Table of Contents

Table of Figures.....x
Table of Tables.....xv
List of Acronyms.....xxii

1. Introduction 1
1.1. Background.....1
1.2. Purpose 1
1.3. Scope.....2
1.4. Authority and References 2
1.5. Statute Compliance Assurances 3

2. State Profile 5
2.1. Geography and Environment.....5
2.2. State Facts 10
2.3. Population and Demographics 10
2.4. Land Use and Development.....17
2.5. Data Sources.....22

3. Planning Process 25
3.1. Update Process and Participation Summary.....25
3.2. State Planning Team 36
3.3. Meetings and Documentation.....39
3.4. Public & Stakeholder Participation 59

4. Risk Assessment.....75
4.1. Update Process Summary 75
4.1.1. THIRA and SSAHMP Relationship..... 77
4.1.2. State Facility Loss Estimation and Data Limitations..... 78
4.1.3. State Critical Facility Vulnerability Assessment and Loss Estimation Methodology and Sources..... 81
4.1.4. Overview of HAZUS Loss Estimation Methodology 88
4.1.5. Non-HAZUS Vulnerability and Loss Estimation Methodology and Summary 88
4.1.6. Local and University Hazard Rankings..... 96
4.1.7. Risk Ranking Methodology and Risk Factor Analysis 99

4.2. Hazard Identification 105
4.2.1. Table of Presidential Disaster Declarations 105
4.2.2. Summary of Hazards 119
4.3. Hazard Profiles and Vulnerability Analysis 135
NATURAL HAZARDS 135
4.3.1. Coastal Erosion 135
4.3.1.1. Location and Extent 135
4.3.1.2. Range of Magnitude 139
4.3.1.3. Past Occurrence 142
4.3.1.4. Future Occurrence 145
4.3.1.5. Environmental Impacts 145
4.3.1.6. Jurisdictional Vulnerability Assessment 145
4.3.1.7. State Facility Vulnerability Assessment 146
4.3.1.8. Jurisdictional Loss Estimation 146
4.3.1.9. State Facility Loss Estimation 149
4.3.2. Drought 149
4.3.2.1. Location and Extent 149
4.3.2.2. Range of Magnitude 149
4.3.2.3. Past Occurrence 153
4.3.2.4. Future Occurrence 163
4.3.2.5. Environmental Impacts 166
4.3.2.6. Jurisdictional Vulnerability Assessment 166
4.3.2.7. State Facility Vulnerability Assessment 172
4.3.2.8. Jurisdictional Loss Estimation 173
4.3.2.9. State Facility Loss Estimation 175
4.3.3. Earthquake 176
4.3.3.1. Location and Extent 176
4.3.3.2. Range of Magnitude 178
4.3.3.3. Past Occurrence 179
4.3.3.4. Future Occurrence 189
4.3.3.5. Environmental Impacts 191
4.3.3.6. Jurisdictional Vulnerability Assessment 192
4.3.3.7. State Facility Vulnerability Assessment 195
4.3.3.8. Jurisdictional Loss Estimation 196
4.3.3.9. State Facility Loss Estimation 205
4.3.4. Extreme Temperature 205
4.3.4.1. Location and Extent 205
4.3.4.2. Range of Magnitude 208
4.3.4.3. Past Occurrence 209
4.3.4.4. Future Occurrence 209
4.3.4.5. Environmental Impacts 214
4.3.4.6. Jurisdictional Vulnerability Assessment 214
4.3.4.7. State Facility Vulnerability Assessment 218
4.3.4.8. Jurisdictional Loss Estimation 220

4.3.4.9. State Facility Loss Estimation 222
4.3.5. Flood, Flash Flood, Ice Jam 222
4.3.5.1. Location and Extent 222
4.3.5.2. Range of Magnitude 225
4.3.5.3. Past Occurrence 226
4.3.5.4. Future Occurrence 232
4.3.5.5. Environmental Impacts 232
4.3.5.6. Jurisdictional Vulnerability Assessment 232
4.3.5.7. State Facility Vulnerability Assessment 239
4.3.5.8. Jurisdictional Loss Estimation 239
4.3.5.9. State Facility Loss Estimation 255
4.3.6. Hailstorm 256
4.3.6.1. Location and Extent 256
4.3.6.2. Range of Magnitude 256
4.3.6.3. Past Occurrence 257
4.3.6.4. Future Occurrence 259
4.3.6.5. Environmental Impacts 259
4.3.6.6. Jurisdictional Vulnerability Assessment 260
4.3.6.7. State Facility Vulnerability Assessment 263
4.3.6.8. Jurisdictional Loss Estimation 263
4.3.6.9. State Facility Loss Estimation 268
4.3.7. Hurricane, Tropical Storm, Nor'easter 268
4.3.7.1. Location and Extent 268
4.3.7.2. Range of Magnitude 268
4.3.7.3. Past Occurrence 271
4.3.7.4. Future Occurrence 273
4.3.7.5. Environmental Impacts 276
4.3.7.6. Jurisdictional Vulnerability Assessment 276
4.3.7.7. State Facility Vulnerability Assessment 279
4.3.7.8. Jurisdictional Loss Estimation 280
4.3.7.9. State Facility Loss Estimation 285
4.3.8. Invasive Species 285
4.3.8.1. Location and Extent 285
4.3.8.2. Range of Magnitude 287
4.3.8.3. Past Occurrence 288
4.3.8.4. Future Occurrence 289
4.3.8.5. Environmental Impacts 289
4.3.8.6. Jurisdictional Vulnerability Assessment 290
4.3.8.7. State Facility Vulnerability Assessment 293
4.3.8.8. Jurisdictional Loss Estimation 293
4.3.8.9. State Facility Loss Estimation 294
4.3.9. Landslide 294
4.3.9.1. Location and Extent 294
4.3.9.2. Range of Magnitude 297
4.3.9.3. Past Occurrence 298

4.3.9.4. Future Occurrence 300
4.3.9.5. Environmental Impacts 300
4.3.9.6. Jurisdictional Vulnerability Assessment 300
4.3.9.7. State Facility Vulnerability Assessment 304
4.3.9.8. Jurisdictional Loss Estimation 305
4.3.9.9. State Facility Loss Estimation 307
4.3.10. Lightning Strike 307
4.3.10.1. Location and Extent 307
4.3.10.2. Range of Magnitude 308
4.3.10.3. Past Occurrence 309
4.3.10.4. Future Occurrence 311
4.3.10.5. Environmental Impacts 311
4.3.10.6. Jurisdictional Vulnerability Assessment 311
4.3.10.7. State Facility Vulnerability Assessment 314
4.3.10.8. Jurisdictional Loss Estimation 315
4.3.10.9. State Facility Loss Estimation 316
4.3.11. Pandemic and Infectious Disease 316
4.3.11.1. Location and Extent 316
4.3.11.2. Range of Magnitude 317
4.3.11.3. Past Occurrence 318
4.3.11.4. Future Occurrence 320
4.3.11.5. Environmental Impacts 320
4.3.11.6. Jurisdictional Vulnerability Assessment 321
4.3.11.7. State Facility Vulnerability Assessment 323
4.3.11.8. Jurisdictional Loss Estimation 323
4.3.11.9. State Facility Loss Estimation 324
4.3.12. Radon Exposure 324
4.3.12.1. Location and Extent 324
4.3.12.2. Range of Magnitude 328
4.3.12.3. Past Occurrence 329
4.3.12.4. Future Occurrence 333
4.3.12.5. Environmental Impacts 333
4.3.12.6. Jurisdictional Vulnerability Assessment 333
4.3.12.7. State Facility Vulnerability Assessment 337
4.3.12.8. Jurisdictional Loss Estimation 338
4.3.12.9. State Facility Loss Estimation 340
4.3.13. Subsidence, Sinkhole 341
4.3.13.1. Location and Extent 341
4.3.13.2. Range of Magnitude 344
4.3.13.3. Past Occurrence 345
4.3.13.4. Future Occurrence 346
4.3.13.5. Environmental Impacts 347
4.3.13.6. Jurisdictional Vulnerability Assessment 347
4.3.13.7. State Facility Vulnerability Assessment 351
4.3.13.8. Jurisdictional Loss Estimation 352
4.3.13.9. State Facility Loss Estimation 353

