide training for ~~construction~~ building code officials.	All Hazards	FEMA Region 3 Building Science Officer; PEMA; DCED; DEP EPO; CERC provider: PCCA (PML)	HMGP 5% Initiative	Ongoing	Continue to provide training at locations throughout Pennsylvania.	Complete and ongoing. Change construction code officials to building code officials in action description. Add PCCA (PML) as a support agency. Identify FEMA Region 3 Building Science Officer as lead agency and add DEP EPO and PCCA (PML) as a

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
						support agency. DEP EPO participating in training for building code officials.
Action 1-6b. Provide briefings for code association and county officials on damage assessment expectations following a disaster.	All Hazards	PEMA; ~~DCED~~; FEMA Region 3	EMPG; HMGP	Ongoing	Conduct PEMA Disaster Assistance Meetings, as required. Develop the following courses: a best management practices course on damage assessment and methodologies; a disaster webinar for County tax assessors, board of appeals employees, and municipal officials.	Complete and ongoing. Remove DCED as support agency due to the transfer of Pennsylvania's NFIP program from DCED to PEMA through Act 65 of 2022. If passed, Federal Senate Bill 2471 (Reforming Disaster Recovery Act) will mandate this action.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 1-6c. Invite ~~the PA Association of Building Code Officials~~ PABCO, ~~PA Association of Code Officials~~ PACO, and Council of Government organizations (COG) to outreach meetings related to building resiliency and mitigation of structures.	All Hazards	PEMA; DCED; PA Municipal League	Organizational funding	Ongoing	Invite code enforcement officials to participate in meetings and events.	Complete and ongoing. Replace PA Association of Building Code Officials with PABCO and PA Association of Code Officials with PACO.
Objective 1-7: Increase coordination, prioritization, and funding availability to address community needs for dam hazards.						
Action 1-7a. Build on DEP's initiative to require dam owners to complete a dam break analysis and map inundation areas for dams of high hazard potential.	Flood, Dam Failure	DEP; PEMA; Counties; DCNR; PFBC	Staff time; National Dam Safety Program grant; HHPD; USACE Silver Jackets; Dam Owner	Ongoing	Increase percentage each year.	Complete and ongoing. Add DCNR and PFBC as support agencies. Add HHPD as a funding source.
Action 1-7b. Identify and implement mitigation actions based on Silver	Flood, Dam Failure	USACE	Staff Time	Oct-23	Completion of Screening Level Risk Assessments by USACE.	Complete and ongoing. Floodplain Management Plan for Heller Dam is under development and may be used as a template for future HHPD grant applicants.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Jacket meeting results.						
Action 1-7c. Evaluate and enforce appropriate remediation of dams.	Flood, Dam Failure	DEP Dam Safety; DEP Regional Offices; USACE District Office	Staff time; PENNVEST loan and grant program; Act 13 Flood Mitigation Program; Growing Greener, State Capital Budget, Dam Owner	Ongoing	Report DEP annual records of dam removals.	Complete and ongoing. Add USACE District Office, DEP Dam Safety; DEP Regional Offices as support agencies. PENNVEST has funded two (2) dam projects as part of a drinking water system. 1) City of Lock Haven: modification to the Warren Ohl Dam, approved 04/20/2020, in construction status. 2) Altoona Water Authority: Bellwood Dam Upgrade/Rehabilitation, approved 01/20/2021, in construction status.
Action 1-7d. Ensure that all high hazard dams have an Emergency Action Plan, as required.	Flood, Dam Failure	DEP; PEMA	HHPD; FEMA Dam Safety Program; IIJA; Staff Time; Dam owner	Ongoing	Achieve 95% EAP approval.	In progress. Add HHPD, FEMA Dam Safety Program, and IIJA as funding sources.
Action 1-7e. Reduce the vulnerability of High Hazard potential Dams (HHPDs) as defined by FEMA.	Flood, Dam Failure	DEP; DCNR, Counties	HHPD Rehabilitation Grant	Ongoing	Securing funding for 8 HHPD in FY19 application cycle. Evaluate HHPDs and apply for funding in	Complete and ongoing. DCNR applied for grant funding to rehabilitate Memorial Lake dam and Kephart Dam in 2022. PEMA secured funding for eleven (11) projects in the application cycle using HHPD: 1 project in 2020; 5 projects in 2021; 6 projects in 2022.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					subsequent years.	
Objective 1-8: Encourage aggressive enforcement of floodplain and stormwater management ordinances and other all-hazards regulations within the Commonwealth to reduce losses in high risk areas.						
Action 1-8a. Continue to track floodplain management ordinance information including adopted building code(s), other relevant ordinance(s), code(s), regulation(s), etc., and the incorporation of any more restrictive requirements.	Flood, All Hazards	~~DCED~~; PEMA; FEMA Region 3	Community Assistance Program – State Support Services Element (CAP-SSSE); Cooperating Technical Partners Program (CTP) Grant	Continuous	Maintain or increase NFIP participation after FIRM update ordinance reviews. Promote early review and submission of ordinances to DCED.	Complete and ongoing. Remove DCED as lead agency as NFIP management has transferred to PEMA. Between 2018 and 2022 a total of 423 floodplain management ordinances were reviewed by the PML for DCED and then PEMA once PEMA began management of the NFIP.
Action 1-8b. Conduct effective outreach with municipalities to explain value of floodplain ordinances and adopting more restrictive requirements.	Flood, All Hazards	~~DCED~~; PEMA; FEMA Region 3	Community Assistance Program – State Support Services Element (CAP-SSSE); PA Municipal League Training	Oct-23	Reach 200 municipalities annually with ordinance related materials.	Complete and ongoing. Remove DCED as lead agency as NFIP management has transferred to PEMA.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 1-8c. Explore the possibility of providing legal support for floodplain management ordinance enforcement to municipalities.	Flood, All Hazards	~~DCED~~; PEMA; FEMA Region 3; State legal counsel; municipal solicitor	Staff time	Jul-19	~~Coordinate with DCED and~~ meet with state and municipal legal counsel.	Complete and ongoing. Remove DCED as lead agency as NFIP management has transferred to PEMA. Add PEMA as lead agency. Modify measure of success to remove DCED.
Action 1-8d. Revise Suggested Floodplain Provisions (model ordinance) using information obtained through the gap analysis and strategic plan (Action 1-15f).	Flood	~~DCED~~; PEMA	Staff time	Dec-20	Distribute Revised Floodplain Provisions for all community ordinance updates.	Complete and ongoing. Remove DCED as lead agency as NFIP management has transferred to PEMA.
Action 1-8e. Schedule and proctor 3 CFM Exams, one each in the Eastern, Central, and Western PEMA Regions every year.	Flood	PAFPM	PAFPM Volunteer Time	December of each year, ongoing	Achieve at least 10 new CFM certifications in Pennsylvania each year.	PAFPM reports at least 52 new CFM certifications during the planning period including: 2019 (16), 2020 (14), 2021 (15), 2022 (7).
Objective 1-9: Promote increased implementation of urban-wild land interface (wildfire) mitigation projects by local communities by 2023.						
Action 1-9a. ~~Conduct formal statewide community risk~~	Wildfire	DCNR Bureau of Forestry; Office of	Staff time	Dec-23	~~Risk assessment disseminated to~~	Complete. This action has been completed nationally: https://wildfirerisk.org/

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
~~assessment using Risk Assessment Mitigation Strategies database.~~ Assess wildfire risk using assessment information available through the USDA Forest Service Wildlife Risk to Community website and the Northeast-Midwest State Foresters Alliance Northeast-Midwest Wildfire Risk Assessment Portal.		State Fire Commissioner			~~all communities.~~ Incorporate USDA and Northeast-Midwest resources into decision making.	and regionally; https://northeastmidwestwildfirerisk.com/. Modify the action to incorporate the national and regional tools into future decision making. Change target completion date to ongoing. Revise the measure of success accordingly.
Action 1-9b. ~~Work with FIREWISE communities to complete grant applications for outreach and fuels reduction projects.~~ Work with local governments and communities to support application for Community Wildfire Defense	Wildfire	DCNR Bureau of Forestry; Office of State Fire Commissioner	Staff time; U.S. Forest Service Community Wildfire Defense Grants	Dec-23	Identify any support available to DCNR through the HMP process.	Complete and ongoing. Modify action description to work with local governments and communities to support application for Community Wildfire Defense Grants through the U.S. Forest Service to mitigate wildfire impacts. Add U.S. Forest Service Community Wildfire Defense Grants as a funding source.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Grants through the U.S. Forest Service to mitigate wildfire impacts.						
Objective 1-10: Enhance Commonwealth efforts to address mine/quarry related hazards by increasing inter-agency cooperation.						
Action 1-10a. Support effort to complete subsidence mapping in the Commonwealth.	Subsidence, Sinkhole	DEP – Mining; DCNR; Counties impacted ~~by surface mine related hazards~~ karst-related hazards.	State Funding	Ongoing	Notify counties, municipalities, and state agencies about resources available to address subsidence; including mine subsidence insurance, if available.	Complete and ongoing. Change surface mine related hazards to karst related hazards. DCNR will continue with geologic and sinkhole mapping, outreach and education. DCNR will continue collecting information and manage through database resources in addition to responding to service requests. FEMA 2022 CTP funding was not awarded for work under this action.
Objective 1-11: Support the Department of Environmental Protection in addressing hazards associated with shale gas formation extraction and distribution.						
Action 1-11a. Identify mitigation options for identified impacts and consequences associated with shale gas formation extraction and distribution.	Environmental Hazard - Unconventional Oil and Gas Wells	DEP; PEMA; Counties impacted by shale gas formation extraction and distribution; PUC; ~~PennDOT~~; Oil and Gas Industry; Pennsylvania 811	Act 13 Impact Fee	Ongoing	Address impacts as wells are permitted/ drilled.	Complete and ongoing. The PUC continues to distribute Act 13 Impact Fee funding to counties and municipalities. Add Pennsylvania 811 (aka PA One Call) as a support agency. Remove PennDOT as support agency as the agency does not regulate natural gas extraction.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 1-11b. Encourage attendance at training courses that enable counties and local governments to mitigate the negative impacts of shale gas formation extraction and distribution.	Environmental Hazard - Unconventional Oil and Gas Wells; Environmental Hazard - Gas and Liquid Pipelines	DEP; Office of State Fire Commissioner and Academy; Partnerships with private sector; Counties impacted by Marcellus Shale; Universities; Pennsylvania 811	Act 13 impact fee	Ongoing	Promote Office of State Fire Commissioner well drilling training and promote US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety (US DOTPHMSA OPS) training webinars as appropriate.	Complete and ongoing. Add Pennsylvania 811 (aka PA One Call) as a support agency.
~~Action 1-11c: Support the development of a Hazmat and Pipeline Training facility in Pennsylvania in collaboration with a college or university~~.	Environmental Hazard - Gas and Liquid Pipelines	DEP; PUC; PHMSA; PEMA; Office of State Fire Commissioner and Academy; Oil and Gas Industry; Pennsylvania College or University	Act 13 impact fee; PHMSA	Dec-21	Agreement in place and funding sources allocated to construct a Hazmat and Pipeline Training facility	Remove. PUC recommends removing from the HMP. The US DOT, PHMSA does not support the establishment of a facility in Pennsylvania. A National Training Center is located in Oklahoma to train responders and certain universities train industry personnel.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					in Pennsylvania.	
Action 1-11d: Promote awareness of new pipeline safety guidelines enacted as part of passage of PA Act 50 of 2017.	Environmental Hazard - Gas and Liquid Pipelines	PUC; DEP; ~~PA One Call~~ Pennsylvania 811	Staff time	Ongoing	Include PA One Call and PA Act 50 as a topic in ~~PEMA sponsored~~ conferences.	Complete and ongoing. Throughout the planning period, Pennsylvania 811 and the PUC Damage Prevention Group spoke at conferences and public meetings about pipeline safety guidelines. Change PA One Call to Pennsylvania 811 under support agency.
Objective 1-12: Ensure reports and databases are updated annually to reflect Repetitive Loss and Severe Repetitive Loss mitigation.						
Action 1-12a. Report the successes of flood- related projects in the annual SHMP update and provide a summary in the triennial plan update. Draft annual report by October 15th and finalize for submittal to FEMA no later than October 31st of the report year.	Flood	PEMA; ~~DCED~~	Staff time; CDBG-DR	Continuous (annual requirement)	Submit annual reports on time; solicit support for RL/SRL funding to compile data.	Complete and ongoing. The PA Silver Jackets Team is updating success stories and FEMA Region 3 is writing a story about the Pine Grove, Schuylkill County project. Mitigation successes are summarized in Table 6.7-1. Remove DCED as a support agency as NFIP management has transferred to PEMA.
Action 1-12b. Annually review the progress of SRL and	Flood	PEMA; Counties; ~~DCED~~; FEMA Region 3	FEMA Hazard Mitigation Assistance	~~Continuous~~ Each disaster or mission	Include information in annual report	Complete and ongoing. Modify action description to change BureauNet to PIVOT. Add FEMA Region 3 as a

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
RL property mitigation to ensure accuracy of ~~BureauNet~~ PIVOT. Submit ~~BureauNet~~ PIVOT updates as needed, particularly for location and mitigation status.			Programs (management costs)		(Action 1-12~~e~~a); 100% compliance needed.	support agency. Change target completion date to each disaster or mission. Modify action reference in measure of success to Action 1-12a. Remove DCED as a support agency as NFIP management has transferred to PEMA.
Objective 1-13: Promote Natural Systems Protection mitigation in the Commonwealth between 2019 and 2023.						
Action 1-13a. Identify cooperative funding opportunities for natural system protection projects.	Flood	PEMA; DEP; NRCS	FEMA Hazard Mitigation Assistance Programs; Growing Greener; DEP Stream Improvement Program; NRCS Emergency Watershed Protection Program; DCED/CFA Act 13 Flood Mitigation Program	Jul-21	Obtain hazard mitigation funds for a stream corridor restoration or wetland restoration project associated with flooding.	Complete and ongoing. Multiple projects were proposed and some funded with American Rivers Associations, Ruffed Grouse Society, DRBC. Lewisburg Borough, Union County completed a Flood Mitigation Study.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Objective 1-14: Promote public and private sector CI/KR physical and cyber security.						
Action 1-14a. Take steps to protect ~~Pennsylvania's communities~~ Pennsylvania from cyber security attacks.	Cyber-terrorism	PEMA; GOHS; county and local government; local government associations (PSATS)	Staff time	Oct-23	~~Incorporate cybersecurity measures (anti-virus software, complex passwords, firewalls, regular data backup, etc.) into local government operations.~~ Continued implementation of the Pennsylvania Cyber Incident Annex.	Complete and ongoing. Modify action description to change Pennsylvania's communities to Pennsylvania. Change measure of success to continued implementation of the Pennsylvania Cyber Incident Annex.
~~Action 1-14b. Work with industry and government to improve the cyber security position of control systems within critical infrastructure.~~	Cyber-terrorism	PEMA; GOHS; county and local government; local chambers of commerce	Staff time	Oct-23	Implement tools and resources developed by the U.S. Department of Homeland Security, Industrial Control	Remove. GOHS recommends removing from the HMP.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					Systems Cyber Emergency Response Team (ICS-CERT).	
Objective 1-15: Increase the capacity and effectiveness of Commonwealth NFIP management.						
Action 1-15a. Increase NFIP support staff.	Flood	PEMA ~~BORM~~ MIRC	Community Assistance Program – State Support Services Element (CAP-SSSE), Cooperating Technical Partner (CTP), State agency funding	Jun-19	Hire two full-time Administrative Officers to support the NFIP.	Complete. Positions authorized. An NFIP coordinator was hired within PEMA MIRC office. Change BORM to MIRC Office under lead agency.
Action 1-15b. Provide technical assistance to NFIP communities through Community Assistance Visits (CAV).	Flood	PEMA ~~BORM~~ MIRC	CAP-SSSE, CTP, State agency funding	Ongoing-Annually	Complete 5-10 CAVs each year.	Complete and ongoing. Contracted to build capacity for seven (7) CAVs in the next 6 months. Will be conducting 19 community assistance contacts virtually between February - April 2023. Change BORM to MIRC under lead agency.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 1-15c. Deliver NFIP Training in the Commonwealth to increase local capacity for NFIP administration and enforcement.	Flood	PEMA ~~BORM~~ MIRC; ~~DCED~~	CAP-SSSE, CTP, State agency funding	December 2019; then Ongoing	Develop a multi-year NFIP Training Plan focused on increasing local capabilities and compliance; Deliver two or more EO273 Trainings: Management Floodplain Development through the NFIP; Deliver four or more one-day NFIP Training for Floodplain Managers; Deliver one or more advanced trainings as needed (E0282, E0284, E0291).	Complete and ongoing. Change BORM to MIRC under lead agency. Remove DCED as a support agency as NFIP management has been transferred to PEMA.
Action 1-15d. Increase awareness and local capacity enforce and support	Flood	PEMA ~~BORM~~ MIRC; FEMA Region 3	CAP-SSSE, CTP, State agency funding	December 2019; then Ongoing	Deliver two or more Substantial Damage	Complete and ongoing. Provided eight (8) virtual elevation certificate trainings. Provided duties and responsibilities of a FPM frequently. Update measure of

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Substantial Damage requirements.					Trainings to assist local officials with preparedness and recovery; Present at PAFPM Conference on Damage Determinations~~; Include additional suggested provisions regarding substantial damages and improvements in the PA model floodplain management ordinance.~~	success to reflect the development of substantial damage (SD) and substantial improvement (SI) handbook and offering virtual training events. Change BORM to MIRC under lead agency. Remove reference to PA model floodplain management ordinance as new action developed by SPB is included in the 2023 mitigation strategy (Action 1-8f).
Action 1-15e. Increase the number of Certified Floodplain Managers (CFMs) in the Commonwealth by developing and	Floods	PEMA ~~BORM~~ MIRC; PAFPM	CAP-SSSE, CTP, State agency funding, PAFPM staff time	Dec-20	Develop course materials building on existing resources: Deliver three or more CFM	Complete and continue. Change BORM to MIRC under lead agency.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
delivering CFM training in advance of scheduled CFM exams.					trainings in advance of the CFM exam; Increase the number of CFMs by 10%.	
Action 1-15f. Complete a gap analysis of the Commonwealth's NFIP Program and subsequent strategic plan to address the findings.	Flood	PEMA ~~BORM~~ MIRC; ~~DCED~~	CAP-SSSE, CTP, State agency funding	Nov-19	Release a Strategic Plan to address identified gaps in the Commonwealth 's NFIP program; ~~Build on and expand on plan in initial CAP Agreement between PEMA, DCED and FEMA to expand program as analysis a planning recommends in future funding years.~~	In progress. PEMA is awaiting new gubernatorial administration policy direction for continued buy in. Change BORM to MIRC under lead agency. Remove DCED as a support agency as NFIP management has transferred to PEMA. Remove reference to agreement between FEMA, DCED, and FEMA in measure of success.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 1-15g. Continue to improve the functionality and accessibility of the PA Flood Tool.	Flood	PEMA ~~BORM~~ MIRC; ~~DCED~~; PEMA GIS; Penn State University; PASDA	CAP-SSSE, CTP, State agency funding	Jan-20	Let PA Flood Tool improvement contract to improve functionality to aid local officials in flood determinations and risk communication.	Complete and continue. Change BORM to MIRC under lead agency. Add PEMA GIS, Penn State University, and PASDA as support agencies. Remove DCED as a support agency as NFIP management has transferred to PEMA.
Goal 2 - Enhance consistent coordination, collaboration, and communications among stakeholders.						
Objective 2-1: Promote development of COOP and COG plans for critical infrastructure within the Commonwealth, focusing on water treatment, water supply, and critical goods and services suppliers.						
Action 2-1a. Identify and prioritize critical government facilities and infrastructure that require back-up systems.	All Hazards	OA with support from all State Agencies; Counties; USACE	State agency funding; DHS grants	Ongoing	Collect latitude/longitude data for identified critical facilities. Request USACE Power team review of generator sizing.	In progress. Partial list provided to USACE from some counties. Pennsylvania has a robust Continuity of Operation program for Commonwealth agencies that identifies critical, facilities, infrastructure, and operations to maintain during disaster events. Most agencies also have an EPLO that works with PEMA to plan for preparedness across agencies. In addition, this action is suitably handled through other planning processes noted in Capability Assessment

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
						including agency COOP planning, THIRA, and EPLO coordination.
Action 2-1b. Conduct outreach to privately-owned businesses and infrastructure that provide critical services in post-disaster situations to encourage them to develop COOP or Business Recovery Plans.	All Hazards	PEMA; OHS; DHS; DCED; DHS Protective Security Advisors and Task Forces	Staff time; DHS Grant Funding	Jan-21	Complete two outreach workshops. Gather information on complementary workshops from DHS/GOHS for next SHMP update.	Complete and continue. Workshops completed in USACE- Pittsburgh District, course developed, and will provide additional training. PA Silver Jackets project for 2023- 24 workload. DCED continues to lead RSF efforts under Housing, Economic Development, and Community Planning Capacity Building during both planning phases and active disasters.
Objective 2-2: Promote integration of mitigation goals, objectives, and actions where appropriate in other federal, state and local planning initiatives by 2023.						
Action 2-2a. Integrate local (county level) risk assessment data into the State Plan updates and vice versa to ensure consistency between state and local plans with respect to the best available data.	All Hazards	PEMA Resiliency Officer; Municipalities; Counties	Staff time; Plans funded by Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Program (HMGP) funding	Continuous	Coordinate with PEMA OPS to integrate HM planning data and local plans into a single PA planning portal. Continue to update the SOG and provide annual training.	Complete and continue. Add PEMA Resiliency Officer to Lead Agency.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 2-2b. Support Silver Jackets work to identify current policies, plans, regulations, and laws that should include mitigation.	All Hazards	PEMA; DEP Energy Programs Office; Other State Agencies; Silver Jackets; PAFPM	Staff time	Jan-20	Include lessons learned and planning guidance for local officials in the PA Climate Action Plan 2021 the SJ Mitigation Guide. Include a link to the guide on the PA Planning Portal.	Complete and ongoing. Add DEP Energy Programs Office (EPO) as a support agency. Add PA Climate Action Plan 2021 in measure of success.
~~Action 2-2c. Identify highest priority action items for counties that do not currently have a highest priority mitigation action identified in Section 6.3.2.~~	All Hazards	PEMA; Municipalities; Counties	Staff time	Ongoing	Update local standard operating procedures to reflect new mitigation action prioritization method so that highest ranking actions can be identified in the 2023 SHMP update.	Complete. Move to capability. SOG updated to reflect mitigation action prioritization. Priorities also set through BRIC and FMA.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Objective 2-3: Support the collection, update, and dissemination of datasets useful for hazard mitigation planning and implementation.						
Action 2-3a. Develop a comprehensive list of types of hazard mitigation data that decision-makers might need by December 2020.	All Hazards	PEMA; FEMA; Pennsylvania State Geospatial Coordinating Board (GeoBoard); PASSHE; Counties (GIS).	Staff time	~~12/1/2020~~ Ongoing	Share the list of identified data with stakeholders. Include SoVI analysis in data set for Counties and the State to utilize and evaluate the nexus of vulnerability and hazards in more detail in future plans.	In progress. Clarify data that decision-makers might need. Render action ongoing due to the constantly changing nature of remote sensing technology and satellite imaging.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 2-3b. Represent the interests of hazard mitigation on the Pennsylvania State Geospatial Coordinating Board (GeoBoard).	All Hazards	PEMA; GeoBoard; Other State Agencies; Counties (GIS)	Staff time	Ongoing	Active participation in the GeoBoard; implementation of GeoBoard initiatives identified in the 2018 Geospatial Strategic Plan which advance hazard mitigation planning.	Complete and ongoing. Agency participation in quarterly Remote Sensing Working Group meeting. PEMA's leadership in GeoBoard has fortified working relationships with data providers. Continue participation through the duration of 2023 HMP.
Action 2-3c. Re-evaluate state GIS database to ensure datasets include hazard mitigation, planning, and critical asset identification to enable the prioritization of mitigation projects.	All Hazards	PEMA; Counties	Staff time	Oct-18	Identify all of the exact databases, and owners of those databases. Ensure data is available on PASDA.	In progress. Ongoing coordination with Penn State PASDA, Office of Administration and counties to integrate databases. New PEMA GIS Director appointed 2022.
Action 2-3d. Continue to use and improve GIS capability to prioritize	All Hazards	PEMA; GOHS; PSP; DGS; CCAP	Staff time	Dec-21	Use GIS to assign mitigation priorities to	Complete and ongoing. PaCIC's CI/KR and Geospatial Sections continue to work with GOHS and DGS to map and prioritize CI/KR facilities within the

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
hazard/critical infrastructure for mitigation.					critical infrastructure.	Commonwealth. Ongoing efforts to identify and map Level III CIKR assets within the Commonwealth in conjunction with Action 1-3b. Add CCAP as a support agency.
Action 2-3e. Acquire remotely sensed data, specifically, ortho- photography, as specified in the Commonwealth's Geospatial Strategic Plan.	Flood	PEMA; GeoBoard; FEMA Region 3	FEMA Emergency Management Performance Grants (EMPG); National Preparedness Funds; PEMA PHMC Program Funds	12/1/2019	Acquire updated ortho-photography for Pennsylvania.	Complete and continue. Currently collecting second set of imagery 2020 through 2023. Completed using 911 program funds. 911 Program leadership role should continue in future acquisitions. Future acquisitions in development. Add PEMA 911 Program Funds to funding source.
Action 2-3f. Improve electronic data sharing between municipalities, counties, PA SHPO and PEMA to ensure statewide data remains current on historic properties and may be used for risk analysis.	All Hazards	State Historic Preservation Office (PA SHPO); PEMA; FEMA	U.S. Department of the Interior National Park Service; PHMC Preservation and Disaster Planning	Ongoing	Identify historic resource survey projects by municipality and county.	Complete and continue. PA SHPO led several electronic data sharing efforts as detailed in Table 6.7-1. Data sharing and historic property documentation should continue to be a priority. Future PA Historic Places Inventory efforts should prioritize areas at high risk from both natural and man-made hazards. Add U.S. Department of the Interior in front up National Park Service.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 2-3g. Designate/develop a reporting mechanism and process that allows local data to be tracked and reported regarding costs and resources associated with the opioid epidemic in order substance use disorder to better understand, quantify and respond to impacts.	~~Opioid Addiction~~ Substance Use Disorder	~~Opioid Task Force~~ DDAP; PEMA	Staff Time; State Targeted Response to the Opioid Crisis Grant	2019	Track the number and costs associated with first responders, calls received, Narcan administration, medical examiner, and other identified losses as deemed necessary by the Task Force.	Remove. Replace action with Action 2-3i (Table 6.4-2) which focuses on implementation of ODIN through PSP.
Objective 2-4: Identify local Hazard Mitigation Officers and increase participation by local community representatives in the Commonwealth's Mitigation Planning Team by 50% between 2019 and 2023.						
Action 2-4a. Maintain planning, emergency management, and GIS/data management contacts lists and expand contacts to include conservation districts.	All Hazards	PEMA and Area Offices; OA; Counties; CCAP; County Conservation Districts	Staff time	Ongoing	Consistently update and expand hazard mitigation contact lists.	Complete and ongoing. PEMA proactively maintains contacts and reaches out to stakeholders throughout the Commonwealth through training and participation in Local HMP updates, seminars, and conferences with PA Silver Jacket partners, and annual SHMP review meetings. The PA SOG also recommends diverse stakeholder contacts for Local HMP updates and maintenance. Add CCAP

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
						and County Conservation Districts as support agencies.
Action 2-4b. Bring county leads and planning champions together for regular meetings, knowledge exchanges, and trainings.	All Hazards	PEMA; DCED; KEMA; FEMA Region 3	Staff time; Agency operating budget; FEMA-sponsored training	Dec-23	Provide three integrated planning workshops/ seminars throughout the state.	Complete and ongoing. High PEMA priority. DCED Planning Team conducted integrated planning meetings around the state in an effort to improve coordination between EMAs and County Planning Directors.
Action 2-4c. Involve appropriate county mitigation plan team members in hazard mitigation implementation activities.	All Hazards	PEMA; Counties; DRBC; SRBC	Staff time; EMPG; HMGP; PDM; PDM; BRIC; Swift Current Initiative; FMA Management costs	Continuous	Offer training or meeting opportunities for county mitigation planning team members at ~~PEMA~~ KEMA Annual Conference and the Annual PA GIS Conference. Encourage counties to conduct annual HMP reviews with mitigation	Complete and ongoing. PIGD workshops held with DRBC and SRBC and highlighted as mitigation successes in Table 6.7-1. Add DRBC and SRBC as support agencies. Add PDM, BRIC, and Swift Current Initiative as funding sources. Change PEMA to KEMA in measure of success. Add Annual PA GIS Conference to measure of success.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					plan team members.	
Action 2-4d. Meet regularly to implement projects that tie-in goals and initiatives of multiple State Planning Team member agencies	All Hazards	PEMA; State Planning Team members	FEMA Hazard Mitigation Assistance Programs; USACE; BRIC	Oct-23	Identify and complete high priority mitigation actions.	Complete and ongoing. Two (2) BRIC projects completed in 2020. 1) Building Code Training with DEP EPO, DCED, L&I, PML. 2) DEP Levee Conduit project. Add BRIC as a funding source.
Action 2-4e. Develop County Hazard Mitigation Suggested Curriculum.	All Hazards	PEMA; Counties	EMPG	Oct-23	Encourage at least one member of the local hazard mitigation team to obtain Certified Floodplain Manager (CFM) certification.	Complete and continue. PAFPM reports 52 new CFM certifications during the planning period including: 2019 (16), 2020 (14), 2021 (15), 2022 (7).
Objective 2-5: Continue to support coordination between mitigation, planning, preparedness, and response personnel throughout the Commonwealth to ensure effectiveness in all-hazard mitigation planning.						
Action 2-5a. Improve cooperation/ coordination of agencies with real time data (gauge	All Hazards	Local, county, and state public safety agencies with planning support agencies	Various	Continuous	Encourage all SPT members to share real time data in Web EOC.	Complete and ongoing. IFLOWS study and grant. Project scopings, 2019 FMA Award and HMGP Award (DR 4506) for 20 sites.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
station data, program availability, etc.).						
Action 2-5b. Reach out to agencies that were invited but did not participate in 2018 planning process.	All Hazards	PEMA; Silver Jackets	Staff time; USACE	Oct-23	Participation in the next State Plan update builds on 2018 success and has more than 55 participating agencies/organizations/ county representatives.	Complete and ongoing. A total of 478 representatives from state agencies, boards, authorities, commissions, and other organizations participated in the 2023 HMP update.
Action 2-5c. Identify strategic locations to deploy USACE Power Teams after a disaster.	All Hazards	PEMA; Silver Jackets; USACE	Staff time	Ongoing	Continue to work with USACE Pittsburgh and Philadelphia Districts after a disaster to identify locations to deploy Power Teams.	Complete and ongoing. EPFAT program is no longer available. USACE would like to complete exercises in winter 2023. Generator list provided to USACE.
Objective 2-6: Support recovery and resiliency planning across the Commonwealth.						

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 2-6a. Develop County Recovery Plans following the template designed in State Disaster Recovery Plan process.	All Hazards	PEMA; County planners and EMCs	Staff time	Oct-23	Complete 12 County Recovery Plans.	In progress. Philadelphia and Columbia Counties stood up a Resiliency Office.
Action 2-6b. Develop a Pennsylvania Resilience Strategy using the Smart Growth America model.	All Hazards	PEMA MIRC Office; County planners and EMCs	Staff time	Oct-23	Statewide resiliency strategy in place and ready to disseminate to local jurisdictions.	Complete and ongoing. PEMA MIRC Office has a designated Resilience Officer.
Action 2-6c. Increase capacity of PennDOT's PA Mobility Plan to further estimate the impacts on the transportation system by simulating traffic patterns to reduce transportation accidents.	Transportation Accidents	PennDOT	Highway Safety Funds	Continuous	~~Reducing the overall number of crashes in the highest crash months of October, November, and December.~~ Reduce reported crashes annually.	Complete and ongoing. Total reported crashes decreased 16.6% from 2019 to 2020. Modify measure of success to reduce reported crashes annually.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 2-6d. Continue Implementation Steps of Extreme Weather Vulnerability Study	Natural Hazards and Building and Structure Collapse	PennDOT	Congestion Mitigation and Air Quality Funds	Continuous	Complete phase 2.	In progress. Continue action.
Goal 3 - Provide a framework for active hazard mitigation planning and implementation.						
Objective 3-1: Identify opportunities for regional organizations, businesses, and academia to be engaged in hazard mitigation planning.						
Action 3-1a. Maintain a comprehensive list of relevant regional agencies, including Councils of Government (COGs), River Basin Commissions, and Metropolitan Planning Organizations (MPOs).	All Hazards	PEMA; Silver Jackets; DCED	Staff time	Continuous	Annually update a list of relevant regional agencies including hazard mitigation planning contacts.	Complete and ongoing. Add DCED as a support agency.
Action 3-1b. Continue to support Pennsylvania Department of Education (PDE) in its multi-hazard school planning efforts.	All Hazards	PDE; PEMA; Safe Schools Initiative; PSP; FEMA Region 3	Agency Operating Budget	Continuous	Customize and update outreach materials and conduct outreach based on current events.	Complete and ongoing. PSP noted that Act 18 of 2019 provides for enhanced school safety measures. In part, the law requires the PSP to establish six, three-member RVATs (Risk and Vulnerability Assessment Teams) to operate within six geographical regions. In addition, PSP's Office of Community Engagement, Heritage Affairs Liaison Officers (OCE/HALOs)

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
						also educate schools on biased-based threats and identification of hate-based crimes within schools.
Action 3-1c. Identify and encourage involvement of key business, industry, and infrastructure stakeholders and stakeholder associations in mitigation.	All Hazards	Local jurisdictions and Chambers of Commerce; Federal and State Legislatures	Agency Operating Budgets; LPDM; Non-Profits	Continuous	Continue to invite a broad range of private sector stakeholders to participate in the HM planning process with a focus on infrastructure and utility stakeholders and large employers.	Complete and ongoing. Add state and federal legislatures under support agency. Add LPDM and non-profits as funding sources.
Action 3-1d Work with hazard mitigation stakeholders to provide increased support to Floodplain Managers.	Flood	~~DCED~~, PEMA MIRC Office; FEMA; Community Engagement and Risk Communication (CERC) provider, Resilience Action Partners; DEP; County	Staff time	Dec-18	Develop a standard municipal toolkit addressing land use and zoning enforcement and train	In progress. Remove DCED as lead agency as NFIP management has transferred to PEMA. Add MIRC Office after PEMA. Add DEP and County Conservation Districts as support agencies.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
		Conservation Districts			stakeholders on its use.	
Action 3-1e. Coordinate with USDA on the mass food contamination analysis phase.	Mass food contamination	Dept. of Agriculture; ~~Conservation districts~~	Staff time	Jan-20	Establish planning and response protocols with the PADAG Rapid Response Task Force.	Complete and ongoing. Remove County Conservation Districts as a support agency as the action is not within the purview of the County Conservation Districts.
Objective 3-2: Enable the Pennsylvania Emergency Management Agency to encourage each participating jurisdiction to secure funding and initiate one mitigation action by 2023.						
Action 3-2a. Maintain and improve Pennsylvania's Standard Operating Guide and other tools.	All Hazards	PEMA	EMPG	Continuous	Require all counties to complete HMP updates using the most current SOG.	Complete. Update SOG to reflect 2023 State HMP update.
Action 3-2b. Assist communities and counties in identifying funding streams to support the implementation of mitigation projects.	All Hazards	PEMA; DCED; DEP; Silver Jackets; Counties	Staff time	Continuous	Fund ten projects and six plans per year.	Complete and ongoing. Mitigation successes are documented in Table 6.7-1.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 3-2c. Update training courses regarding planning, project tools, as well as FEMA eGrants trainings.	All Hazards	PEMA	Staff time; FEMA support	Continuous	Conduct timely eGrants trainings as a part of at least two quarterly trainings per year. Track all training and technical assistance location, date, and attendance.	In progress. eGrants, Keystone ESA, and FEMA GO hands-on trainings have been completed.
Action 3-2d. Promote training and project tours for new members of hazard mitigation planning community, including personnel at universities, businesses, and regional organizations.	All Hazards	PEMA	EMPG	Jul-21	Develop and implement training for businesses and regional organizations.	Complete and ongoing. Conducted class for planning contractors with FEMA on new FEMA local plan guide. Provided 2019 EMI tour of Harrisburg to include review of sinkholes and City Island. Conducted PML tour.
Action 3-2e. Promote Hazard mitigation project tours to showcase successful	Flood	PEMA; Silver Jackets	Staff time	Continuous	Provide at least two bus tours through Silver Jackets.	Complete and ongoing. Provided 2019 EMI tour of Harrisburg to include review of sinkholes and City Island.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
flood mitigation projects.						
Action 3-2f. Explore funding for County EMAP accreditation.	All Hazards	PEMA	Staff time and EMPG	Jul-20	Disseminate information to counties pertaining to the incorporation of EMAP compliance into HM planning.	In progress.
Goal 4 - Build legislative and other organizational support and leverage funding for mitigation efforts.						
Objective 4-1: Provide opportunities for Pennsylvania Emergency Management Agency and County Emergency Management Agencies to educate State, county and local government officials, and legislators about hazard risk and mitigation by 2023.						
Action 4-1a. Facilitate tours for local, county, and state legislative officials focusing on mitigation projects or areas where mitigation efforts are needed.	All Hazards	Counties; Local Jurisdictions; PEMA; DCED; FEMA	Staff time	Oct-23	Coordinate local official and legislative site tours in four locations. Encourage the participation of at least 20 state legislative officials.	Complete and continue. Conducted 2021 tour with legislative representatives in Harrisburg.
Action 4-1b. Develop and disseminate relevant information	All Hazards	Counties; PEMA; DEP; DCED; Silver Jackets; CCAP;	FEMA Hazard Mitigation	Ongoing	Coordinate with FEMA and other agencies	Complete and ongoing. Relevant information on hazard mitigation programs disseminated at trainings

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
on hazard mitigation programs.		PML; PSATS; PSAB; NHMA	Assistance Programs		to obtain relevant mitigation information to disseminate to the public.	and workshops conducted during the planning period. Refer to Table 6.7-1 for a list of trainings and workshops conducted during the planning period. Add CCAP; PML; PSATS; PSAB; NHMA as support agencies.
Action 4-1c. Document and share in-state success stories and best practices.	All Hazards	PEMA; Counties	Staff time	Continuous	As part of the 2018 HMP update, develop online success stories to be updated and cataloged on Pennsylvania's Hazard Mitigation Plan website.	Complete and ongoing. PA Silver Jackets Work Plan updated.
Action 4-1d. Collect more detailed building information for mitigation projects to improve "Losses Avoided" analysis in SHMP.	Flood	PEMA; ~~DCED~~	State funding and time; Reach out to partners through Silver Jackets, Communities with a large number of mitigation projects and	Jun-23	Improved "Losses Avoided" analysis results included in the 2023 Plan Update.	Complete. Move to capability. County HMPs are required to have enhanced HAZUS analysis with building attribute data.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
			universities to support analysis.			
Action 4-1e. ~~Press for Act 166 and 167 funding to be allocated.~~ Fund, revitalize, and modernize the Act 167 program.	Floods	~~KEMA; PEMA~~; DCED; DEP; DCNR; CCAP, PSATS; PSAB; PML	Staff time	~~6/1/2023~~ December 2028	~~Coordinate with DEP to determine statistics and figures needed to present a case for Act 167 funding from a HM perspective~~. Act 167 program updates including addressing funding are implemented.	In progress. Modify with revised action developed by the State Planning Board in the *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.
Action 4-1f. Provide legislator webinar to explain disaster declaration and hazard mitigation funding process.	Flood; All hazards	KEMA; PEMA	Staff time; conference fees; printing fees; and WebEx costs	Continuous	~~Obtain a spot on legislator calendar for training/outreach.~~ PEMA will share information/white paper with	Complete and ongoing. Pennsylvania Legislative Services (mypls.com) provides an up-to-date legislative calendar for members. Remove reference to calendar from measure of success.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions						
Action Description	**Hazard**	**Lead/Support Agency**	**Funding Source**	**Target Completion Date**	**Measure of Success**	**Evaluation**
					KEMA as part of this effort.	
Objective 4-2: Expand working relationships with at least two volunteer and professional organizations to improve mitigation efforts within the Commonwealth.						
Action 4-2a. Expand working relationship with professional organizations including: NHMA; PACO; PAFPM; NEMA, IAEM, ASFPM, KEMA, League of Cities, and Code Enforcement Officers.	All Hazards	PEMA	Staff time; Agency operating budget	Jun-23	Attend at least two new organization conferences and invite two new organizations to the State Emergency Management Conference.	Complete and ongoing. Attended and presented at annual conferences for PAFPM, CCAP, APA-PA, and PSATS. Add NHMA, PACO, and PAFPM to action description. Tom Hughes is President of NHMA and the lead SHMO for the NHMA Hazard Mitigation/Resilience Work Group
Action 4-2b. Encourage PA-based professional organizations to be involved in the Silver Jackets Program.	All Hazards	PEMA; Silver Jackets	Staff time; Agency operating budget	Jun-23	At least two new professional organizations regularly attend Silver Jackets meetings between 2018 and 2021.	Complete and ongoing. American Rivers and PANO regularly attend PA Silver Jackets meetings.
Action 4-2c. Develop a working relationship with private insurance	All Hazards	DCED; Department of Insurance; FEMA	Staff time	Annually	Convene an annual meeting with the PA Department of	Complete and ongoing. Participate in the CDBG-DR funded PSU Insurance Study.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
and financial sector companies.					Insurance to address current insurance issues impacting hazard mitigation.	
Action 4-2d. Outreach to utilities to develop ideas to mitigate utility damage, such as gas and electric distribution utilities, outside of easements or rights of way.	Winter Storm; Subsidence, Sinkhole	PEMA; PUC	Staff time	Dec-21	Work with utilities to mitigate damage to infrastructure outside of utility ROW.	Complete and ongoing. Modify action description to add 'such as gas and electric distribution utilities' to address the PUC's comment that fallen trees onto wires outside the ROW are a recurring issue. The US DOT, PHMSA has developed risk mitigation guidance on subsidence and the PUC raises awareness on this topic at conferences and during Damage Prevention Advisory Board meetings. Several land use permission letters are in place. Working with FEMA Region 3.
Objective 4-3: Identify statutory, regulatory, or other barriers to completing mitigation efforts within the Commonwealth, and leverage support against these barriers to implement mitigation actions by 2023.						

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Action 4-3a. Identify statutory, regulatory, or other barriers that currently exist with respect to mitigation efforts and build consensus and plan integration with partners and decision makers.	All Hazards	PEMA; Office of General Counsel; DCED	Staff time	Jun-21	Continue to address and expand plan integration and eliminate barriers to mitigation through SJ Initiative and document successes. Develop a list of counties in the Commonwealth that cover municipal zoning.	Complete and continue. FEMA Region 3 agreed to land use options in 2022 at FEMA Region 3/ SHMO/NFIP workshop in Arlington, Virginia.
Action 4-3b. Assist county and regional planning organizations to integrate preservation priorities into plans for economic growth, revitalization, natural resource, hazard mitigation and emergency	All Hazards	PA SHPO; PEMA; FEMA	Staff time	Jun-21	Identify at-risk communities for disasters and create hazard mitigation and/or emergency management plans for	Complete and continue. PA SHPO provided guidance and/or led several planning efforts to integrate preservation priorities into planning as detailed in Table 6.7-1.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
management planning.					historic resources.	
Action 4-3c. Encourage counties and local municipalities to develop land bank authorities for the purpose of converting vacant or tax-delinquent properties at risk from the impacts of natural and human- made hazards into productive use.	Building and Structure Collapse	DCED; Counties; County Conservation Districts; Municipalities	Staff time; Local operating budgets	Oct-23	Encourage adoption of the provisions of PA Title 68 (Real and Personal Property) to encourage the development of land bank authorities.	Complete and continue. Add County Conservation Districts as support agencies.
Objective 4-4: Encourage the use of state funding for hazard mitigation for projects and plans.						
Action 4-4a. Support new state-funded flood protection and prevention projects.	Flood	PEMA; DEP; DGS; DCNR; PFBC	FEMA Hazard Mitigation Assistance Programs; USACE; NRCS; PA State Capital Budget Project Authorization (Capital Budget); DEP	Jun-21	Secure funding for at least four new state-funded flood protection/prevention projects, one of which should focus on flood fighting supplies and training.	Complete and continue. Add DCNR and PFBC as support agencies.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
			Growing Greener Watershed Protection Grants; PennDOT; DCED CFA Act 13 Flood Mitigation Program			
Action 4-4b Provide non-federal match to project sponsors for FEMA Hazard Mitigation Assistance, NRCS, USACE and other federal funding sources.	Flood	Governor's Office; State Legislators	Agency Operating Budget, Capital Budget, DEP	Jun-21	Allocate state funding for the non-federal match. Pursue developing a stormwater management revolving fund over the next 5 years with legislative support. ~~for the projects listed in funding sources listed in Action 4-4b, including funding for mitigation projects and~~	Modify measure of success to pursue developing a stormwater management revolving fund over the next 5 years with legislative support. Add state legislators under support agency.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions						
Action Description	**Hazard**	**Lead/Support Agency**	**Funding Source**	**Target Completion Date**	**Measure of Success**	**Evaluation**
					~~local hazard mitigation plan updates.~~	
Action 4-4c. Consider tax incentives and bonds for mitigation.	All Hazards	Pennsylvania Department of Revenue; PEMA; KEMA	State funding	~~10/1/2023~~ 12/31/28	~~Promote and gain approval for a tax-free mitigation day were people may purchase items like generators tax free.~~ Promote and seek approval for potential tax	In progress. Per DOR, change measure of success to 'Promote and seek approval for potential tax free opportunities'.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					free opportunities.	
Action 4-4d. Identify funding for sinkhole mitigation.	Subsidence, Sinkhole	PEMA; PUC; DCED	Staff time	Dec-21	Complete two sinkhole mitigation projects.	Complete and continue.
Goal 5 - Increase awareness, understanding, and preparedness across all sectors.						
Objective 5-1: Support all-hazards mitigation and preparedness programs to educate private and public stakeholders, academia, government employees and elected officials on the hazards pertinent to the Commonwealth.						
Action 5-1a. Develop and provide presentations on hazard mitigation programs and sponsor conference booths (exhibits).	All Hazards	PEMA; State Planning Team members	State funding	Annually	Attend and present at one conference per year.	Complete and continue. Presentations at PAFPM, CCAP, APA-PA, and PSATS annual conferences.
Action 5-1b. Schedule workshops and outreach sessions with local jurisdictions and invite home and business owners of mitigated structures to speak and share	All Hazards	PEMA	EMPG	Ongoing	Draft lessons learned for elevation and acquisition projects to present at workshops and sessions.	Complete and continue. PIGD workshops completed in conjunction with FEMA, DRBC, and SRBC, and eight (8) virtual elevation certificate trainings conducted. Refer to Table 6.7-1 for further details.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
their experience with potential applicants.						
~~Action 5-1c. Work with the Citizen Corps Program to educate the public on hazard mitigation and preparedness.~~	All Hazards	Counties; PEMA	Citizen Corps Funding; FEMA	Annually	Meet annually with Citizen Corps program director to discuss integration of hazard mitigation and preparedness into Citizen Corps Program.	Remove action.
Action 5-1d. Conduct a public information campaign through various media outlets.	All Hazards	PEMA Press Office; FEMA Public Information Officer; Governor's Office of Communications & Press; DCED; FEMA Region 3	Staff time; Media expenses	Oct-23	Create a media strategy/campaign plan. Build outreach related coordination for Long Term Recovery	Complete and continue. Several media campaigns were completed during the planning period.
Action 5-1e. Collaborate with the business community to implement hazard mitigation information and strategies.	All Hazards	PEMA; Pennsylvania Chamber; Regional Chambers; Regional Task Force Business	Staff time; Small Business Administration funds	Oct-23	Attend three Chamber of Commerce events.	Complete and continue.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
		and Pennsylvania Chamber; Regional Chambers; Regional Task Force Business and Labor Infrastructure Committees (or equivalent)				
Action 5-1f. Collaborate with non-profit, non-governmental and civic organizations to help inform their constituents about hazard mitigation.	All Hazards	Local/County Governments; Voluntary Organizations Active in Disaster (VOAD)	Staff time	Oct-23	Invite VOAD groups to next SJ outreach session.	Complete and continue. PEMA VOAD lead invited to PA Silver Jackets webinars and meetings.
Action 5-1g. Collaborate with higher education institutions to identify existing ~~incorporate~~ hazard mitigation ~~into relevant~~ curricula, gaps, and suggest new curricula.	All Hazards	~~PDE~~; PEMA; County EMAs; PA Commission for Community Colleges; ~~PA Association of Colleges and Universities~~ PASSHE	Staff time	Oct-23	~~Work with PA Commission for Community Colleges and PA Association of Colleges and Universities to identify candidate institutions with relevant~~	Complete. Modify action and measure of success to identify existing hazard mitigation curricula at educational institutions and identify gaps based on current needs. Remove PDE as lead agency as the action is outside of agency purview. Remove PA Association of Colleges and Universities as a support agency as the organization has disbanded. Former members were PASSHE, Pitt,

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					~~programs.~~ Identify curricula needed to meet hazard mitigation needs.	Temple, Penn State, Lincoln, and AICUP.
Action 5-1h. Prepare hazard mitigation information to disseminate to specific audiences (i.e. multi- lingual, special needs).	All Hazards	PEMA; Counties; FEMA Region 3; organizations that organize jurisdictions; NGOs	Staff time	Oct-23	Create a list of hazard mitigation topics and target audiences.	Complete and continue. PEMA participated in and presented HMP info to PA Grant Equity Working Group at a meeting.
Action 5-1i. Develop and conduct education efforts that increase residential and business owners' knowledge and awareness of mitigation grants by conducting various outreach activities.	Flood	PEMA; Counties; FEMA Region 3; state associations	Staff time	Annually	Complete four sessions per year.	Complete and continue.
Action 5-1j. Work with county and municipal officials to educate property owners	Flood	~~DCED~~, FEMA Region 3, PEMA	CAP-SSSE and Risk MAP	Continuous	Document meeting dates and outreach for HMA in	Complete and continue. Remove DCED as lead agency as NFIP management has transferred to PEMA.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
about grandfathering and revisions to the NFIP program.					detail for 2018 SHMP.	
Action 5-1k. Increase Pennsylvania participation in the CRS program through a State education strategy.	Flood	~~DCED~~; PEMA	Staff time	Ongoing	Implement State CRS outreach Strategy; Develop a CRS Checklist that lists common activities within the Commonwealth and corresponding points to encourage communities to participate in the program; Designate a State-CRS representative.	Complete and continue. Remove DCED as lead agency as NFIP management has transferred to PEMA.
Action 5-1l. Increase public and private awareness about cyber threats.	Cyber-terrorism	PEMA; GOHS	Staff time	Dec-21	~~Document public and private sector participation in the U.S. Department of~~	Complete and continue. Modify measure of success to 'Continue to provide public/private sector cyber security outreach.'

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					~~Homeland Security's national public awareness campaign, 'Stop. Think. Connect.'~~ Continue to provide public/private sector cyber security outreach.	
Action 5-1m. ~~Work with Pennsylvania Department of Health to increase~~ Raise broad awareness about ~~treating and preventing opioid addiction~~ substance use disorder (SUD) to reduce stigmatizing attitudes.	~~Opioid Addiction Response~~ Substance Use Disorder	DDAP; PCCD; DHS; DOC; PA Board of Pardons; PA Parole Board; PEMA; DOH; DMVA; PDE; PDA (Aging); PID: DGS; OA; PennDOT; PSP; DEP; Juvenile Court Judges' Commission; PLCB; OVA; PA Gaming Control Board; PA Lottery	Staff time	Ongoing	~~Include opioid addiction response as a topic in PEMA Commonwealth sponsored conferences.~~ Reinforce whole community resiliency, continuity planning and recovery concepts while providing an awareness on	Complete. Modify action and move under new objective addressing Substance Use Disorder (Objective 3-3). Change Opioid Addiction Response to Substance Use Disorder. In 2018 the Opioid Command Center was created within DOH to coordinate the Commonwealth's response to the opioid crisis. The Opioid Command Center increased awareness about the health crisis, helped to reduce stigma, and distributed over 9,000 doses of naloxone. Distribution was coordinated through PCCD. Addressing Substance Use Disorder has shifted to DDAP. The wording of the action has been modified by DDAP. DDAP will work

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
		Commission; DCED			substance use disorder and behavioral health response during disasters through regionalized events and continuity trainings.	with identified support agencies on an ongoing basis through the reporting period to address the action.
Action 5-1n. Brief emergency management officials on resources available to respond to ~~opioid addiction~~ substance use disorder in their community.	~~Opioid Addiction Response~~ Substance Use Disorder	DDAP; OSFC; PSP; PEMA; DOH BEMS; DOC	Staff time	Ongoing	Include ~~opioid addiction response~~ substance use disorder as a topic in emergency management officials' training including the potential for hazardous materials conditions when responding to incidents.	Complete. Modify action and move under new objective addressing Substance Use Disorder (Objective 3-3). Change Opioid Addiction Response to Substance Use Disorder. Identify DDAP as lead agency with the Office of State Fire Commissioner (OSFC), PSP, and DOC as support agencies. Add action involving distribution of naloxone (see Action 3-3d, Table 6.4-2).

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
					Training should include: crisis response, stigma awareness, poly-drug use, naloxone and fentanyl test strips, addressing common misconceptions about overdosing by touching fentanyl.	
Action 5-1o. Include recovery and resiliency planning as an outreach topic over the planning period.	All Hazards	PEMA	Staff time	Oct-23	Recovery and resiliency added to agendas for upcoming PEMA training and outreach.	Complete and continue. Recovery and resiliency information has been integrated to all presentations and classes on HM planning and projects, and is briefed at PEMA quarterly trainings.
Action 5-1p. Include the impact of flooding on the agricultural sector as a training and outreach topic	Flood	PEMA; DOA; Penn State Extension; USDA Farm Service Agency	Staff time	Oct-23	Flooding impacts to the agricultural sector added to agendas for upcoming	Complete and continue. Add USDA Farm Service Agency as support agency.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
over the planning period.					PEMA training and outreach.	
Action 5-1q. Increase awareness about the impacts of Climate Change.	~~Climate Change~~ Extreme Temperature; Floods; Hurricane, Tropical Storm, Nor'easter; Landslide	PEMA; DEP; DOH	Staff time; FEMA BRACE; FEMA BRIC	Ongoing	Include climate change as a topic in ~~PEMA~~ Commonwealth sponsored conferences. Conduct Joint Agency outreach (DEP, DOH) for local communities on how climate change impacts citizens.	Complete and continue. Governor's Executive Order 2021-07 established the Office of Environmental Justice within DEP to address the adverse impacts of climate change on low-income residents, communities of color, and vulnerable residents and created an Environmental Justice Interagency Council. Identify DEP as lead agency. Add DOH as a support agency. Add FEMA BRIC and BRACE to funding sources. Change measure of success to 'Conduct Joint Agency outreach (DEP, DOH) for local communities on how climate change impacts citizens.' Under Hazard replace Climate Change with those hazards impacted by Climate Change.
Action 5-1r. Develop and implement a comprehensive community education program for youth and families about hazards and mitigation (CREATE Resilience:	All Hazards	Nurture Nature Center, NWS, NOAA, Northampton County Emergency Management Agency	NOAA Office of Education Environmental Literacy Grant	Sep-22	New program that may be shared with other locations in Commonwealth .	Complete. Move to Capability. Resources housed on the Nurture Nature Center CREATE Resilience website: https://nurturenaturecenter.org/create-resilience/

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
Community Resilience through Education, Art, Technology and Engagement).						
Objective 5-2: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications between 2019 and 2023.						
Action 5-2a. Increase outreach to the 110 priority communities impacted by flooding as identified by PEMA.	Flood	PEMA; FEMA; ~~DCED~~	Staff time	Ongoing	Through the annual Risk Reduction Consultation, develop a strategy to outreach to priority communities and implement the strategy.	Complete and continue. Update on priority community outreach provided at 6 Month RRC Check-Ins. Remove DCED as support agency as NFIP management has transferred to PEMA.
Action 5-2b. Conduct one meeting annually in each region of the state targeting RL and SRL community officials who serve as HMA grant sponsors.	Flood	PEMA; ~~DCED~~; Counties	EMPG; FMA; HMGP	Oct-23	Document meeting dates and outreach for 2023 SHMP.	Complete and continue. Remove DCED as support agency as NFIP management has transferred to PEMA.
Action 5-2c. Use the RL/SRL marketing and implementation	Flood	PEMA; Counties; ~~DCED~~	HMGP when under a	Annually	Submit one story per year to FEMA	Complete and continue. Remove DCED as support agency as NFIP management has transferred to PEMA.

Table 6.1.2-1 Evaluation of 2018 Mitigation Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Evaluation
program successes in PA communities as a platform for outreach efforts to other RL/SRL communities.			disaster declaration		website, KEMA Newsletter, PEMA Pointers, and SJ Buzz.	
Action 5-2d. Provide an update on SRL and RL mitigation strategies and accomplishments at the annual Commonwealth of Pennsylvania Emergency Management Conference.	Flood	PEMA; ~~DCED~~	Staff time	Annually	Ensure slot on agenda annually in March.	Complete and continue, updated provided at KEMA conference. Remove DCED as support agency as NFIP management has transferred to PEMA.

6.2. State Mitigation Strategy

6.2.1 Developing 2023 Goals and Objectives

With input on goals and objectives received from the SPT as summarized in Table 6.1-1, the updated risk and capability assessments were analyzed to identify potential changes that should be considered when developing 2023 goals and objectives. Additionally, national priorities identified by FEMA such as climate change mitigation and adaptation and disadvantaged communities that are marginalized, overburdened, and underserved - longstanding Pennsylvania priorities as well - were considered when developing goals and objectives for the 2023 mitigation strategy.

The risk level of several hazards at the national, state, regional, and local levels, as documented in the Risk Assessment (Chapter 4), warrants renewed and expanded focus on existing hazards. Renewed and expanded focus on existing hazards requires either the modification of existing goals and objectives or the development of new goals and objectives.

Pennsylvania's five (5) goals did not require modification in the 2023 mitigation strategy as it was determined that addressing identified risks could be accomplished through the existing goals combined with the modification of existing or addition of new objectives. Therefore, each of the goals from the 2018 State HMP carried forward to the 2023 State HMP.

The addition of new objectives along with new actions under existing objectives addresses hazards with increased risk as well as FEMA priorities. The following sections provide details on new objectives included in the 2023 mitigation strategy.

6.2.1.1 Floods

Flood, Flash Flood, and Ice Jam has been ranked as Pennsylvania's highest risk hazard in each state level HMP prepared. The priority that PEMA and numerous SPT members have placed on addressing flooding is documented in the Capability Assessment and in the 2018 mitigation strategy. After review of the 2018 mitigation strategy and a meeting held in November 2022 with DEP, DEP identified adding a new objective focused on addressing funding shortfalls to repair existing, aging infrastructure like levees.

The 2023 HMP adds one (1) new objective to address Floods as well as Levee Failure. Under Goal 1, the following objective is added:

- Objective 1-16: Increase the funding available to communities for rehabilitation of existing flood protection projects that will mitigate the aging infrastructure and protect at risk structures against hazards by 2028.

6.2.1.2 Substance Use Disorder

Pennsylvania added Opioid Addiction as a hazard in the 2018 HMP. For the 2023 HMP update, Opioid Addiction was changed to Substance Use Disorder to focus not on a particular class of drugs, but to reflect Substance Use Disorder (SUD) as a complex condition in which there is continued use of substance(s) despite harmful outcomes. It is ranked as the 2nd highest risk hazard in the 2023 HMP update.

Pennsylvania has been particularly focused on addressing SUD over the past decade. The Commonwealth created the Department of Drug and Alcohol Programs (DDAP) in 2012. Formerly a bureau under the Pennsylvania Department of Health, identifying DDAP as a separate state agency reflects the strong commitment to support education, intervention, treatment, and recovery to reduce addiction to substances, as well as gambling, in Pennsylvania.

The 2023 HMP adds one (1) new objective to address Substance Use Disorder. Under Goal 3, the following objective is added:

- Objective 3-3: Identify opportunities to support citizens impacted by Substance Use Disorder.

New actions included under this objective focus on community crisis prevention and existing and new SUD mitigation strategies. Several actions addressing substance use disorder from the 2018 HMP will be moved under this new objective.

Additional details pertaining to Substance Use Disorder are included in Section 4.3.33 and the Capability Assessment (Chapter 5).

6.2.1.3 Pandemic

The COVID-19 Pandemic began mid-way during the HMP planning period. While Pandemic has been profiled in past Pennsylvania HMPs, the magnitude of the Pandemic and the vast amount of health, social, and economic disruption it caused, necessitates additional focus in the 2023 HMP. Pandemic was ranked as a medium risk hazard in the 2018 HMP and is ranked as a high risk hazard in the 2023 HMP.

The 2023 HMP adds one (1) new objective to address Pandemic. Under Goal 3, the following objective is added:

- Objective 3-7: Increase Commonwealth efforts to mitigate the adverse impacts of Pandemics and other healthcare incidents.

Several new actions are added under this objective and additional actions are included under existing objectives.

Additional details pertaining to Pandemic are included in Section 4.3.15 and the Capability Assessment (Chapter 5).

6.2.1.4 Climate Change

Since 2013 Climate Change has been incorporated into profiles of hazards that may be exacerbated by Climate Change such as Floods, Extreme Temperature, and Utility Interruption. Pennsylvania has been addressing Climate Change for nearly two decades. The Commonwealth developed its first Climate Action Plan in response to the Pennsylvania Climate Change Act (Act 70 of 2008), which required DEP to prepare a climate action plan regularly. The first Climate Action Plan was developed in 2008 and *Pennsylvania Climate Action Plan 2021* is the most current. Several actions added to the mitigation strategy are recommendations from the State Climate Action Plan. Refer to Section 6.4.1.3.

The 2023 HMP adds two (2) new objectives to address Climate Change. Under Goal 1, the following objective is added:

- Objective 1-17: Implement hazard mitigation projects that address Climate Change.

This objective focuses on specific physical projects that address Climate Change such as the deployment of EV infrastructure, implementing clean energy generation projects, improving electric grid resilience, and reducing the impact of urban heat islands.

Under Goal 3, the following objective is added:

- Objective 3-6: Integrate Climate Change into hazard mitigation planning.

This objective focuses on integrating ongoing Climate Change planning efforts such as planning for microgrids, mitigating greenhouse gases, and addressing climate impacts adaptation priorities into hazard mitigation planning.

6.2.1.5 Disadvantaged Communities that are Marginalized, Overburdened, and Underserved

Pennsylvania acknowledged the importance of addressing the needs of disadvantaged communities that are marginalized, overburdened, and underserved through the establishment of the Environmental Justice initiative in 1999. At that time, an Office of Environmental Justice was established within DEP as well as a statewide Environmental Justice Work Group. The Work Group produced the Environmental Justice Work Group Report with recommendations implemented through an Environmental Justice Advisory Board.

Governor's Executive Order 2021-07 strengthened existing Environmental Justice initiatives by expanding responsibilities of the Office of Environmental Justice. The following items are addressed in Executive Order 2021-07.

- Make recommendations to DEP's Secretary on integration of Environmental Justice considerations; coordinate the Environmental Justice Interagency Council; and staff the Environmental Justice Advisory Board.
- May establish an online repository of Environmental Justice information and data.
- May establish may establish an Environmental Justice mapping tool to examine environmental and health impacts on vulnerable Pennsylvania communities with additional data provided by other agencies at the request of the OEJ.

- Shall work with other DEP program offices to identify economic development opportunities, environmental benefits, and funding opportunities that do, or should, consider Environmental Justice in the grant awarding process.
- Shall develop and publish an Environmental Justice strategic plan (EJ Plan) every five (5) years.
- Shall develop a revised comprehensive Environmental Justice Policy.

The Executive Order also establishes the Environmental Justice Advisory Board (EJAB) within DEP and establishes the Environmental Justice Interagency Council (EJIC) to include members from DEP, DCNR, DOE, PDA (agriculture), DOH, PennDOT, DCED, and other agencies as determined by the Governor.

The 2023 HMP adds two (2) new objectives to address disadvantaged communities that are marginalized, overburdened, and underserved. Under Goal 3, the following objective is added:

- Objective 3-4: Enhance the resilience of historically underserved and marginalized communities.

This objective focuses on planning activities that will benefit Pennsylvania underserved and marginalized citizens whose environment has been negatively impacted by land use decisions.

Under Goal 3, the following objective is added:

- Objective 3-5: Ensure the requirements of ADA and Section 504 of the Rehabilitation Act of 1973 (Section 504) are applied to emergency preparedness to make certain persons with disabilities are accommodated (or served) during a hazard incident.

Similar to Objective 3-4, this objective focuses on planning activities for underserved and marginalized citizens whose environment has been negatively impacted by land use decisions. The objective differs in that it emphasizes accommodations for persons with disabilities during a hazard incident. This objective was suggested by Disability Rights PA, an organization representing the interests of citizens with disabilities and a new participant in the HMP planning process for the 2023 HMP.

6.2.2 2023 Goals and Objectives

6 includes goals and objectives for the 2023 State HMP. Each of the goals from the 2018 HMP will carry forward to the 2023 HMP. Objectives were updated to continue, modify, or remove per SPT comments identified in 1. New objectives were added based on analysis of the updated risk and capability assessments as summarized in Section 6.2.1 above.

Table 6.2.2-1 Updated Goals and Objectives for 2023 State HMP

Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including high-risk properties.

Table 6.2.2-1 Updated Goals and Objectives for 2023 State HMP
Objective 1-1: Continue reduction of flood-related losses (with an emphasis on reducing NFIP identified repetitive loss and severe repetitive loss properties) through promotion of the Commonwealth's flood protection program through local, county, state, and federal partners.
Objective 1-2: Continue implementation of projects prepared for design by the Commonwealth that will mitigate the most vulnerable structures against hazards by 2028.
Objective 1-3: Identify and work toward implementation of ten feasible and cost-effective projects related to the mitigation of critical buildings, state facilities, and infrastructure.
Objective 1-4: Identify projects related to advanced warning within the Commonwealth by 2028.
Objective 1-5: Minimize risk to communities posed by levee structures by increasing participation with Federal standards developed by the Federal Emergency Management Agency and the United States Army Corps of Engineers, focusing on planning and certification if feasible.
Objective 1-6: Continue to provide outreach and training opportunities for local building code enforcers throughout the Commonwealth.
Objective 1-7: Increase coordination, prioritization, and funding availability to address community needs for dam hazards.
Objective 1-8: Encourage aggressive enforcement of floodplain and storm water management ordinances and other all-hazards regulations within the Commonwealth to reduce losses in high risk areas.
Objective 1-9: Promote increased implementation of urban-wild land interface (wildfire) mitigation projects by local communities by 2028.
Objective 1-10: Enhance Commonwealth efforts to address mine/quarry related hazards by increasing inter-agency cooperation.
Objective 1-11: Support the Department of Environmental Protection in addressing hazards associated with shale gas formation extraction and distribution.
Objective 1-12: Ensure reports and databases are updated annually to reflect Repetitive Loss and Severe Repetitive Loss mitigation.
Objective 1-13: Promote Natural Systems Protection mitigation in the Commonwealth between 2024 and 2028.
Objective 1-14: Promote public and private sector CI/KR physical and cyber security.
Objective 1-15: Increase the capacity and effectiveness of Commonwealth NFIP management.
Objective 1-16: Increase the funding available to communities for rehabilitation of existing flood protection projects that will mitigate the aging infrastructure and protect at risk structures against hazards by 2028.
Objective 1-17: Implement hazard mitigation projects that address Climate Change.
Goal 2: Enhance consistent coordination, collaboration, and communications among stakeholders.
Objective 2-1: Promote development of COOP and COG plans for critical infrastructure within the Commonwealth, focusing on water treatment, water supply, and critical goods and services suppliers.
Objective 2-2: Promote integration of mitigation goals, objectives, and actions where appropriate in other federal, state and local planning initiatives by 2028.
Objective 2-3: Support the collection, update, and dissemination of datasets useful for hazard mitigation planning and implementation.
Objective 2-4: Identify local Hazard Mitigation Officers and increase participation by local community representatives in the Commonwealth's Mitigation Planning Team by 50% between

Table 6.2.2-1 Updated Goals and Objectives for 2023 State HMP
2024 and 2028.
Objective 2-5: Continue to support coordination between mitigation, planning, preparedness, recovery, and response personnel throughout the Commonwealth to ensure effectiveness in all-hazard mitigation planning.
Objective 2-6: Support and prioritize collaborative efforts toward recovery and resiliency planning across the Commonwealth.
Goal 3: Provide a framework for active hazard mitigation planning and implementation.
Objective 3-1: Identify opportunities for regional organizations, businesses, and academia to be engaged in hazard mitigation planning.
Objective 3-2: Enable the Pennsylvania Emergency Management Agency to encourage each participating jurisdiction to secure funding and initiate one mitigation action by 2028.
Objective 3-3: Identify opportunities to support citizens impacted by Substance Use Disorder.
Objective 3-4: Enhance the resilience of disadvantaged communities that are marginalized, overburdened, and underserved.
Objective 3-5: Ensure the requirements of ADA and Section 504 of the Rehabilitation Act of 1973 (Section 504) are applied to emergency preparedness to make certain persons with disabilities are accommodated (or served) during a hazard incident.
Objective 3-6: Integrate Climate Change into hazard mitigation planning**.**
Objective 3-7: Increase Commonwealth efforts to mitigate the adverse impacts of Pandemics and other healthcare incidents.
Goal 4: Build legislative and other organizational support and leverage funding for mitigation efforts.
Objective 4-1: Provide opportunities for Pennsylvania Emergency Management Agency and County Emergency Management Agencies to educate State, county and local government officials, and legislators about hazard risk and mitigation by 2028.
Objective 4-2: Expand working relationships with at least two volunteer and professional organizations to improve mitigation efforts within the Commonwealth.
Objective 4-3: Identify statutory, regulatory, or other barriers to completing mitigation efforts within the Commonwealth, and leverage support against these barriers to implement mitigation actions by 2028.
Objective 4-4: Encourage the use of state funding for hazard mitigation for projects and plans.
Goal 5: Increase awareness, understanding, and preparedness across all sectors.
Objective 5-1: Support all-hazards mitigation and preparedness programs to educate private and public stakeholders, academia, government employees and elected officials on the hazards pertinent to the Commonwealth.
Objective 5-2: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications between 2024 and 2028.

6.3. Identification and Analysis of Mitigation Techniques

The goals and objectives identify the focus for hazard mitigation in the Commonwealth for the next five years. However, to effectively minimize losses experienced and reduce risk, the goals and objectives are supported by mitigation actions.

In the 2018 Plan Update, the mitigation actions were classified by four mitigation technique categories outlined in FEMA's Local Mitigation Planning Handbook (March 2013), also included in the Pennsylvania SOG (2020). The four categories include:

- Plans and Regulations: These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.
- Structure and Infrastructure: These actions involve modifying existing structures and infrastructure or constructing new structures to reduce hazard vulnerability. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- Natural Systems Protection: These actions minimize damage and losses to natural systems and preserve or restore the functions of natural systems.
- Education and Awareness Programs: These actions 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. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.

Education and Awareness Programs were the most common mitigation technique deployed in the 2018 mitigation strategy at 52%, followed by Plans and Regulations (34%), Structure and Infrastructure (12%), and Natural Systems Protection (2%).

Pennsylvania's 2023 mitigation strategy uses these four categories of techniques to address each of the hazards that affect the Commonwealth. Hazards listed by risk and the techniques that will be deployed to address each are shown in Table 6.3-1. The risk rankings are detailed in Section 4.1.

Specific actions associated with these techniques are included in Section 6.4. For consistency across hazard mitigation plans, PEMA requires local communities to classify mitigation actions using these four mitigation technique categories per the Pennsylvania SOG. More information on local plan actions can be found in Section 6.5.