4.3.14. Tornado, Windstorm ... 353
4.3.14.1. Location and Extent ... 353
4.3.14.2. Range of Magnitude ... 354
4.3.14.3. Past Occurrence ... 358
4.3.14.4. Future Occurrence ... 363
4.3.14.5. Environmental Impacts ... 366
4.3.14.6. Jurisdictional Vulnerability Assessment ... 367
4.3.14.7. State Facility Vulnerability Assessment ... 371
4.3.14.8. Jurisdictional Loss Estimation ... 371
4.3.14.9. State Facility Loss Estimation ... 374
4.3.15. Wildfire ... 374
4.3.15.1. Location and Extent ... 374
4.3.15.2. Range of Magnitude ... 377
4.3.15.3. Past Occurrence ... 377
4.3.15.4. Future Occurrence ... 380
4.3.15.5. Environmental Impacts ... 380
4.3.15.6. Jurisdictional Vulnerability Assessment ... 381
4.3.15.7. State Facility Vulnerability Assessment ... 390
4.3.15.8. Jurisdictional Loss Estimation ... 391
4.3.15.9. State Facility Loss Estimation ... 393
4.3.16. Winter Storm ... 393
4.3.16.1. Location and Extent ... 393
4.3.16.2. Range of Magnitude ... 394
4.3.16.3. Past Occurrence ... 396
4.3.16.4. Future Occurrence ... 399
4.3.16.5. Environmental Impacts ... 399
4.3.16.6. Jurisdictional Vulnerability Assessment ... 399
4.3.16.7. State Facility Vulnerability Assessment ... 402
4.3.16.8. Jurisdictional Loss Estimation ... 403
4.3.16.9. State Facility Loss Estimation ... 404
HUMAN-MADE HAZARDS ... 404
4.3.17. Civil Disturbance ... 404
4.3.17.1. Location and Extent ... 404
4.3.17.2. Range of Magnitude ... 404
4.3.17.3. Past Occurrence ... 405
4.3.17.4. Future Occurrence ... 407
4.3.17.5. Environmental Impacts ... 407
4.3.17.6. Jurisdictional Vulnerability Assessment ... 407
4.3.17.7. State Facility Vulnerability Assessment ... 410
4.3.17.8. Jurisdictional Loss Estimation ... 410
4.3.17.9. State Facility Loss Estimation ... 411
4.3.18. Dam Failure ... 411
4.3.19. Environmental Hazards ... 411
4.3.19.1. Location and Extent ... 411
4.3.19.2. Range of Magnitude ... 427

4.3.19.3. Past Occurrence 431
4.3.19.4. Future Occurrence 437
4.3.19.5. Environmental Impacts 438
4.3.19.6. Jurisdictional Vulnerability Assessment 439
4.3.19.7. State Facility Vulnerability Assessment 450
4.3.19.8. Jurisdictional Loss Estimation 452
4.3.19.9. State Facility Loss Estimation 458

4.3.20. Levee Failure 459
4.3.20.1. Location and Extent 459
4.3.20.2. Range of Magnitude 462
4.3.20.3. Past Occurrence 462
4.3.20.4. Future Occurrence 463
4.3.20.5. Environmental Impacts 463
4.3.20.6. Jurisdictional Vulnerability Assessment 463
4.3.20.7. State Facility Vulnerability Assessment 468
4.3.20.8. Jurisdictional Loss Estimation 468
4.3.20.9. State Facility Loss Estimation 469

4.3.21. Mass Food and Animal Feed Contamination 469
4.3.21.1. Location and Extent 469
4.3.21.2. Range of Magnitude 470
4.3.21.3. Past Occurrence 470
4.3.21.4. Future Occurrence 471
4.3.21.5. Environmental Impacts 471
4.3.21.6. Jurisdictional Vulnerability Assessment 471
4.3.21.7. State Facility Vulnerability Assessment 471
4.3.21.8. Jurisdictional Loss Estimation 471
4.3.21.9. State Facility Loss Estimation 472

4.3.22. Nuclear Incident 472
4.3.22.1. Location and Extent 472
4.3.22.2. Range of Magnitude 474
4.3.22.3. Past Occurrence 476
4.3.22.4. Future Occurrence 477
4.3.22.5. Environmental Impacts 478
4.3.22.6. Jurisdictional Vulnerability Assessment 478
4.3.22.7. State Facility Vulnerability Assessment 484
4.3.22.8. Jurisdictional Loss Estimation 485
4.3.22.9. State Facility Loss Estimation 487

4.3.23. Terrorism 487
4.3.23.1. Location and Extent 487
4.3.23.2. Range of Magnitude 487
4.3.23.3. Past Occurrence 489
4.3.23.4. Future Occurrence 490
4.3.23.5. Environmental Impacts 490
4.3.23.6. Jurisdictional Vulnerability Assessment 491
4.3.23.7. State Facility Vulnerability Assessment 493
4.3.23.8. Jurisdictional Loss Estimation 494

4.3.23.9. State Facility Loss Estimation 495
4.3.24. Transportation Accident 495
4.3.24.1. Location and Extent 495
4.3.24.2. Range of Magnitude 499
4.3.24.3. Past Occurrence 499
4.3.24.4. Future Occurrence 503
4.3.24.5. Environmental Impacts 503
4.3.24.6. Jurisdictional Vulnerability Assessment 503
4.3.24.7. State Facility Vulnerability Assessment 513
4.3.24.8. Jurisdictional Loss Estimation 516
4.3.24.9. State Facility Loss Estimation 522
4.3.25. Urban Fire and Explosion 523
4.3.25.1. Location and Extent 523
4.3.25.2. Range of Magnitude 525
4.3.25.3. Past Occurrence 525
4.3.25.4. Future Occurrence 526
4.3.25.5. Environmental Impacts 526
4.3.25.6. Jurisdictional Vulnerability Assessment 526
4.3.25.7. State Facility Vulnerability Assessment 530
4.3.25.8. Jurisdictional Loss Estimation 531
4.3.25.9. State Facility Loss Estimation 531
4.3.26. Utility Interruption 531
4.3.26.1. Location and Extent 531
4.3.26.2. Range of Magnitude 537
4.3.26.3. Past Occurrence 538
4.3.26.4. Future Occurrence 541
4.3.26.5. Environmental Impacts 542
4.3.26.6. Jurisdictional Vulnerability Assessment 542
4.3.26.7. State Facility Vulnerability Assessment 546
4.3.26.8. Jurisdictional Loss Estimation 546
4.3.26.9. State Facility Loss Estimation 546
4.4. Future Development and Vulnerability 547
4.5. Consequence Analysis 553
5. Capability Assessment 557
5.1. Update Process Summary 557
5.2. Legal Context 558
5.2.1. Federal Laws 558
5.2.2. State Laws 560
5.2.3. Local Ordinances 564
5.3. State Capability Assessment 564
5.3.1. Pre-disaster Capability 564
5.3.1.1. Federal Programs Supporting Hazard Mitigation in Pennsylvania 565