Table 6.3-1 Mitigation Techniques for Pennsylvania Hazards

Hazard *(Ordered from Highest Risk Factor to Lowest Risk Factor)* Natural (N) or Manmade (M)	Mitigation Technique			
	Plans and Regulations	Structure and Infrastructure Projects	Natural Systems Protection	Education and Awareness Programs
Flood, Flash Flood, Ice Jam (N)	✓	✓	✓	✓
Substance Use Disorder (M)	✓			✓
Cyber Terrorism (M)	✓	✓		✓
Winter Storm (N)	✓	✓		✓

Table 6.3-1 Mitigation Techniques for Pennsylvania Hazards				
Hazard *(Ordered from Highest Risk Factor to Lowest Risk Factor)* **Natural (N) or Manmade (M)**	**Mitigation Technique**			
	Plans and Regulations	**Structure and Infrastructure Projects**	**Natural Systems Protection**	**Education and Awareness Programs**
Transportation Accidents (M)	✓			✓
EH - Hazardous Materials Release (M)	✓			✓
Extreme Temperature (N)			✓	✓
Hurricane, Tropical Storm, Nor'easter (N)	✓	✓		✓
Pandemic (N)	✓		✓	✓
Utility Interruption (M)	✓	✓		✓
Tornado, Wind Storm (N)	✓	✓		✓
Wildfire (N)	✓	✓	✓	✓
Building and Structure Collapse (M)	✓	✓		✓
Invasive Species (N)	✓		✓	✓
Landslide (N)	✓	✓	✓	✓
Mass Food/Animal Feed Contamination (M)	✓		✓	✓
Dam Failure (M)	✓	✓		✓
Nuclear Incident (M)	✓			✓
Civil Disturbance (M)		✓		✓
Drought (N)	✓	✓	✓	✓
Terrorism (M)		✓		✓
EH - Coal Mining (M)				✓
EH - Gas and Liquid Pipelines (M)	✓			✓
EH - Unconventional Oil and Gas Wells (M)	✓	✓		✓
EH - Conventional Oil and Gas Wells (M)	✓	✓		✓
Coastal Erosion (N)	✓	✓		✓
Lightning Strike (N)		✓		✓
Radon Exposure (N)	✓			✓
Subsidence, Sinkhole (N)	✓		✓	✓
Levee Failure (M)	✓	✓		✓
Earthquake (N)	✓	✓		✓
Hailstorm (N)		✓		✓
Urban Fire and Explosion (M)	✓	✓		✓

6.4. Mitigation Action Plan

The 2023 mitigation strategy addresses existing state-level efforts put in place to address each hazard, identifies new objectives and actions to address gaps, and integrates them into the HMP.

The 2023 mitigation strategy actions reflect the tremendous level of interagency and interorganizational partnerships that exist in Pennsylvania. A total of 219 mitigation actions are included in the 2023 mitigation strategy.

- 123 of the 129 actions in the 2018 mitigation strategy will carry over to the 2023 mitigation strategy.

- 96 new actions are added.

The increase in the number of actions reflects not only Pennsylvania's current risk assessment but PEMA's concerted efforts to increase participation from state agencies, boards, commissions, and other partners.

6.4.1 Discussion of New Mitigation Actions Added

PEMA's goal to ensure the 2023 HMP is a Commonwealth focused plan - focused on the mitigation priorities of many state agencies, boards, authorities, and commissions - resulted in a sizable increase in new mitigation actions. New mitigation actions were developed based on the current risk assessment and input from an expanded number of SPT members. The actions address vulnerability to both jurisdictions within the state as well as state-owned assets.

The process used to develop new mitigation actions was as follows.

- SPT Worksheets: SPT members were encouraged to suggest new mitigation actions in online worksheets available throughout the planning process beginning in June 2022 through January 2023.
- HMP Meetings: Ideas for new mitigation actions were suggested by SPT members during the in person and virtual Risk Assessment, Capability Assessment, and Mitigation Strategy meetings.
- Sector Meetings: New for the 2023 HMP planning process, a total of eight (8) sector meetings, detailed discussed in Section 3 provided the opportunity for SPT members to share additional information informing not only the hazard profiles and Capability Assessment, but new mitigation actions as well.
- One-on-One Input: To ensure the mitigation strategy reflected PEMA's goal to broaden state agency participation, agencies and organizations were contacted individually through phone calls, emails, and meetings as summarized in Section 6.1.

Ideas for new mitigation actions were reviewed with SPT members and developed into draft actions. SPT members then provided input and eventual concurrence on new actions. The following sections highlight how the new actions incorporated into the 2023 mitigation strategy address several high risk hazards as well as FEMA priorities.

6.4.1.1 Substance Use Disorder

The impacts of Substance Use Disorder (SUD) are found in communities across Pennsylvania and the nation. Opioid Addiction was added as a hazard in the 2018 HMP and changing the name of the hazard to Substance Use Disorder in the 2023 State HMP reflects the nationwide approach of reducing the stigma of substance use. Several actions addressing this nationwide concern are included under Objective 3-3: Identify opportunities to support citizens impacted by Substance Use Disorder.

Three (3) new Substance Use Disorder actions will be included in the mitigation strategy. One implements a statewide network operated by PSP to collect overdose information (Action 2-3i). The second supports crisis prevention, intervention, and stabilization behavioral health services, an important alternative to incarceration or unnecessary emergency department utilization (Action 3-3c). The third new action supports the continued distribution of naloxone as required

as well as monitoring emerging mitigation strategies as they are developed, and as harm reduction methods are legalized in Pennsylvania (Action 3-3d). Two (2) actions from the 2018 Mitigation Strategy will be included under the Objective 3-3. These actions have been updated to reflect SUD and will be integrated with ESF 6, ESF 8, and additional ESFs to be identified. Existing 2018 Action 5-1m, now Action 3-3a, has been updated to include a comprehensive list of support agency partners DDAP will work with collaboratively over the planning period to raise awareness about SUD and reduce stigmatizing attitudes. Through this action, DDAP will work with each support agency to strengthen existing partnerships and establish new partnerships to address the Substance Use Disorder hazard.

6.4.1.2 Pandemic

Fifteen (15) new actions were developed to help mitigate Pennsylvania from the future impacts of a pandemic, infectious disease, and other health care incidents. The actions reflect input from multiple agencies and organizations having responsibility of working through the impact of the COVID-19 pandemic first hand and address broad topic areas ranging from readily available PPE (Actions 3-7b and 3-7c), to ensuring future health care workers are available and trained (Action 3-1f), to addressing legislative barriers to delivery needed commodities such as milk in times of crisis (Actions 4-3f and 4-3g). Pandemic focused actions are included in Objective 3.7: Increase Commonwealth efforts to mitigate the adverse impacts of Pandemics and other healthcare incidents as well as interspersed throughout other goals and objectives.

6.4.1.3 Climate Change

As noted in Section 6.2.1.4 Pennsylvania has been addressing Climate Change for more than 20 years. With new federal funding to mitigate impacts, Pennsylvania is well-positioned to implement projects planned over the past few decades. Several new actions address hazards such as Extreme Temperature, Floods, and Utility Interruption that are impacted by Climate Change. These actions are included in the mitigation strategy primarily under two (2) new objectives focused on projects, infrastructure, and planning:

- Objective 1-17: Implement hazard mitigation projects that address Climate Change.
- Objective 3-6: Integrate Climate Change into hazard mitigation planning.

Ensuring the resilience of Pennsylvania's electric infrastructure and addressing extreme temperatures is addressed in actions such as implementing clean onsite energy generation projects (Action 1-17d); developing a plan for resilient electric power at critical facilities to optimize clean energy generation technology such as PV solar plus and energy storage microgrids (Action 3-6a); and tracking and encouraging the implementation of greenhouse gas mitigation strategies laid out in *Pennsylvania Climate Action Plan 2021* (Action 3-6c).

6.4.1.4 Disadvantaged Communities that are Marginalized, Overburdened, and Underserved

As discussed in Section 6.2.1.5 above, Pennsylvania has been working with disadvantaged communities that are marginalized, overburdened, and underserved through the Environmental Justice Initiative since 1999. Several new actions addressing environmental justice and disadvantaged communities that are marginalized, overburdened, and underserved are included under Objectives 3-4 and 3-5.

With historic levels of federal funding available in recent years and the federal government's Justice40 Initiative, Commonwealth agencies have worked together to ensure communities that have been historically left out of funding opportunities, due in part to lack of organizational capacity, are prepared. Action 3-4c was developed to incorporate Justice40 goals into state grant funding criteria. Pennsylvania's Funding Equity Interagency Workgroup, representing nineteen (19) state agencies and organizations, has been developing protocols to simplify the application process for historically underserved and marginalized populations. The mitigation strategy includes an action focusing on these protocols (Action 3-4b). PENNVEST, the Commonwealth authority funding clean water projects, has committed to increase the number of environmental justice and disadvantaged communities applying for and receiving funding by more than 42% (Action 3-4d). Finally, affordable housing is an ongoing, critical concern for underserved and marginalized citizens in Pennsylvania and throughout the nation. Encouraging the development of disaster resistant affordable housing to ensure lower income communities remain resilient during future hazard events is addressed in Action 3-4f.

6.4.2 Assessment of Mitigation Actions

Prioritizing mitigation actions over the next five years was important to ensure the SPT has clear direction once the HMP is finalized. To prioritize actions, the Multi-Objective Mitigation Action Prioritization criteria outlined in the Pennsylvania SOG and reviewed and approved by the SPT during preparation of the 2023 was applied to each of the 218 mitigation actions.

Scores were assigned to each criterion using the weighted, multi-objective mitigation action prioritization criteria outlined in Table 6.4.2-1.

Table 6.4.2-1 Multi-Objective Mitigation Action Prioritization Criteria

Mitigation Action Ranking Criteria	Criteria Description	Weight Value
Effectiveness	The extent to which an action reduces the vulnerability of people and property.	20%
Efficiency	The extent to which time, effort, and cost is well used as a means of reducing vulnerability.	30%
Multi-Hazard Mitigation	The action reduces vulnerability for more than one hazard.	20%
Addresses High Risk Hazard	The action reduces vulnerability for people and property from a hazard(s) identified as high risk.	15%
Addresses Critical Communications/Critical Facilities	The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.	15%

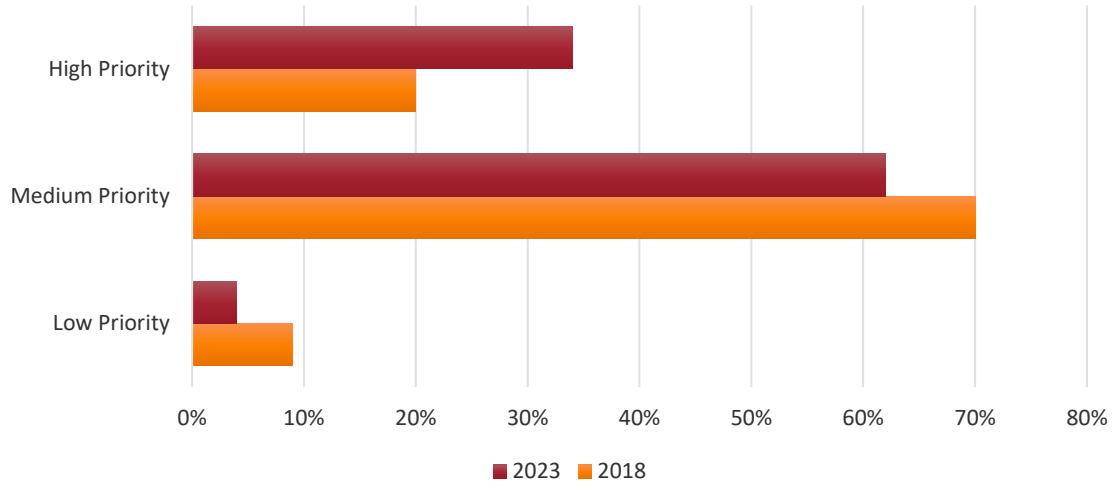
Applying the mitigation action assessment criteria resulted in an overall score between 0 and 3 where a score of 0 is of the lowest priority and a score of 3 is of the highest priority. Mitigation actions were categorized as High, Medium, and Low as follows:

- High Priority: 2.5 - 3.0
- Medium Priority: 1.9 - 2.4
- Low Priority: 0 - 1.8

The prioritization ensures cost-effective activities that address high ranking or multiple hazards and critical facilities are given priority. The high, medium, and low rankings are illustrated by color in the 2023 Mitigation Strategy included in Section 6.4.3 (Table 6.4-2) where each action is labeled red (high), yellow (medium), or green (low). The color-coded labels allow easy identification of the urgency of assigned actions and makes it easier to focus on high priority actions throughout the five-year planning period.

The SPT reviewed the results of the evaluation and prioritization process during review of the draft HMP in March and April 2023. SPT comments were incorporated into the evaluation. The percentage of high ranked actions in the 2023 mitigation strategy increased compared to the 2018 mitigation strategy. Refer to Figure 6.4.2-1.

Figure 6.4.2-1 Mitigation Actions by Priority (2018 and 2023).



The prioritized actions and associated numerical rankings for the 2023 mitigation strategy are included in Appendix I.

6.4.3 2023 Mitigation Strategy

The 2023 mitigation strategy was prepared by incorporating comments and evaluations from the SPT along with the analysis of Risk Reduction Priorities presented in Section 6.4.4. The 2023 mitigation strategy includes 218 actions presented in Table 6.4.2-2.

- Existing Actions: The 2018 mitigation strategy included 129 actions. A total of six (6) actions were completed and moved to capabilities or removed from the plan per the evaluation included in Table 6.1-2. Therefore, a total of 123 existing actions carried over to the 2023 mitigation strategy. Many existing actions were modified as reflected in Table 6.1-2.
- New Actions: 99 new actions were added as discussed in Section 6.4.1. The new actions reflect PEMA's concerted outreach to ensure the mitigation strategy reflects actions developed by a broad array of state agencies, boards, and commissions.

Table 6.4-2 includes the following information for each of the 218 actions:

- A general description of the mitigation action;
- The hazard(s) it is designed to mitigate;
- The agency assigned responsibility for carrying out the strategy (the primary or Lead agency is the first listed);
- Potential funding sources in place at the time the SHMP was prepared, if applicable;
- A target completion date;
- Measure of success to demonstrate success over the planning period; and
- Priority (using the mitigation action prioritization system described in Section 6.4.2).

Actions are arranged by goal and objective and will be a useful tool during annual state plan reviews. See the List of Acronyms in the Table of Contents for a list of definitions for acronyms referenced in the table. While the lead and support agencies listed in throughout are committed to completing mitigation actions within the target completion date identified, completion is subject to staff capacity and financial resources available during the planning period. The actions listed in the mitigation strategy do not legally bind agencies to complete actions.

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including high-risk properties.						
Objective 1-1: Continue reduction of flood-related losses (with an emphasis on reducing NFIP identified repetitive loss and severe repetitive loss properties) through promotion of the Commonwealth's flood protection program through local, county, state, and federal partners.						
Action 1-1a. Support the maintenance of existing flood protection projects and construction.	Floods	DEP; DCED; DGS; USACE; USDA; NRCS; Local Communities	DCED/CFA Act 13 Flood Mitigation Program; DEP Growing Greener Watershed Protection Grants; PENNVEST; Capital Budget; Clean Water Fund; USACE; USDA NRCS; FEMA BRIC; FEMA FMA	Ongoing	Ensure existing flood protection projects are operated and maintained to ensure a state of readiness. Provide workshops for Project Sponsors to discuss maintenance tips and latest technology.	High
Action 1-1b. Participate in discussions about potential solutions/policy changes regarding farmland flooding due to stream impediments.	Floods	PEMA; PDA (Agriculture); DCED; USDA Farm Service Agency; Penn State Extension; County	Agency Legislative Liaisons Agency operating budget; Legislative Officials Agency operating budget; FEMA	December 2028	Determine feasibility of developing supporting legislation. Develop policies to prioritize crop and livestock support infrastructure during hazard	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
		Conservation Districts	Cooperating Technical Partners (CTP) Program; FEMA BRIC; FEMA FMA		incidents, flagging farm risks as a priority.	
Action 1-1c. Target SRL and RL properties for mitigation (including demolition, acquisition, and elevation) during annual HMA project review and prioritization process.	Floods	PEMA; Counties; DCED; PAFPM; Local Floodplain Managers	FEMA Hazard Mitigation Assistance Programs; Agency operating budget	December 2024	Mitigate five or more SRL properties per year. Use the list of 'shovel ready' projects from recent DRs to facilitate mitigation project application process for future funding opportunities.	High
Objective 1-2: Continue implementation of projects prepared for design by the Commonwealth that will mitigate the most vulnerable structures against hazards by 2028.						
Action 1-2a. Maximize use of FEMA HMA grant and other programs to support all-hazard mitigation as well as acquisition/ demolition, elevation, and relocation of flood- prone residences along with flood-proofing of non-residential structures.	Floods; All Natural Hazards	PEMA; Local jurisdictions	FEMA Hazard Mitigation Assistance Programs; CDBG-DR; USACE	December 2028	Identify at least 100 structures to be acquired/ demolished/ elevated/ relocated with FEMA HMA grant support.	High
Action 1-2b. Increase FEMA HMGP Section 404 funding and identify Public	All Hazards	PEMA	FEMA Section 404 -b. Hazard Mitigation Grant	December 2028	Identify at least five projects to be funded by FEMA HMGP Section 404 and	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Assistance Program Section 406 projects.			Program; FEMA Section 406 - Public Assistance Program		Public Assistance Program Section 406.Track and share success stories.	
Action 1-2c. Mitigate buildings and structures, including historic structures, at risk from the impacts of natural and human- made hazards.	Building and Structure Collapse; Floods	PEMA; PA SHPO	FEMA Hazard Mitigation Assistance Programs; CDBG-DR; PHMC Keystone Historic Preservation Construction Grant Program; NPS Federal Rehabilitation Investment Tax Credit Program.	December 2028	Mitigate at least five buildings and/or historic structures.	High
Action 1-2d. Administer American Rescue Plan funding per state statute (HB 1421 of 2021-22) to implement best management practices to reduce nutrient runoff.	Floods	PDA (Agriculture); DEP; PACD; DCNR; County Conservation Districts (as delegated)	American Rescue Plan	December 2026	Allocate and disperse funding in accordance with state statute.	High
Objective 1-3: Identify and work toward implementation of ten feasible and cost-effective projects related to the mitigation of critical buildings, state facilities, and infrastructure.						

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-3a. Define critical infrastructure/key resources (CI/KR) in terms of mitigation.	All Hazards	PEMA; GOHS; FEMA Region 3 PSA Office	Agency operating budget	December 2024	Update the definition of critical infrastructure /key resources (CI/KR) in the SOG.	High
Action 1-3b. Establish and sustain a business, industry, and infrastructure subcommittee on the regional task force level.	All Hazards	PEMA; L&I; DCED; OHS; DHS; GOHS; PSP; OA; PUC; DOS; DOH	Agency operating budget; PSP	Ongoing	Coordinate with Regional Task Forces and key private industry sectors to bridge information.	Medium
Action 1-3c. Leverage support of the eight (8) Regional Task Forces to support critical infrastructure mitigation.	All Hazards	PEMA; Regional Tasks Forces	DHS Hardening/Protection related funding; Homeland Security Grant Program.	December 2028	Complete one (1) project through each Regional Task Force.	Medium
Action 1-3d. Identify insurable state-owned flood-prone buildings and appropriate mitigation methods if located in the special flood hazard area (SFHA).	Floods	DGS; PEMA MIRC Office; DCNR	FEMA Hazard Mitigation Assistance Programs; USACE	December 2028	Continue to coordinate with DGS to see progress of DGS database for use in State Enhanced HMP Support.	Medium
Action 1-3e. Evaluate state-owned structures for mitigation options for non-	All Hazards	PEMA; Identified State Agencies	Homeland Security Grant Programs 20%	December 2026	Conduct a workshop with state agencies to identify state- owned structures	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
flood related high-priority hazards.			Portion; FEMA BRIC		vulnerable to high priority hazards.	
Action 1-3f. Provide emergency electrical backup generation to key state, county, and municipal critical infrastructure.	All Hazards	PEMA, FEMA; DHS	FEMA Hazard Mitigation Assistance Programs; HMGP 5% initiative	December 2026	Continue to identify and prioritize emergency backup generation projects, including pad and patch panel installation. Submit five projects.	High
Action 1-3g. Add internet interruption to the list of reportable incidents in Knowledge Center.	Utility interruption	PEMA, Counties; PUC; DEP	Agency operating budget	December 2026	Data tracking in place for utility interruption incidences that can be used for hazard mitigation planning.	Low
Action 1-3h. Bolster available geospatial data for critical facilities to include more characteristics, such as function, elevation, and community lifeline designation.	All Hazards	PEMA	Agency operating budget	Ongoing	Database created that includes additional characteristics beyond location and ownership. Utilize information in next plan update	Low
Objective 1-4: Identify projects related to advanced warning within the Commonwealth by 2028.						
Action 1-4a. Support the sustainment and enhancement of	Terrorism; Civil Disturbance	PSP; OHS; OAG	Department of Homeland Security (DHS) Grant Funding	Ongoing	Continue to support the operation of Commonwealth fusion centers.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Commonwealth fusion centers.						
Action 1-4b. Promote reverse notification systems in high-hazard areas.	All Hazards	Counties (911 Operations)	DHS Grant Funding; Act 78 of 1990 (Public Safety Emergency Telephone Act) Funding	Ongoing	Identify and catalog success stories of jurisdictions utilizing reverse notification systems.	Medium
Action 1-4c. Increase participation in Alert PA.	All Hazards	OA	Agency operating budget	Ongoing	Continue to increase participation in Alert PA.	Medium
Action 1-4d. Establish Water Monitoring Council Action to improve stream gauge coordination in the Commonwealth.	Floods	USGS; River Basin Commissions; PEMA; DEP; DCNR; NWS; USACE; Water Authorities; Municipalities; FEMA; PaWARN	USGS; USACE; DEP; C2P2 Grant Funding; Water Authorities; Municipalities; FEMA BRIC	December 2028	A consistently meeting Council and an updated dashboard of monitoring/weather data.	Medium
Action 1-4e. Complete inundation mapping for high risk and high population centers.	Floods	SJ Initiative including USGS; USACE; NWS; PEMA; River Basin Commissions; FEMA	USGS; USACE; FEMA CTP; FEMA BRIC; FEMA FMA	July 2026	Complete one flood inundation mapping project and related outreach per year based on funding availability.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-4f. Support PSP in conducting increased Risk and Vulnerability Assessment Team (RVAT) assessments per the requirements of Act 18 of 2019.	Terrorism; Civil Disturbance	PSP; PDE; PSBA; PCCD	Safe Schools Targeted Grants	Ongoing	Conduct RVAT assessments annually as requested by support agency partners.	High
Action 1-4g. Ensure Pennsylvania Wing Civil Air Patrol interoperability with the Commonwealth's communications network and prepare to provide communications support during hazard incidents.	All Hazards	CAP; PEMA	Agency operating budget	December 2028	CAP communications infrastructure is interoperable with the Commonwealth's communications network.	Medium
Objective 1-5: Minimize risk to communities posed by levee structures by increasing participation with Federal standards developed by the Federal Emergency Management Agency and the United States Army Corps of Engineers, focusing on planning and certification if feasible.						
Action 1-5a. Re- examine impacts of federal levee guidance and identify necessary actions.	Floods; Levee Failure	DEP; USACE; FEMA; PEMA MIRC Office; DCED; DCNR; PFBC	Act 13 Flood Mitigation Grants; Agency operating budget; FEMA BRIC; USACE	Ongoing	Support USACE in efforts to conduct inspections and risk assessments of non-Program levees.	Medium
Action 1-5b. Support non-state and non- federal levee owners, identified in the National Levee Inventory, with information on	Floods; Levee Failure	DEP; PEMA; USACE; FEMA	Act 13 Flood Mitigation Program; FEMA	Ongoing	Support USACE outreach activities with levee owners.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
compliance with the National Levee Safety Program and appropriate funding streams.			BRIC; Agency operating budget			
Action 1-5c. Assist flood protection project sponsors with developing project specific EAPs including inundation maps.	Floods; Levee Failure	DEP; USACE; PEMA; levee owners; County EMAs	Agency operating budget; FEMA BRIC	Ongoing	Increasing percentage of completed and updated EAPs.	Medium
Action 1-5d. Identify and work with local sponsors of state levee systems, given an unacceptable or minimally acceptable rating, to bring them back up to acceptable rating.	Floods; Levee Failure	DEP; DCED; USACE	Agency operating budget; Capital Budget; Act 13 Flood Mitigation Program; FEMA BRIC	Ongoing	Explore funding opportunities to provide support for levee project improvements.	Medium
Action 1-5e. Encourage local, state, and federal levee system sponsors to develop Emergency Action Plans.	Floods; Levee Failure	USACE; DEP; Counties; Local Municipalities	Agency operating budget	Ongoing	Obtain Emergency Action Plans for all state levee systems.	Medium
Action 1-5f. Encourage local levee system sponsors to complete levee conduit inspections.	Floods; Levee Failure	USACE; FEMA; PEMA; DEP; Local Municipalities	Agency operating budget; DEP; FEMA BRIC	Ongoing	Coordinate and provide funding for levee conduit inspections every 5 years or as required by USACE for all state levee systems.	High
Objective 1-6: Continue to provide outreach and training opportunities for local building code enforcers throughout the Commonwealth.						

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-6a. Continue to conduct statewide training for building code officials.	All Hazards	FEMA Region 3 Building Science Officer; PEMA; DCED; DEP EPO; CERC provider: PCCA (PML)	HMGP 5% Initiative; FEMA BRIC; HUD CBDG	Ongoing	Continue to provide training at locations throughout Pennsylvania.	Medium
Action 1-6b. Provide briefings for code association and county officials on damage assessment expectations following a disaster.	All Hazards	PEMA; FEMA Region 3	EMPG; HMGP; FEMA BRIC; FEMA FMA	Ongoing	Conduct PEMA Disaster Assistance Meetings, as required. Develop the following courses: a best management practices course on damage assessment and methodologies; a disaster webinar for County tax assessors, board of appeals employees, and municipal officials.	Medium
Action 1-6c. Invite PABCO, PACO, and Council of Government organizations (COG) to outreach meetings related to building resiliency and mitigation of structures.	All Hazards	PEMA; DCED; PML	Organizational funding	Ongoing	Invite code enforcement officials to participate in meetings and events.	Medium
Action 1-6d. Promote municipal adoption of the most current Pennsylvania Uniform Construction Code	All Hazards	DEP; PEMA; PML; PSATS; DCED CLGS; L&I	FEMA BRIC; USDOE funding	Ongoing	Improved building code compliance and enforcement.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
(UCC), effective June 15, 2019, to focus on the link between risk reduction and mitigation and ensure energy efficiency across building sectors through outreach, public information, study, and research.						
Objective 1-7: Increase coordination, prioritization, and funding availability to address community needs for dam hazards.						
Action 1-7a. Build on DEP's initiative to require dam owners to complete a dam break analysis and map inundation areas for dams of high hazard potential.	Floods; Dam Failure	DEP; PEMA; Counties; DCNR; PFBC	Agency operating budget; National Dam Safety Program grant; HHPD; USACE Silver Jackets; Dam Owner	Ongoing	Increase percentage each year.	High
Action 1-7b. Identify and implement mitigation actions based on Silver Jacket meeting results.	Floods; Dam Failure	USACE	Agency operating budget	December 2028	Completion of Screening Level Risk Assessments by USACE.	Medium
Action 1-7c. Evaluate and enforce appropriate remediation of dams.	Floods; Dam Failure	DEP Dam Safety; DEP Regional Offices; USACE District Office	Agency operating budget; PENNVEST loan and grant program; Act 13 Flood Mitigation Program;	Ongoing	Report DEP annual records of dam removals.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
			Growing Greener, State Capital Budget, Dam Owner			
Action 1-7d. Ensure that all high hazard dams have an Emergency Action Plan, as required.	Floods; Dam Failure	DEP; PEMA	HHPD; FEMA Dam Safety Program; IIJA; Agency operating budget; Dam owner	Ongoing	Achieve 95% EAP approval.	High
Action 1-7e. Reduce the vulnerability of High Hazard potential Dams (HHPDs) as defined by FEMA.	Floods; Dam Failure	DEP; DCNR, Counties	HHPD Rehabilitation Grant; FEMA BRIC	Ongoing	Securing funding for 8 HHPD in FY19 application cycle. Evaluate HHPDs and apply for funding in subsequent years.	High
Action 1-7f. Implement high hazard dam improvements at PFBC and DCNR dams throughout the Commonwealth.	Floods; Dam Failure	PFBC, DCNR, DEP, DGS	State Capital Budget	December 2028	Complete 5 high hazard dam improvement projects.	High
Action 1-7g. Digitize dam maps and add to the PA Flood Risk Tool.	Floods; Dam Failure	DEP; PEMA; PSU; Dam Owners	FEMA CTP	December 2028	Digitization of dam maps complete and incorporated into the PA Flood Risk Tool.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-7h. Utilize the newest dam classification and prioritization system to develop and update list of dams, including periodic updates to ensure data reflects changing conditions of dams.	Floods; Dam Failure	PEMA; DEP	Agency operating budget	Ongoing	Completed list of dams classified using updated prioritization method.	Medium
Action 1-7i. Develop capability to include underserved and disadvantaged communities in inundation area analysis for HHPDs.	Floods; Dam Failure	PEMA; DEP	Agency operating budget	Ongoing	Add this population data into inundation data for HHPDs. Complete analysis for any new HHPDs that are added to list periodically.	Medium
Objective 1-8: Encourage aggressive enforcement of floodplain and stormwater management ordinances and other all-hazards regulations within the Commonwealth to reduce losses in high risk areas.						
Action 1-8a. Continue to track floodplain management ordinance information including adopted building code(s), other relevant ordinance(s), code(s), regulation(s), etc., and the incorporation of any more restrictive requirements.	Floods; All Hazards	PEMA; FEMA Region 3	FEMA CAP-SSSE; FEMA CTP Grant; FEMA BRIC; FEMA FMA	Continuous	Maintain or increase NFIP participation after FIRM update ordinance reviews. Promote early review and submission of ordinances to DCED.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-8b. Conduct effective outreach with municipalities to explain value of floodplain ordinances and adopting more restrictive requirements.	Floods; All Hazards	PEMA; FEMA Region 3	FEMA CAP-SSSE; PML Training; FEMA BRIC; FEMA FMA	December 2028		Medium
Action 1-8c. Explore the possibility of providing legal support for floodplain management ordinance enforcement to municipalities.	Floods; Al l Hazards	PEMA; FEMA Region 3; State legal counsel; municipal solicitor	Agency operating budget	July 2024	Meet with state and municipal legal counsel.	Low
Action 1-8d. Revise Suggested Floodplain Provisions (model ordinance) using information obtained through the gap analysis and strategic plan (Action 1-15f).	Floods	PEMA	Agency operating budget	December 2025	Distribute Revised Floodplain Provisions for all community ordinance updates.	Medium
Action 1-8e. Schedule and proctor 3 CFM Exams, one each in the Eastern, Central, and Western PEMA Regions every year.	Floods	PAFPM	PAFPM Volunteer Time	December of each year, ongoing	Achieve at least 10 new CFM certifications in Pennsylvania each year.	Low
Action 1-8f. Promote the use of Model Floodplain Ordinances which prohibit	Floods	DCED; PEMA; DCNR	Agency operating budget	December 2028	Ongoing outreach to municipalities on using floodplain ordinances to	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
re/development in the floodplain, except by Conditional Use as outlined in the PA State Planning Board *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.					prohibit development in flood prone areas.	
Objective 1-9: Promote increased implementation of urban-wild land interface (wildfire) mitigation projects by local communities by 2028.						
Action 1-9a. Assess wildfire risk using assessment information available through the USDA Forest Service Wildlife Risk to Community website and the Northeast-Midwest State Foresters Alliance Northeast-Midwest Wildfire Risk Assessment Portal.	Wildfire	DCNR Bureau of Forestry; OSFC	Agency operating budget	Ongoing	Incorporate USDA and Northeast-Midwest resources into decision making.	Medium
Action 1-9b. Conduct outreach, including working with representatives from local governments and communities and state and private landowners to support applications for U.S. Forest Service's Community Wildfire Defense Grants and	Wildfire	DCNR Bureau of Forestry; OSFC	Agency operating budget; U.S. Forest Service Community Wildfire Defense Grants; FMAG	December 2028	Identify any support available to DCNR through the HMP process.	Low

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
FEMA's Fire Management Assistance Grant (FMAG) Program to mitigate wildfire impacts through Community Wildfire Protection Plans, mobilization and demobilization activities, field camps, and equipment.						
Objective 1-10: Enhance Commonwealth efforts to address mine/quarry related hazards by increasing inter-agency cooperation.						
Action 1-10a. Support efforts to complete subsidence mapping in the Commonwealth.	Subsidence/ Sinkhole	DEP – Mining; DCNR; Counties impacted by karst-related hazards.	State Funding	Ongoing	Notify counties, municipalities, and state agencies about resources available to address subsidence; including mine subsidence insurance, if available.	Low
Action 1-10b. Establish best practices and recommendations for karst areas, including land use, resiliency, and infrastructure.	Subsidence/ Sinkhole	DCNR; DEP	Agency operating budget	December 2028	Develop regional best practices and recommendations including an outreach strategy.	Low
Objective 1-11: Support the Department of Environmental Protection in addressing hazards associated with shale gas formation extraction and distribution.						
Action 1-11a. Identify mitigation options for identified impacts and consequences associated	Environmental Hazard -	DEP; PEMA; Counties impacted by shale gas formation extraction	Act 13 Impact Fee	Ongoing	Address impacts as wells are permitted/ drilled.	Low

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
with shale gas formation extraction and distribution.	Unconventional Oil and Gas Wells	and distribution; PUC; Oil and Gas Industry; Pennsylvania 811				
Action 1-11b. Encourage attendance at training courses that enable counties and local governments to mitigate the negative impacts of shale gas formation extraction and distribution.	Environmental Hazard - Unconventional Oil and Gas Wells; Environmental Hazard - Gas and Liquid Pipelines	DEP; OSFC; Partnerships with private sector; Counties impacted by Marcellus Shale; Universities; Pennsylvania 811	Act 13 impact fee	Ongoing	Promote Office of State Fire Commissioner well drilling training and promote US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety (US DOTPHMSA OPS) training webinars as appropriate.	Medium
Action 1-11c. Promote awareness of new pipeline safety guidelines enacted as part of passage of PA Act 50 of 2017.	Environmental Hazard - Gas and Liquid Pipelines	PUC; DEP; Pennsylvania 811	Agency operating budget	Ongoing	Include PA One Call and PA Act 50 as a topic in conferences.	Medium
Objective 1-12: Ensure reports and databases are updated annually to reflect Repetitive Loss and Severe Repetitive Loss mitigation.						
Action 1-12a. Report the successes of flood- related projects in the annual SHMP update and provide a summary in the triennial plan update. Draft annual report	Floods	PEMA	Agency operating budget; CDBG-DR; FEMA BRIC	Continuous (annual requirement)	Submit annual reports on time; solicit support for RL/SRL funding to compile data.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
by October 15th and finalize for submittal to FEMA no later than October 31st of the report year.						
Action 1-12b. Annually review the progress of SRL and RL property mitigation to ensure accuracy of PIVOT. Submit PIVOT updates as needed, particularly for location and mitigation status.	Floods	PEMA; Counties; FEMA Region 3	FEMA Hazard Mitigation Assistance Programs (management costs)	Each disaster or mission	Include information in annual report (Action 1-12a); 100% compliance needed.	Medium
Objective 1-13: Promote Natural Systems Protection mitigation in the Commonwealth between 2024 and 2028.						
Action 1-13a. Identify cooperative funding opportunities for natural system protection projects.	Floods	PEMA; DEP; NRCS	FEMA Hazard Mitigation Assistance Programs; Growing Greener; DEP Stream Improvement Program; NRCS Emergency Watershed Protection Program; DCED/CFA Act 13 Flood	July 2026	Obtain hazard mitigation funds for a stream corridor restoration or wetland restoration project associated with flooding.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
			Mitigation Program			
Objective 1-14: Promote public and private sector CI/KR physical and cyber security.						
Action 1-14a. Take steps to protect Pennsylvania from cyber security attacks.	Cyber Terrorism	PEMA; GOHS; county and local government; CCAP; PSATS; PSAB; PML	Agency operating budget	December 2028	Continued implementation of the Pennsylvania Cyber Incident Annex.	High
Action 1-14b. Share cyber threat information between PSP and state agencies through PA CyberCom.	Cyber Terrorism	PSP; All State Agencies	Agency operating budget	December 2024	Implement PA CyberCom.	High
Objective 1-15: Increase the capacity and effectiveness of Commonwealth NFIP management.						
Action 1-15a. Increase NFIP support staff.	Floods	PEMA MIRC Office	FEMA CAP-SSSE; FEMA CTP; Agency operating budget	June 2024	Hire two full-time Administrative Officers to support the NFIP.	Medium
Action 1-15b. Provide technical assistance to NFIP communities through Community Assistance Visits (CAV).	Floods	PEMA MIRC Office	FEMA CAP-SSSE; FEMA CTP; Agency operating budget	Ongoing-Annually	Complete 5-10 CAVs each year.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-15c. Deliver NFIP Training in the Commonwealth to increase local capacity for NFIP administration and enforcement.	Floods	PEMA MIRC Office	FEMA CAP-SSSE; FEMA CTP; Agency operating budget; FEMA BRIC	December 2024; then Ongoing	Develop a multi-year NFIP Training Plan focused on increasing local capabilities and compliance; Deliver two or more EO273 Trainings: Management Floodplain Development through the NFIP; Deliver four or more one-day NFIP Training for Floodplain Managers; Deliver one or more advanced trainings as needed (E0282, E0284, E0291).	Medium
Action 1-15d. Increase awareness and local capacity enforce and support Substantial Damage requirements.	Floods	PEMA MIRC Office; FEMA Region 3	FEMA CAP-SSSE; FEMA CTP; Agency operating budget	December 2019; then Ongoing	Deliver two or more Substantial Damage Trainings to assist local officials with preparedness and recovery; Present at PAFPM Conference on Damage Determinations.	Medium
Action 1-15e. Increase the number of Certified Floodplain Managers (CFMs) in the Commonwealth by developing and delivering CFM training in advance of scheduled CFM exams.	Floods	PEMA MIRC Office; PAFPM	FEMA CAP-SSSE; FEMA CTP; Agency operating budget	December 2025	Develop course materials building on existing resources: Deliver three or more CFM trainings in advance of the CFM exam; Increase the number of CFMs by 10%.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-15f. Complete a gap analysis of the Commonwealth's NFIP Program and subsequent strategic plan to address the findings.	Floods	PEMA MIRC Office	FEMA CAP-SSSE; FEMA CTP; Agency operating budget	December 2024	Release a Strategic Plan to address identified gaps in the Commonwealth's NFIP program.	Medium
Action 1-15g. Continue to improve the functionality and accessibility of the PA Flood Tool.	Floods	PEMA MIRC Office; PEMA GIS; PSU; PASDA	FEMA CAP-SSSE; FEMA CTP; State agency funding; FEMA BRIC	December 2024	Let PA Flood Tool improvement contract to improve functionality to aid local officials in flood determinations and risk communication.	Medium
Objective 1-16: Increase the funding available to communities for rehabilitation of existing flood protection projects that will mitigate the aging infrastructure and protect at risk structures against hazards by 2028.						
Action 1-16a. Support the development of set aside funding within the Act 13 FMP administered by DCED specifically for repairs to existing state constructed flood protection infrastructure.	Floods; Levee Failure	DEP; DCED	Agency operating budget; Act 13 FMP	December 2024	Provide dedicated funding within Act 13 FMP specifically for local government sponsors of state-constructed flood protection project levee rehabilitation and/or accreditation efforts.	High
Objective 1-17: Implement hazard mitigation projects that address Climate Change.						