5.3.1.2. Pennsylvania Emergency Management Agency 566
5.3.1.3. Other State and Multi-Agency Programs in Pennsylvania 584
5.3.2. Post-disaster Capability 590
5.3.3. Funding and Technical Assistance Capability 594
5.3.3.1. Federal-Level Funding and Technical Assistance 594
5.3.3.2. State-Level Funding and Technical Assistance 604
5.3.4. Development and Construction Management Capability 612
5.4. Local Capability Assessment 618
5.4.1. Status of Local Hazard Mitigation Plans 618
5.4.2. Summary & Evaluation of Local Mitigation Capability 623
5.4.3. Local Mitigation Plan Integration 645
5.5. State-Level Program and Plan Integration 647
5.5.1. Integration with Existing Mechanisms 647
5.5.2. SSAHMP Integration into Other Planning and Program Initiatives . 669
6. Mitigation Strategy 672
6.1. Update Process Summary 672
6.2. State Mitigation Strategy 676
6.2.1. Mitigation Goals and Objectives 676
6.2.2. Identification & Analysis of Mitigation Techniques 679
6.2.3. Assessment of Mitigation Actions 681
6.2.4. Mitigation Action Plan 685
6.3. Local Mitigation Strategy 759
6.3.1. Local Mitigation Planning Assistance 759
6.3.1.1. Support of Local Hazard Mitigation Planning 759
6.3.1.2. Support of Local Hazard Mitigation Projects 762
6.3.1.3. Prioritizing Local Assistance 777
6.3.2. Integration of Local Mitigation Plans 780
6.4. Pennsylvania Repetitive Loss and Severe Repetitive Loss Mitigation Strategy 781
6.4.1. Introduction 781
6.4.2. Strategy Overview 781
6.4.3. Review of Implementation Actions from 2010 SRL Strategy 786
6.4.4. Partnerships 789
6.5. Mitigation Success 790
7. Plan Maintenance 794
7.1. Update Process Summary 794
7.2. Monitoring, Evaluating and Updating the Plan 796

7.3. Continued Public Involvement 797
7.4. Monitoring Progress of Mitigation Actions.....798
7.4.1. Project Reporting.....798
7.4.2. Project Closeout Process 799
8. Plan Adoption.....800
9. Appendices
Appendix A – Bibliography……A-1
Appendix B – Standard Plan Crosswalk……....B-1
Appendix C – Planning Process Documentation……C-1
Appendix D – Data Sources List……..D-1
Appendix E – Critical Facilities……E-1
Appendix F – Repetitive Loss and Severe Repetitive Loss Properties Inventory (Data Disk)……....F-1
Appendix G – HAZUS Results Reports……..……..G-1
Appendix H – Dam Failure Profile……...H-1
Appendix I – PA STEEL Evaluations……..……..I-1
Appendix J – Mitigation Projects List……...……J-1
Appendix K NFIP Local Floodplain Management Regulations and NFIP Municipal Coverage……..……...K-1

Table of Figures

Figure 2.1-1 Major Watersheds in Pennsylvania (PA DEP, 2009). 6
Figure 2.1-2 Physiographic Provinces of Pennsylvania (DCNR, 2000). 9
Figure 2.3-2 Map displaying distribution by county of 2012 census populations estimates throughout Pennsylvania (Census, 2013). 12
Figure 2.3-3 Pennsylvania 2007-2011 Population Density (ESRI, 2011). 16
Figure 2.4-1 Map of land cover throughout Pennsylvania (PASDA 2007). 19
Figure 2.4-2 Major Highways in Pennsylvania (PennDOT, 2013). 20
Figure 2.4-3 Stream miles per county (National Hydrography Dataset, 2012). 21
Figure 3.3-2 *SWOT Analysis Worksheet*, March 20, 2013 47
Figure 3.3-3 Commonwealth Agency consequence scores on systems during disaster events, May 21, 2013 49
Figure 3.3-4 Frequency vs. Impact chart Station at Nurture Nature Center Meeting, June 13, 2013. 52
Figure 3.3-5 iMapInvasives geographic information sharing system, June 13, 2013. 53
Figure 3.3-6 Presentation on State Plan Update at the WPAC meeting, July 8, 2013. 54
Figure 3.3-7 Table at the Carnegie Science Center, July 9-10, 2013. 55
Figure 3.3-8 Flooding demonstration at the Carnegie Science Center, July 9-10, 2013. 56
Figure 3.3-9 Flooding demonstration at the Nature Awareness Program at the Discover Presque Isle Event, July 26, 2013. 57
Figure 3.3-10 Demonstration showing the importance of floodplain management at the Nature Awareness Program at the Discover Presque Isle Event, July 26, 2013. 58
Figure 3.4-1 Online County Briefing Webinar Survey, http://www.pemahmp.com/county-survey 60
Figure 3.4-2 Flyer for Online Public Outreach Survey and Photo Contest 61
Figure 3.4-3 Online Outreach on PAFPM Website, http://www.pafpm.org 62
Figure 3.4-4 Outreach Calendar and Event Information Posted on PAFPM Website, http://www.pafpm.org/TDE_CMS/database/userfiles//OutreachSessions_Table.pdf 63
Figure 3.4-5 Online Outreach on Nurture Nature Website, http://www.nurturenaturecenter.org /ai1ec_event/public-open-house-for-the-2013-standard-state-all-hard-mitigation-plan-update 64
Figure 3.4-6 Online Outreach on Nurture Nature Facebook Page, http://www.facebook.com/nurturenaturecenter 65
Figure 3.4-7 Online Outreach on APA Website, http://planningpa.org/event/3969/ 66
Figure 3.4-8 Online Outreach on APA Website for Open House at Nurture Nature Center, http://planningpa.org/event/open-house-at-nurture-nature-center/ 67
Figure 3.4-9 Online Outreach on APA Website for Land Use Planning Matters Training, http://planningpa.org/event/apa-pa-event-land-use-planning-matters-4/ 68
Figure 3.4-10 Online Outreach on DRBC Website for SSAHMP Update, http://www.state.nj.us/drbc/home/spotlight/approved/20130607_PaMitigationPlan.html 69
Figure 3.4-11 Online Outreach on KEMA Website for SSAHMP Update, http://www.kema-pa.org/ 70
Figure 3.4-12 PA Hazard Mitigation Public Outreach Survey on 2013 Plan Update website, http://www.pemahmp.com/pa-mitigation-general-public-outreach-survey 72
Figure 3.4-13 Announcement of FEMA online survey on 2013 Plan Update website, http://www.pemahmp.com/annou/participateintheonlinefemarisksurvey 73
Figure 4.2.1-1 Total Presidential disaster declarations in Pennsylvania by county between 1954 and 2013. 118
Figure 4.2.2-2 Inter-relationships between hazard events in Pennsylvania. 128
Figure 4.3.1-1 Map identifying areas where coastal erosion hazards are present in Pennsylvania (ESRI, 2010). 136
Figure 4.3.1-2 Bluff Recession Hazard Areas along the Lake Erie Shoreline (PADEP, 2011) 138