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 1-17a. Continue to transition PennDOT's passenger vehicle fleet to electric/hybrid vehicles.	Extreme Temperature	PennDOT	Capital Equipment Budget	December 2025	25% of PennDOT's passenger fleet vehicles are fueled by electricity or hybrid.	Medium
Action 1-17b. Support electric vehicle (EV) deployment through education and incentives.	Extreme Temperature	DEP EPO; DEP BAQ; DCNR; PennDOT	DEP AFIG; DEP Driving PA Forward; US DOE; USEPA	December 2025	Increase total EV registration in Pennsylvania to 5% by 2025.	Medium
Action 1-17c. Deploy electric vehicle charging infrastructure throughout the Commonwealth.	Extreme Temperature	PennDOT; DCNR; DEP	DEP AFIG; DEP Driving PA Forward; FHWA NEVI	December 2028	5,000 new EV charging ports at 2,000 sites by 2028 per PennDOT EV Mobility Plan	Medium
Action 1-17d. Implement clean onsite energy generation projects as outlined in *Pennsylvania Climate Action Plan 2021*.	Extreme Temperature; Utility Interruption	DEP EPO	Agency operating budget; US DOE	Ongoing	Implement clean onsite energy generation projects.	High
Action 1-17e. Deploy federal Infrastructure Investment and Jobs Act (IIJA) Building a Better Grid Programs to improve grid resilience.	All Hazards	DEP EPO; PUC; Utilities including MEUs and rural electric cooperatives	US DOE IIJA Section 40101(D) Formula Grants to States and Indian Tribes for Preventing Outages and Enhancing the Resilience of the	Ongoing	Improve grid reliability and resiliency metrics.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
			Electric Grid; US DOE GRIP			
Action 1-17f. Reduce the impact of urban heat islands by increasing tree canopy and natural open space in urban communities.	Extreme Temperature; Utility Interruption	DCNR; PA Horticultural Society; Penn State Extension	DCNR TreeVitalize	Ongoing	Continued investment in reducing urban heat islands through state funding.	Medium
Goal 2 - Enhance consistent coordination, collaboration, and communications among stakeholders.						
Objective 2-1: Promote development of COOP and COG plans for critical infrastructure within the Commonwealth, focusing on water treatment, water supply, and critical goods and services suppliers.						
Action 2-1a. Identify and prioritize critical government facilities and infrastructure that require back-up systems.	All Hazards	OA with support from All State Agencies; Counties; USACE	State agency funding; DHS grants	Ongoing	Collect latitude/longitude data for identified critical facilities. Request USACE Power team review of generator sizing.	High
Action 2-1b. Conduct outreach to privately- owned businesses and infrastructure that provide critical services in post-disaster situations to encourage them to develop COOP or Business Recovery Plans.	All Hazards	PEMA; OHS; DHS; DCED; DHS Protective Security Advisors and Task Forces	Agency operating budget; DHS Grant Funding	December 2025	Complete two outreach workshops. Gather information on complementary workshops from DHS/GOHS for next SHMP update.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 2-1c. Update and maintain Commonwealth and state agency COOPs to reflect current hazard risks as specified in the State HMP.	All Hazards	OA; PEMA; All State Agencies	Agency operating budget	December 2025	State agency COOPs updated to reflect current hazard risks.	High
Action 2-1d. Work with BOLDplanning Inc. to adjust the COOP software and add capabilities, providing greater consistency between COOP and HMP planning.	All Hazards	OA; PEMA	Agency operating budget	December 2028	BOLDplanning Inc. software adjusted.	High
Action 2-1e. Continue to develop and implement protocols for the operation and staffing of Pennsylvania's water and wastewater treatment utilities to support emergency preparedness, disaster response, and mutual aid assistance.	All Hazards	PaWARN; DEP; PUC; County EMAs; PEMA	Agency operating budget; Organizational dues	Ongoing	Protocols developed and implemented.	High
Objective 2-2: Promote integration of mitigation goals, objectives, and actions where appropriate in other federal, state and local planning initiatives by 2028.						
Action 2-2a. Integrate local (county level) risk assessment data into the State Plan updates and vice	All Hazards	PEMA Resiliency Officer;	Agency operating budget; plans funded by FEMA	Continuous	Coordinate with PEMA OPS to integrate HM planning data and local plans into a single PA planning portal.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
versa to ensure consistency between state and local plans with respect to the best available data.		Municipalities; Counties	BRIC and HMGP funding		Continue to update the SOG and provide annual training.	
Action 2-2b. Support Silver Jackets work to identify current policies, plans, regulations, and laws that should include mitigation.	All Hazards	PEMA; DEP EPO; Other State Agencies; Silver Jackets; PAFPM	Agency operating budget	December 2024	Include lessons learned and planning guidance for local officials in the PA Climate Action Plan 2021 the SJ Mitigation Guide. Include a link to the guide on the PA Planning Portal.	Medium
Action 2-2c. Continue to coordinate with AAA and DHS to provide meals during emergency incidents.	All Hazards	PDA (Aging); AAA; DHS	Operating budget	Ongoing	Successfully meet the nutritional needs of older adults during emergency incidents.	High
Action 2-2d. Provide agency support to coordinate needs for older adults in DHS mass care shelters during emergency incidents.	All Hazards	DHS; PDA (Aging); AAA	Operating budget	Ongoing	Successfully meet the shelter needs of older adults during emergency incidents.	High
Action 2-2e. Continue to assist older adults during emergency incidents through use of PDA's emergency mapping program.	All Hazards	PDA (Aging); OA IT; AAA	Operating budget	Ongoing	Continue to render assistance to older adults during emergency incidents.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 2-2f. Incentivize landowners and municipalities to protect and preserve open space while also exploring flood-safe alternative uses in floodplains as outlined in the PA State Planning Board *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.	Floods	DCED; DCNR; PennDOT; PDA (Agriculture)	Agency operating budget; FEMA BRIC	December 2028	Increase in the number of flood-safe alternative use projects in Pennsylvania.	Medium
Action 2-2g. Highlight and elevate existing comprehensive plans and model ordinances which embrace green infrastructure and low-impact, resilient development practices through planning, technical assistance, and training as outlined in the PA State Planning Board *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.	All Hazards	DCED; DCNR	Agency operating budget	December 2028	Integration of green infrastructure best practices disseminated through local government and planning partner channels.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 2-2h. Continue to work with PennDOT on winter weather maintenance collaboration.	Winter Storm; Transportation Accidents	PTC; PennDOT; NWS	Agency operating budget; PTC Toll Revenue	Ongoing	Reduced incident clearance times on major Interstate highways.	High
Objective 2-3: Support the collection, update, and dissemination of datasets useful for hazard mitigation planning and implementation.						
Action 2-3a. Develop a comprehensive list of types of hazard mitigation data that decision-makers need by December 2024.	All Hazards	PEMA; FEMA; Pennsylvania State Geospatial Coordinating Board (GeoBoard); PASSHE; Counties (GIS).	Agency operating budget	December 2024	Share the list of identified data with stakeholders. Include SoVI analysis in data set for Counties and the State to utilize and evaluate the nexus of vulnerability and hazards in more detail in future plans.	Medium
Action 2-3b. Represent the interests of hazard mitigation on the Pennsylvania State Geospatial Coordinating Board (GeoBoard).	All Hazards	PEMA; GeoBoard; Other State Agencies; Counties (GIS)	Agency operating budget	Ongoing	Active participation in the GeoBoard; implementation of GeoBoard initiatives identified in the 2018 Geospatial Strategic Plan which advance hazard mitigation planning.	Medium
Action 2-3c. Re- evaluate state GIS database to ensure datasets include hazard mitigation, planning, and critical asset identification to	All Hazards	PEMA; Counties	Agency operating budget	December 2028	Identify all of the exact databases, and owners of those databases. Ensure data is available on PASDA.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
enable the prioritization of mitigation projects.						
Action 2-3d. Continue to use and improve GIS capability to prioritize hazard/critical infrastructure for mitigation.	All Hazards	PEMA; GOHS; PSP; DGS; CCAP	Agency operating budget;	December 2026	Use GIS to assign mitigation priorities to critical infrastructure.	Medium
Action 2-3e. Acquire remotely sensed data, specifically, ortho-photography, as specified in the Commonwealth's Geospatial Strategic Plan.	Floods	PEMA; GeoBoard; FEMA Region 3	FEMA EMPG; FEMA BRIC; National Preparedness Funds; PEMA 911 Program Funds	December 2024	Acquire updated ortho-photography for Pennsylvania.	Medium
Action 2-3f. Improve electronic data sharing between municipalities, counties, PA SHPO and PEMA to ensure statewide data remains current on historic properties and may be used for risk analysis.	All Hazards	PA SHPO; PEMA; FEMA	U.S. Department of the Interior National Park Service; PHMC Preservation and Disaster Planning	Ongoing	Identify historic resource survey projects by municipality and county.	High
Action 2-3g. Facilitate efficient damage assessment and reporting by supporting PEMA's maintenance and upkeep of the	All Hazards	PEMA; County EMAs	Agency operating budget	Ongoing	Use of the Commonwealth Damage Reporter for all damage assessment reporting.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Commonwealth Damage Reporter.						
Action 2-3h. Assess the integration of the Commonwealth Damage Reporter with municipal tracking software for the purpose of streamlining state and municipal damage reporting and substantiate information necessary for future funding requests.	All Hazards	PEMA; PSATS; PSAB; PML	Agency operating budget	December 2028	Assessment complete	High
Action 2-3i. Implement Act 158 of 2022 which establishes the Overdose Information Network (ODIN) requiring PSP to collect overdose information for all police agencies within the Commonwealth, including overdose spike alerts.	Substance Use Disorder	PSP; DOH; DDAP	Agency operating budget; additional funding sources to be Identified	December 2028	Implement ODIN, continually collect data, and develop an annual report in conjunction with DOH.	Medium
Action 2-3j. Evaluate the development of a statewide dashboard to monitor county resources during and after an emergency event.	All Hazards	OA; PEMA; County EMAs	Agency operating budget	December 2024	Evaluation to consider development of a statewide dashboard complete.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 2-3k. Improve follow-up for hazard survivors by working with FEMA to secure County EMC access to disasterassistance.gov data.	All Hazards	PEMA; FEMA	Agency operating budget	December 2028	County access to disasterassistance.gov data is provided.	High
Action 2-3l. Create and update mapping around environmental justice concerns to better identify communities facing EJ issues in a way that is useful for both commonwealth agencies and the general public.	All Hazards	DEP; EJAB; DCNR; DCED; DHS	Agency operating budget	December 2024	Mapping reflecting environmental justice concerns is developed.	Medium
Action 2-3m. Collect and provide aggregate data on the impacts of flooding and other hazards on quality of life and community health and well-being as outlined in the PA State Planning Board *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.	All Hazards	DCED; DHS; DEP; PEMA	Agency operating budget	December 2028	Data sets identified and process for collecting data established.	Medium
Action 2-3n. Develop metrics to quantify loss of life and reduced quality of life for the	All Hazards	DCED; PEMA; DHS	Agency operating budget	December 2028	Metrics identified to incorporate into BCAs.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
purpose of benefit-cost analyses (BCAs) used for federal disaster recovery funding allocations as outlined in the PA State Planning Board *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.						
Action 2-3o. Use existing geologic data and mapping through DCNR's Bureau of Geological Survey to help assess suitable locations for carbon sequestration.	Extreme Temperature	DCNR; DEP	Agency operating budget	Ongoing	Data and mapping available to help assess suitable locations for carbon sequestration.	Low
Action 2-3p. Develop a plan to regularly update elevation data statewide and in critical regions such areas impacted by floods and karst.	Floods; Subsidence/ Sinkhole	DCNR; DEP	Agency operating budget	Ongoing	Complete a statewide plan to regularly update elevation data, including an assessment of the collection, dissemination, and use of 3D elevation data.	High
Action 2-3q. Prioritize areas at high risk from both natural and human-made hazards when updating the PA Historic Places Inventory.	All Hazards	PA SHPO; PEMA	NPS; PHMC	December 2028	Integrate hazard risk assessments into agency-led survey efforts where historic resources have the potential to be in high risk	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
					areas. Make survey data available in PA-SHARE.	
Action 2-3r. Leverage the aerial photography capabilities of Pennsylvania Wing Civil Air Patrol to support hazard mitigation by documenting existing ground conditions such as flood prone areas, and farmlands for the visual assessment of disease spread.	Dam Failure; Floods; Levee Failure; Mass Food/Animal Feed Contamination	CAP; PEMA; DCNR; PDA (Agriculture)	Agency operating budget	December 2028	CAP aerial photography capabilities used to support at least 2 missions for hazard mitigation.	Medium
Objective 2-4: Identify local Hazard Mitigation Officers and increase participation by local community representatives in the Commonwealth's Mitigation Planning Team by 50% between 2024 and 2028.						
Action 2-4a. Maintain planning, emergency management, and GIS/data management contacts lists and expand contacts to include conservation districts.	All Hazards	PEMA and Area Offices; OA; Counties; CCAP; County Conservation Districts	Agency operating budget	Ongoing	Consistently update and expand hazard mitigation contact lists.	Medium
Action 2-4b. Bring county leads and planning champions together for regular meetings, knowledge exchanges, and trainings.	All Hazards	PEMA; DCED; KEMA; FEMA Region 3	Agency operating budget; Agency operating budget; FEMA-sponsored training	December 2028	Provide three integrated planning workshops/ seminars throughout the state.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 2-4c. Involve appropriate county mitigation plan team members in hazard mitigation implementation activities.	All Hazards	PEMA; Counties; DRBC; SRBC	Agency operating budget; EMPG; HMGP; LPDM; FEMA BRIC; Swift Current Initiative; FMA Management costs	Continuous	Offer training or meeting opportunities for county mitigation planning team members at KEMA Annual Conference and the Annual PA GIS Conference. Encourage counties to conduct annual HMP reviews with mitigation plan team members.	High
Action 2-4d. Meet regularly to implement projects that tie-in goals and initiatives of multiple State Planning Team member agencies	All Hazards	PEMA; State Planning Team members	FEMA Hazard Mitigation Assistance Programs; USACE; FEMA BRIC	December 2028	Identify and complete high priority mitigation actions.	High
Action 2-4e. Develop County Hazard Mitigation Suggested Curriculum.	All Hazards	PEMA; Counties	EMPG	December 2028	Encourage at least one member of the local hazard mitigation team to obtain Certified Floodplain Manager (CFM) certification.	Medium
Objective 2-5: Continue to support coordination between mitigation, planning, preparedness, and response personnel throughout the Commonwealth to ensure effectiveness in all-hazard mitigation planning.						
Action 2-5a. Improve cooperation/ coordination of agencies with real time data	All Hazards	Local, county, and state public safety agencies with	Various	Continuous	Encourage all SPT members to share real time data in Web EOC. HMGP	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
(gauge station data, program availability, etc.).		planning support agencies			funded install of IFLOWS 2.0 enhancement will be ongoing through 2025 for 30 sites.	
Action 2-5b. Reach out to agencies that were invited but did not participate in 2023 planning process.	All Hazards	PEMA; Silver Jackets	Agency operating budget; USACE	December 2028	Participation in the next State Plan update builds on 2023 success and has more than 55 participating agencies/organizations/ county representatives.	Medium
Action 2-5c. Identify strategic locations to deploy USACE Power Teams after a disaster.	All Hazards	PEMA; Silver Jackets; USACE	Agency operating budget	Ongoing	Continue to work with USACE Pittsburgh and Philadelphia Districts after a disaster to identify locations to deploy Power Teams.	Medium
Action 2-5d. Implement and maintain the Statewide Broadband Plan in accordance with Act 96 of 2021 to address broadband service infrastructure and availability, digital equity and affordability, digital literacy, and device and technology access.	All Hazards	PA Broadband Development Authority, Governor's Office of the Budget, DCED, PDA (Agriculture), PDE, DGS	Agency operating budget; U.S. Department of the Treasury, Capital Projects Fund; NTIA BEAD	December 2027	Implementation of Statewide Broadband Plan recommendations and annual plan maintenance.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 2-5e. Continue to develop and offer training on emergency energy related topics such as liquid fuel and energy storage technology to help critical facilities and local governments plan for energy backup and resilience measures.	Civil Disturbance; Cyber Terrorism; Urban Fire/Explosion; Utility Interruption	DEP EPO; DEP Emergency Response; PUC; PEMA	Agency operating budget; US DOE funding	Ongoing	Provide training as needed.	High
Action 2-5f. Implement the Commonwealth of Pennsylvania Inclement Winter Weather Travel Restriction and Ban Framework.	Winter Storm; Transportation Accidents	PennDOT; PEMA; PTC; PSP	Agency operating budget	Ongoing	Fewer total closures of Interstate roadways during winter storms.	High
Action 2-5g. Implement the PTC Weather Event Management Playbook.	Floods; Hurricane, Tropical Storm, Nor'easter; Tornado/Windstorm ; Hailstorm; Lightning Strike; Winter Storm	PTC	PTC Toll Revenue	Ongoing	Improved situational awareness across all PTC Departments; improved support for field operations; and fewer winter crashes, injuries and fatalities.	High
Action 2-5h. Continue support for the Black Sky Steering Committee's recommendations to improve lifeline utility sector	Cyber Terrorism; Hurricane, Tropical Storm, Nor'easter; Terrorism; Utility Interruption	PUC; GOHS; PEMA	Agency operating budget	Ongoing	Implement the Black Sky Steering Committee's recommendations.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
interdependencies and associated priorities.						
Objective 2-6: Support recovery and resiliency planning across the Commonwealth.						
Action 2-6a. Develop County Recovery Plans following the template designed in State Disaster Recovery Plan process.	All Hazards	PEMA; County planners and EMCs	Agency operating budget	December 2028	Complete 12 County Recovery Plans.	Medium
Action 2-6b. Develop a Pennsylvania Resilience Strategy using the Smart Growth America model.	All Hazards	PEMA MIRC Office; County planners and EMCs	Agency operating budget	December 2028	Statewide resiliency strategy in place and ready to disseminate to local jurisdictions.	Medium
Action 2-6c. Increase capacity of PennDOT's PA Mobility Plan to further estimate the impacts on the transportation system by simulating traffic patterns to reduce transportation accidents.	Transportation Accidents	PennDOT	Highway Safety Funds	Continuous	Reduce reported crashes annually.	Low
Action 2-6d. Continue Implementation Steps of Extreme Weather Vulnerability Study	Natural Hazards; Building and Structure Collapse	PennDOT	Congestion Mitigation and Air Quality Funds	Continuous	Complete phase 2.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 2-6e. Continue to train first responders on water rescue training.	Floods	PFBC; Local Emergency Agencies	Operating budget; FEMA BRIC	Ongoing	Annually offer 4 water rescue training sessions specifically for water rescue trainers. Annually certify 30 water rescue instructors.	High
Action 2-6f. Develop procedures to provide guidance on regulatory variances for professional licensure during a disaster.	All Hazards	DOS	Agency operating budget	December 2024	Procedures developed for providing guidance on regulatory variances under the purview of the Department of State.	High
Goal 3 - Provide a framework for active hazard mitigation planning and implementation.						
Objective 3-1: Identify opportunities for regional organizations, businesses, and academia to be engaged in hazard mitigation planning.						
Action 3-1a. Maintain a comprehensive list of relevant regional agencies, including Councils of Government (COGs), River Basin Commissions, and Metropolitan Planning Organizations (MPOs).	All Hazards	PEMA; Silver Jackets; DCED	Agency operating budget	Continuous	Annually update a list of relevant regional agencies including hazard mitigation planning contacts.	Medium
Action 3-1b. Continue to support Pennsylvania Department of Education (PDE) in its multi-hazard school planning efforts.	All Hazards	PDE; PEMA; Safe Schools Initiative; PSP; FEMA Region 3	Agency operating budget	Continuous	Customize and update outreach materials and conduct outreach based on current events.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 3-1c. Identify and encourage involvement of key business, industry, and infrastructure stakeholders and stakeholder associations in mitigation.	All Hazards	Local jurisdictions and Chambers of Commerce; Federal and State Legislatures	Agency operating budget; LPDM; Non-Profits	Continuous	Continue to invite a broad range of private sector stakeholders to participate in the HM planning process with a focus on infrastructure and utility stakeholders and large employers.	Medium
Action 3-1d Work with hazard mitigation stakeholders to provide increased support to Floodplain Managers.	Floods	PEMA MIRC Office; FEMA; Community Engagement and Risk Communication (CERC) provider, Resilience Action Partners; DEP; DCNR; County Conservation Districts	Agency operating budget; FEMA BRIC	December 2024	Develop a standard municipal toolkit addressing land use and zoning enforcement and train stakeholders on its use.	High
Action 3-1e. Coordinate with USDA on the mass food contamination analysis phase.	Mass Food/Animal Feed Contamination	PDA (Agriculture)	Agency operating budget	December 2024	Establish planning and response protocols with the PADAG Rapid Response Task Force.	Medium
Action 3-1f. Recommend convening an interorganizational task force to develop recommendations addressing the barriers to	Pandemic/Infectious Disease	Governor's Office. Task force to include representatives from: PDA (Aging);	Agency operating budget	December 2024	Determination made on convening a task force.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
increasing the number of physicians, nurses, and allied health professionals in the Commonwealth. Barriers include but are not limited to, lack of: clinical sites, educators, licensure, and funding.		DOH; DHS; PDE; DOS (State Board of Nursing); PASSHE; AICUP; PACCC; State-Related Universities; PAMED; HAP; PHCA; PACCC				
Action 3-1g. Implement a pilot project for #Prepared4PA, an online credential registry for Pennsylvania, which will display credentials and credential pathways leading to a desired occupation or occupational advancement in searchable format, helping to mitigate critical workforce shortages.	All Hazards	PASSHE; L&I; PACCC	Agency operating budget	December 2024	#Prepared4PA pilot project implemented.	Medium
Action 3-1h. Address workforce needs of illegal immigrants through organizations working with regional Workforce Development Boards (WDB) and PA CareerLink®.	All Hazards	L&I; WDB; PA CareerLink®; PEMA; DCED	Agency operating budget	December 2024	Identify organizations and resources at PA CareerLink® to potentially provide assistance to illegal immigrants.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 3-1i. Protect the financial assets of Pennsylvania government and citizens through multi-agency coordination and collaboration via the State Agency Financial Exchange ($AFE).	All Hazards	DoBS; OAG; PA Parole Board; PHEAA; PHFA; PID; DMVA; DOR; PSERS; Treasury	Agency operating budget	Ongoing	Develop and deliver financial preparedness information to Pennsylvania consumers and businesses.	High
Action 3-1j. Further incorporate private industry perspective into hazard mitigation planning by engaging industry to better understand barriers and opportunities associated with mitigating hazards.	All Hazards	PEMA/PA BEOC; State agencies representing critical lifeline sectors	Agency operating budget; FEMA BRIC	December 2028	Host at least 2 industry discussions. Identify at least 2 barriers and opportunities for sectors to be identified from review of the 2023 State HMP.	High
Objective 3-2: Enable the Pennsylvania Emergency Management Agency to encourage each participating jurisdiction to secure funding and initiate one mitigation action by 2028.						
Action 3-2a. Maintain and improve Pennsylvania's Standard Operating Guide and other tools.	All Hazards	PEMA	EMPG; FEMA BRIC	Continuous	Require all counties to complete HMP updates using the most current SOG.	Medium
Action 3-2b. Assist communities and counties in identifying funding streams to	All Hazards	PEMA; DCED; DCNR; DEP; Silver Jackets; Counties	Agency operating budget	Continuous	Fund ten projects and six plans per year.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
support the implementation of mitigation projects.						
Action 3-2c. Update training courses regarding planning, project tools, as well as FEMA eGrants/GO/NEMIS trainings.	All Hazards	PEMA	Agency operating budget; FEMA support	Continuous	Conduct timely eGrants/GO/NEMIS trainings as a part of at least two quarterly trainings per year. Track all training and technical assistance location, date, and attendance.	Medium
Action 3-2d. Promote training and project tours for new members of hazard mitigation planning community, including personnel at universities, businesses, and regional organizations.	All Hazards	PEMA	EMPG	July 2026	Develop and implement training for businesses and regional organizations.	Medium
Action 3-2e. Promote Hazard mitigation project tours to showcase successful flood mitigation projects.	Floods	PEMA; Silver Jackets	Agency operating budget; FEMA FMA; USACE	Continuous	Provide at least two bus tours through Silver Jackets.	High
Action 3-2f. Explore funding for County EMAP accreditation.	All Hazards	PEMA	Agency operating budget; EMPG	July 2025	Disseminate information to counties pertaining to the incorporation of EMAP	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
					compliance into HM planning.	
Action 3-2g. Prepare hazard mitigation plans for each PA DOC facility to understand risks across facilities and integrate into the state HMP.	All Hazards	DOC	Agency operating budget	December 2028	HMPs prepared for each DOC facility.	High
Objective 3-3: Identify opportunities to support citizens impacted by Substance Use Disorder.						
Action 3-3a. Raise broad awareness about substance use disorder (SUD) to reduce stigmatizing attitudes.	Substance Use Disorder	DDAP; PCCD; DHS; DOC; PA Board of Pardons; PA Parole Board; PEMA; DOH; DCNR; DMVA; PDE; PDA (Aging); PID; OA; PennDOT; PSP; DEP; DGS; Juvenile Court Judges' Commission; PLCB; OVA; PA Gaming Control Board; PA Lottery Commission; DCED	Agency operating budget	Ongoing	Reinforce whole community resiliency, continuity planning and recovery concepts while providing an awareness on substance use disorder and behavioral health response during disasters through regionalized events and continuity trainings.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 3-3b. Brief emergency management officials on resources available to respond to substance use disorder in their community.	Substance Use Disorder	DDAP; OSFC; PSP; PEMA; DOH BEMS; DOC	Agency operating budget	Ongoing	Include substance use disorder as a topic in emergency management officials' training including the potential for hazardous materials conditions when responding to incidents. Training should include: crisis response, stigma awareness, poly-drug use, naloxone and fentanyl test strips, addressing common misconceptions about overdosing by touching fentanyl.	Medium
Action 3-3c. Support the development of community crisis prevention, intervention, and stabilization behavioral health services.	Substance Use Disorder	DDAP; DOH; DHS; PSP; DOC	Agency operating budget	Ongoing	Increase in the number of individuals admitted to treatment; decrease in the number of SUD patients in the emergency department and jail.	Medium
Action 3-3d. Support the continued distribution of naloxone and emerging mitigation strategies throughout Pennsylvania.	Substance Use Disorder	DDAP; PCCD; OSFC; PSP; DOH; DHS	Agency operating budget	Ongoing	Continued distribution of naloxone, new distribution of fentanyl test strips, and monitoring of additional mitigation strategies as legalization of harm	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
					reduction methods occurs in Pennsylvania.	
Objective 3-4: Enhance the resilience of disadvantaged communities that are marginalized, overburdened, and underserved						
Action 3-4a. Revise and implement Pennsylvania DEP's Environmental Justice Policy to improve consideration of environmental justice community concerns through enhanced public participation in the permitting process, grant funding awards, inspection and compliance processes, climate change efforts, and other DEP work activities.	All Hazards	DEP; EJAB	Agency operating budget	December 2023	Pennsylvania DEP's Environmental Justice Policy is revised and implemented.	High
Action 3-4b. Implement the funding equity principles developed by the Funding Equity Interagency Workgroup which include simplifying the application and administration process; removing unnecessary barriers; and enhancing	All Hazards	DCNR; PCCD; Council on the Arts; PDA (Aging); PDA (Agriculture); DCED; PDE; DEP; DOH; DHS; L&I; DMVA; PennDOT; Governor's Office of Advocacy & Reform; Governor Office of	Agency operating budget	December 2028	Funding equity principles are integrated into agency funding decisions.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
technical assistance and outreach efforts.		Performance through Excellence; PFBC; OA; PEMA; PENNVEST				
Action 3-4c. Incorporate Justice40 and 30x30 goals into Commonwealth grant funding criteria by 2030.	All Hazards	DCNR; DCED; DEP	Agency operating budget; FEMA BRIC	Ongoing	Develop and implement strategy to incorporate Justice40 and 30x30 goals into funding criteria by 2030.	High
Action 3-4d. Work with environmental justice communities to complete water quality projects by providing technical assistance in securing public funding.	Floods	PENNVEST; DEP; EPA; CCAP; PMAA; PRWA; PSATS; PSAB	Agency operating budget; PENNVEST; FEMA BRIC	Ongoing	The number of environmental justice and disadvantaged communities applying for and receiving PENNVEST funding increases to greater than 42% of total budgeted funding.	High
Action 3-4e. Support PSP OCE/HALOs (Office of Community Engagement, Heritage Affairs Liaison Officers) efforts in addressing hate and bias crimes.	Civil Disturbance	PSP; Governor's Advisory Commission on African American Affairs; Governor's Advisory Commission on Asian American Affairs; Governor's Advisory Commission on	Agency Operating Budget	Continuous	Continue to build relationships with minority organizations and local community leaders through outreach.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
		Latino Affairs; Governor's Advisory Commission on LGBTQ Affairs; PHRC				
Action 3-4f. Encourage the development of disaster resistant affordable housing to increase community resiliency during hazard events.	All Hazards	DCED CLGS; PHFA; CCAP; PSATS; PML; PSAB	Agency operating budget; Federal Low Income Housing Tax Credit; HUD CBDG	December 2028	Affordable housing is included as a municipal outreach topic.	High
Objective 3-5: Ensure the requirements of ADA and Section 504 of the Rehabilitation Act of 1973 (Section 504) are applied to emergency preparedness to make certain persons with disabilities are accommodated (or served) during a hazard incident and recovery.						
Action 3-5a. Develop county-level emergency management processes and procedures by individuals with specialized expertise in disability related topics to ensure persons with disabilities are served during a hazard incident in areas such as: notification and necessary information; evacuation; emergency transportation; sheltering; access to medications,	All Hazards	PEMA; DHS; Disability Rights PA; County EMAs	Agency operating budget; FEMA HMGP; FEMA BRIC	December 2028	County level MOUs/MOAs are in place with local providers/business to provide accessible communications, evacuation support, transportation (para-transit vehicles), generator/power back-up equipment, identified locations and number of shelters, including pet shelters/kennels.	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
refrigeration and back up power; and access to mobility devices or service animals while in transit or at shelters.						
Objective 3-6: Integrate Climate Change into hazard mitigation planning.						
Action 3-6a. Develop a plan for resilient electric power at critical facilities to optimize clean energy generation technology such as PV solar plus energy storage microgrids.	Extreme Temperature; Utility Interruption	DEP EPO; PUC; DCED; US DOE	Agency operating budget; US DOE	December 2024	Plan for resilient electric power at critical facilities developed.	High
Action 3-6b. Continue implementing recommendations from the *2021 Pennsylvania Energy Storage Assessment: Status, Barriers, and Opportunities* report such as Energy Storage Consortiums and Microgrid outreach.	Extreme Temperature; Utility Interruption	DEP EPO; PEMA; PUC	Agency operating budget; US DOE	Ongoing	Continued implementation of recommendations.	High
Action 3-6c. Track and encourage implementation of greenhouse gas mitigation strategies laid out in	Extreme Temperature	DEP EPO; DEP BAQ; PennDOT; PUC; DCED;	Agency operating budget; US DOE	Ongoing	Continued implementation of recommendations.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Pennsylvania Climate Action Plan 2021.		DCNR; PDA (Agriculture)				
Action 3-6d. Develop detailed plans to address climate impacts adaptation priorities as identified in *Pennsylvania Climate Impacts Assessment 2021* and informed by adaptation pathways laid out in *Pennsylvania Climate Action Plan 2021*.	Extreme Temperature; Floods; Hurricane, Tropical Storm, Nor'easter; Landslide	DEP; PDA (Agriculture); DCNR; PennDOT	Agency operating budget; US DOE	December 2024	Development of Climate Adaptation Plans.	Medium
Action 3-6e. Establish grid-scale solar best practices and incentives that protect forested areas that are already contributing to climate mitigation.	Extreme Temperature; Utility Interruption	DCNR; DEP EPO; PDA (Agriculture)	Agency operating budget	December 2026	Grid-scale solar best practices and incentives developed.	Medium
Action 3-6f. Improve coordination between state agencies to leverage IIJA funds that support conservation and remediation projects.	All Hazards	DCNR; DEP EPO; DCED; PennDOT; PENNVEST; PEMA	Agency operating budget	December 2024	Develop protocols to improve state and regional coordination of IIJA funds.	Medium
Action 3-6g. Encourage the use of agrivoltaics to co-locate renewable energy	Extreme Temperature; Utility Interruption	PDA (Agriculture); DCNR; DEP; Penn State Extension	Agency operating budget	December 2028	Develop statewide best practices and resources for incorporating agrivoltaics	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
generation and agricultural production.					into renewable energy strategies.	
Action 3-6h. Invest in targeted research and demonstration projects that would support innovative conservation practices to mitigate downstream impacts and occurrences of harmful algal blooms (HABs).	Extreme Temperature; Mass Food/Animal Feed Contamination; Pandemic/Infectious Disease	DCNR; DOH; DEP; PDA (Agriculture); PFBC; PGC; PEMA	Agency operating budget	December 2028	Research completed; demonstration projects underway.	High
Action 3-6i. Increase statewide surveillance and testing capabilities as well as interagency communication related to harmful algal blooms (HABs).	Extreme Temperature; Mass Food/Animal Feed Contamination; Pandemic/Infectious Disease	DCNR; DOH; DEP; PDA (Agriculture); PFBC; PGC; PEMA	Agency operating budget	Ongoing	Increased participation and capabilities from entities with reporting HAB conditions and sample collection.	Medium
Action 3-6j. Implement recommendations from Pennsylvania state agency climate action plans and strategies to protect Pennsylvania's natural ecosystems.	All Hazards	PFBC; DCNR	Agency operating budget	Ongoing	Implement priority recommendations from each plan.	Medium
Objective 3-7: Increase Commonwealth efforts to mitigate the adverse impacts of Pandemics and other healthcare incidents.						