Figure 4.3.1-3 Diagram showing many of the natural and human-induced processes which influence result in coastal erosion along the Lake Erie shoreline. 139
Figure 4.3.1-4 Photograph of large avulsive event along the Lake Erie, PA shoreline (USGS, 2009 and the Pennsylvania Coastal Resource Management Program. 140
Figure 4.3.1-5 Photograph of collapsed retaining wall structure along the Lake Erie, PA shoreline (PADEP, 2011). 141
Figure 4.3.1-6 Lake Erie water levels between 1860 and 2009 (NOAA GLERL, 2011). 142
Figure 4.3.1-7 Historical erosion rates along the Pennsylvania Lake Erie Shoreline (PADEP, 2007). 143
Figure 4.3.2-1 Streamgage locations and period of record (USGS, 2009). 152
Figure 4.3.2-2 Number of emergency drought declarations in Pennsylvania by County between 1980 and 2013 (PADEP, 2013). 156
Figure 4.3.2-3 Percent of time areas of the United States have PSDI values <= -3 (NDMC, 2009). 165
Figure 4.3.3-1 Relative earthquake hazard zones of Pennsylvania (Millersville University Department of Earth Sciences, 2009). 177
Figure 4.3.3-2 Map of earthquake epicenters in Pennsylvania (DCNR, 2004). 181
Figure 4.3.3-3 Isoseismal lines of the Lancaster, PA earthquake on April 23, 1984 (modified from Stover, 1988). 187
Figure 4.3.3-4 Isoseismal lines of the New Jersey earthquake on August 23, 1938 (modified from Neumann, 1940). 188
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). 189
Figure 4.3.3-6 Pennsylvania probabilistic earthquake hazard map. Contours represent PHGA values that have a 2-percent probability of being experienced over a 50-year period (PADCNR, 2007). 190
Figure 4.3.3-7 Cumulative number (N) of earthquakes versus epicentral intensity (I_0) for the period 1786 – 1986 in Pennsylvania and adjacent areas. 191
Figure 4.3.3-8 HAZUS Earthquake map for the Philadelphia event. 200
Figure 4.3.3-9 HAZUS Earthquake map for the Reading/Lancaster event. 201
Figure 4.3.3-10 HAZUS Earthquake map for the Mercer County event (historical). 202
Figure 4.3.3-11 HAZUS Earthquake map for the Indiana County event. 203
Figure 4.3.3-12 HAZUS Earthquake map for the Spring Township event. 204
Figure 4.3.4-1 Map showing average minimum temperature throughout Pennsylvania based on temperature data collected between 1981 and 2010. 206
Figure 4.3.4-2 Map showing average maximum temperature throughout Pennsylvania based on temperature data collected between 1981 and 2010. 207
Figure 4.3.4-3 Four categories of heat stress (NOAA, 2010). 208
Figure 4.3.4-4 Map of yearly occurrences of temperature greater than 90°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the frequency of occurrence of extreme values per year as data points. 211
Figure 4.3.4-5 Map of yearly occurrences of temperature greater than 95°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the frequency of occurrence of extreme values per year as data points. 211
Figure 4.3.4-6 Map of yearly occurrences of temperature greater than 100°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the period of years between each occurrence of the extreme. 212
Figure 4.3.4-7 Map of yearly occurrences of temperature below 0°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the frequency of occurrence of extreme values per year as data points. 212
Figure 4.3.4-8 Map of yearly occurrences of temperature below -10°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the period of years between each occurrence of the extreme. 213
Figure 4.3.4-9 Map of yearly occurrences of temperature below -20°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the period of years between each occurrence of the extreme. 213

Figure 4.3.5-1 Diagram identifying Special Flood Hazard Area, 1%-annual-chance (100-Year) floodplain, floodway and flood fringe. 223
Figure 4.3.5-2 Map showing Special Flood Hazard Areas throughout Pennsylvania (FEMA). 224
Figure 4.3.5-3 Number of flood events by county between 1950 and 2013 (NCDC, 2013). 228
Figure 4.3.5-4 Plot of historic high watermarks in Pennsylvania vs. watershed area. 233
Figure 4.3.5-5 DFIRM Status by county as of June 2013. 237
Figure 4.3.5-6 Map showing the location of mitigated Repetitive Loss and Severe Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013). 248
Figure 4.3.5-7 HAZUS-calculated loss estimates by county. 252
Figure 4.3.6-1 Number of hailstorm events by county between 1950 and 2013 (NCDC, 2013). 258
Figure 4.3.6-2 Hail events per square mile in Pennsylvania (Pennsylvania State Climatologist). 259
Figure 4.3.7-1 Total Rainfall from the remnants of Tropical Storm Lee (NWS, 2012). 270
Figure 4.3.7-2 Map showing historical coastal storm events which tracked through Pennsylvania. 272
Figure 4.3.7-3 Seasonal probability of Atlantic Basin hurricanes or tropical storms across Pennsylvania. 275
Figure 4.3.7-4 HAZUS 100-year probabilistic hurricane event estimated total economic losses by Census tract. Note that only tracts experiencing at least $1000 in losses are displayed on the map. Total economic losses include both direct building losses (shown in Table 4.3.7-9) and business interruption losses. 283
Figure 4.3.9-1 Map showing landslide susceptibility and incidence areas across Pennsylvania. 296
Figure 4.3.9-2 Photos showing damage to a private home (left) and PA Route 51 (right) due to landslide incidents. 297
Figure 4.3.9-3 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 (PADCNR, 2009). 299
Figure 4.3.10-1 Mean annual flash density, 2000-2009 (Cooperative for Applied Meteorological Studies, 2013) 308
Figure 4.3.10-2 Map showing the number of lightning events in each county across Pennsylvania between 1950 and 2013 (NCDC, 2010). 310
Figure 4.3.12-1 Sketch of radon entry points into a house (Arizona Geological Survey, 2006). 325
Figure 4.3.12-2 Radon hazard zones in Pennsylvania (USEPA, 1993). 326
Figure 4.3.12-3 Pennsylvania Average Basement Radon Test Results from 1990-2010 (PA DEP, 2013) 331
Figure 4.3.12-4 Pennsylvania Average First Floor Radon Test Results from 1990-2010 (PA DEP, 2013) 332
Figure 4.3.13-1 Map showing areas of Pennsylvania subject to natural subsidence due to the presence of limestone bedrock. Inventoried surface depression and sinkhole locations are also shown. 343
Figure 4.3.13-2 Example of map showing density of karst features in Cumberland County. An index map showing the coverage of the inventory is also provided. 344
Figure 4.3.13-3 Example of damage which can occur as a result of abrupt sinkhole and long-term subsidence events. 345
Figure 4.3.14-1 Design wind speeds for community shelters across the United States (FEMA 2009). 357
Figure 4.3.14-2 Map showing tornado tracks during the May 31, 1985 tornado outbreak (NOAA NWS, 2005). 358
Figure 4.3.14-3 Graph showing the number of tornado events across Pennsylvania by county between 1950 and June 2013 (NCDC, 2013). 360
Figure 4.3.14-4 Map showing the number of tornadoes in each county across Pennsylvania between 1950 and 2012 (NOAA SPC, 2013). Note that the F5 tornado which tracked through Ohio and Pennsylvania on May 31, 1985 is not identified in this dataset. 361
Figure 4.3.14-5 Graph showing the number of windstorm events across Pennsylvania by county between 1950 and June 2013 (NCDC, 2013). 362
Figure 4.3.14-6 Map showing historical tornado activity in Pennsylvania from 1950-1998. 364

Figure 4.3.14-7 Total tornado events per square mile in Pennsylvania (Pennsylvania State Climatologist). 365
Figure 4.3.14-8 Wind events per square mile in Pennsylvania (Pennsylvania State Climatologist). 366
Figure 4.3.15-1 Percentage of wildfires occurring each month (PA DCNR, 2013). 375
Figure 4.3.15-2 Map showing location of wildfire events with known locations reported to DCNR across Pennsylvania (PADCNR-BOF, 2013). 376
Figure 4.3.15-3 Map showing wildfire *hazard* by jurisdiction across Pennsylvania. 382
Figure 4.3.16-1 Pennsylvania mean annual snowfall (NOAA NWS, 2012). 395
Figure 4.3.16-2 Map showing the number of winter storm events by county across Pennsylvania (NCDC, 2013). 397
Figure 4.3.19-1 Distribution of Pennsylvania Coals (PADCNR-BTGS, 2008). 415
Figure 4.3.19-2 Coal Mining Operations in Pennsylvania (PADEP 2013). 416
Figure 4.3.19-3 Conventional Oil and Gas Well Locations and the location in Pennsylvania (PADEP, 2013). 421
Figure 4.3.19-4 Unconventional Oil and Gas Well Locations and the location in Pennsylvania (PADEP, 2013). 424
Figure 4.3.19-5 Typical slurry or tailing (coal-fines) impoundment in Pennsylvania's Anthracite region. 428
Figure 4.3.19-6 Natural Gas fire in Hopewell Township, Washington County, Pennsylvania. *Photo from Pittsburgh Post Gazette, June 17, 2010.* 430
Figure 4.3.20-1 Location of levees and floodwalls identified in the Mid-Term Levee Inventory throughout Pennsylvania. 460
Figure 4.3.20-2 Location of PA Flood Protection Projects with Federal and State Sponsorship (DEP, 2013) 461
Figure 4.3.22-1 Location of Pennsylvania nuclear power stations, their Emergency Planning Zones (EPZs), and the population density of affected municipalities (PEMA, 2009 and Census, 2011). 473
Figure 4.3.24-1 Average annual daily traffic on the Pennsylvania highway system (PennDOT 2013). 496
Figure 4.3.24-2 Pennsylvania major airports and their associated passenger volumes (National Atlas, 2013). 498
Figure 4.3.24-3 Deficient Bridges in Pennsylvania (PennDOT 2013). 509
Figure 4.3.25-1 Percent of residential buildings older than 50 years (US Census, 2008b). 524
Figure 4.3.26-1 Liquid pipeline mileage per county (PHMSA, 2013). 533
Figure 4.3.26-2 Gas pipeline mileage per county (PHMSA, 2013). 534
Figure 4.4-2 Projected population change by county (PADEP, 2012). 551
Figure 5.3.1-1 Organizational structure for the Pennsylvania Emergency Management Agency (as of December 18, 2012) 572
Figure 5.3.1-2 Mitigation staff structure for the Pennsylvania Emergency Management Agency, Bureau of Recovery and Mitigation (as of May 23, 2013). 573
Figure 5.3.1-3 FEMA and PEMA staff speaking with West Pittston, PA residents at the Non-Structural Flood Proofing Workshop (Marisa Lewis, USACE Baltimore District, 2013). 577
Figure 5.3.1-4 Mitigation staff using in-house survey equipment (BORM photos Summer 2013). 580
Figure 5.3.1-5 Web Analytics for www.PEMAHMP.com Location of Hits (Google 2013). 582
Figure 5.3.2-1 2nd Version HMPO Handbook 590
Figure 5.4.1-1 Pennsylvania county HMP expiration dates (PEMA, 2013). 620
Figure 5.4.1-2 Status of county hazard mitigation plans in Pennsylvania (FEMA, 2013). 621
Figure 5.4.2-2 Map showing the municipalities, for which data is available, that have included a Conservation District permit review requirement in their floodplain management ordinance. 629
Figure 5.4.2-3 Map showing the municipalities, for which data is available, that have included a freeboard provision in their floodplain management ordinance. 630

Figure 5.4.2-4 Map showing the municipalities, for which data is available, that have included a provision in their floodplain management ordinance which prohibits new construction or development within the area measured fifty (50) feet landward from the top-of-bank of any watercourse. 631
Figure 5.4.2-5 NFIP Community Rating System Participation (FEMA, 2012). 637
Figure 5.4.2-6 Act 167 Watersheds (PADEP, 2011). 641
Figure 5.4.2-7 County Greenway and Open Space Planning Efforts (DCNR, 2011). 644
Figure 5.5-1 State-Level Plan Integration – Hazards covered by respective plans 670
Figure 6.2.3-1 Sample PA STEEL worksheet 683
Figure 6.4.2-1 Sample RL and SRL outreach materials provided by PEMA to interested applicants. 782