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 3-7a. Develop the capability to deploy EMS Strike teams to assist in the distribution of medical countermeasures (vaccines and other appropriate medical care needs).	Pandemic/Infectious Disease	DOH	Agency operating budget; HPP	December 2025	Develop and implement plans that allow for intrastate deployment of strike teams with appropriate funding to respond to public health crisis or pandemics.	High
Action 3-7b. Encourage health care facilities to maintain a 30 day supply of PPE above operational needs.	Pandemic/Infectious Disease	DOH; HCCs	Agency operating budget; HPP	December 2028	Develop protocols for healthcare facilities to stock a 30 day supply of PPE in the event of a health care incident.	Medium
Action 3-7c. Work with private industry to increase the Commonwealth's capacity to produce and secure PPE.	Pandemic/Infectious Disease	DOH; DGS; DCED; Private Industry	Agency operating budget	December 2028	Reliable access to PPE at the state and local levels.	Medium
Action 3-7d. Deploy Innovative Hospital Models to make Pennsylvania hospitals more resilient during health care incidents, reducing the need for offsite alternative care facilities.	Pandemic/Infectious Disease	DOH; HCCs	Agency operating budget; HPP	December 2028	Implement a plan for health care facility upgrades across Pennsylvania to improve hospital resiliency during health care emergencies.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 3-7e. Build awareness and institutional knowledge about using public assistance programs to fund health care needs, including staffing and supplies, during health care incidents.	Pandemic/Infectious Disease	DOH; HCCs	Agency operating budget	December 2028	Increase the use of public assistance programs to meet health care funding needs during health care incidents.	Medium
Action 3-7f. Improve emergency preparedness at licensed and non-licensed health care facilities.	All Hazards	DHS; DOH; PEMA; County EMAs; HCCs; PHCA	Agency operating budget; Hazard Mitigation Funding	Ongoing	Increase in the number of facilities meeting CMS emergency preparedness standards.	Medium
Action 3-7g. Complete a Joint State Interagency After Action Review of the COVID-19 Pandemic and share / coordinate recommendations with county and private emergency management and health care partners.	Pandemic/Infectious Disease	Governor's Office; PEMA; DOH, DHS; DCED; DOS	Agency operating budget	December 2024	Joint State Interagency After Action Review complete.	Medium
Goal 4 - Build legislative and other organizational support and leverage funding for mitigation efforts.						
Objective 4-1: Provide opportunities for Pennsylvania Emergency Management Agency and County Emergency Management Agencies to educate State, county and local government officials, and legislators about hazard risk and mitigation by 2028.						
Action 4-1a. Facilitate tours for local, county, and state legislative officials focusing on mitigation projects or	All Hazards	Counties; Local Jurisdictions;	Agency operating budget	December 2028	Coordinate local official and legislative site tours in four locations. Encourage the	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
areas where mitigation efforts are needed.		PEMA; DCED; FEMA			participation of at least 20 state legislative officials.	
Action 4-1b. Develop and disseminate relevant information on hazard mitigation programs.	All Hazards	Counties; PEMA; DEP; DCED; Silver Jackets; CCAP; PML; PSATS; PSAB; NHMA	FEMA Hazard Mitigation Assistance Programs	Ongoing	Coordinate with FEMA and other agencies to obtain relevant mitigation information to disseminate to the public.	High
Action 4-1c. Document and share in-state success stories and best practices.	All Hazards	PEMA; Counties	Agency operating budget	Continuous	As part of the 2023 HMP update, develop online success stories to be updated and cataloged on Pennsylvania's Hazard Mitigation Plan website.	High
Action 4-1d. Fund, revitalize, and modernize the Act 167 program.	Floods	DCED; DEP; DCNR; CCAP, PSATS; PSAB; PML	Agency operating budget	December 2028	Act 167 program updates including addressing funding are implemented.	High
Action 4-1e. Provide legislator webinar to explain disaster declaration and hazard mitigation funding process.	Floods; All hazards	KEMA; PEMA	Agency operating budget; conference fees; printing fees; and WebEx costs	Continuous	PEMA will share information/white paper with KEMA as part of this effort.	Medium
Objective 4-2: Expand working relationships with at least two volunteer and professional organizations to improve mitigation efforts within the Commonwealth.						

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 4-2a. Expand working relationship with professional organizations including: NHMA; PACO; PAFPM; NEMA, IAEM, ASFPM, KEMA, League of Cities, and Code Enforcement Officers.	All Hazards	PEMA	Agency operating budget	December 2028	Attend at least two new organization conferences and invite two new organizations to the State Emergency Management Conference.	Medium
Action 4-2b. Encourage PA-based professional organizations to be involved in the Silver Jackets Program.	All Hazards	PEMA; Silver Jackets	Agency operating budget	December 2028	At least two new professional organizations regularly attend Silver Jackets meetings between 2023 and 2028.	Medium
Action 4-2c. Develop a working relationship with private insurance and financial sector companies.	All Hazards	DCED; PID; FEMA	Agency operating budget	Annually	Convene an annual meeting with the PA Department of Insurance to address current insurance issues impacting hazard mitigation.	Medium
Action 4-2d. Outreach to utilities to develop ideas to mitigate utility damage, such as gas and electric distribution utilities, outside of easements or rights of way.	Winter Storm; Subsidence/ Sinkhole	PEMA; PUC	Agency operating budget	December 2026	Work with utilities to mitigate damage to infrastructure outside of utility ROW.	High
Objective 4-3: Identify statutory, regulatory, or other barriers to completing mitigation efforts within the Commonwealth, and leverage support against these barriers to implement mitigation actions by 2028.						

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 4-3a. Identify statutory, regulatory, or other barriers that currently exist with respect to mitigation efforts and build consensus and plan integration with partners and decision makers.	All Hazards	PEMA; Office of General Counsel; DCED	Agency operating budget; FEMA BRIC	June 2026	Continue to address and expand plan integration and eliminate barriers to mitigation through SJ Initiative and document successes. Develop a list of counties in the Commonwealth that cover municipal zoning.	Medium
Action 4-3b. Assist county and regional planning organizations to integrate preservation priorities into plans for economic growth, revitalization, natural resource, hazard mitigation and emergency management planning.	All Hazards	PA SHPO; PEMA; FEMA	Agency operating budget; DEP Growing Greener Grant	June 2026	Identify at-risk communities for disasters and create hazard mitigation and/or emergency management plans for historic resources.	Medium
Action 4-3c. Encourage counties and local municipalities to develop land bank authorities for the purpose of converting vacant or tax- delinquent properties at risk from the impacts of natural and human- made hazards into productive use.	Building and Structure Collapse	DCED; Counties; County Conservation Districts; Municipalities	Agency operating budget; Municipal operating budget	December 2028	Encourage adoption of the provisions of PA Title 68 (Real and Personal Property) to encourage the development of land bank authorities.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 4-3d. Work with FEMA to remove the requirement that riparian buffers require hydrologic and hydraulic (H&H) studies and no longer consider trees as development.	Floods; Coastal Erosion	PEMA; FEMA; DCNR	Agency operating budget	December 2028	Feasible solutions identified.	High
Action 4-3e. Develop and implement legislative changes to Title 35 addressing the requirement that every municipality requires an emergency management coordinator.	All Hazards	PEMA	Agency operating budget	December 2028	Title 35 legislation modified.	Medium
Action 4-3f. Assess the need to modify the Milk Marketing Law to address market disruptions should a state emergency declaration be issued.	Pandemic/Infectious Disease	Pennsylvania Milk Marketing Board	Agency operating budget	December 2024	Determine if legislative changes are required.	Medium
Action 4-3g. Evaluate modifying the minimum pricing for milk in the event of an emergency.	Pandemic/Infectious Disease	Pennsylvania Milk Marketing Board	Agency operating budget	Ongoing	Determination made during each emergency incident.	Medium
Agency 4-3h. Review existing Emergency Management Assistance	Pandemic/Infectious Disease	PEMA	Agency operating budget	December 2024	Determination made; legislative	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Compacts (EMAC) for Pennsylvania (35 Pa. C.S. § 7601) and adjoining states' legislation to determine if mutual aid assistance relating to pandemic events is adequately addressed.					recommendations introduced, if needed.	
Action 4-3i. Amend the Administrative Code of 1929 to include PEMA and PHMC on the State Planning Board as outlined in the PA State Planning Board *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.	All Hazards	DCED; PEMA; PHMC	Agency operating budget	December 2028	Administrative Code of 1929 amended to include PEMA and PHMC on the State Planning Board.	High
Action 4-3j. Assess the potential of using flood buy back properties along waterways for public recreational access.	Floods; Coastal Erosion	PFBC; DCNR; PEMA	Agency operating budget; DCNR C2P2	December 2028	Complete assessment.	High
Action 4-3k. Track and encourage legislation promoting community solar.	Extreme Temperature; Utility Interruption	DEP EPO; DCNR	Agency operating budget	Ongoing	Community solar legislation advances towards adoption.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 4-3l. Establish statewide licensing standards and regulations for private water wells.	Environmental Hazard – Hazardous Materials Release; Floods	DCNR; DOS; DEP; DOH; L&I	Agency operating budget	December 2024	Statewide licensing standards and regulations developed.	High
Objective 4-4: Encourage the use of state funding for hazard mitigation for projects and plans.						
Action 4-4a. Support new state-funded flood protection and prevention projects.	Floods	PEMA; DEP; DGS; DCNR; PFBC	FEMA Hazard Mitigation Assistance Programs; USACE; NRCS; PA State Capital Budget Project Authorization (Capital Budget); DEP Growing Greener Watershed Protection Grants; PennDOT; DCED CFA Act 13 FMP	June 2026	Secure funding for at least four new state-funded flood protection/prevention projects, one of which should focus on flood fighting supplies and training.	High
Action 4-4b Provide non-federal match to project sponsors for FEMA Hazard Mitigation Assistance, NRCS,	Floods	Governor's Office; State Legislators	Agency operating budget; Capital Budget; DEP	June 2026	Allocate state funding for the non-federal match. Pursue developing a stormwater management revolving fund over the next	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
USACE and other federal funding sources.					5 years with legislative support.	
Action 4-4c. Consider tax incentives and bonds for mitigation.	All Hazards	DOR; PEMA; KEMA	Agency operating budget	December 2028	Promote and seek approval for potential tax free opportunities.	Medium
Action 4-4d. Identify funding for sinkhole mitigation.	Subsidence/ Sinkhole	PEMA; PUC; DCED; DCNR	Agency operating budget; FEMA BRIC	December 2026	Complete two sinkhole mitigation projects.	Medium
Action 4-4e. Identify financial assistance for EMTs to become paramedics and nurses by promoting the provisions of Act 104 of 2022 and Act 155 of 2022 which provides for tuition and loan assistance for active volunteers.	Pandemic/Infectious Disease	DOH	Agency operating budget	December 2025	Activate the provisions of Act 104 of 2022 and Act 155 of 2022 to provide tuition and loan assistance for active volunteers.	Medium
Action 4-4f. Prioritize planning and infrastructure grants to counties, municipalities, and regional planning partners that demonstrate multi-municipal, watershed-based, or regional planning where feasible as outlined in the PA State Planning Board *2021 Storm*	Floods	DCED; PennDOT; DCNR; PEMA; PennDOT	Agency operating budget	December 2025	Increase in multi-municipal planning.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Preparedness, Flood Hazard Mitigation, and Community Resilience report.						
Goal 5 - Increase awareness, understanding, and preparedness across all sectors.						
Objective 5-1: Support all-hazards mitigation and preparedness programs to educate private and public stakeholders, academia, government employees and elected officials on the hazards pertinent to the Commonwealth.						
Action 5-1a. Develop and provide presentations on hazard mitigation programs and sponsor conference booths (exhibits).	All Hazards	PEMA; State Planning Team members	State funding	Annually	Attend and present at one conference per year.	Medium
Action 5-1b. Schedule workshops and outreach sessions with local jurisdictions and invite home and business owners of mitigated structures to speak and share their experience with potential applicants.	All Hazards	PEMA	EMPG	Ongoing	Draft lessons learned for elevation and acquisition projects to present at workshops and sessions.	Medium
Action 5-1c. Conduct a public information campaign through various media outlets.	All Hazards	PEMA Press Office; FEMA Public Information Officer; Governor's Office of Communications	Agency operating budget; Media expenses	December 2028	Create a media strategy/campaign plan. Build outreach related coordination for Long Term Recovery	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
		& Press; DCED; FEMA Region 3				
Action 5-1d. Collaborate with the business community to implement hazard mitigation information and strategies.	All Hazards	PEMA; Pennsylvania Chamber; Regional Chambers; Regional Task Force Business and Pennsylvania Chamber; Regional Chambers; Regional Task Force Business and Labor Infrastructure Committees (or equivalent)	Agency operating budget; Small Business Administration funds	December 2028	Attend three Chamber of Commerce events.	Medium
Action 5-1e. Collaborate with non-profit, non-governmental and civic organizations to help inform their constituents about hazard mitigation.	All Hazards	Local/County Governments; Voluntary Organizations Active in Disaster (VOAD)	Agency operating budget	December 2028	Invite VOAD groups to next SJ outreach session.	Medium
Action 5-1f. Collaborate with higher education institutions to identify existing hazard mitigation curricula, gaps, and suggest new curricula.	All Hazards	PEMA; County EMAs; PACCC; PASSHE	Agency operating budget	December 2028	Identify curricula needed to meet hazard mitigation needs.	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Action 5-1g. Prepare hazard mitigation information to disseminate to specific audiences (i.e. multi- lingual, special needs).	All Hazards	PEMA; Counties; FEMA Region 3; organizations that organize jurisdictions; NGOs	Agency operating budget	December 2028	Create a list of hazard mitigation topics and target audiences.	Medium
Action 5-1h. Develop and conduct education efforts that increase residential and business owners' knowledge and awareness of mitigation grants by conducting various outreach activities.	Floods	PEMA; Counties; FEMA Region 3; state associations	Agency operating budget; FEMA FMA	Annually	Complete four sessions per year.	Medium
Action 5-1i. Work with county and municipal officials to educate property owners about grandfathering and revisions to the NFIP program.	Floods	FEMA Region 3, PEMA	FEMA CAP-SSSE; FEMA Risk MAP	Continuous	Document meeting dates and outreach for HMA in detail for 2023 SHMP.	Medium
Action 5-1j. Increase Pennsylvania participation in the CRS program through a State education strategy.	Floods	PEMA	Agency operating budget	Ongoing	Implement State CRS outreach Strategy; Develop a CRS Checklist that lists common activities within the Commonwealth and corresponding points to encourage communities to participate in the program;	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
					Designate a State-CRS representative.	
Action 5-1k. Increase public and private awareness about cyber threats.	Cyber Terrorism	PEMA; GOHS	Agency operating budget	December 2026	Continue to provide public/private sector cyber security outreach.	High
Action 5-1l. Include recovery and resiliency planning as an outreach topic over the planning period.	All Hazards	PEMA	Agency operating budget	December 2028	Recovery and resiliency added to agendas for upcoming PEMA training and outreach.	Medium
Action 5-1m. Include the impact of flooding on the agricultural sector as a training and outreach topic over the planning period.	Floods	PEMA; PDA (Agriculture); Penn State Extension; USDA Farm Service Agency	Agency operating budget	December 2028	Flooding impacts to the agricultural sector added to agendas for upcoming PEMA training and outreach.	Medium
Action 5-1n. Increase awareness about the impacts of Climate Change.	Extreme Temperature; Floods; Hurricane, Tropical Storm, Nor'easter; Landslide	PEMA; DEP; DOH	Agency operating budget; FEMA BRACE; FEMA BRIC	Ongoing	Include climate change as a topic in Commonwealth sponsored conferences. Conduct Joint Agency outreach (DEP, DOH) for local communities on how climate change impacts citizens.	Medium
Action 5-1o. Familiarize CRCC personnel with DMVA capabilities and limitations to make more effective and	All Hazards	DMVA; PEMA; GOHS; DCNR	Agency operating budget	Ongoing	Integrate briefings on DMVA capabilities and resources request decision	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
efficient use of National Guard resources while minimizing adverse effects on wartime missions.					process into CRCC training and exercises.	
Action 5-1p. Work with the Governor's Office of Public Affairs to improve the coordination and sharing of information among and between state agencies and counties.	All Hazards	Governor's Office of Public Affairs	Agency operating budget	Ongoing	Increased hazard mitigation outcomes, particularly at the county level.	Medium
Action 5-1q. Offer the installation of free smoke alarms in areas of need as identified in concert with local fire departments.	Urban Fire/Explosion; Wildfire	American Red Cross; Local Fire Departments	Operating budget	Ongoing	Continued outreach and smoke detector installation.	High
Action 5-1r. Provide training to state and local government officials on disaster preparedness and protecting essential records.	All Hazards	PHMC	Agency operating budget	Continual; annually	Over 100 local government officials trained in 5 years	High
Action 5-1s. Ensure alternative fuel vehicle (AFV) training is available to Pennsylvania first responders.	Urban Fire/Explosion; Utility Interruption	OSFC; PennDOT; PTC; NFPA	Agency operating budget	December 2024	Inventory existing AFV first responder training programs across Pennsylvania and CONUS, identify training gaps, and develop a plan to ensure	High

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
					training is available statewide in resident and on-line formats.	
Action 5-1t. Continue PennTIME Incident management training.	All Hazards	PTC; PennDOT; PSP; PEMA, Regional Planning Commissions; Responder Organizations	Agency operating budget; Joint funding	Ongoing	Improved first responder training, safety, and cooperation. Fewer injuries and fatalities involving roadside responses.	High
Action 5-1u. Increase training opportunities for healthcare workers to care for highly infectious patients.	Pandemic/Infectious Disease	DHS; DOH; PEMA	Agency operating budget; Hazard Mitigation Funding	Ongoing	Develop a program to deliver training on a quarterly basis.	Medium
Acton 5-1v. Increase statewide awareness about the impacts of harmful algal blooms (HABs).	Extreme Temperature; Mass Food/Animal Feed Contamination; Pandemic/Infectious Disease	DOH; DCNR; DEP; PDA (Agriculture); PFBC; PGC; PEMA	Agency operating budget	Ongoing	Use DOH developed public awareness resources to continue to inform the public about warning signs and reporting HABs.	Medium
Objective 5-2: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications between 2024 and 2028.						
Action 5-2a. Increase outreach to the 110 priority communities impacted by flooding as identified by PEMA.	Floods	PEMA; FEMA	Agency operating budget	Ongoing	Through the annual Risk Reduction Consultation, develop a strategy to outreach to priority	Medium

Table 6.4.3-1 2023 Mitigation Strategy Actions

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
					communities and implement the strategy.	
Action 5-2b. Conduct one meeting annually in each region of the state targeting RL and SRL community officials who serve as HMA grant sponsors.	Floods	PEMA; Counties	EMPG; FEMA FMA; FEMA HMGP	October 2028	Document meeting dates and outreach for 2028 SHMP.	High
Action 5-2c. Use the RL/SRL marketing and implementation program successes in PA communities as a platform for outreach efforts to other RL/SRL communities.	Floods	PEMA; Counties	FEMA HMGP when under a disaster declaration; FEMA BRIC; FEMA FMA	Annually	Submit one story per year to FEMA website, KEMA Newsletter, PEMA Pointers, and SJ Buzz.	Medium
Action 5-2d. Provide an update on SRL and RL mitigation strategies and accomplishments at the annual Commonwealth of Pennsylvania Emergency Management Conference.	Floods	PEMA	Agency operating budget	Annually	Ensure slot on agenda annually in March.	Medium

The mitigation strategy included in Table 6.4.2-2 represents a concerted effort to increase participation in development of the HMP by other state agencies and organizations. It reflects the engagement and input of 109 individuals from 65 different state agencies and other organizations.

The mitigation strategy also demonstrates an increase in agencies other than PEMA taking leadership in addressing hazard mitigation PEMA is clearly a catalyst for mitigation action, leading 58% of the actions in the 2018 HMP. PEMA is leading 39% of the actions in the 2023 State HMP, a decrease of 19% demonstrating increased interagency participation in the 2023 HMP. The 2023 mitigation actions are led by 41 different agencies, compared to 24 in the 2018 HMP, a 71% increase in agencies and organizations leading actions. Table 6.4.3-2 lists the agencies leading mitigation actions and how many actions each has committed to leading. Please note PEMA is also meeting with counties regularly to ensure awareness of funding opportunities including but not limited to FEMA programs.

Table 6.4.3-2 Agencies/Organizations Leading 2023 Mitigation Actions

PEMA	87	PUC	2
DEP	28	American Red Cross	1
DCNR	13	DGS	1
DCED	11	DMVA	1
DOH	7	DoBS	1
Local/County Governments	6	DOC	1
OA	5	DOR	1
PennDOT	5	DOS	1
PSP	5	KEMA	1
DDAP	4	L&I	1
Governor's Office	4	OSFC	1
PFBC	4	Local/Cty/State Public Safety Agencies	1
PA SHPO/PHMC	4	PA Broadband Development Authority	1
DHS	3	PAFPM	1
PDA (Agriculture)	3	PASSHE	1
PTC	3	PaWarn	1
USACE	3	PDE	1
CAP	2	PENNVEST	1
FEMA	2	SJ Initiative	1
PDA (Aging)	2	USGS	1
PA Milk Marketing Board	2		

Many additional agencies and organizations provide support in carrying out mitigation actions. A total of 129 agencies and organizations, including those leading mitigation actions, provide support on 2023 mitigation actions.

6.4.4 Risk Reduction Priorities

The SPT reviewed and considered Pennsylvania's Risk Reduction Priorities to ensure alignment between the priorities and the 2023 mitigation actions. FEMA Region 3, PEMA, and Commonwealth agency partners participated in a Pennsylvania Risk Reduction Consultation (RRC) 6-Month Check-In in December 2022. Regular RRCs have taken place throughout the planning period with a shift to a virtual format in 2020 due to the COVID-19 pandemic. The purpose of each RRC is to discuss collaboration to advance Pennsylvania's hazard mitigation program priorities and identify progress, successes, and challenges to achieving mitigation goals.

Various federal, state, and local entities regularly participate in the consultations bringing ideas for integrating priorities into their agency's work and leveraging collaborative projects. The regular attendees represent: CCAP, DCED, DCNR, DEP, DOH, DHS, FEMA, GOHS, Millersville University, PAFPM, PEMA, PennDOT, PDA (Agriculture), PID, PSATS, PASSHE, Pennsylvania State University, Philadelphia Office of Emergency Management, PHMC, PUC, Resilience Action Partners, SEDA-Council of Governments, USACE, USDA, and USGS.

Three (3) Risk Reduction Priorities were identified at the 2022 RRC. These are the same priorities discussed and reaffirmed at the 2018, 2019, and 2020 events and include:

1. Engage more stakeholders to support local Floodplain Managers (FPMs).
2. Increase outreach to priority communities.
3. Conduct outreach to elected officials to educate them about risk and mitigation.

To ensure these three (3) priorities are addressed in the 2023 mitigation strategy, the alignment between each priority and the mitigation actions were identified. Where alignment between the priorities and the mitigation action plan was not clearly demonstrated, adjustments were made to actions in the 2023 mitigation strategy. Table 6.4.4-1 demonstrates how each of the priorities aligns with and was integrated into the 2023 mitigation strategy.

Table 6.4.4-1 Aligning 2022 Risk Reduction Priorities with the 2023 Mitigation Strategy

Risk Reduction Priority 1: Engage more stakeholders to support local Floodplain Managers (FPMs).

Engaging additional stakeholders to support Floodplain Managers and delivering information focused on consumers and public interest is addressed in several objectives and associated actions of the mitigation action plan.
 	
• Objective 1-15: Increase the capacity and effectiveness of Commonwealth NFIP management.
  ○ Action 1-15a. Increase NFIP support staff.
  ○ Action 1-15b. Provide technical assistance to NFIP communities through Community Assistance Visits (CAV).
  ○ Action 1-15c. Deliver NFIP Training in the Commonwealth to increase local capacity for NFIP administration and enforcement.
  ○ Action 1-15d. Increase awareness and local capacity enforce and support Substantial Damage requirements.
  ○ Action 1-15e. Increase the number of Certified Floodplain Managers (CFMs) in the Commonwealth by developing and delivering CFM training in advance of scheduled CFM exams.
  ○ Action 1-15g. Continue to improve the functionality and accessibility of the PA Flood Tool.

Table 6.4.4-1 Aligning 2022 Risk Reduction Priorities with the 2023 Mitigation Strategy

- Objective 2-4: Identify local Hazard Mitigation Officers and increase participation by local community representatives in the Commonwealth's Mitigation Planning Team by 50% between 2024 and 2028.
  - Action 2-4b. Bring county leads and planning champions together for regular meetings, knowledge exchanges, and trainings.
- Objective 3-1: Identify opportunities for regional organizations, businesses, and universities to be engaged in hazard mitigation planning.
  - Action 3-1a. Maintain a comprehensive list of relevant regional agencies, including Councils of Government (COGs), River Basin Commissions, and Metropolitan Planning Organizations (MPOs).
  - Action 3-1c. Identify and encourage involvement of key business, industry, and infrastructure stakeholders and stakeholder associations in mitigation.
  - Action 3-1d Work with hazard mitigation stakeholders to provide increased support to Floodplain Managers.
- Objective 4-2: Expand working relationships with at least two volunteer and professional organizations to improve mitigation efforts within the Commonwealth.
  - Action 4-2a. Expand working relationship with professional organizations including: NHMA, PACO, PAFPM, NEMA, IAEM, ASFPM, KEMA, League of Cities, and Code Enforcement Officers.
  - Action 4-2c. Develop a working relationship with private insurance and financial sector companies.

The addition of NHMA, PACO, and PAFPM to Action 4-2a will increase professional resources, ideas, and solutions that will benefit local Floodplain Managers.

Risk Reduction Priority 2: Increase outreach to priority communities.

Pennsylvania identified a list of 110 priority communities, primarily historic river towns with high flood risk. An objective and action was added in the 2018 mitigation strategy to support outreach to these priority communities. This objective and action will continue in the 2023 mitigation action plan.

- Objective 5-2: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications between 2024 and 2028.
  - Action 5-2a. Increase outreach to the 110 priority communities impacted by flooding as identified by PEMA.

Risk Reduction Priority 3: Conduct outreach to elected officials to educate them about risk and mitigation.

Several objectives and associated actions focus on conducting outreach to municipal and county officials and planning champions to provide education, project tools, training on risks and hazard mitigation. Risk Reduction Priority 3 aligns with the following objectives and associated actions.

- Objective 1-8: Encourage aggressive enforcement of floodplain and stormwater management ordinances and other all-hazards regulations within the Commonwealth to reduce losses in high risk areas.
  - Action 1-8b. Conduct effective outreach with municipalities to explain value of floodplain ordinances and adopting more restrictive requirements.
  - Action 1-8f. Promote the use of Model Floodplain Ordinances which prohibit re/development in the floodplain, except by Conditional Use as outlined in the PA State Planning Board *2021 Storm Preparedness, Flood Hazard Mitigation, and Community Resilience* report.
- Objective 2-4: Identify local Hazard Mitigation Officers and increase participation by local community representatives in the Commonwealth's Mitigation Planning Team by 50% between 2024 and 2028.

Table 6.4.4-1 Aligning 2022 Risk Reduction Priorities with the 2023 Mitigation Strategy

- Action 2-4b. Bring county leads and planning champions together for regular meetings, knowledge exchanges, and trainings.

- Objective 4-1: Provide opportunities for Pennsylvania Emergency Management Agency and County Emergency Management Agencies to educate State, county and local government officials and legislators about hazard risk and mitigation by 2028.
  - Action 4-1a. Facilitate tours for local, county, and state legislative officials focusing on mitigation projects or areas where mitigation efforts are needed.
  - Action 4-1b. Develop and disseminate relevant information on hazard mitigation programs.
  - Action 4-1c. Document and share in-state success stories and best practices.
  - Action 4-1f. Provide legislator webinar to explain disaster declaration and hazard mitigation funding process.
- Objective 5-1: Support all-hazards mitigation and preparedness programs to educate private and public stakeholders, academia, government employees and elected officials on the hazards pertinent to the Commonwealth.
  - Action 5-1b. Schedule workshops and outreach sessions with local jurisdictions and invite home and business owners of mitigated structures to speak and share their experience with potential applicants.
  - Action 5-1j. Work with county and municipal officials to educate property owners about grandfathering and revisions to the NFIP program.
  - Action 5-1r. Provide training to state and local government officials on disaster preparedness and protecting essential records.

The addition of Action 1-8f developed by the State Planning Board and to be implemented by DCED strengthens the need to adopt floodplain ordinances which will reduce municipal risk. Action 5-1r was added to the mitigation strategy by PHMC to ensure officials understand the risk associated with not being prepared to maintain critical records in the event of a hazard incident. Preparing before an incident will improve record retention.

6.5. Local Mitigation Strategy

6.5.1 Local Mitigation Planning Assistance

6.5.1.1 Support of Local Hazard Mitigation Planning

Pennsylvania provides strong support to local hazard mitigation planning efforts and shares risk assessment data through technical and funding resources. There is the PA Flood Risk Tool PA Flood Risk (psu.edu). The PA Flood Risk Tool is designed to provide floodplain managers, insurance agents, developers, real estate agents, local planners, and citizens with an effective means by which to make informed decisions about the degree of flood risk for a specific area or property. Pennsylvania Spatial Data Access (PASDA) Pennsylvania Spatial Data Access (psu.edu) is Pennsylvania's official public access open geospatial data portal. PASDA was developed in 1995 by the Pennsylvania State University and has served as the geospatial data portal for Pennsylvania for over twenty-six years.

The SHMP is a living document that resides on the PEMA website 2018 State Hazard Mitigation Plan (pa.gov). Counties and other stakeholders are encouraged to download the plan and use any or all of it in their HMPs. Feedback and questions are encouraged and the meta-data for the state level risk analysis is available for the counties to modify as they tailor it to their

communities. The state conducts annual reviews of the plan, to which counties are invited and encourages and supports county annual reviews.

State guidance and priorities are further refined via Disaster Administrative Plans and Strategies. These documents, developed with FEMA Region 3, layout Pennsylvania priorities and funding strategies for a given disaster. A similar process is followed for non-disaster funding. Following the release of a FEMA Notice of Funding Opportunity for BRIC, FMA or LPDM funding, PEMA develops a funding strategy based on the Mitigation Strategy outlined in the current SHMP. PEMA coordinates with both FEMA and other state agencies, principally DCED, to develop a funding strategy to best utilize all resources federal, state, or local. This strategy is presented to the counties during a series of webinars conducted live and virtually.

Standard Operating Guide

To standardize hazard mitigation planning and streamline the process of integrating local plans into the State HMP, PEMA funded the development of the first SOG in 2010. The SOG was updated in 2013 and 2020 and captures FEMA requirements, clarifies and combines existing guidance, and allows communities a greater opportunity to excel in the preparation of HMPs.

Key modifications made in the 2020 SOG update included:

- An updated Standard List of Hazards to incorporate the new hazards added during the 2018 plan update.
- Incorporating information on historic preservation mitigation including data requirements and funding sources.
- Adding information on how to address Climate Change and assess future risk in applicable hazard profiles.
- Formalizing the requirement to follow the Model Plan Outline in Pennsylvania on the Plan Review Tool.

The step-by-step “how-to” guidance provided in the SOG makes the HMP development process more manageable while creating consistency among local hazard mitigation plans. Project and funding information included in the SOG gives local planning entities the tools necessary to maintain and implement the HMP in between updates. The developments of key standards in the SOG allow for simplification of the plan review process, allowing PEMA to conduct a more thorough and detailed HMP review in less time. The SOG provides several checklists and templates to provide consistency across county HMPs such as a Hazard Mitigation Planning Checklist, Model Plan Outline, Hazard Identification and Risk Evaluation Worksheet, Hazard Prioritization Matrix, and Mitigation Strategy Action Plan Template. The purpose is to foster plan integration and cooperation across the commonwealth. Counties are encouraged but not required to nest their mitigation strategies within Pennsylvania’s mitigation strategy. This nesting of strategies allows for more efficient use of funding. Likewise, the Commonwealth Mitigation Strategy, like the HIRA, is an amalgamation of the 67 County Mitigation Strategies and HIRAs. This cyclical and collaborative planning process ensures that the state provides resources and guidance to counties and that the State HMP reflects their hazards and mitigation strategies.

Local Hazard Mitigation Plan Development

PEMA supports all 67 counties as required under Commonwealth statute. Support is based on inherent needs dependent upon the level of each county's planning cadre and expertise. PEMA prioritizes support for counties whose capabilities are less than others and/or experience greater risk and vulnerability by comparison.

In the Commonwealth, land use authority is vested in the 2560 local municipalities vs the 67 counties. These municipalities range in size from the City of Philadelphia with 1.6 million people, to the Borough of Centralia with just seven people. The majority of municipalities have a population under 2,500 people. FEMA requires that HMPs be adopted and approved at the level of government with land use authority. Since creating and tracking 2560 separate plans is not feasible, municipalities participate in county plans. Once county plans receive FEMA's Approval Pending Adoption designation, the municipalities adopt the county plan.

This process can be very problematic. While most municipalities do participate in and adopt county plans, a significant number are unwilling or unable. In many cases these municipalities are quite small and have a few staff, and some might have all volunteer staff. PEMA encourages the counties to make it as easy as possible for these under-resourced communities to provide their input.

Appendix R contains a standard Statement of Work (SOW), jointly developed by PEMA and FEMA Region 3 Community Planning. This SOW is required for counties seeking Hazard Mitigation Planning grants through disaster or non-disaster funding. It details the steps counties must take to facilitate local participation. This outreach goes far beyond physical meetings to include virtual meetings, online forums, setting hazard mitigation tables up at other community events, and individual outreach to smaller boroughs. Many local officials are under the mistaken impression that they only need an HMP if they plan on seeking funding under FEMA programs. While this is a requirement, PEMA works hard to educate local officials on the importance of building resilient communities through Hazard Mitigation Planning. PEMA tracks municipal adoption and coordinates closely with FEMA Region 3 to track down missing adoptions. As of June 30, 2023, there are 2,441 local communities with that are either approved, being amended, approved pending adoption, in review, awaiting revisions, or have the planning process underway. This represents 95.2% of all communities in Pennsylvania. There are 124 communities with plans that are expired or archived.

Another common assumption is that a municipality does not have to participate in the county planning effort but can always adopt it later if needed. PEMA works very hard to educate counties and municipalities on the requirement to participate to adopt. FEMA Region 3 has assisted in this by disapproving municipal adoptions if there is no evidence of participation. Key engagement points include the SOW which lays out for counties the expectations for outreach and the fiscal briefing conducted one on one between PEMA and the county once a grant is awarded. This Fiscal Brief is present in Appendix R. It lays out the timelines for administering the grant, as well as plan submission and review.

The Commonwealth facilitates local risk assessment as it provides training and resources for Hazard Mitigation Planning through several venues. It conducts an annual review of the State HMP each fall, inviting counties to participate and sharing the results. It encourages and

supports county annual reviews. It provides FEMA courses G-393 (Hazard Mitigation For Emergency Managers), G-318 (Hazard Mitigation Planning Workshop), taught in conjunction with FEMA Region 3, and G-205 (Recovery from Disaster). In addition to FEMA courses, PEMA conducts multiple outreach events throughout the Commonwealth to help counties access risk analysis data and develop HMPs. These events include Plan Implementation and Grant Development (PIGD) workshops presented in conjunction with FEMA Region 3, Quarterly Training presentations, "What Makes a Good Project" workshops, and one-on-one technical assistance. PEMA is the state lead for the USACE's Silver Jackets program that brings together flood risk mitigators from Federal, State, local, public and private organizations Pennsylvania (army.mil). In the Fiscal Briefing presented to each HMP sub-grant recipient, PEMA encourages counties to include and invite PEMA and FEMA to their county planning events. This active collaboration leads to better local plans, and fewer surprises at plan submission.