Table of Tables

Table 2.3-1 Summary of 2010 census populations for each county in Pennsylvania. 11
Table 2.3-2 Age Distribution and Median Age of County Populations, 5-Year Estimates 2007-2011 (Census, 2013). 13
Table 3.1-1 Summary of updates of the SSAHMP 26
Table 3.1-2 Commonwealth agency SSAHMP progress update as of August 8, 2007. 32
Table 3.2-1 Summary of agencies participating on the State Planning Team in 2013. 37
Table 3.3-1 SSAHMP Meeting and Project Calendar 41
Table 3.3-1 SSAHMP Meeting and Project Calendar 42
Table 3.3-2 Summary of updates of the SSAHMP Summary of County Outbrief Webinar Participation 50
Table 4.1-1 List of hazards identified and profiled in the 2004, 2007, and 2010 Pennsylvania SSAHMPs. 75
Table 4.1.1-1 Comparison between SSAHMP and THIRA 77
Table 4.1.2-1 Overview of Risk Related Information Collected by Department of General Service 79
Table 4.1.3-1 Summary of critical facility data by facility type. 84
Table 4.1.3-2 Summary of critical facility types. 85
Table 4.1.3-3 Summary of critical facilities per county and their total replacement value. 87
Table 4.1.5-1 Summary of structural and content asset values for all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes. 90
Table 4.1.5-2 Summary of total buildings in all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes. 93
Table 4.1.6-1 Summary of hazards profiled in county HMPs throughout Pennsylvania. 96
Table 4.1.6-2 Summary of hazards profiled in university HMPs throughout Pennsylvania. 98
Table 4.1.7-1 THIRA hazard Rankings. 100
Table 4.1.7-2 Summary of Risk Factor approach used to rank hazard risk. 102
Table 4.1.7-3 Ranking results by hazard for Pennsylvania using the Risk Factor methodology. 104
Table 4.2.1-1 Presidential Disaster and Emergency Declarations affecting Pennsylvania. 105
Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations 109
Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance 113
Table 4.2.1-4 Disaster events where no declaration occurred. 116
Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions. 119
Table 4.2.2-2 Overview of vulnerable structures and loss estimates per hazard. 130
Table 4.3.1-1 Summary of the impact of damages caused by high water levels on the Pennsylvania Coastal Zone in Erie County, 1985-1987 (PA DEP 1987). 144
Table 4.3.1-2 Summary of life spans used to calculate Minimum Bluff Setback Distances for development in Lake Erie Bluff Recession Hazard Areas. 146
Table 4.3.1-3 Buildings identified in 100-yr Erosion Hazard Area by community with associated building and land value data. 147
Table 4.3.2-1 Precipitation deficit drought indicators for Pennsylvania (PADEP, 2012) 151
Table 4.3.2-2 Palmer Drought Severity Index (PSDI) classifications (NDMC, 2009). 153
Table 4.3.2-3 Summary of declared drought status from 1980 to 2013 by county (PADEP, 2013). 154
Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013). 157
Table 4.3.2-5 Domestic water wells by county (PADEP, 2013). 167
Table 4.3.2-6 Counties profiling drought hazards with hazard ranking and risk factor (if available). 168

Table 4.3.2-7 Annual precipitation normals by county for the period 1961 to 1990 (PADEP, 2010b). 171
Table 4.3.2-8 Monthly and annual precipitation normals from 1971 to 2000 for select cities in Pennsylvania (NOAA, 2009) 172
Table 4.3.2-9 Number of State Critical Facilities per county that their primary sector is Agriculture. 173
Table 4.3.2-10 Estimated jurisdictional losses relating to agricultural production (USDA, Census of Agriculture, 2007). 173
Table 4.3.3-1 Richter scale magnitudes and associated earthquake size effects. 178
Table 4.3.3-2 Modified Mercalli Intensity Scale with associated impacts. 178
Table 4.3.3-3 Catalog of earthquakes with epicenters in Pennsylvania (DCNR, 2004). 182
Table 4.3.3-4 Recent earthquakes with epicenters in Pennsylvania reported to USGS (USGS, 2013). 186
Table 4.3.3-5 Counties profiling earthquakes with hazard ranking and risk factor (if available). 192
Table 4.3.3-6 Number of State Critical Facilities impacted by earthquakes located in each county. 195
Table 4.3.3-7 State Critical Facilities vulnerable to earthquakes by Critical Facility Type. 196
Table 4.3.3-8 Estimated jurisdictional losses due to earthquakes. 197
Table 4.3.3-9 HAZUS earthquake model event parameters. 199
Table 4.3.3-10 Summary of earthquake losses predicted by HAZUS. 199
Table 4.3.4-1 Counties profiling extreme temperature hazards with hazard ranking and risk factor (if available). 215
Table 4.3.4-2 Number of State Critical Facilities impacted by Extreme Heat in each county 217
Table 4.3.4-3 Number of State Critical Facilities impacted by Extreme Cold in each county 218
Table 4.3.4-4 State Critical Facilities vulnerable to Extreme Heat by Critical Facility Type 219
Table 4.3.4-5 State Critical Facilities vulnerable to Extreme Cold by Critical Facility Type 220
Table 4.3.4-6 Estimated jurisdictional losses in Extreme Heat areas 220
Table 4.3.4-7 Estimated jurisdictional losses in Extreme Cold Temperature areas 221
Table 4.3.5-1 Number of flood events by county between 1950 and 2013 (NCDC, 2013). 226
Table 4.3.5-2 Historic Flood Losses and Payments (PEMA, 2013). 231
Table 4.3.5-3 Counties profiling flood hazards with hazard ranking and risk factor (if available). 234
Table 4.3.5-4 Number of Critical Facilities within the 1%-annual-chance flood hazard areas in each county 238
Table 4.3.5-5 State Critical Facilities within the 1%-annual-chance flood hazard area by Facility Type 239
Table 4.3.5-6 Total and mitigated Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013). 241
Table 4.3.5-7 Total and mitigated Severe Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013). 243
Table 4.3.5-8 Losses Avoided in Hurricane Sandy Based on Last Payment to RL and SRL Properties Prior to Hurricane Sandy. Data from PA RL & SRL Inventory (July 2013). 246
Table 4.3.5-9 HAZUS-MH results for a 1%-annual-chance flood event in Pennsylvania. 249
Table 4.3.5-10 Summary of funds distributed in Pennsylvania as a result of disaster declarations related to flooding between 2003 and 2013 (PEMA, 2010, and FEMA, 2013). 254
Table 4.3.6-1 Hailstone size and relationship to updraft speed (NOAA, 2 May 2013). 256
Table 4.3.6-2 Counties profiling hailstorm hazards with hazard ranking and risk factor (if available). 260
Table 4.3.6-3 Number of agriculture State Critical Facilities per county. 263
Table 4.3.6-4 Hailstorms per county according to the NCDC between 1950 and 2013 (NCDC, 2013) 264
Table 4.3.6-5 Estimated jurisdictional losses relating to agricultural production (USDA Census of Agriculture 2007) 266
Table 4.3.7-1 Saffir-Simpson Scale categories with associated wind speeds and damages (NHC, 2009). 269

Table 4.3.7-2 Tropical cyclone events which tracked through Pennsylvania between 1952 and present (NOAA CSC, 2010). Note that events with circulation centers that did not move through Pennsylvania are not included in this table, but are identified in text. Storm categories: E = Extra-tropical storm, TD = Tropical depression, TS = Tropical storm 271
Table 4.3.7-3 Counties profiling hurricane, tropical storm, and nor'easters with hazard ranking and risk factor (if available). 276
Table 4.3.7-4 Number of State Critical Facilities within storm event probability zones of 12 and 18 percent. 279
Table 4.3.7-5 State Critical Facilities within 12 and 18 percent storm event probability zones by facility type. 280
Table 4.3.7-6 Estimated jurisdictional losses in 12 and 18 percent storm event probability zones. 281
Table 4.3.7-7 Summary of hurricane losses predicted by HAZUS. 282
Table 4.3.7-8 Total building-related losses from the HAZUS Probabilistic 100-year Hurricane Event. 284
Table 4.3.8-1 Invasive species of concern to the Commonwealth (PISC 2010). 285
Table 4.3.8-2 Previous Occurrences of Invasive Species Events Requiring State Action or Quarantine. 288
Table 4.3.8-3 Counties profiling invasive species hazards with hazard ranking and risk factor (if available). 291
Table 4.3.8-4 Estimated agricultural jurisdictional losses due to Invasive Species. 294
Table 4.3.9-1 Counties profiling landslides with hazard ranking and risk factor (if available). 301
Table 4.3.9-2 Number of State Critical Facilities impacted by landslides in each county 303
Table 4.3.9-3 State Critical Facilities vulnerable to landslides by Critical Facility Type 304
Table 4.3.9-4 Estimated jurisdictional losses due to landslides. 305
Table 4.3.10-1 Counties profiling lightning strike hazards with hazard ranking and risk factor (if available). 312
Table 4.3.10-2 State critical facilities vulnerable to lightning strikes by county. 314
Table 4.3.10-3 State Critical Facilities vulnerable to lightning by Critical Facility Type 315
Table 4.3.10-4 Estimated jurisdictional losses due to lightning strikes. 316
Table 4.3.11-1 Estimated morbidity and mortality during an influenza pandemic within 12-16 weeks 317
Table 4.3.11-2 Previous West Nile Virus occurrences in Pennsylvania 2000-2012 (PA DEP). 319
Table 4.3.11-3 List of previous significant outbreaks of influenza over the past century (Global Security, 2009; WHO, 2009). 320
Table 4.3.11-4 Counties profiling pandemic hazards with hazard ranking and risk factor (if available). 321
Table 4.3.12-1 Radon risk for smokers and non-smokers (USEPA, 2010). 329
Table 4.3.12-2 Counties profiling radon exposure with hazard ranking and risk factor (if available). 334
Table 4.3.12-3 Number of State Critical Facilities falling within zip codes with high average radon test results. 336
Table 4.3.12-4 State Critical Facilities vulnerable to High Potential (Level 1) EPA Radon Zones by Critical Facility Type 338
Table 4.3.12-5 Estimated jurisdictional losses in areas with high radon test results 339
Table 4.3.13-1 Summary of sinkholes identified in the Pennsylvania (PA DCNR, 2013) 346
Table 4.3.13-2 Counties profiling subsidence/sinkhole hazards with hazard ranking and risk factor (if available). 348
Table 4.3.13-3 Number of State Critical Facilities impacted by subsidence and sinkholes in each county 350
Table 4.3.13-4 State Critical Facilities vulnerable to subsidence and sinkholes by critical facility type 351
Table 4.3.13-5 Estimated jurisdictional losses due to subsidence and sinkholes. 352
Table 4.3.14-1 Enhanced Fujita Scale (EF-Scale) categories with associated wind speeds and description of damages. 355

Table 4.3.14-2 Counties profiling tornado and windstorm hazards with hazard ranking and risk factor (if available). 367
Table 4.3.14-3 Number of State Critical Facilities impacted by tornados in each county using a 5 mile buffer of historical tornados (F1 or greater) 370
Table 4.3.14-4 State Critical Facilities vulnerable to tornados by Critical Facility Type 371
Table 4.3.14-5 Potential jurisdictional losses due to tornados. 372
Table 4.3.15-1 Pennsylvania wildfire history (DCNR, 2013). 378
Table 4.3.15-2 Number of reported wildfires and acres burned per county from 2002-2013 (PADCNR, 2013) 383
Table 4.3.15-3 Farmland, woodland, and idle cropland by county (USDA, Census of Agriculture, 2007). 384
Table 4.3.15-4 Counties profiling wildfire hazards with hazard ranking and risk factor (if available). 386
Table 4.3.15-5 Number of state critical facilities impacted by wildfire located in each county 388
Table 4.3.15-6 State Critical Facilities vulnerable to wildfire by Critical Facility Type 391
Table 4.3.15-7 Estimated jurisdictional losses in wildfire High Hazard areas 392
Table 4.3.16-1 Summary of Pennsylvania snowfall and snow depth extremes (NCDC, 2010) 396
Table 4.3.16-2 Counties profiling winter storm hazards with hazard ranking and risk factor (if available). 400
Table 4.3.16-3 Number of State Critical Facilities impacted by winter storms in each county 402
Table 4.3.16-4 State Critical Facilities vulnerable to winter storms by Critical Facility Type 403
Table 4.3.16-5 Estimated jurisdictional losses due to winter storms. 403
Table 4.3.17-1 Civil disturbance events reported to PEIRS, 2001-2009 (PEMA, 2010) 406
Table 4.3.17-2 Civil disturbance events reported to WebEOC, 2010-2012 (PEMA, 2013) 406
Table 4.3.17-3 Counties profiling civil disturbance hazards with hazard ranking and risk factor (if available). 408
Table 4.3.17-4 State Critical Facilities vulnerable to Civil Disturbance incidents by Critical Facility Type 410
Table 4.3.17-5 Estimated jurisdictional losses due to civil disturbances. 410
Table 4.3.19-1 Number of SARA Title III facilities in Pennsylvania Counties (PEMA, 2010). 412
Table 4.3.19-2 Number of Active and Abandoned Coal Mines in Pennsylvania Counties (PADEP, 2013) 417
Table 4.3.19-3 Summary of Coal Slurry Impoundments in the Commonwealth. (Coal Impoundment LIS 2012). 418
Table 4.3.19-4 Number of conventional oil and gas wells by county throughout Pennsylvania. . 422
Table 4.3.19-5 Number of unconventional well permits issued and unconventional wells drilled to date (7/2013) in Pennsylvania Counties (PA DEP, 2013). 425
Table 4.3.19-6 Number of Hazardous Material Release Incidents in Pennsylvania Counties 2006 - 2011 (PEMA Pennsylvania Hazardous Material Emergency Planning and Response Act Annual Reports) 431
Table 4.3.19-7 Highway-Related Hazardous Material Release Incident Statistics (PHMSA). 433
Table 4.3.19-8 Rail-Related Hazardous Material Release Incident Statistics (PHMSA). 434
Table 4.3.19-9 Air-Related Hazardous Material Release Incident Statistics (PHMSA). 435
Table 4.3.19-10 Oil and gas incidents in Pennsylvania between 2009 and 2010. 437
Table 4.3.19-11 Counties profiling environmental hazards with hazard ranking and risk factor (if available). 441
Table 4.3.19-12 Number of State Critical Facilities impacted by hazardous materials releases in each county 444
Table 4.3.19-13 Pennsylvania county chemical facility and transportation threat ratings (PEMA, 2007a). 445
Table 4.3.19-14 Number of state critical facilities vulnerable by coal mine incidents in each county. 447
Table 4.3.19-15 Number of State Critical Facilities impacted by conventional oil and gas well incidents in each county. 448
Table 4.3.19-16 Number of State Critical Facilities impacted by oil and gas well incidents in each county 449