Since the 2018 SHMP, nearly every county has utilized funding and assistance opportunities to support their own HMP updates. Counties received comprehensive services including community outreach assistance, data collection, risk analysis, meeting and workshop set-up and facilitation, and mitigation strategy and plan development. There were a few different funding programs that created these assistance opportunities. FEMA's HMGP program provided funding for 37 plans, mostly associated with opportunities from DR-4506. Funding from the Pre-Disaster Mitigation (PDM) program helped 24 counties update their plans in 2018 and 2019. The new BRIC Program funded 7 plans in 2020. Lastly, two counties utilized Flood Mitigation Assistance (FMA) funding for their plans in 2019 and 2020. These numbers add up to more than the 67 counties across Pennsylvania due to some counties utilizing multiple programs.

These plans are updated using the standards set forth in the FEMA Local Mitigation Planning Policy Guide (April 2022) and the PEMA SOG. Since 2015, PEMA has made sure that PEMA planning requirements are fully integrated with FEMA requirements. The intent is to ensure that communities are not faced with two sets of standards.

Local Mitigation Plan Review

PEMA's MIRC Office staff tracks the expiration dates and funding requirements of all county HMPs via the HM Planning Updates (Appendix R). PEMA issues reminders to counties about key dates for funding application and turn in. PEMA encourages counties to submit their HMP update to PEMA no later than 3 months prior to expiration. The three months allow time for PEMA to review the county hazard mitigation plans within two weeks of reception at PEMA. Counties will make any revisions required by PEMA and then submit them to FEMA. FEMA normally takes up to 45 days for their review. PEMA coordinates a conference call with the County, any planning consultants, FEMA and PEMA to review FEMA comments. The county then revises the HMP and resubmits. Upon Approval Pending Adoption, PEMA assists the county in tracking municipal adoptions. If an HMP is missing plan components, the plan is returned to the planning entity with comments for plan improvement and editing. PEMA encourages that multi-jurisdictional plans follow the SOG.

Pennsylvania Hazard Mitigation Planning Website

The MIRC Office is building and expanding on its website: Hazard Mitigation Planning. The website was expanded for the SHMP to share resources, including the All-Hazard Mitigation Planning Standard Operation Guide. The website contains links to view the 2018 State HMP, which was broken into each section for easier viewing. There is an understanding that the SHMP has the best compilation of data and research on hazards in the Commonwealth and that it can be made more accessible through sharing in new and creative ways online. The website has planned upgrades for Summer 2023 that include providing additional HM planning resources for counties and municipalities.

6.5.1.2 Support of Local Hazard Mitigation Projects

The Commonwealth supports hazard mitigation projects with funding and technical assistance. The Commonwealth has funded the cost of the non-federal match to HMGP funding completely since the disaster declaration for Hurricane Sandy was declared in 2013 and near completely at 22% for the declaration for Tropical Storm Lee and Hurricane Irene in 2011. This means Pennsylvania provided over $20 million dollars in hazard mitigation assistance funding to communities recovering from the state's most recent disasters. See Table 6.5.1-1. The funding is planned to continue and increase. The State share for the last five years was $12 million dollars and is planned for 2019 at $13 million dollars. This is a significant investment in mitigation that assists local communities and property owners.

Table 6.5.1-1 Pennsylvania Funded Match to HMGP Funding by Recent DR

DR	Date	State HMGP Match	Federal Share	Non-Federal Share	Admini-stration	DR Total	PA Total
4506 COVID-19 Pandemic*	Jan - 20	10%	$23,222,787	$1,940,491	$522,935	$25,686,212	$1,940,491
4408 – Severe Storms	Nov-18	25%	$6,600,000	$2,200,000	$1,200,000	$10,000,000	$3,400,000
4292 – Flood	Dec-16	25%	$2,725,781	$908,594	$205,159	$3,839,534	$1,113,753
4267 – Snow	Mar-16	25%	$6,296,721	$2,098,907	$324,891	$8,720,519	$2,423,79
4149 – Severe Storms	Oct-13	25%	$1,696,162	$565,387	$89,489	$2,351,038	$654,876
4099 – Hurricane Sandy	Jan-13	25%	$1,548,899	$516,300	$92,328	$2,157,527	$608,628

4030 – Flood	Sep-11	22%	$31,055,979	$10,351,993	$1,867,350	$43,275,322	$12,219,343
4025 – Hurricane Irene	Sep-11	22%	$8,754,956	$2,918,319	$548,537	$12,221,812	$3,466,856
		Totals	$81,901,285	$21,499,991	$4,850,689	$108,251,964	$23,403,947

Note: DRs in Green are still active, amounts reflect FMEA approved project costs, not final costs. DR-4506 numbers are as of April 3, 2023.

PEMA conducts outreach to county and local officials, universities, and other agencies as applicable to engage them in applying for both annual HMA funding and post-disaster HMGP funding. Annual notice of funding availability is publicized through county contacts, and post-disaster briefings are held for disaster-impacted areas to engage county and local officials in opportunities for mitigation funding. PEMA uses the Letter of Intent for HMGP projects and the Letter of Interest for other HMA projects to identify leads on hazard mitigation projects. If the projects described in the letters fit the eligibility guidelines, the HMPO form is completed. In addition, PEMA supports local HMA application development by providing technical assistance and trainings.

For example, in 2021 and 2022, PEMA with support from FEMA and partners DRBC and SRBC hosted three (3) Plan Implementation and Grant Development (PIGD) workshops per year for county and municipal planners. The targeted PIGDs were designed to: increase the capacity of local municipalities to apply for grants, provide education and outreach to local EMCs to increase their understanding of the HMA and HMGP application process and timeline, and advance HMPs to mitigation project development and ultimately hazard mitigation actions.

Throughout Commonwealth government, hazard mitigation projects are solicited throughout the year and are identified through the local hazard mitigation planning process. When funding is available, the Hazard Mitigation Project Review Committee of the Commonwealth's Hazard Mitigation Team is convened to review, evaluate, and rank order all available mitigation projects. The process for how mitigation projects are prioritized is described in Section 6.5.1.3 Prioritizing Local Assistance.

PEMA supports local hazard mitigation projects by providing technical assistance and trainings. A summary of training conducted through the planning period summarized in Table 6.7-1. PEMA also uses its website to provide guidance on mitigation grant programs and supply forms and documents: Hazard Mitigation.

PEMA is consistently working to track progress on mitigation. The MIRC Office maintains and updates lists on mitigation projects that are in progress and complete and conducts three-year monitoring of projects and particularly open space to ensure it is not developed post-mitigation.

PEMA currently tracks 1,719 closed local hazard mitigation projects, and FEMA tracks 1,795 closed, approved, or obligated with 1,603 being closed. The difference in numbers is not alarming between PEMA and FEMA datasets. Examining the data reveals several individual properties tracked in one project or separated into individual projects between the two databases. Sometimes projects are listed more than once. The OpenFEMA Dataset of HMA Mitigated Properties is a consistently updated dataset. In time, the tracking between datasets will become more consistent. Table 6.5-2 summarizes local hazard mitigation projects by county that have FEMA HMA Grant Funds closed, approved, or obligated from 1999 – 2022; Table 6.5-3 lists the number of closed PEMA mitigation projects by county.

Table 6.5.1-2 Number of Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2023 (FEMA, 2023)						
County	Mitigation Technique					Total
	Acquisition	Elevation	Floodproofing	Relocation	Other	
Adams	0	0	0	0	2	2
Allegheny	8	0	2	0	9	19
Armstrong	0	0	0	0	5	5
Beaver	3	0	0	0	2	5
Bedford	1	1	0	0	3	5
Berks	1	0	0	0	4	5
Blair	1	0	0	0	4	5
Bradford	6	0	0	0	3	9
Bucks	5	9	3	1	5	23
Butler	2	0	0	0	2	4
Cambria	0	0	0	0	2	2
Cameron	0	0	0	0	3	3
Carbon	0	0	0	0	1	1
Centre	0	0	0	0	3	3
Chester	8	1	2	1	7	19
Clarion	0	0	0	0	2	2
Clearfield	0	0	0	0	1	1
Clinton	1	0	0	0	3	4
Columbia	22	2	2	0	4	30
Crawford	0	0	0	0	3	3
Cumberland	1	0	0	0	3	4
Dauphin	23	1	3	0	49	76
Delaware	5	1	1	0	6	13
Elk	1	0	0	0	2	3
Erie	0	0	0	0	2	2
Fayette	5	0	0	0	1	6
Forest	0	0	0	0	3	3
Franklin	2	0	0	0	1	3
Fulton	0	0	0	0	3	3
Greene	0	0	0	0	2	2
Huntingdon	0	0	1	0	5	6
Indiana	0	0	0	0	3	3

Table 6.5.1-2 Number of Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2023 (FEMA, 2023)						
County	Mitigation Technique					Total
	Acquisition	Elevation	Floodproofing	Relocation	Other	
Jefferson	0	0	0	0	2	2
Juniata	0	0	0	0	3	3
Lackawanna	0	0	1	0	7	8
Lancaster	0	0	1	0	6	7
Lawrence	0	0	0	0	3	3
Lebanon	15	0	0	0	4	19
Lehigh	1	0	1	0	3	5
Luzerne	30	0	3	0	7	40
Lycoming	15	0	1	0	6	22
McKean	0	0	0	0	1	1
Mercer	0	0	0	0	3	3
Mifflin	0	0	0	0	3	3
Monroe	0	0	0	0	5	5
Montgomery	27	4	2	0	3	36
Montour	6	0	0	0	2	8
Northampton	3	1	0	0	6	10
Northumberland	3	0	1	0	3	7
Perry	0	0	0	0	4	4
Philadelphia	0	0	2	0	7	9
Pike	0	0	0	0	2	2
Potter	0	0	0	0	2	2
Schuylkill	6	0	0	0	6	12
Snyder	0	2	1	0	3	6
Somerset	0	0	0	0	3	5
Sullivan	1	0	0	0	3	4
Susquehanna	8	0	0	0	3	11
Tioga	0	0	0	0	5	5
Union	1	1	0	0	3	5
Venango	0	0	1	0	6	7
Warren	0	0	0	0	3	3
Washington	2	0	0	0	2	4
Wayne	0	0	0	0	3	3
Westmoreland	4	0	0	0	4	8
Wyoming	8	0	1	0	4	13

Table 6.5.1-2 Number of Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2023 (FEMA, 2023)						
County	Mitigation Technique					Total
	Acquisition	Elevation	Floodproofing	Relocation	Other	
York	6	0	1	0	8	15
Total	**231**	**23**	**32**	**2**	**306**	**594**

Table 6.5.1-3 Number of Closed Projects for which FEMA HMA Grant Funds was Received 2000-2023 (PEMA, 2023)			
County	Projects	County	Projects
Adams	2	Lackawanna	2
Allegheny	12	Lancaster	4
Armstrong	4	Lawrence	2
Beaver	5	Lebanon	20
Bedford	1	Lehigh	5
Berks	4	Luzerne	35
Blair	4	Lycoming	16
Bradford	4	McKean	0
Bucks	18	Mercer	1
Butler	3	Mifflin	2
Cambria	1	Monroe	3
Cameron	3	Montgomery	14
Carbon	1	Montour	4
Centre	2	Northampton	3
Chester	10	Northumberland	6
Clarion	2	Perry	3
Clearfield	0	Philadelphia	2
Clinton	2	Pike	3
Columbia	21	Potter	1
Crawford	2	Schuylkill	7
Cumberland	3	Snyder	3
Dauphin	56	Somerset	2
Delaware	5	Sullivan	5
Elk	2	Susquehanna	6
Erie	1	Tioga	3
Fayette	3	Union	5
Forest	2	Venango	6
Franklin	2	Warren	2
Fulton	2	Washington	2
Greene	1	Wayne	2
Huntingdon	5	Westmoreland	3
Indiana	2	Wyoming	12
Jefferson	1	York	7
Juniata	2	**Total**	**393**

There have been 206 projects since 2019 for which FEMA HMA grant funds were either used, are currently being used, or are still pending approval. Out of these 206 projects, there are 189 that are either in progress or pending approval as of May 2023. Out of these 189, eleven of these projects have been funded in Pennsylvania under either the PDM or LPDM, 114 by HMGP, 38 by the FMA program, and 26 by BRIC since the start of 2019. There are currently 38 plan update projects that are still considered in progress as of May 2023, all of which are funded through the HGMP. Table 6.5.1-4 identifies all of the local mitigation projects for which FEMA HMA grants have been obligated, approved, or are pending, excluding these plan updates.

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)

Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
HMGP	2019	City of Pittsburgh Acquisition	Allegheny	City of Pittsburgh	PENDING APPROVAL
PDM	2019	Penn Hill Landslide Mitigation	Allegheny	Penn Hill	IN PROGRESS
PDM	2019	Pittsburgh Landslide Mitigation	Allegheny	Pittsburg	IN PROGRESS
FMA	2019	Advance Assistance for Upper Susquehanna River Basin Mitigation	Bedford	Bradford	IN PROGRESS
FMA	2019	93 Yardley Elevation	Bucks	Yardley Borough	IN PROGRESS
FMA	2019	Yardley Borough Elevation of 8 Structures	Bucks	Yardley Borough	IN PROGRESS
FMA	2019	Yardley Mitigation/Reconstruction	Bucks	Yardley Borough	IN PROGRESS
FMA	2019	Town of Bloomsburg Elevation Project	Columbia	Town of Bloomsburg	IN PROGRESS
FMA	2019	State Management Costs	Dauphin	Susquehanna	IN PROGRESS
FMA	2019	FMA Technical Assistance	Dauphin	Susquehanna	IN PROGRESS
FMA	2019	Middle Paxton Elevation	Dauphin	Middle Paxton	IN PROGRESS
PDM	2019	Susquehanna upper steam mitigation	Dauphin	Susquehanna	IN PROGRESS
PDM	2019	State IFLOWS 2.0	Dauphin	Susquehanna Township	IN PROGRESS
PDM	2019	Management cost	Dauphin	Susquehanna	IN PROGRESS
FMA	2019	Hallam Borough Frysville Rd FMA Acquisition	York	Hallam Borough	IN PROGRESS
FMA	2020	Project Scoping: Saw Mill Run Blvd	Allegheny	City of Pittsburgh	IN PROGRESS
BRIC	2020	Berks County Hazard Mitigation Planning Grant	Berks	Berks	IN PROGRESS
FMA	2020	Lower Makefield Township Elevation Project	Bucks	Lower Makefield Twp.	IN PROGRESS
BRIC	2020	Clinton County Hazard Mitigation Planning Grant	Clinton	Clinton	IN PROGRESS
BRIC	2020	PA Building Code Project Application	Dauphin	Susquehanna	IN PROGRESS

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)

Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
BRIC	2020	Project Scoping: Comm of PA Flood Protect Conduit Inspects/SOG Dev/Study for Resilience	Dauphin	Susquehanna	IN PROGRESS
BRIC	2020	MC Cost	Dauphin	Susquehanna	IN PROGRESS
FMA	2020	PEMA Technical Assistance	Dauphin	Susquehanna	IN PROGRESS
FMA	2020	MC Cost	Dauphin	Susquehanna	IN PROGRESS
FMA	2020	Project Scoping: Haverford Twp Delaware County	Delaware	Haverford Township	IN PROGRESS
BRIC	2020	Indiana County Hazard Mitigation Planning Grant	Indiana	Indiana	IN PROGRESS
BRIC	2020	Jefferson County Hazard Mitigation Planning Grant	Jefferson	Jefferson County	IN PROGRESS
FMA	2020	Penn Lake Park Borough-Luzerne Co.- project scoping	Luzerne	Penn lake	IN PROGRESS
FMA	2020	Lycoming Co Nature Based Solution FMA Plan	Lycoming	Lycoming	IN PROGRESS
FMA	2020	Upper Providence Twp Acquisition Montgomery County	Montgomery	Upper Providence Township	IN PROGRESS
FMA	2020	Project Scoping: Bethlehem Twp-Lehigh/Northampton County	Northampton	Bethlehem Twp	IN PROGRESS
FMA	2020	Project Scoping Palmer Township	Northampton	Palmer	IN PROGRESS
BRIC	2020	Susquehanna County Hazard Mitigation Planning Grant	Susquehanna	Susquehanna	IN PROGRESS
BRIC	2020	DTA Railroad Borough	York	Railroad Borough	IN PROGRESS
HMGP	2021	Oakdale Borough	Allegheny	Oakdale Borough	PENDING APPROVAL
HMGP	2021	Findlay Twp	Allegheny	Findlay Twp	PENDING APPROVAL
HMGP	2021	Londonderry Township Acquisition	Bedford	Londonderry Twp	PENDING APPROVAL
HMGP	2021	Londonderry Township Elevation	Bedford	Londonderry Township	PENDING APPROVAL
HMGP	2021	Morrisville Borough Flood Gate	Bucks	Morrisville	PENDING APPROVAL
HMGP	2021	Northampton Township- Tanner Estates SWM	Bucks	Northampton Township	PENDING APPROVAL
HMGP	2021	Bristol Borough- Green Lane Flood Study	Bucks	Bristol Borough	PENDING APPROVAL
HMGP	2021	Upper Makefield Township Acquisition	Bucks	Upper Makefield Township	PENDING APPROVAL

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)					
Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
HMGP	2021	Tredyffrin Twp Yellow Springs Acquisition	Chester	Tredyffrin Township	PENDING APPROVAL
HMGP	2021	Tredyffrin Township Acquisition	Chester	Tredyffrin Twp	PENDING APPROVAL
HMGP	2021	Upper Chichester Acquisition	Delaware	Upper Chichester	PENDING APPROVAL
HMGP	2021	Middletown Township Acquisition	Bucks	Middletown Township	IN PROGRESS
HMGP	2021	Manheim Borough	Lancaster	Manheim Borough	PENDING APPROVAL
HMGP	2021	City of Lancaster PW- Wastewater Treatment flooding	Lancaster	City of Lancaster PW	PENDING APPROVAL
HMGP	2021	Upper Providence Acquisition Project - 1	Montgomery	Upper Providence	PENDING APPROVAL
HMGP	2021	Green Lane Borough Acquisition	Montgomery	Green Lane Borough	PENDING APPROVAL
HMGP	2021	Skippack Township Acquisition	Montgomery	Skippack Township	PENDING APPROVAL
HMGP	2021	Lower Providence Acquisition	Montgomery	Lower Providence	PENDING APPROVAL
HMGP	2021	Hatfield Township Acquisition	Montgomery	Hatfield Township	PENDING APPROVAL
HMGP	2021	Green Lane Borough 2 Historic Home Acquisition	Montgomery	Green Lane Borough	PENDING APPROVAL
HMGP	2021	Marlborough Township Acquisition	Montgomery	Marlborough Township	IN PROGRESS
HMGP	2021	Perkiomen Township Acquisition	Montgomery	Perkiomen Township	IN PROGRESS
HMGP	2021	Bridgeport Borough Acquisition	Montgomery	Bridgeport Borough	IN PROGRESS
HMGP	2021	Whitemarsh Township Acquisition	Montgomery	Whitemarsh Township	IN PROGRESS
HMGP	2021	Northampton Combined Elevation	Northampton	Northampton Combined	PENDING APPROVAL
HMGP	2021	Collegeville Borough Acquisition	Montgomery	Collegeville Borough	IN PROGRESS
HMGP	2021	Upper Mount Bethel Township Acquisition	Northampton	Upper Mount Bethel Township	IN PROGRESS
HMGP	2021	Northampton County Combined Acquisition	Northampton	City of Bethlehem/Easton City	IN PROGRESS
HMGP	2021	Selinsgrove Borough-Elevation	Snyder	Selinsgrove Borough	PENDING APPROVAL

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)					
Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
HMGP	2021	DCNR H&H Field Study	State Agency/Dept	Statewide	IN PROGRESS
HMGP	2021	Penn State University Flood Study	State Agency/Dept	Statewide	IN PROGRESS
HMGP	2021	Ruffed Grouse Society (RGS)/Mid Atlantic Forest Conservation	State Agency/Dept	Statewide	PENDING APPROVAL
HMGP	2021	IFLOW 2.0 Integrated Flood Observation & Warning System	State Agency/Dept	Statewide	IN PROGRESS
HMGP	2021	Honesdale Borough - Levee Study	Wayne	Honesdale Borough	IN PROGRESS
HMGP	2021	Railroad Borough Adv Asst	York	Railroad Borough	IN PROGRESS
HMGP	2021	Smith Township Acquisition	Washington	Smith Township	PENDING APPROVAL
BRIC	2021	State Management Costs	Dauphin	Susquehanna	IN PROGRESS
FMA	2021	Management cost	Dauphin	Susquehanna	PENDING APPROVAL
FMA	2021	Technical assistance	Dauphin	Susquehanna	PENDING APPROVAL
HMGP	2021	State Management Costs	Dauphin	Harrisburg	IN PROGRESS
BRIC	2021	Delaware River Basin Commission Mid-Delaware Project Scoping	Delaware	Delaware River Basin	IN PROGRESS
BRIC	2021	Penn Lake Park Borough	Luzerne	Penn Lake Borough	IN PROGRESS
FMA	2021	Scoping West Pittston Luzerne Levee	Luzerne	West Pittston	PENDING APPROVAL
BRIC	2021	Lycoming - Jersey Shore / Lawshee Run	Lycoming	Lycoming - Combined	IN PROGRESS
FMA	2021	Easton Northampton Acquisition/Demolition	Northampton	Easton	PENDING APPROVAL
BRIC	2021	Shamokin Coal Twp- JSA	Northumberland	Shamokin Coal	PENDING APPROVAL
BRIC	2021	Philadelphia Direct Technical Assistance (Eastwick)	Philadelphia	Philadelphia	IN PROGRESS
BRIC	2021	City of Philadelphia Cohocksink Flood Mitigation	Philadelphia	Philadelphia	PENDING APPROVAL
FMA	2021	Management cost	Dauphin	Susquehanna	PENDING APPROVAL
FMA	2021	Technical assistance	Dauphin	Susquehanna	PENDING APPROVAL
HMGP	2021	State Management Costs	Dauphin	Harrisburg	IN PROGRESS
BRIC	2021	Delaware River Basin Commission Mid-Delaware Project Scoping	Delaware	Delaware River Basin	IN PROGRESS

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)					
Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
BRIC	2021	Penn Lake Park Borough	Luzerne	Penn Lake Borough	IN PROGRESS
FMA	2021	Scoping West Pittston Luzerne Levee	Luzerne	West Pittston	PENDING APPROVAL
BRIC	2021	Lycoming - Jersey Shore / Lawshee Run	Lycoming	Lycoming - Combined	IN PROGRESS
FMA	2021	Easton Northampton Acquisition/Demolition	Northampton	Easton	PENDING APPROVAL
BRIC	2021	Shamokin Coal Twp- JSA	Northumberland	Shamokin Coal	PENDING APPROVAL
BRIC	2021	Philadelphia Direct Technical Assistance (Eastwick)	Philadelphia	Philadelphia	IN PROGRESS
BRIC	2021	City of Philadelphia Cohocksink Flood Mitigation	Philadelphia	Philadelphia	PENDING APPROVAL
BRIC	2021	City of Philadelphia - Germantown	Philadelphia	City of Philadelphia - Germantown	IN PROGRESS
BRIC	2021	Orwigsburg Schuylkill Flood Mitigation Scoping	Schuylkill	Orwigsburg	IN PROGRESS
FMA	2021	Hempfield Township Acquisition	Westmoreland	Hempfield Township	PENDING APPROVAL
FMA	2021	Westmoreland Hempfield Greensburg Acquisition	Westmoreland	Hempfield Greensburg	PENDING APPROVAL
HMGP	2022	Bristol Township Inlet Replacements	Bucks	Bristol Township	PENDING APPROVAL
HMGP	2022	Morrisville- Williamson Park Back Flow.	Bucks	Morrisville	PENDING APPROVAL
HMGP	2022	Pocopson Township Acquisition	Chester	Pocopson Township	PENDING APPROVAL
HMGP	2022	Downingtown Borough ACQ 1	Chester	Downingtown Borough	PENDING APPROVAL
HMGP	2022	Willistown Twp-Ronnie Park Storm Water Management System	Chester	Willistown	PENDING APPROVAL
HMGP	2022	Downingtown Borough ACQ 2	Chester	Downingtown	PENDING APPROVAL
HMGP	2022	Renovo Borough Acquisition	Clinton	Renovo Borough	PENDING APPROVAL
HMGP	2022	Bloomsburg Municipal Authority Flood Mitigation Study	Columbia	Bloomsburg	PENDING APPROVAL
HMGP	2022	Lower Swatara Acquisition	Dauphin	Lower Swatara	PENDING APPROVAL
HMGP	2022	Highspire Borough	Dauphin	Highspire Borough	PENDING APPROVAL

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)					
Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
HMGP	2022	Brandywine Conservancy Elevation	Delaware	Chadds Ford Township	PENDING APPROVAL
HMGP	2022	Ridley Twp Acquisition	Delaware	Ridley Township	PENDING APPROVAL
HMGP	2022	Upper Darby TWP	Delaware	Upper Darby Township	PENDING APPROVAL
HMGP	2022	City of Connellsville Acquisition	Fayette	City of Connellsville	PENDING APPROVAL
HMGP	2022	Chambersburg Borough Acquisition	Franklin	Chambersburg Borough	PENDING APPROVAL
HMGP	2022	Montoursville Borough Acquisition	Lycoming	Montoursville Borough	PENDING APPROVAL
HMGP	2022	Lycoming County (Muncy Borough) Acquisition	Lycoming	Muncy Borough	PENDING APPROVAL
HMGP	2022	Lower Providence Elevation	Montgomery	Lower Providence	PENDING APPROVAL
HMGP	2022	West Norriton Elevation	Montgomery	West Norriton	PENDING APPROVAL
HMGP	2022	West Norriton Acquisition	Montgomery	West Norriton	PENDING APPROVAL
HMGP	2022	Collegeville Borough (Montgomery) Infrastructure	Montgomery	Collegeville Borough	PENDING APPROVAL
HMGP	2022	Upper Providence Twp 2 ACQ Project	Montgomery	Upper Providence Township	PENDING APPROVAL
HMGP	2022	Schwenksville Centennial Street SWM	Montgomery	Schwenksville Borough	PENDING APPROVAL
HMGP	2022	City of Philadelphia - East Germantown Study	Philadelphia	City of Philadelphia	PENDING APPROVAL
HMGP	2022	Orwigsburg Borough Acquisition.	Schuylkill	Orwigsburg Borough	PENDING APPROVAL
HMGP	2022	DCNR Tree Planting 5%	State Agency/Dept	Statewide	PENDING APPROVAL
HMGP	2022	Watrous Water Infrastructure	Tioga	Gains Township	PENDING APPROVAL
HMGP	2022	City of Harrisburg- Paxton Creek Flood Scoping	Dauphin	City of Harrisburg	IN PROGRESS
HMGP	2022	Moosic Borough Advanced Assistance	Lackawanna	Moosic Borough	IN PROGRESS
HMGP	2022	Jessup Borough Advance Assistance	Lackawanna	Jessup Borough	IN PROGRESS
HMGP	2022	City of Scranton Advanced Assistance	Lackawanna	Scranton City	IN PROGRESS

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)

Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
HMGP	2022	Upper Moreland Township Acquisition	Montgomery	Upper Moreland Township	IN PROGRESS
HMGP	2022	Upper Providence Twp 3 ACQ Project	Montgomery	Upper Providence Township	IN PROGRESS
HMGP	2022	12 County HHPD Integration	State Agency/Dept	PEMA	IN PROGRESS
HMGP	2022	New Freedom Borough	York	New Freedom Borough	PENDING APPROVAL
HMGP	2022	Springfield TWP	York	Springfield Township	PENDING APPROVAL
BRIC	2022	Adams County HMP Update	Adams	Adams County	PENDING APPROVAL
FMA	2022	SWIFT CURRENT Modena Borough Mitigation Reconstruction	Chester	Modena Borough	IN PROGRESS
FMA	2022	2022 FMA Project Scoping - City of Coatesville SWM Improvements	Chester	City of Coatesville	PENDING APPROVAL
FMA	2022	SWIFT CURRENT - Town of Bloomsburg Elevation	Columbia	Town of Bloomsburg	IN PROGRESS
BRIC	2022	Cumberland County HMP Update	Cumberland	Cumberland County	PENDING APPROVAL
BRIC	2022	City of Harrisburg	Dauphin	City of Harrisburg	PENDING APPROVAL
FMA	2022	SWIFT CURRENT STATE MANAGEMENT COSTS	Dauphin	Susquehanna	IN PROGRESS
HMGP	2022	Brandywine Conservancy-Flood Study (5% Inn)	Delaware	Chadds Ford Township	PENDING APPROVAL
FMA	2022	2022 FMA Project Scoping - Lehigh Valley Watersheds Assessment and Global Act Ordinance	Lehigh	Lehigh/Northampton Counties	PENDING APPROVAL
FMA	2022	2022 FMA Project Scoping - Coolbaugh Monroe SWM	Monroe	Coolbaugh Township	PENDING APPROVAL
FMA	2022	SWIFT CURRENT West Norriton Township Elevation	Montgomery	West Norriton Township	PENDING APPROVAL
FMA	2022	SWIFT CURRENT Upper Providence Township Elevation	Montgomery	Upper Providence Township	PENDING APPROVAL
HMGP	2022	Upper Dublin Willow Manor Streambank Stabilization	Montgomery	Upper Dublin	PENDING APPROVAL
FMA	2022	2022 FMA Project Scoping - Philadelphia Eastwick Flood Resilience	Philadelphia	Eastwick Area of Philadelphia	PENDING APPROVAL
BRIC	2022	Direct Technical Assistance Tremont Borough	Schuylkill	Tremont Borough	IN PROGRESS

Table 6.5.1-4 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated 2019-2023 (as of May 23, 2023)					
Program	Program FY	Project	County	Jurisdiction/ Sub-Applicant	Project Status
FMA	2022	2022 FMA Project Scoping - Selinsgrove Borough, Snyder County	Snyder	Selinsgrove Borough	PENDING APPROVAL
FMA	2022	2022 FMA Technical Assistance - Pennsylvania	State Agency/Dept	Statewide	PENDING APPROVAL
FMA	2022	2022 FMA State Management Costs - Pennsylvania	State Management Cost	Statewide	PENDING APPROVAL
BRIC	2022	Venango County HMP Update	Venango	Venango County	PENDING APPROVAL
BRIC	2022	West Newton Borough	Westmoreland	West Newton Borough	PENDING APPROVAL
LPDM	2022	Upper Burrell Township Landslide Mitigation	Westmoreland	Upper Burrell Township	IN PROGRESS
BRIC	2022	Railroad Borough- Flood Resiliency Plan	York	Railroad Borough	PENDING APPROVAL
HMGP	2022	Dover Township Acquisition	York	Dover Township	IN PROGRESS
LPDM	2023	#2 Flood Control Project Columbia County (Phase 3 Bloomsburg Flood Wall)	Columbia	Town of Bloomsburg	PENDING APPROVAL
LPDM	2023	#1 Mayfield Borough Levee Upgrade (FEMA HQ Designated EDRC)	Lackawanna	Mayfield Borough	PENDING APPROVAL
LPDM	2023	#4 West Pittston Levee Project (Construction)	Luzerne	West Pittston Borough	PENDING APPROVAL
LPDM	2023	#3 Greater Williamsport Flood Control Project	Lycoming	City of Williamsport	PENDING APPROVAL

Public assistance is readily used in Pennsylvania, resulting in over $1.3 billion in funding over the last five years. PEMA continues to prioritize mitigation under Section 406 of the Stafford Act for cost-effective measures that will prevent future similar damage. However, in the post-disaster recovery setting many partners prioritize returning functionality over the lengthier process for Section 406 mitigation approval. See Table 6.5.1-5. Action 1-2b is a continuing mitigation strategy action to prioritize Section 406 mitigation and share the success of implemented projects.

Table 6.5.1-5 Public Assistance Federal Obligation since 2018.			
Types of Projects	**DR-4408**	**DR-4506**	**DR-4618**
Emergency Work	$5,940,346	$1,202,994,937	$9,538,576
Permanent Work	$71,093,764	$0	$24,177,785
TOTAL	**$80,279,879**	**$1,202,994,937**	**$35,629,347**

6.5.1.3 Prioritizing Local Assistance

Mitigation projects are created at several governmental levels and can include ongoing projects, state obligated projects, and projects identified in local Hazard Mitigation Plans. The number and cost of hazard mitigation projects may exceed the amount of funds available for such activities. Therefore, a process is needed to prioritize projects using metrics such as cost effectiveness and consistency with local and state mitigation goals. Many efforts to study the appropriate mitigation actions are multi-disciplinary in nature and require coordination between jurisdictions and governmental agencies. The process used for prioritizing mitigation projects depends on the specific program from which funds are allocated. During a declared disaster, the Commonwealth along with FEMA develops a Planning strategy typically through an Administrative Plan to target counties with planning needs and prioritize based on risk and capabilities.

PEMA developed a Hazard Mitigation Project Officer Handbook that includes Hazard Mitigation Assistance application process and review guidance to ensure compliance and consistency is applied to projects across the Commonwealth. This also helps ensure that the most effective mitigation projects are funded and implemented. The Handbook instructs Hazard Mitigation Project Officers (HMPOs) to review applications for eligibility and completeness and to coordinate and convene a State Hazard Mitigation Review Team. The State Hazard Mitigation Review Team consists of both PEMA personnel and Agency Representatives from other PA State Agencies and Commissions who integrate their hazard mitigation and resiliency efforts with PEMA. The most common Mitigation Project Review Team members come from DEP, DCED, PennDOT, DCNR, Health and Human Services, PA Historic and Museum Commission, PA Dept of Insurance and the 3 PEMA Area Offices.

The Review Team uses the Commonwealth Hazard Mitigation Program Application Checklist (see Figure 6.5-2) to evaluate, score and rank all projects. The Checklist includes 15 criteria that give weight to projects that address repetitive loss, loss of life, are located in the SFHA, and are cost-effective among other considerations. Social considerations have always been considered in the Pennsylvania review methodology, known as PASTEEL (Political, Administrative, Social, Technical, Economic, Environmental, Legal). In response FEMA Justice 40 initiatives, Pennsylvania is adjusting how it scores projects to add a greater weight to projects which will benefit underserved and disadvantaged communities, which many times are dictated by the FEMA Notice of Funding Opportunity strategies, eligibility, and scoring criterium. A particular issue is the ability of these communities to apply for grants. The goal is to help these communities ‘break the code’ by having at least one successful mitigation project grant so that the community understands the process and perceives it as an effective means of building resiliency within their community. Pennsylvania employs the Grant Equity Working Group, led by DCNR, to identify and develop best practices for enabling underserved and disadvantaged Communities to successfully apply for HM grants. These communities are identified through review of local Hazard Mitigation Plans, their Social Vulnerability Index (SoVI), and via screening using the CJEST database. This data will be used to highlight projects for approval that might not have ranked as highly due to more traditional criteria such as BCA.

Each member of the State Hazard Mitigation Review Team scores each project, with the maximum score each for each project by each Team member being 150, and scores are totaled, and projects ranked accordingly. Selection of mitigation projects for RL and SRL properties is based on the number of flood-related events, the dollar amount of insurance claims paid, a cost-benefit evaluation, environmental soundness, and technical feasibility. When PEMA receives project applications, it examines each to determine if it is an RL or SRL property. The Commonwealth strives to fund all plans and projects that meet application standards for any HMA grant. Mitigating SRL properties is given first priority, RL properties is second priority, and non-RL or SRL properties would be third priority overall. Acquisition is also prioritized over elevation; therefore, the prioritization of projects may be expanded to allow SRL acquisition first, RL acquisition second, SRL elevation third, RL elevation fourth, non-RL acquisition fifth, and non-RL elevation sixth.

Additionally, the State Hazard Mitigation Review Team will reference approved local HMPs and consider local project/action ranking. Counties that have recommendations to utilize the Pennsylvania SOG for HMP updates will apply the Pennsylvania Multi-Objective Mitigation Action Prioritization Criteria to rank all feasible actions in their HMPs (see Section 6.4.2). The methodology allows actions to be scored from zero to three. Actions that address multiple hazards, critical facilities, and high-ranking hazards are scored higher.

Local assistance provided for local Hazard Mitigation Plan updates between 2018 and 2022 was prioritized based solely on plan expiration dates. Those counties with immediate plan expiration dates were offered assistance first. In the event that a chosen county was not interested in assistance, the next county with the most immediate expiration date was chosen to receive funding assistance.

This process for mitigation project prioritization and funding aligns with the goals and objectives of the Pennsylvania Hazard Mitigation Strategy. Project ranking and prioritization in this manner helps ensure that the most effective projects are funded and those that address repetitive damages and high-risk hazards are given preference. The Commonwealth’s mitigation success, summarized in Section 6.7, is a reflection of the careful and thorough consideration that is given to mitigation project evaluation.

Figure 6.5.1-1 Commonwealth Hazard Mitigation Program Application Evaluation Checklist from HMPO Handbook (PEMA, 2022)

Review of risk and history of damages caused by natural/technological hazards, matched with a project that produces a reasonable level of protection for the cost involved.

- Proper identification of the hazard
- Defining the population and infrastructure at-risk
- Level of protection provided by the measure
- Effectiveness and feasibility of the measure **(Note: Projects that address high risk areas should have the highest probability of being funded.)**
- Has the appropriate non-federal match.
- Is not covered by the authority of another federal agency.
- Can be completed in the required performance period.
- Meets all program specific eligibility requirements.
- Conforms to state and local mitigation plans.
- Independently solves a problem caused by the hazard (not dependent on another phase).
- Directly reduces damage.
- Is a mitigation project and not:
  - An emergency response activity
  - An emergency preparedness activity
  - Replacement of infrastructure near the end of its project useful life
  - A maintenance project
- Considering community lifelines.
- Identification of how the project will encourage diversity, equity, and inclusion.
  - Social Vulnerability and the National Risk Index
- How will climate change impact the project?

6.6. Pennsylvania Repetitive Loss and Severe Repetitive Loss Mitigation Strategy

6.6.1. Introduction

RL and SRL information are woven throughout this Pennsylvania Hazard Mitigation Plan. This section updates the Repetitive Loss (RL) and Severe Repetitive Loss (SRL) Mitigation Strategy for Pennsylvania that specifies the state's strategy to reduce the number of RL and SRL properties and specifically identifies sections of the HMP that address this information. The SPT determined that it would be helpful to maintain the SRL strategy and expand it to be the Repetitive Loss and Severe Repetitive Loss Mitigation Strategy, even though this strategy will not result in increased funding. These properties reflect a priority for mitigation and are deserving of a specific strategy.

PEMA received approval for its first Severe Repetitive Loss Strategy on May 30, 2008. The 2008 strategy was revised as part of this section of the Pennsylvania 2010 Hazard Mitigation Plan and expanded to cover both RL and SRL properties in 2013. Additionally, a CD resides as Appendix G to this plan and features SRL and RL property files which have been merged with

the Commonwealth's Mitigated Properties file so that mitigated repetitive loss properties are properly characterized.

6.6.2 Strategy Overview

The Commonwealth seeks to reduce the number of RL and SRL properties through a strategy that focuses on three categories:

- Data
  Maintenance of accurate datasets is essential to characterizing the portfolio of Pennsylvania Severe Repetitive Loss and Repetitive Loss Properties. These datasets facilitate program planning, HMA grant targeting, and outreach efforts to potential project sponsoring communities as well as the property owners. The methodology that the Commonwealth employs compares the known mitigation project locations with the repetitive loss locations as identified by FEMA in Microsoft Excel workbooks contained in Appendix G. Data within PIVOT and within analysis completed by Region 3's Floodplain Management and Insurance Branch accomplishes similar analysis.

- Planning
  In Pennsylvania, counties, and municipalities have developed local hazard mitigation plans that target and prioritize mitigation actions, consistent with the principle that all-hazard mitigation begins locally. Counties and municipalities serve as HMA local sponsors, applying to PEMA for grant programs to mitigate flood-prone properties. Specifically, municipalities with RL and SRL properties must include strategies to address these properties in their hazard mitigation plans. PEMA provides data as requested from PIVOT to share with counties for HMP updates, always noting the requirement to not disclose specific property addresses publicly.

- Outreach
  Education and awareness provided through outreach is the key to increasing the number of mitigated structures in Pennsylvania and reducing reliance on the NFIP. Outreach activities continue to be developed to provide services beyond conventional limits and segments of a community.

As of November 2022, Pennsylvania had 10,902 repetitive loss and severe repetitive loss properties, an increase of 2,387 since January 2018. This information is contained in the flood hazard profile in Section 4.3.5 and summarizes Pennsylvania data on SRL and RL claims, properties, and mitigated structures by county and provides tables and maps of this information. Table 4.3.5-9 and Table 4.3.5-10 show the number and type of RL and SRL property for each county in Pennsylvania. The tables also show how many properties for each type of building (i.e., 2-4 family, single-family, non-residential, etc.) were mitigated. Figure 4.3.5-15 shows the location of RL and SRL properties in Pennsylvania.

In order for the Commonwealth to reduce the number of these RL and SRL properties, the SPT reviewed the 2018 State mitigation strategy and developed 2023 mitigation goals, objectives, and actions. This is detailed in Sections 6.1, 6.2, and 6.4 of this Plan Update.

6 MITIGATION STRATEGY

Goals guide the selection process of actions to mitigate and reduce potential losses from hazards, including mitigation activities for repetitive loss properties. Although there are many actions incorporated in the mitigation action plans found in Section 6.4.3, the following Goals, Objectives, and Actions represent the RL and SRL mitigation strategy.

Table 6.12.2-1 RL and SRL related Goals, Objectives, and Actions from Full Mitigation Strategy						
Action Description	**Hazard**	**Lead/Support Agency**	**Funding Source**	**Target Completion Date**	**Measure of Success**	**Priority**
Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including high-risk properties.						
Objective 1-1: Continue reduction of flood-related losses (with an emphasis on reducing NFIP identified repetitive loss and severe repetitive loss properties) through promotion of the Commonwealth's flood protection program through local, county, state, and federal partners.						
Action 1-1c. Target SRL and RL properties for mitigation (including demolition, acquisition, and elevation) during annual HMA project review and prioritization process.	Floods	PEMA; Counties; DCED; PAFPM; Local Floodplain Managers	FEMA Hazard Mitigation Assistance Programs; Agency operating budget	December 2024	Mitigate five or more SRL properties per year. Use the list of 'shovel ready' projects from recent DRs to facilitate mitigation project application process for future funding opportunities.	High
Objective 1-12: Ensure reports and databases are updated annually to reflect Repetitive Loss and Severe Repetitive Loss mitigation.						
Action 1-12b. Annually review the progress of SRL and RL property mitigation to ensure accuracy of PIVOT. Submit PIVOT updates as needed, particularly for location and mitigation status.	Floods	PEMA; Counties; FEMA Region 3	FEMA Hazard Mitigation Assistance Programs (management costs)	Each disaster or mission	Include information in annual report (Action 1-12a); 100% compliance needed.	Medium
Goal 5 - Increase awareness, understanding, and preparedness across all sectors.						
Objective 5-2: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications between 2024 and 2028.						
Action 5-2b. Conduct one meeting annually in each region of the state targeting RL and SRL community	Floods	PEMA; Counties	EMPG; FMA; HMGP	October 2028	Document meeting dates and outreach for 2028 SHMP.	High

Table 6.12.2-1 RL and SRL related Goals, Objectives, and Actions from Full Mitigation Strategy						
Action Description	**Hazard**	**Lead/Support Agency**	**Funding Source**	**Target Completion Date**	**Measure of Success**	**Priority**
officials who serve as HMA grant sponsors.						
Action 5-2c. Use the RL/SRL marketing and implementation program successes in PA communities as a platform for outreach efforts to other RL/SRL communities.	Floods	PEMA; Counties	HMGP when under a disaster declaration	Annually	Submit one story per year to FEMA website, KEMA Newsletter, PEMA Pointers, and SJ Buzz.	Medium
Action 5-2d. Provide an update on SRL and RL mitigation strategies and accomplishments at the annual Commonwealth of Pennsylvania Emergency Management Conference.	Floods	PEMA	Agency operating budget	Annually	Ensure slot on agenda annually in March.	Medium

PEMA is working to mitigate RL and SRL properties and is working with counties with large numbers of repetitive loss properties. The Commonwealth has had several success stories in RL and SRL mitigation. For example, homes were elevated in a county in southeastern Pennsylvania that experienced repeated flood losses.

The Commonwealth's prioritization process for selecting projects and properties for mitigation is described in Section 6.5.1. In particular, PEMA works to mitigate RL and SRL properties through FEMA's HMA program. The Commonwealth strives to fund all plans and projects that meet application standards for any HMA grant. Though if funding became limited in the future and all grant criteria were equal, mitigating SRL properties would be first priority, RL properties would be second priority, and non- RL or SRL properties would be third priority. Acquisition is also prioritized over elevation; therefore, the prioritization of projects may be elaborated on to be SRL acquisition first, RL acquisition second, SRL elevation third, RL elevation fourth, non-RL acquisition fifth, and non-RL elevation sixth.

Prioritization has resulted in mitigating 1,486 RL and SRL properties in Pennsylvania. The State and local capabilities to fund and mitigate RL and SRL properties are discussed in Section 5.3. Sections 5.3 and 6.5.1 of the Hazard Mitigation Plan describe the Commonwealth's process to provide local mitigation planning assistance. In particular, Section 6.5.1 describes how the Commonwealth supports the development of local mitigation plans.

Table 6.12.2-2 Review of Implementation Actions from 2018 RL and SRL Strategy

2018 RL & SRL Strategy Actions	Progress & Edits for 2023 Update
Action 1-1c. Target SRL and RL properties for mitigation (including demolition, acquisition, and elevation) during annual HMA project review and prioritization process.	Complete and continue. Add PAFPM and Local Floodplain Managers as support agencies. Refer to Section 6.5.
Action 1-12b. Annually review the progress of SRL and RL property mitigation to ensure accuracy of BureauNet. Submit BureauNet updates as needed, particularly for location and mitigation status.	Complete and ongoing. Modify action description to change BureauNet to PIVOT. Add FEMA Region 3 as a support agency. Change target completion date to each disaster or mission. Remove DCED as a support agency as NFIP management has transferred to PEMA.
Action 4-1d. Collect more detailed building information for mitigation projects to improve "Losses Avoided" analysis in SHMP.	Complete. Move to capability. County HMPs are required to have enhanced HAZUS analysis with building attribute data.
Action 5-2a. Increase outreach to the 110 priority communities impacted by flooding as identified by PEMA.	Complete and continue. Update on priority community outreach provided at 6 Month RRC Check-Ins. Remove DCED as support agency as NFIP management has transferred to PEMA.

Table 6.12.2-2 Review of Implementation Actions from 2018 RL and SRL Strategy	
2018 RL & SRL Strategy Actions	**Progress & Edits for 2023 Update**
Action 5-2b. Conduct one meeting annually in each region of the state targeting RL and SRL community officials who serve as HMA grant sponsors.	Complete and continue. Remove DCED as support agency as NFIP management has transferred to PEMA.
Action 5-2c. Use the RL/SRL marketing and implementation program successes in PA communities as a platform for outreach efforts to other RL/SRL communities.	Complete and continue. Remove DCED as support agency as NFIP management has transferred to PEMA
Action 5-2d. Provide an update on SRL and RL mitigation strategies and accomplishments at the annual Commonwealth of Pennsylvania Emergency Management Conference.	Complete and continue. Remove DCED as support agency as NFIP management has transferred to PEMA.

6.7. High-Hazard Potential Dams

6.7.1. Introduction

High Hazard Potential Dams (HHPDs) are an important focus for hazard mitigation in Pennsylvania. HHPDs are typically considered dams where failures are likely to cause severe flooding, the loss of human life, and significant property and infrastructure damage. The FEMA HHPD Grant Program (The National Dam Safety Program Act (Pub. L. 92–367), as amended, 33 U.S.C. § 467f-2) offered an opportunity to address the many HHPDs throughout the Commonwealth. The detailed requirements of the HHPD Grant required close and continuous cooperation between PEMA MIRC and DEP Division of Dam Safety. PEMA and DEP conducted dozens of physical and virtual meetings to clarify definitions, identify candidate dams, submit grant applications, and amend the State and local HMPs as needed to qualify for the grants. This HMP update and the PEMA HHPD program are fully integrated with the DEP mission and agency priorities. DEP personnel initiate HHPD grants and coordinate with PEMA for amendments to HMPs as needed. DEP reviews and approves all HHPD efforts and serves as the technical expertise on Dam Safety matters. DEP expertise was critical to the negotiations between PEMA and FEMA to adjust FEMA requirements for HHPD analysis in HMPs. These adjustments allowed far more communities to apply for HHPD grants than would otherwise have been possible. One of the key integration issues was the correct identification of HHPDs due to differing definitions at the state and federal level.

Currently, there are multiple ways to classify dams and the risk they pose, including FEMA's system, USACE's, and PA DEP's. The Commonwealth has commissioned a contractor to bridge the gaps between these different classification systems to ensure that communities are analyzing dams and applying for grant funding using the same methodology. This led to the creation of PEMA's Ram Risk Prioritization Methodology document. More information on this classification system and most of the data on HHPDs can be found in Appendix H. This section outlines the HHPD Mitigation Strategy for Pennsylvania, specifying the focus areas and actions

that will help reduce the risks associated with these structures. HHPDs reflect a priority for mitigation and are deserving of a specific strategy and discussion in this plan.

6.7.2. Strategy Overview

The Commonwealth seeks to reduce the risks associated with HHPDs through a strategy that focuses on three categories:

- Data
  Maintenance of accurate datasets is essential to understanding the risks from HHPDs. These datasets help identify which dams fit into this classification, which in turn helps prioritize grant funding and outreach efforts to dam owners. Currently, this plan primarily uses data from DEP's Bureau of Dam Safety. Next steps for data collection include continuing to work with USACE to identify and evaluate HHPDs, expanding the number of dams that have their inundation areas mapped, and digitizing dam maps so they can be added to the PA Flood Risk Tool. Consistently collecting new data and updating existing datasets ensures that the Commonwealth is prioritizing projects in an evidence-backed manner and making decisions based on the best available information.

- Planning
  All HHPDs in Pennsylvania are required to have approved Emergency Action Plans. These plans identify potential incidents that may lead to emergencies, identify areas that will be affected by failures, and outlines actions that will minimize impacts such as loss of life and property damage. Dam owners are responsible for creating and maintaining these plans, while DEP periodically reviews them. State officials may also provide technical assistance during plan development. In addition to these plans, county HMPs also include information on dam failures, HHPDs, and their strategies to address their risks. Dam Failure was the fifth most-profiled hazard across all Pennsylvania County HMPs and five counties labeled specific actions to address HHPDs as some of their highest priority mitigation actions.

- Outreach
  Education and awareness provided through outreach is the key to increasing dam owners' awareness of their required activities and assistance programs. This outreach helps build relationships with dam owners, which in turn helps the continued development and improvement of datasets. From the public perspective, more successful methods of notifying those that live and work within the potential inundation area of a high hazard dam that they are at risk would improve general awareness.

As of August 2023, Pennsylvania has 788 High Hazard Potential Dams. This information is also contained in the dam failure hazard profile in Appendix H. Table 4.3.18-3 shows the number and classification of HHPDs for each county in Pennsylvania. Figure 4.3.18-2 shows the location of these dams.

In order for the Commonwealth to continue reducing the risks associated with HHPDs, the SPT reviewed the 2018 State Mitigation Strategy and developed 2023 mitigation goals, objectives, and actions. This is detailed in Sections 6.1, 6.2, and 6.4 of this Plan Update.

6 MITIGATION STRATEGY

Goals guide the selection process of actions to mitigate and reduce potential losses from hazards, including mitigation activities for HHPDs. Although there are many actions incorporated in the mitigation action plans found in Section 6.4.3, the following Goals, Objectives, and Actions represent the HHPD mitigation strategy. Note that these actions have been given high priority by the mitigation action prioritization formula discussed in Section 6.4.2.

Table 6.7.2-1 HHPD related Goals, Objectives, and Actions from full Mitigation Strategy						
Action Description	**Hazard**	**Lead/Support Agency**	**Funding Source**	**Target Completion Date**	**Measure of Success**	**Priority**
Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including high-risk properties.						
Objective 1-7: Increase coordination, prioritization, and funding availability to address community needs for dam hazards.						
Action 1-7a. Build on DEP's initiative to require dam owners to complete a dam break analysis and map inundation areas for dams of high hazard potential.	Floods; Dam Failure	DEP; PEMA; Counties; DCNR; PFBC	Agency operating budget; National Dam Safety Program grant; HHPD; USACE Silver Jackets; Dam Owner	Ongoing	Increase percentage each year.	High
Action 1-7b. Identify and implement mitigation actions based on Silver Jacket meeting results.	Floods; Dam Failure	USACE	Agency operating budget	December 2028	Completion of Screening Level Risk Assessments by USACE.	Medium
Action 1-7c. Evaluate and enforce appropriate remediation of dams.	Floods; Dam Failure	DEP Dam Safety; DEP Regional Offices; USACE District Office	Agency operating budget; PENNVEST loan and grant program; Act 13 Flood Mitigation Program; Growing Greener, State Capital Budget, Dam Owner	Ongoing	Report DEP annual records of dam removals.	High
Action 1-7d. Ensure that all high hazard dams have an	Floods; Dam Failure	DEP; PEMA	HHPD; FEMA Dam Safety Program; IIJA; Agency operating	Ongoing	Achieve 95% EAP approval.	High

Table 6.7.2-1 HHPD related Goals, Objectives, and Actions from full Mitigation Strategy

Action Description	Hazard	Lead/Support Agency	Funding Source	Target Completion Date	Measure of Success	Priority
Emergency Action Plan, as required.			budget; Dam owner			
Action 1-7e. Reduce the vulnerability of High Hazard potential Dams (HHPDs) as defined by FEMA.	Floods; Dam Failure	DEP; DCNR, Counties	HHPD Rehabilitation Grant	Ongoing	Securing funding for 8 HHPD in FY19 application cycle. Evaluate HHPDs and apply for funding in subsequent years.	High
Action 1-7g. Digitize dam maps and add to the PA Flood Risk Tool.	Floods; Dam Failure	DEP; PEMA; PSU; Dam Owners	FEMA CTP	December 2028	Digitization of dam maps complete and incorporated into the PA Flood Risk Tool.	Medium
Action 1-7h. Utilize the newest dam classification and prioritization system to develop and update list of dams, including periodic updates to ensure data reflects changing conditions of dams.	Floods; Dam Failure	PEMA; DEP	Agency operating budget	Ongoing	Completed list of dams classified using updated prioritization method.	Medium
Action 1-7i. Develop capability to include underserved and disadvantaged communities in inundation area analysis for HHPDs.	Floods; Dam Failure	PEMA; DEP	Agency operating budget	Ongoing	Add this population data into inundation data for HHPDs. Complete analysis for any new HHPDs that are added to list periodically.	Medium

PEMA, USACE, and DEP are working with dam owners, other state agencies, and counties and municipalities with HHPDs to implement this mitigation strategy. In particular, the Commonwealth works to assess and mitigate HHPDs through FEMA's Dam Safety Program and the HHPD Rehabilitation Program. The HHPD Rehabilitation Program provides technical, planning, design, and construction assistance through grant funding for eligible dams and projects. Dams must be non-federal, fail to meet minimum dam safety standards, and have an Emergency Action Plan. DEP works directly with communities through the design and construction phases to provide support, including discussions on testing methods, ground disturbances, water penetration, soil testing, and more. The Commonwealth strives to assist with funding on all dam plans and projects that meet application standards for grant funding, though if funding became limited in the future and all grant criteria were equal, mitigating HHPD properties is the top priority. This does not diminish the importance of promoting dam safety and monitoring for all dams across the Commonwealth. There is no difference in prioritization criteria for HPPD projects and other mitigation projects.

PEMA, DEP, and PA Silver Jackets also provide trainings for local stakeholders. On September 14, 2022, this group and other state and federal agencies participated in a training exercise at Lake Williams Dam that focused on stakeholders evaluating the effectiveness of their EAPs and local emergency manager and personnel response to a flood emergency at the dam. There were presentations from the National Weather Service on different storm scenarios and breakout discussions were held to answer specific questions.

County HMPs are another way in which the Commonwealth and local government work together to implement this mitigation strategy. One of the critical requirements for County HMPs is that the plans include analysis of the HHPD risk in their communities. They are prompted to use PEMA's HHPD Classification System: Dam Risk Prioritization Methodology document to evaluate dams within their planning area. Communities must include potential cascading impacts of different hazards on dams, the socioeconomic impacts, the location and size of the PAR from HHPDs, methods for risk data and inundation analysis, and documentation of limitations and an approach to address these deficiencies. County HMPs have identified HHPD monitoring and plan review as high-priority mitigation actions. Currently, there are still challenges involved with properly identifying and evaluating all HHPDs.

Overall, the greatest challenge for HHPDs is the cost of operation, maintenance and rehabilitation. This is particularly true of individual private dam owners and homeowners' associations. With homeowners' associations, there can be the additional challenge of disagreement between the individuals that make up the association. It is also true that many of these owners are also less knowledgeable regarding available resources to them when compared to larger private owners, such as major water companies, and government entities. Further, available funding assistance is minimal for private dam owners, unless the project proposes to breach or remove the dam.

The focus on HHPDs and this strategy has resulted in an increasing number of Emergency Action Plans. In the 2018 SHMP, it was reported that approximately 902 of the dams regulated by DEP had approved plans. Since the 2018 SHMP, PEMA has secured funding for eleven

projects using HHPD: 1 project in 2020; 5 projects in 2021; 6 projects in 2022. More information on HHPD-related actions from the 2018 SHMP can be found in the table below.

Table 6.7.2-2 Review of Implementation Actions from 2018 HHPD Strategy

2018 HHPD Strategy Actions	Progress & Edits for 2023 Update
Action 1-7a. Build on DEP's initiative to require dam owners to complete a dam break analysis and map inundation areas for dams of high hazard potential.	Complete and ongoing. Add DCNR and PFBC as support agencies. Add HHPD as a funding source.
Action 1-7b. Identify and implement mitigation actions based on Silver Jacket meeting results.	Complete and ongoing. Floodplain Management Plan for Heller Dam is under development and may be used as a template for future HHPD grant applicants.
Action 1-7c. Evaluate and enforce appropriate remediation of dams.	Complete and ongoing. Add USACE District Office, DEP Dam Safety; DEP Regional Offices as support agencies. PENNVEST has funded two (2) dam projects as part of a drinking water system. 1) City of Lock Haven: modification to the Warren Ohl Dam, approved 04/20/2020, in construction status. 2) Altoona Water Authority: Bellwood Dam Upgrade/Rehabilitation, approved 01/20/2021, in construction status.
Action 1-7d. Ensure that all high hazard dams have an Emergency Action Plan, as required.	In progress. Add HHPD, FEMA Dam Safety Program, and IIJA as funding sources.
Action 1-7e. Reduce the vulnerability of High Hazard potential Dams (HHPDs) as defined by FEMA.	Complete and ongoing. DCNR applied for grant funding to rehabilitate Memorial Lake dam and Kephart Dam in 2022. PEMA secured funding for eleven (11) projects in the application cycle using HHPD: 1 project in 2020; 5 projects in 2021; 6 projects in 2022.

6.8. Mitigation Success

Pennsylvania maintains a strong program of mitigation success, possible through the strong relationships with federal, state, regional, and local stakeholders, and the effective use of multiple funding sources.

The Commonwealth has 206 projects funded through HMA which are pending, approved, or obligated since 2018 (see Table 6.5.1-2). After the completion of the 2018 plan and in light of the COVID-19 Pandemic, PEMA and its partners continue to make great strides improving state and local capability for mitigation. PEMA's mitigation success can be attributed to its commitment in providing local mitigation planning assistance along with various training and education programs, and strong partnerships with state agencies and local and regional partner

organizations. With 67 counties in Pennsylvania and 2,560 municipalities, local capacity building is fundamental to risk reduction and mitigation. Ensuring the thousands of Pennsylvania local officials charged with administering the NFIP and planning for mitigation action have the tools and training to be effective is just as important as addressing and mitigating the Commonwealth's most vulnerable properties.

A list of Pennsylvania's mitigation success since the 2018 HMP update is included in 6. The mitigation successes were achieved during a period of intense activity by PEMA and numerous state agencies during the COVID-19 pandemic and multiple, concurrent activations. A snapshot of PEMA leadership during concurrent activations between February 2020 and March 2021 is included in 6.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**
County HMPs	• 67 County HMPs updated using Pennsylvania Hazard Mitigation Plan Standard Operating Guide • Pennsylvania Hazard Mitigation Plan Standard Operating Guide was updated in 2020, including increased information for Historic Preservation Planning.

Training/Workshops / Conferences	• PEMA and state partners participated in the FEMA's Pennsylvania Risk Reduction Consultation (RRC) annually during the 2018 – 2022 planning period.
	  ○ RRCs were held in 2018 and 2019. The COVID-19 pandemic necessitated a RRC Webinar in May 2020, and regular 6-month RRC Check-Ins have been convened with the most recent 6-Month Check-In held December 2022.
	• PEMA with support from FEMA and partners DRBC and SRBC hosted three (3) Plan Implementation and Grant Development (PIGD) workshops per year for county and municipal planners. The targeted PIGDs are designed to:
	  ○ Increase the capacity of local municipalities to apply for grants.
	  ○ Provide education and outreach to local EMCs to increase their understanding of the HMA and HMGP application process and timeline.
	  ○ Advance HMPs to mitigation project development and ultimately hazard mitigation actions.
	• PEMA participated in numerous DRBC Upper Delaware River and Lackawaxen Watershed Mitigation PIGD events between July 2021 and June 2022. The study area included Wayne, Pike, Monroe, and Lackawanna Counties.
	  ○ The PIGD was funded through two (2) FEMA Advance Assistance grants: 2019 Flood Mitigation Assistance Grant (Project No. FMA-PJ-03-PA-2018-010); 2019 Pre-Disaster Mitigation Grant (Project No. PDM-PJ-03-PA-2018-024).
	  ○ 14 workshop and webinar sessions (in-person and virtual) held over the course of the project reached more than 5,600 people.
	  ▪ More than 70 FPMs and emergency management personnel in Wayne, Pike, Monroe, and Lackawanna Counties.
	  ▪ More than 2,500 FPMs throughout the Commonwealth.
	  ▪ More than 1,200 DRBC LinkedIn followers.
	  ▪ More than 1,400 DRBC Twitter followers.
	  ▪ More than 440 DRBC Hydrology Listserv members.
	  ▪ Attendees at the April 2022 PSATs Annual Conference
	• PEMA participated in additional DRBC events during the planning period including:
	  ○ Climate Change Adaptation Forums (2/3/2020, 2/3/22, 9/13/22)
	  ○ Preparing for Electric Grid for Changing Climate (6/30/2020)
	• PEMA participated in SRBC events during the planning period including:
	  ○ PIGDs
	  ○ Applying for Advanced Assistance HM Projects (4/15/22, 10/27/22).
	• PEMA participated in an Emergency Management Accreditation Program from the National Emergency Management Association.
	• DCED "Excellence in Government Partnership Award" received for a project in the City of Harrisburg.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**

	• Pennsylvania state partners participated in the FEMA Region 3 Coffee Break webinar, "Utilizing University Partnerships in Hazard Mitigation Planning" in November 2022.
	• Conducted a legislative delegation tour in Harrisburg in 2022.
	• USACE 2 non-structural workshops conducted.
	• PEMA/PML delivered training through the PA Construction Codes Academy.
	• During the planning period, PEMA along with partners DCED, PHMC, DCNR, and DEP, participated in conferences for the following organizations: Pennsylvania Association of Floodplain Managers (PAFPM), County Commissioners Association of Pennsylvania (CCAP), American Planning Association Pennsylvania Chapter (APA-PA), and Pennsylvania State Association of Township Supervisors (PSATS).
	• The Inaugural Emergency Preparedness Conference by Keystone Emergency Management Association (KEMA) was held in October 2018. The conference was held in October 2019, postponed in 2020 due to the COVID-19 pandemic, 2021 in virtual, video on-demand format, and in October 2022.
	  ○ The conference showcases concepts, technology, processes, and evidence-based practices in emergency management and is supported by PEMA staff.
	• DEP EPO provided training augmenting PEMA training opportunities.
	  ○ Offered several training programs for building code enforcers throughout the Commonwealth.
	  ○ Developed and offered training on energy emergency related topics, specifically liquid fuel and energy storage technology, to help critical facilities and local government plan for energy backup and resilience measures.
	  ○ Worked with private fuel industry stakeholders such as the Pennsylvania Propane Association and the Petroleum Marketers Association to educate and exercise emergency plans for liquid fuel emergencies.
	  ○ Assisted local government and critical facilities in applying for BRIC funding for energy related resilience efforts.

Funding Assistance	• During the planning period, PEMA and partners began review of the new Building Resilience Infrastructure and Communities (BRIC) grant program applications supported by agency partners DEP and DCED. The new program was launched in 2020.
	  ○ Many communities applying for funding and impacted by Hurricane Ida in 2021 did not track historical landmarks prior to the disaster. This impacted the Environmental and Historic Preservation (EHP) review process conducted as part of BRIC review.
	  ○ To address this PEMA will work with PHMC to help local governments track historic landmarks before the next disaster. This is included in the 2023 mitigation strategy as Action 2-3p (Table 6.4-2).
	• Two BRIC projects completed in 2020
	  ○ Building Code Training with DEP EPO, DCED, L&I, PML.
	  ○ DEP Levee Conduit project.
	• DCED's Community Housing and Development Center continues to administer funding for CDBG-Disaster Recovery allocations and financed the state's Pre-Disaster Recovery Plan.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**

Increased RL/SRL and NFIP Capabilities	• The PA Flood Risk Tool launched in 2021 as a joint effort between PEMA and FEMA and is designed to provide floodplain managers, insurance agents, developers, real estate agents, local planners and citizens with a clear picture of flood risk for a specific area or property.
	• PIVOT replaced BureauNet in 2019 and is consistently and regularly updated.
	• PEMA resumed state responsibility for NFIP from DCED in 2020.
	  ○ Prior to 2020 DCED CLGS co-hosted several floodplain management trainings with PEMA through its contract with PML.
	  ▪ DCED CGLS through its Municipal Statistics division provided significant technical assistance on floodplain topics through its call center.
	  ▪ DCED accompanied PEMA on Community Assistance Visits (CAVs) to provide permitting technical assistance and monitor for local flood readiness, funded through FEMA CAP.
	  ▪ DCED Municipal Assistance Program (MAP) maintained an annual set-aside for municipal Floodplain Ordinance work reimbursements.
	• Through the planning period, the Pennsylvania Insurance Department:
	  ○ Continued an increase in flood insurance coverage throughout the Commonwealth, with 10,935 total policies.
	  ○ Admitted market increase from 489 policies in January 2016 to 5,299 policies in January 2020.
	  ○ Continued increase in communication, partnerships, and education with FEMA, PEMA, and DCED.

Private Sector Integration / Partnerships	• PEMA completed the full stand-up of the Commonwealth Response Coordination Center of the PA Business Emergency Operations Center (PA BEOC) which encourages multi-sector coordination between private and State agencies. • PA BEOC, PTC, and PennDOT in conjunction with private industry developed the Commonwealth of Pennsylvania Inclement Winter Weather Travel Restriction and Ban Framework. Implementation of the framework is included in the 2023 mitigation strategy as Action 2-5f (Table 6.4-2). • DEP, PUC, PEMA, and GOHS along with private industry developed the DEP Energy Assurance Plan (ENAP) to address energy assurance concerns associated with liquid fuels energy emergencies and electric and natural gas emergencies. • PA BEOC regularly coordinates with the fuels industry sector which includes representation from both the propane and petroleum industries. • DEP EPO worked with private fuel industry stakeholders such as the Pennsylvania Propane Association and the Petroleum Marketers Association to educate and exercise emergency plans for liquid fuel emergencies.
Recovery and Resiliency Planning	• Creation of a statewide recovery plan. • PEMA hired a new resiliency program manager to help local communities strengthen their risk reduction and mitigation efforts before disasters. • PEMA and DCED staff received National Disaster Recovery Framework (NDRF) leadership training to more effectively prepare and formally plan for active disaster response. • DCED continues to lead recovery support function (RSF) efforts under Housing, Economic Development, and Community Planning Capacity Building during both planning phases and active disasters.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**
	• Completed 2 ARC-X Case Studies: Pennsylvania Protects Coldwater Fisheries and Water Quality from Climate Change and American Cyanamid Superfund Site Reduces Climate Exposure that were presented as examples at the Region 3 Climate Adaptation Seminar in July 2022. • The Pennsylvania 2021 Climate Impacts Assessment was developed in collaboration between PA DEP, ICF, Penn State, and Hamel. • Partnership between the PA Housing Finance Agency, DCED, PEMA, DHS, PA HMA, and PennDel AHMA to develop a search engine for available housing. While oriented toward the post-disaster consumer, The website (pahousingsearch.com) is available to the general public pre-disaster as well.
Building Code Enforcement/ Increasing Local Partnerships/ Planning	• Building code enforcement continues to be a Pennsylvania focus. ○ Pennsylvania has adopted the 2018 International Building Code (IBC) through the most current Pennsylvania Uniform Construction Code (UCC), effective June 15, 2019. ○ State partners are working with counties and local municipalities to adopt the 2018 IBC with a focus on educating local governments about the link between IBC and risk reduction and mitigation and ensuring energy efficiency across building sectors through outreach, public information, study, and research. Refer to 1-6d in the 2023 mitigation strategy (Table 6.4-2). • DCED's Planning Team conducted integrated planning meetings around the Pennsylvania in an effort to improve partnerships between County EMAs and County Planning Directors. • PEMA is developing a platform to link local communities with colleges and universities in the state. ○ The platform would allow colleges and universities working in risk reduction and mitigation to link their resources to projects in local communities. The platform was delayed as of December 2022 due to Pennsylvania's gubernatorial administration change. • Nurture Nature Center and partners NWS, NOAA, and Northampton County Emergency Management Agency developed and implemented a comprehensive community education program for youth and families about hazards and mitigation (CREATE Resilience: Community Resilience through Education, Art, Technology and Engagement). ○ Program resources are available on Nurture Nature Center's CREATE Resilience website and are available to share with other Pennsylvania communities.
Flood Protection Monitoring/Dam/Levee Safety	• DEP regulates 3,375 dams: 740 of which are classified as High Hazard Dams; 289 are classified as Significant Hazard Dams; and 2,345 are classified as Low Hazard Dams. • During the planning period DEP conducted enhanced public awareness and media coverage, an executive re-focus on compliance and enforcement initiatives, and received the High Hazard Potential Dam (HHPD) Grant Award. • Secured funding for 11 projects using HHPD: 1 project in 2020; 5 projects in 2021; 6 projects in 2022. • Through inspection, DEP identifies potential work and provides sponsors with information on how they can apply for DCED Flood Mitigation Program (FMP) grants. • Fifty-five (55) dam remediation projects completed between 2018 and 2022. • PA Silver Jackets, PEMA, DEP, and other state and federal agencies participated in a training exercise at Laker Williams Dam on September 14, 2022 that focused on stakeholders evaluating the effectiveness of their EAPs and local emergency manager and personnel response to a flood emergency at the dam.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**

	• DEP has an inventory of the 46 levees currently inspected under USACE's Inspection of Completed Works Program.
	• 2021 CPDM Grants were awarded for 1) City of Williamsport, 2) Town of Bloomsburg (Stage 1,2, and 3) Mayfield Borough Levee Enhancement.
	• DEP's Stream Improvement Program provided funding to restore stream channels damaged in floods and to stabilize streambanks affected by erosion with between 15 to 20 projects annually.
	• DEP Project Highlights:
	  ○ Dunbar Borough, Fayette County – channel improvement.
	  ○ Hyndman Borough, Bedford County – scour repair along the levee.
	  ○ Danville Borough, Montour County – levee slough/spall repair.
	  ○ City of Butler, Butler County – channel and culvert work.
	  ○ Blakley Borough, Luzerne County – The Hull Creek Hydraulic Analysis Report was completed in August 2019.
	  ○ Mount Carmel Township, Northumberland County – Butternut Creek Hydraulic Analysis Report completed in June 2019.
	  ○ City of Warren, Warren County – Glade Run Hydraulic Analysis report completed in September 2019.
	• DEP Upcoming Projects:
	  ○ City of Jeannette, Westmoreland County – Phase 2 levee replacement project on Bush Creek 95% complete; completed with land acquisition.
	  ○ City of Pitcairn, Allegheny County – Dirty Camp Run channel/culvert project 95% complete with land acquisition.
	  ○ Northern Cambria, Cambria County – Drainage structure replacement and levee cut repair for an existing project on West Branch of the Susquehanna River is 75% complete with land acquisition.
	  ○ Jermyn Borough, Lackawanna County – The 105/404 permit for the channel/culvert project on Rush Brook Creek will be issued soon.
	  ○ Mount Carmel Township, Northumberland County – Butternut Creek permit application for the channel/culvert project is over 90% complete.
	  ○ City of Warren, Warren County – Glad Run permit application review is over 90% complete.
	• PENNVEST funded two dam projects as part of a drinking water system.
	  ○ City of Lock Haven – Modification to the Warren Ohl Dam. Approved 04/20/2020, in construction status.
	  ○ Altoona Water Authority – Bellwood Dam Upgrade/Rehabilitation. Approved 01/20/2021; in construction status.

Flood Protection Education/Tools/ Certifications	• PA Silver Jackets continually updates Best Pennsylvania Flood Protection, Preparedness documents for Public and Municipal Officials. • PA Silver Jackets documented 15 Pennsylvania success stories; available online. • FEMA Region 3 is writing a story about the Pine Grove, Schuylkill County project. • PA Sliver Jackets held two ice jam training sessions in December 2021, one in Bloomsburg, Columbia and one in Oil City, Venango County. • PA Sliver Jackets completed Susquehanna River Flood Inundation Mapping Wyoming Valley Flood in 2019. The project included 101 miles along the main stem of the Susquehanna River in Columbia, Luzerne, Montour, Northumberland, and Snyder counties.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**
	• PA Silver Jackets presented "Filling Flood-Related Outreach Gaps: Flooding 101" as part of Flood Awareness Week in March 2022. • PA Sliver Jackets in conjunction with USACE, 3 Rivers Wet Weather, ALCOSAN, Allegheny County Conservation District, DEP, PEMA, FEMA Region 3, Southwestern Pennsylvania Commission and Watersheds of South Pittsburgh hosted five (5) Flood Risk education Workshops between July and August 2021. ○ Topics included the basics of flooding; how to prepare and protect people and property; available resources and contacts; and other information to prepare before, during, and after a flood. The goal of the workshop series was to create better prepared and flood-resilient communities. • PA Silver Jackets held two flood proofing workshops in Lebanon County. One workshop was focused on public officials and the other for the public. ○ Agency partners included USACE presenting on flood proofing techniques and technical assistance programs, PEMA presenting on grant programs, PHMC presenting on disaster planning for historic properties, and FEMA Region 3 presenting on NFIP CIS. • Approximately 423 floodplain ordinances were adopted between 2018 and 2022 and reviewed by PML. • PEMA provided eight (8) virtual elevation certificate trainings. • PEMA provided duties and responsibilities of a FPM frequently. • PEMA is developing a substantial damage (SD) and substantial improvement (SI) handbook and will offer virtual training events. • PAFPM reports 52 new CFM certifications during the planning period 2018 – 2022. • EMAP accreditation received by Chester County in 2019. The County's original accreditation was in 2014.
Advanced Notification Systems	• AlertPA operated by OA currently has approximately 200,000 subscribers.
Shale Gas Impacts/Plans/Training	• The PUC continues to distribute Act 13 Impact Fee funding to counties and municipalities. • Throughout the planning period, Pennsylvania 811 and the PUC Damage Prevention Group spoke at conferences and public meetings about pipeline safety guidelines.
SHPO/Historic Preservation	• During the planning period, the PA SHPO achieved a significant level of success in implementing several actions from the 2018 mitigation strategy. • Mitigation of buildings and structures, including historic structures at risk from the impacts of natural and human-made hazards. (Action 1-2c) ○ South Perkasie Covered Bridge, Borough of Perkasie, Bucks County. Perkasie Borough received a Keystone Historic Preservation Construction Grant from PHMC in 2019 to restore the bridge. The design was revised in 2021 following Hurricane Ida to correct flood damage and prevent future loss. ○ Federal Historic Preservation Tax Credit projects: PA SHPO staff reviewed and provided routine technical assistance to property owners of undertaking significant rehabilitation projects of historic buildings located in floodplains. Guidance included sensitive modifications that would not destroy the historic character of the buildings.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**
	○ Environmental Review projects: Projects included creek bank stabilization to help prevent repetitive flooding in historic communities such as Lewisburg, Union County. PA SHPO staff also reviewed and provided guidance on how to address "target hardening" projects to provide enhanced security for properties that could be the target of terrorist actions. ▪ PA Temple Sinai Hardening, Pittsburgh ▪ Temple Beth Israel Security Upgrades, Altoona, Blair County ▪ Chabad-Lubavitch Security Project, Newton Borough, Bucks County ▪ St. Mark Coptic Orthodox Church Target Hardening, Harrisburg ▪ Talmudical Properties of Pennsylvania Target Hardening, New Bloomfield, Perry County ○ Mather Mill and Valley Green Inn Workshops: ▪ Mather Mill, Whitemarsh Township, Montgomery County (October 2018) – PA SHPO hosted a demonstration workshop to explore resiliency options for the National Register-listed gristmill. https://pahistoricpreservation.com/mather-mill-model-for-developing-resiliency-for-historic-properties/ ▪ Valley Green Inn, Philadelphia (September 2019) – In partnership with the Philadelphia Office of Emergency Management, PA SHPO organized the Valley Green Inn Climate Resilience Design Workshop. PA SHPO sought innovative design solutions to balance the building's historic significance with mitigation efforts to permit adaptive reuse while preventing or lessening the effects of repetitive flooding. ○ PA SHPO provided information on its blog to educate Pennsylvanians on planning for hazards: ▪ https://pahistoricpreservation.com/floodproofing-workshops/ ▪ https://pahistoricpreservation.com/hazard-mitigation-historic-context-disaster-planning-historic-properties-initiative/ ▪ https://pahistoricpreservation.com/hazard-planning-part-2/ • Improve electronic data sharing between municipalities, counties, PA SHPO and PEMA to ensure statewide data remains current on historic properties and may be used for risk analysis. (Action 2-3f) ○ City of Philadelphia, Arches: PA SHPO provided the City with a Certified Local Government grant to develop enhancements to the City's Arches heritage data management system. The enhancements will allow increased capacity to collect, maintain, and access data to be collected during citywide survey efforts. ○ PA-SHARE: In February 2021 PA SHPO launched PA-SHARE which integrates disparate records and processes into one state-of-the-art data management portal. PA-SHARE combines the GIS platform and custom-built project management software to make it easier and faster for users to find information online about historic places and archaeological sites, to process project submissions, and to utilize state and federal historic preservation programs. ○ Baseline Survey: In 2020, PA SHPO initiated a multi-phased, 3-year project to collect baseline survey data of geographies and property types underrepresented in the Pennsylvania Historic Places Inventory. To identify the survey priorities, PA SHPO staff analyzed existing data and identified fifty-two Pennsylvania counties and municipalities where previous survey efforts did not comprehensively document historic properties. To date, over 12,000 newly recorded historic properties have been added to the PA Historic Places Inventory and the data is accessible in PA-SHARE.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**
	○ Deindustrialized Community Survey: In 2019, PA SHPO undertook a multi-phased project to investigate the economic development and community revitalization prospects in specific southwestern Pennsylvania communities that have experienced significant de-industrialization. ▪ The overall goal of this effort was to identify ways for communities to develop relevant market in the context of their older, historic commercial business districts. Many of the historic properties in these areas had never been documented, or existing surveys were dated. ▪ The first phase of the deindustrialized communities effort was to develop historic property inventory and to assist in identifying areas where preservation incentives could be leveraged in the future. Survey was completed in Monongahela River Valley communities in Washington and Westmoreland counties as well as in Ohio and Beaver River Valley communities in Beaver County. ○ Disaster Planning for Historic Properties Initiative, Survey: Conducted extensive surveys of at-risk properties in communities in Cumberland, Dauphin, Juniata, and Perry Counties. Survey data included information regarding current flood risk to assist with future planning. ▪ Approximately 1,400 individual properties were surveyed, and 23 properties were determined individually eligible for listing in the National Register of Historic Places. Six (6) historic districts were also determined eligible. Additionally, 14 individual resources and three historic districts surveyed between 2015 and 2017 were determined eligible and multiple venues for future research and survey efforts were identified. • Assist county and regional planning organizations to integrate preservation priorities into plans for economic growth, revitalization, natural resource, hazard mitigation and emergency management planning. (Action 4-3b) ○ Deindustrialized Communities Market Study: *(see above)*. ○ Disaster Planning for Historic Properties Initiative, Phase 2: Produced recommendations for future county Hazard Mitigation Plan updates based on the results of survey efforts in Philadelphia and Bedford, Columbia, and Monroe Counties. https://www.phmc.pa.gov/Preservation/Disaster-Planning/Pages/default.aspx ○ Tri-County Regional Planning Commission partnership to document 1,200 historic properties in flood prone areas of Cumberland, Dauphin, and Perry counties. This data will continue to inform the region's preparation and implementation of county HMPs. ○ Designing for Distance: In collaboration with the PA Downtown Center, PHMC provided funding to support the Designing for Distance pilot program. The Designing for Distance (D4D) project was developed by PDC's COVID-19 Recovery and Resiliency Task Force, Public Space Working Group. The goal of the pilot program was to provide municipal leader and community revitalization organizations with practical designs, planning solutions, and implementation strategies to help their businesses adapt to the difficult circumstances created by COVID-19.
Commonwealth Geospatial Strategic Plan	• PEMA staff participate in quarterly Remote Sensing Working Group meeting. • PEMA's leadership in GeoBoard has fortified working relationships with data providers. • OA through the GeoBoard completed updated ortho-photography for Pennsylvania using 911 Program funds and is collecting a second set of imagery for 2020 through 2023.

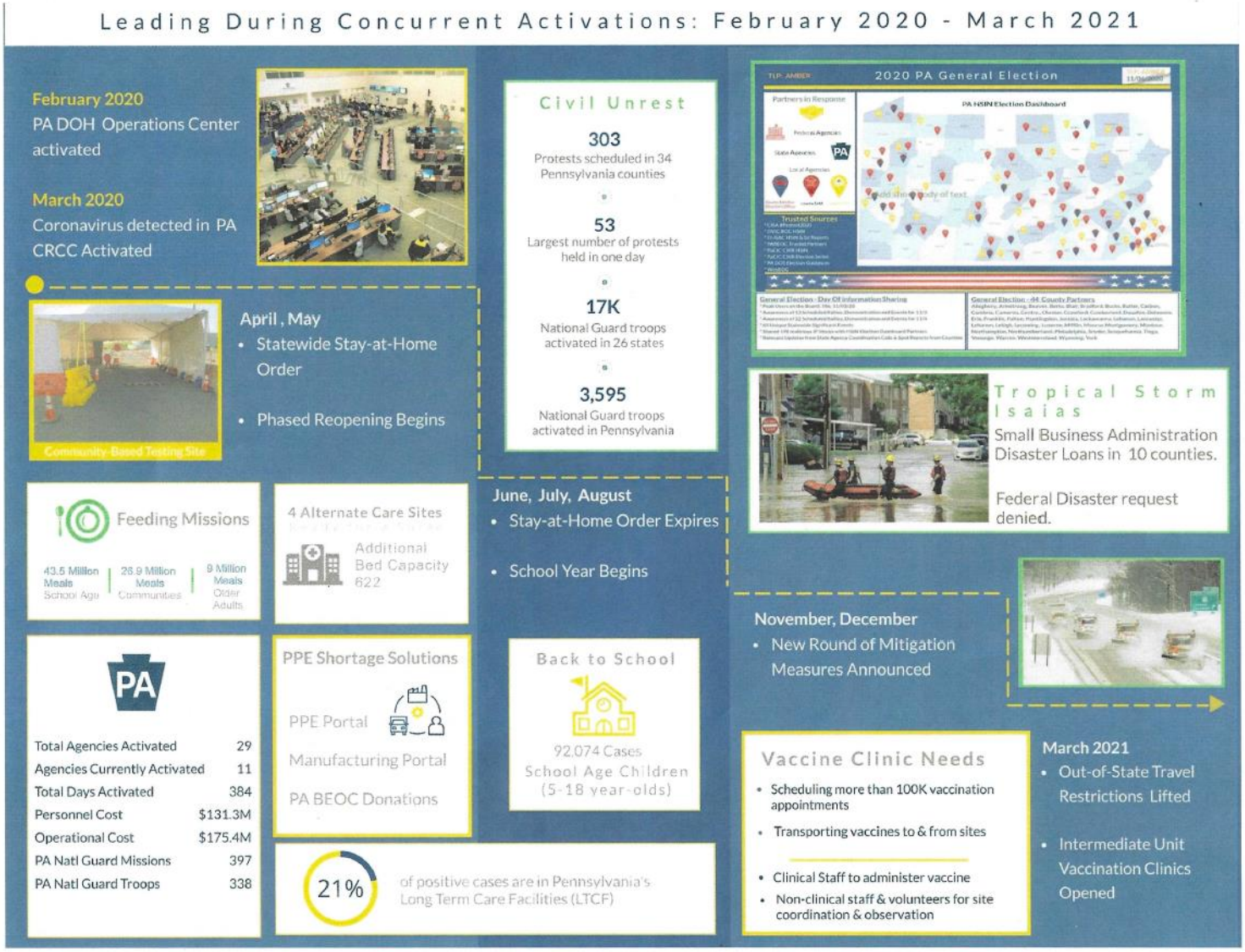
Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**
Commonwealth Fusion Centers /Cyber Security	• PSP's improvement plan identifies Level III CIKR assets within Pennsylvania with Level IV to be completed at a local level. Levels I and II were previously identified by CISA. • PaCIC's CI/KR and Geospatial Sections continue to work with GOHS and DGS to map and prioritize CI/KR facilities within the Commonwealth. Ongoing efforts to identify and map Level III CIKR assets within the Commonwealth in conjunction with Action 1-3b (Table 6.4-2). • Per DOS, election infrastructure was added to the list of CI/KR in 2019. • CyberCom and Overdose Identification Network (ODIN) sections have been added to PaCIC. • PSP continues to build operations in PaCIC, WPAHFC, DVIC, and on-board contributing partners. • In June 2019, Act 18 was signed into law providing for enhanced school safety measures. The Act requires PSP to establish six (6), three-member RVATs (Risk and Vulnerability Assessment Teams) to operate within six 6) geographical regions within Pennsylvania. • PSP's RVAT Section continues to field an increasing number of requests for assessments annually. PSP RVAT assessments are completed with priority given to schools and large congregate settings. PSP's Office of Community Engagement and Heritage Affairs Units also educate schools on biased-based threats and identification of hate-based crimes within schools. Refer to Action 3-4e in the 2023 mitigation strategy (Table 6.4-2).

Addressing Substance Use Disorder	• DDAP worked on several successful initiatives during the planning period to help mitigate Substance Use Disorder.
	  ○ As of fall 2019, the Get Help Now Hotline (launched in November 2016) and staffed by trained professionals 24 hours a day, 7 days a week, 365 days a year, provided assistance to more than 50,000 individuals with 45% of calls transferred directly to treatment.
	  ○ In July 2018, DDAP fully transitioned to the nationally recognized, evidence-based American Society of Addiction Medicine Criteria (ASAM) for the screening and appropriate level-of-care determination for an individual seeking treatment.
	  ▪ The transition involved the training of clinicians throughout the Commonwealth to adopt the practices of the ASAM Criteria.
	  ▪ Since the transition, about 8,500 individuals have completed a 2-day skill building workshop.

Public Utilities / Broadband Infrastructure	• Throughout the planning period the Pennsylvania Public Utility Commission:
	  ○ Developed Black Sky Event (BSE) planning materials for lifeline sector workgroups to develop high-level strategic plans.
	  ○ Worked to "operationalize" the BSE lifeline sector working groups; groups started to meet in 2019/2020.
	  ○ Delivered a gas exercise to raise the awareness of State agencies that would need to deal with the consequence management aspects of a large natural gas outage affecting customers during winter.
	  ○ Since 2013, PUC has allowed Gas, Electric, Water, and Wastewater utilities to utilize a distribution system improvement charge (DSIC) to accelerate reliability and resiliency improvements. The DSIC requires a Long-Term Infrastructure Improvement Plan (LTIIP), which is approved by the PUC. All large Gas, Electric, Water, and Wastewater utilities have an LTIIP, with the exception of National Fuel Gas.
	• The Pennsylvania Broadband Development Authority was created by through Pennsylvania Act 96 of 2021 to meet the Broadband needs of Pennsylvania's citizens, businesses, and government.

Table 6.8-1 Summary of Mitigation Success since 2018	
Success	**Description**
	○ A legislatively required Broadband Plan was completed in December 2022 and is moving into implementation. See Action 2-5d in the 2023 mitigation strategy (Table 6.4-2).
Health and Human Services	• Through the planning period DHS: ○ Established and integrated multi-agency, human services-related task forces to ensure essential disability integration, sheltering and housing, and emergency behavioral health ○ Developed a concept of operations for strategic staging of human services related resources such as food and sheltering items. ○ Ensured the human services disaster training program meets National Incident Management System standards.
Filling Gaps During Disasters	• Beyond success associated with PEMA's focus on hazard mitigation, during State and local disasters, PEMA works to fill information and resource gaps through initiatives such as Crisis Cleanup, Multi-Agency Resource Center (MARC), and the PA VALOR Pilot, which evaluates the ability to make homes safe and accessible for those lacking assistance.

Figure 6.8-1 PEMA Leadership During Concurrent Activations



7 Plan Maintenance

7. Plan Maintenance

7.1. Update Process Summary

Monitoring, evaluating, and updating this plan are critical to maintaining its value and success in the Commonwealth'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 and updating 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.

7.1.1. Plan Maintenance History

2004 through 2007 Plan Maintenance Efforts

In the years between the 2004 and 2007 plans, plan maintenance was led by PEMA. In this time frame, several modifications were undertaken in order to meet Enhanced Plan Status. The plan was updated to more fully integrate with other plans, especially the State Emergency Operations Plan and local hazard mitigation plans. PEMA also incorporated local planning efforts and research documents into the risk and capability assessments of the existing plan. In the years between plans, PEMA also began exploring an information management system for tracking actions and projects based on NEMIS and the National Tool. PEMA did not maintain the plan in isolation, though; all Commonwealth agencies and departments were asked to review their mitigation actions and examine whether their organization had funding sources that could aid in completing mitigation actions.

2007 through 2010 Plan Maintenance Efforts

The plan maintenance procedure for 2007-2010 focused on having PEMA prepare any plan updates and submit them to the State Flood Budget Task Force, an entity incorporating the Office of Administration, Office of the Governor, PEMA, DEP, DCNR, and the Office of Administration for review and evaluation. This Task Force was charged with reviewing goals and objectives to determine their applicability to the changing situations and policies of the Commonwealth. They were also responsible for reviewing the risk assessment and capabilities to determine if the information needed to be changed, updated, or removed. Reporting was to be compiled and added to the Elements of Change document accompanying the 2007 Plan. Due to technical, administrative, and financial constraints, this plan maintenance process could not be completed.

2010 through 2013 Plan Maintenance Efforts

The plan maintenance procedure for 2010-2013 was led by PEMA's Bureau of Recovery and Mitigation and assisted by the USACE Silver Jackets and (for more information, see Section 3.2). The USACE Silver Jackets was established to support implementation of the flood-related mitigation actions of the SHMP. Separate meetings to review the SHMP annually were planned but did not occur due to the volume of disaster response related work handled by BORM between 2010 and 2013. A great deal of progress was made towards implementation the mitigation strategy, though separate plan review meetings did not take place.

The Silver Jackets was an effective method for maintenance on the SHMP and will be used moving forward. Membership in the PA Silver Jackets includes:

Federal

- USACE
- FEMA Region 3
- NOAA and NWS
- USGS
- HUD
- NRCS
- EDA

Regional

- SRBC
- DRBC
- ICPRB

Commonwealth

- PennDOT
- PA Insurance Department
- PA Department of Agriculture
- PEMA
- DCED
- DEP
- DCNR
- PA SHPO

Professional

- PA Association of Floodplain Managers (PAFPM)
- Keystone Emergency Management Agency (KEMA)
- American Rivers Organization (ARO)

2013 through 2018 Plan Maintenance Efforts

Annual SHMP review meetings were held in October of 2014, 2015, 2016, and 2017. The State Planning Team and Silver Jackets were invited to these meetings. In 2016, another set of in-depth meetings focused on the SHMP update concluded around the start of the 2018 SHMP update.

2018 through 2023 Plan Maintenance Efforts

Annual plan reviews were conducted between the approval of the 2018 SHMP and the beginning of the 2023 Plan Update Process in early 2022. PEMA conducted the 2019 Annual Review in October 2019. Through this annual review process, it was determined that several updates should be made to the plan, such as adding an executive summary, updating information on development trends and vulnerability, and adding a new section in the Capability Assessment titled State-Level Program and Plan Integration.

In 2020 the annual plan review process looked slightly different due to COVID-19.

PEMA held an Annual Plan Review Meeting in March 2021 to kick-off the 2021 annual review. PEMA presented on all components of the 2018 plan, and asked questions to target how to best improve the plan moving forward. PEMA requested feedback from meeting participants to help with the update process.

7.2. Monitoring, Evaluating and Updating the Plan

The Commonwealth recognizes that the Hazard Mitigation Plan is not a static document and requires regular review and evaluation. The plan will be monitored for changes in the conditions

under which the plan was developed, such as new or revised state laws, major disaster declarations, or availability of funding. PEMA's Emergency Management Mitigation, Insurance and Resilient Communities (MIRC) Office staff will take the lead in monitoring, evaluating, and conducting future updates. The MIRC Office will be assisted in this effort by the USACE Silver Jackets program, facilitated by PEMA's Area Offices, SHMO, Hazard Mitigation Planner, DEP Emergency Response Program, NFIP Coordinator, and/or the Bureau of Recovery and Mitigation to ensure the support of and representation from federal, state, and regional organizations and agencies. Additional members of the 2023 SPT and other interested parties will be encouraged to join and build the Silver Jackets.

The Commonwealth Hazard Mitigation Plan will be reviewed annually by the SPT. In instances where there is a disaster declaration, a meeting of the Silver Jackets will be held soon after the disaster event to gather lessons learned. A meeting will also be held after a disaster event in order to bring in all Commonwealth agencies, describe what the disaster declaration means, and determine if any agencies have projects that could be funded through the declaration. In non-disaster settings, the MIRC Office supported by the Silver Jackets group will review the plan for changes in policy and will ensure that the plan addresses the current and expected conditions. Members will also review the risk assessment and capabilities portion of the plan to determine if this information needs to be updated or modified. Mitigation strategies and their associated actions will be reported upon by the party, agency, or department responsible for their implementation, and will include which implementation processes worked well, difficulties encountered, how coordination efforts were proceeding, and which strategies or processes need to be revised or strengthened.

Goals, objectives, and actions will be reviewed annually and in the event of a disaster to determine whether they need to be modified to reflect new conditions. The Commonwealth will assess the effectiveness of mitigation actions as well as their timelines and use the findings to either append the existing plan and/or inform future plan updates. For instance, the Pennsylvania Silver Jackets Team have many success stories over the years when it comes to mitigation work and have revised this document for locals to reach out to their peers regarding project-types, application process, financing/cost sharing, executing and completing projects – this document provides roadblocks and lessons learned to hopefully assist others in doing the same mitigation work; this document has been updated 3 times since the teams chartering in 2010. Since the last plan update, the team, made up of federal, state, county and local agencies, commission, associations, and authorities, have hosted flood proofing workshops and a flood risk education workshop series for residents and businesses, helped developed a Susquehanna River Flood Inundation Mapping Tool for Wyoming Valley, and completed four ice jam training sessions. They also developed a Flood Mitigation Program Guide for Pennsylvania, which is a great resource for local communities to understand what kind of help is available. These have helped achieve mitigation actions that were developed in previous plans and that work will continue to be a part of Pennsylvania's hazard mitigation strategy. Additionally, the annual reviews will be used to collect actions recognizing what state partners other than PEMA are doing to support hazard mitigation in the Commonwealth and actions for hazards other than flooding and the all-hazard category. The team has presented and attended the USACE

National Silver Jackets Program Biannual Workshops held around the US when scheduled, either virtually or in-person.

Objectives pertinent to HMGP are also reviewed after each disaster and are formalized with the preparation of the Administrative Plan, which is defined in section 5.3.5.7; this provides a roadmap to consistency between funding programs. A new Administrative Plan will be added after each disaster, if applicable.

PEMA, with assistance by the Silver Jackets, will then create a list of recommendations that suggests ways to update the plan. PEMA will be responsible for making the necessary changes to the plan. The revised plan will be submitted for approval to FEMA, and upon approval, will be incorporated into the State Emergency Operations Plan. FEMA will be notified that the plan was changed. The plan will be updated after each disaster event to include a post-disaster mitigation strategy that outlines Commonwealth priorities for future disaster events. This plan maintenance process will be modified as appropriate should a significant fiscal or personnel constraint arise. The five-year update of the State Mitigation Plan will be completed, FEMA Approved, and State Adopted before the 2028 Anniversary date.

A key component of the annual review of the SHMP will be ensuring continued compliance of 44 CFR 13.11. At each review, the Commonwealth will ensure that it still complies with federal statutes and regulations that pertain to grant funding. This will additionally ensure proper distribution of grant funding. In addition, the Commonwealth of Pennsylvania will amend its plan whenever necessary to reflect changes in State or Federal laws and statues as required in 44 CFR 13.11(d).

Minutes from meetings related to the plan will be filed and saved so that they may be included in the Planning Process Appendix for the 2028 SHMP update. Other information pertinent to the Commonwealth's progress with hazard mitigation, such as news articles, should also be saved in this file for incorporation in the updated SHMP appendix.

The Pennsylvania's Silver Jackets Team was recognized in September of 2013 for being the Silver Jackets team of the year. This award recognizes everything that the team accomplished since being established during the 2010 SHMP update and illustrates that their role in implementing the 2023 SHMP continues to be an excellent choice.

7.3. Continued Public Involvement

PEMA will involve the public during periodic evaluations of the SHMP by providing an opportunity to submit comments about the plan. The public will have access to the plan online and through pema.pa.gov. The public is encouraged to submit comment on the plan at any time. Relevant comments will be incorporated into the plan's next update. Additionally, information in the plan will be modified for ease of use online for local officials and other interested in hazard mitigation in the Commonwealth.

PEMA's Bureau of Recovery and Mitigation will also distribute ReadyPA preparedness and mitigation information at meetings. Information on upcoming events relating to hazard mitigation planning will be announced in newsletters, newspapers, mailings, and on the PEMA website

(www.pema.pa.gov). The Bureau of Recovery and Mitigation will also engage the public by encouraging the use of the PA Alert system, which provides citizens and partners with timely information on emergency and weather alerts, health notifications, tax notifications, and updates. When applicable, contact information for PEMA will be included in alert notices to encourage two-way communication. Additionally, the MIRC Office supports individual counties with information and materials as well as personnel to support local hazard mitigation efforts.

7.4. Monitoring Progress of Mitigation Actions

7.4.1. Project Reporting

PEMA's MIRC Office is responsible for monitoring and tracking progress of mitigation measures taken on a Commonwealth-wide basis by the individual actions of Commonwealth agencies and departments as well as the counties and their jurisdictions. The PEMA State Hazard Mitigation Planner is the custodian of the Mitigation Strategy and Mitigation Action List. They coordinate with the state agency, board or commission that is the lead agency for each of the 219 mitigation actions to identify a POC within the agency, board, or commission. This POC has a number of duties. The first and most important duty is acknowledging and validating that they and their organization accept responsibility for the action and agree to champion that action as part of their organizational mission. The second is to track the progress of the action, seeing if it is completed, ongoing or should it be dropped and evaluating if the measures of success are being achieved and are still appropriate. The causes of a project being dropped will vary. For example, for acquisition and demolition projects a homeowner may simply decide against it. Since these programs are voluntary, there is little PEMA can do if a homeowner changes their mind after project approval. Other causes include loss of key personnel for administering the project. When a PEMA Project Officer identifies that a sub-grant recipient is struggling with their project, PEMA can provide additional technical assistance to help the sub-grantee with such things contract management and reimbursements. PEMA also works with communities to extend periods of performance or amend scopes of work. PEMA has also used management costs to provided technical support, such as bringing in a vendor to provide Benefit Cost Analysis (BCA) support which consists of training for their engineer or direct technical support for running the BCA. MIRC coordinates with the PEMA area offices which have geographic expertise and unique insights about particular communities and will review FEMA Discovery Reports and historical damages. It is only when all of these methods have been explored, does PEMA drop a project. The third is to identify and coordinate funding for the action either through HM funding, organizational funds, or other funding.

Progress on mitigation actions is normally coordinated via one-on-one meetings. For example, PEMA routinely coordinates with DCED, DEP and DCNR as they share common projects that integrate the HMP with other agency missions and funding. However, there is at least one annual statewide meeting, the HMP Annual Review that is held each October. It consists of both virtual and physical meetings inviting all stakeholders, but in particular those who are lead agencies on mitigation actions. The review looks at changes to the Commonwealth in the last year and determines if changes should be made to the risk, capabilities, or mitigation strategy portions of the plan. Key questions include: 'Which mitigation actions have been

accomplished?', 'Which actions should be dropped?', and 'Which actions have achieved partial success and should be continued?'. While the annual review focuses internally, the annual FEMA Risk Reduction Consultation with FEMA focuses externally. This meeting involves FEMA Region 3, PA State Agencies, USACE, and others to review progress on Commonwealth mitigation activities.

In addition to planned reviews of mitigation actions, additional reviews are conducted in response to Notifications of Funding Opportunity (NOFOs). NOFOs may come through FEMA or other agencies. As the Commonwealth develops a strategy for use of the funding, it reviews the standing list of mitigation actions to see if any meet the NOFO criteria, and the priority they were given in the HMP vs FEMA or other federal priorities in the NOFO. This analysis is incorporated into the state management plan for the disaster or non-disaster grant.

PEMA will provide FEMA with the status of properties acquired, relocated, elevated, or retrofitted. PEMA sends out Three Year Monitoring Letters to grant recipients to ensure that lands acquired through HM funding have not been developed. The Bureau, through the SPT, will also assign personnel to follow up with other agencies' staff on a quarterly basis as to the progress of state-obligated mitigation measures. PEMA staff will submit quarterly project reports to FEMA to address all active projects in all grant areas. They also track project awards and progress in the grants management database. Once a project has a Letter of Intent or Interest, it will become part of the PEMA Hazard Mitigation Fiscal and Project database.

7.4.2. Project Closeout Process

"Project closeout" is the process that finalizes a completed mitigation project that FEMA has funded. Closeout will be conducted based on FEMA Region 3 closeout procedures. Projects and activities funded through other federal or state grant programs, state general funds, or that can be achieved without targeted funding will be completed as dictated by the funding source or state program with administrative oversight for the activity of the project.

The PEMA administrative closeout process for HMGP is a 12-step process that is carried out by PEMA, the applicant, and FEMA. As established in the PEMA process, final site visit inspections are required with both the applicant and PEMA present at the conclusion of the project. Additionally, all acquisition projects have a mandatory three-year mitigation compliance inspection to ensure the property is still being maintained as open space. According to HMA Guidance, municipalities are responsible for this triennial maintenance; they must report to compliance to the Commonwealth, who in turn reports to FEMA. There are twelve main steps to completing the close-out process:

1. Site Stabilization
2. Sub-grantee Closeout Request Letter (R-25)
3. Site Visits/Photos/Latitude-Longitude by PEMA/FEMA
4. Codes Compliance Letter (R-26)
5. NFIP RL Update Worksheet AW-501 (R-27 & R-28)
6. PEMA will conduct a desk audit of project file
7. PEMA Financial Reconciliation/Revised Budget

8. PEMA Close-out Request Letter to FEMA Region 3
9. HMGP Quarterly Webinars/Reports continue
10. FEMA Close-out Letter received
11. Open Space Requirements/Subsequent transfer
12. Monitoring, Reporting, and Inspection

Additional details on the project reporting, closeout and full grants management process are outlined in PEMA's HMPO Handbook.

8 Plan Adoption

8. Plan Adoption

The 2023 State Hazard Mitigation Plan was submitted by the Pennsylvania State Hazard Mitigation Officer to FEMA on June 28, 2023. FEMA reviewed and provided comments on the plan August 8, 2023. These comments were addressed to re-submit to FEMA on August 18, 2023, and received approval-pending-adoption on August 28, 2023. The Commonwealth of Pennsylvania adopted the plan on September 12, 2023. Full approval from FEMA was received on September 12, 2023 and was effective as of September 12, 2023.

This section of the plan includes a copy of the adoption resolution passed by PEMA and the approval letter from FEMA. A completed Standard and Enhanced State Mitigation Plan Regulation Checklist can be found in *Appendix B – Plan Review Tool*.

Commonwealth of Pennsylvania
2023 State Hazard Mitigation Plan Update
State Adoption Resolution

WHEREAS, the Commonwealth of Pennsylvania is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, section 322 of the Disaster Mitigation Act of 2000, Public Law 106-390, (DMA 2000) requires state governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, the Commonwealth of Pennsylvania acknowledges the requirements of section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the Commonwealth of Pennsylvania 2023 State Hazard Mitigation Plan update has been developed through the efforts of the Pennsylvania Emergency Management Agency, members of the State Hazard Mitigation Planning Team, and other state, regional, and local agencies and organizations, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the Commonwealth of Pennsylvania 2023 State Hazard Mitigation Plan update, and

WHEREAS, the Commonwealth of Pennsylvania 2023 State Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural and human-made hazards that face the Commonwealth and its municipal governments and will be amended as necessary to ensure continual compliance with 2 CFR Part 200, and all federal and state laws and statutes,

NOW THEREFORE BE IT RESOLVED by the Pennsylvania Emergency Management Agency and the Pennsylvania Emergency Management Council that:

- The Commonwealth of Pennsylvania State Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of Pennsylvania, and
- The respective officials and agencies identified in the implementation strategy of the Commonwealth of Pennsylvania 2023 State Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this 12th day of September 2023.

David R. Padfield Digitally signed by David R. Padfield
Date: 2023.09.12 12:13:12 -04'00'

David R. Padfield
Director, PA Emergency Management Agency

Region 3
615 Chestnut Street, 6th Floor
Philadelphia, PA 19106-4404

FEMA

August 28, 2023

Mr. David R. Padfield
Director
Pennsylvania Emergency Management Agency
1310 Elmerton Avenue
Harrisburg, Pennsylvania 17110

Dear Mr. Padfield:

The Federal Emergency Management Agency (FEMA) has determined that the Pennsylvania Enhanced State Hazard Mitigation Plan has achieved a status of "Approvable Pending Adoption" or APA. Prior to formal approval by FEMA, the State is required to provide FEMA with an adopted resolution and a final electronic copy of the adopted plan.

A FEMA approved state mitigation plan is a condition of receiving certain non-emergency Stafford Act assistance and FEMA mitigation grants from the following programs:

Public Assistance-Categories C through G
Fire Management Assistance Grants (FMAG)
Hazard Mitigation Grant Program (HMGP)
Pre-Disaster Mitigation (PDM) / Building Resilient Infrastructure and Communities (BRIC)
Flood Mitigation Assistance (FMA)
Rehabilitation of High Hazard Potential Dam (HHPD)

The Pennsylvania Enhanced State Hazard Mitigation Plan meets the FMAG requirement, as well as the optional HHPD requirement. FEMA recognizes Pennsylvania's dedication to hazard mitigation, demonstrated in the timely preparation and adoption of a strategy to reduce future disaster losses. Finally, once adopted and approved by FEMA, we look forward to working with you to discuss the status of the Commonwealth's enhanced mitigation program each year over the effective period.

If you have any questions, please contact Sarah Wolfe, Chief, Floodplain Management and Insurance Branch at 215-931-5532.

Sincerely,

APRIL D CUMMINGS

Digitally signed by APRIL D CUMMINGS
Date: 2023.08.31 17:21:58 -04'00'

April D. Cummings
Director, Mitigation Division

cc: Lawrence D. West, Deputy Director for Recovery
Thomas Hughes, State Hazard Mitigation Officer
Rick Deal, Deputy State Hazard Mitigation Officer
Ernest Szabo, State Hazard Mitigation Planner
Sarah Wolfe, Chief, Floodplain Management and Insurance Branch