Table 4.3.19-17 State critical facilities vulnerable to hazardous materials releases by critical facility type. 450
Table 4.3.19-18 State Critical Facilities vulnerable to coal mine incidents by Critical Facility Type 451
Table 4.3.19-19 State Critical Facilities vulnerable to oil and gas well incidents by critical facility type 451
Table 4.3.19-20 State Critical Facilities vulnerable to oil and gas well incidents by critical facility type 452
Table 4.3.19-21 Estimated jurisdictional losses due to hazardous materials releases. 453
Table 4.3.19-22 Estimated jurisdictional losses due to coal mine incidents. 455
Table 4.3.19-23 Estimated jurisdictional losses due to oil and gas well incidents. 456
Table 4.3.19-24 Estimated jurisdictional losses due to unconventional oil and gas well incidents. 457
Table 4.3.20-1 Counties profiling levee failure with hazard ranking and risk factor (if available). 464
Table 4.3.20-2 Number of State Critical Facilities falling within levee Protected Areas and 2,000-foot GIS buffer of levees in each county 466
Table 4.3.20-3 State Critical Facilities vulnerable to levee failure by Critical Facility Type 468
Table 4.3.20-4 Estimated jurisdictional losses in 2,000 foot Levee GIS buffer areas. 469
Table 4.3.22-1 Population located in the Plume Exposure and Ingestion EPZs for PA nuclear power generating stations (PEMA, 2009). 474
Table 4.3.22-2 Counties and municipalities located within each the 10-mile Plume Exposure Pathway EPZ (DEP Bureau of Radiation Protection, 2009) 478
Table 4.3.22-3 Counties profiling nuclear incidents with hazard ranking and risk factor (if available). 480
Table 4.3.22-4 Number of State Critical Facilities impacted by the 10-mile EPZ in each county .. 483
Table 4.3.22-5 Number of food and agriculture State Critical Facilities impacted by the 50-mile EPZ in affected counties 483
Table 4.3.22-6 State Critical Facilities vulnerable to nuclear incidents by critical facility type 484
Table 4.3.22-7 Estimated jurisdictional losses due to nuclear incidents. 485
Table 4.3.22-8 Estimated 50-mile EPZ jurisdictional losses relating to agricultural production. . 486
Table 4.3.23-1 Threat and suspected terrorist activity events reported to PEIRS, 2001-2009 (PEIRS) 489
Table 4.3.23-2 Threat and suspected suspicious activity events reported to PEIRS, 2001-2009 (PEIRS) 490
Table 4.3.23-3 Counties profiling terrorism with hazard ranking and risk factor (if available). 491
Table 4.3.24-1 Pennsylvania vehicular transportation accident trends, 2004-2012 (PennDOT, 2012) 500
Table 4.3.24-2 Rail incidents by county from 2010-2013 (Federal Railway Administration, 2013). 501
Table 4.3.24-3 Counties profiling transportation hazards with hazard ranking and risk factor (if available). 504
Table 4.3.24-4 Pennsylvania Bridge Inventory (Federal Highway Administration, 2012) 507
Table 4.3.24-5 Number of State Critical Facilities impacted by highway accidents in each county 510
Table 4.3.24-6 Number of State Critical Facilities impacted by air accidents in each county 511
Table 4.3.24-7 Number of State Critical Facilities impacted by rail accidents in each county 513
Table 4.3.24-8 State Critical Facilities vulnerable to highway accidents by critical facility type .. 514
Table 4.3.24-9 State Critical Facilities vulnerable to air transportation accidents by critical facility type 515
Table 4.3.24-10 State critical facilities vulnerable to rail transportation accidents by critical facility type 516
Table 4.3.24-11 Estimated jurisdictional losses due to highway accidents. 517
Table 4.3.24-12 Estimated jurisdictional losses due to air transportation accidents. 519
Table 4.3.24-13 Estimated jurisdictional losses due to rail accidents. 521
Table 4.3.25-1 Urban fire and explosion events reported to PEIRS, 2001-2009 (PEIRS) 525

Table 4.3.25-2 Counties profiling urban fire and explosion hazards with hazard ranking and risk factor (if available). 527
Table 4.3.25-3 Number of State Critical Facilities impacted by urban fire and explosion in identified vulnerable jurisdictions 530
Table 4.3.25-4 State Critical Facilities vulnerable to urban fires and explosions by Critical Facility Type 530
Table 4.3.25-5 Estimated jurisdictional losses due to urban fires and explosions. 531
Table 4.3.26-1 Snapshot of PUC users in Pennsylvania (PUC, 2012).* 535
Table 4.3.26-2 Community Public Water Supply Populations by County and Primary Source (DEP, 2013) 535
Table 4.3.26-3 Utility outage events reported to PEIRS, 2001-2009 (PEIRS) 538
Table 4.3.26-4 Utility interruption events reported to Pennsylvania Public Utilities Commission, 2002-2013 (PUC, 2013). 539
Table 4.3.26-5 Counties profiling utility interruption hazards with hazard ranking and risk factor (if available). 543
Table 4.4-1 Population Projections of Pennsylvania Counties (PADEP, 2012) 547
Table 4.5-1 Commonwealth Agency consequence scores on systems during disaster events 554
Table 5.2.2-1 2012 Act 13 Impact Fee Distribution 563
Table 5.3.1-1 Pennsylvania CERT and Citizen Corp Groups (PEMA Bureau of Strategic Planning, 2013) 567
Table 5.3.1-2 State Hazard Mitigation Plan Contact Information 571
Table 5.3.1-3 Location and participation in International Building Code Essentials Training in PA from 2010-2013 (PCCA, 2013) 588
Table 5.3.3-1 FEMA Grant Program Eligible Activities (FEMA Hazard Mitigation Assistance Unified Guidance, July 2013) 596
Table 5.3.3-2 PENNVEST Stormwater Projects 1993-2013 (PENNVEST, 2013) 606
Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from August 15, 2010 to August 15, 2013 (CIS, 2013) 614
Table 5.4.1-1 University Hazard Mitigation Plan Status 622
Table 5.4.2-1 Community Participation in the NFIP (FEMA, 2013). 624
Table 5.4.2-2 The percentage of municipalities, of which data has been collected, that adopted extra, more restrictive provisions in their floodplain management ordinance. 632
Table 5.4.2-3 Communities Suspended from the NFIP. 632
Table 5.4.2-4 NFIP policies and total dollar amount of coverage per county (FEMA, August 2013). 633
Table 5.4.2-5 NFIP policies and total dollar amount of coverage for municipalities with greater than $100 million in coverage (FEMA, August 2013). 635
Table 5.4.2-6 CRS classes and associated credit points. 635
Table 5.4.2-7 Jurisdictional participation in FEMA's CRS program (FEMA, 2013). 638
Table 5.4.2-8 Pennsylvania Firewise Communities. 639
Table 5.4.2-9 Pennsylvania StormReady Communities. 640
Table 5.4.2-10 Act 167 Plan Status in Pennsylvania (PADEP, 2011). 641
Table 5.5-1 Summary of other local, state and federal planning mechanisms. 648
Table 6.1-1 2010 Actions categorized by mitigation Technique 673
Table 6.1-2 2010 Actions categorized by hazard 674
Table 6.1-3 2010 Mitigation vs. Risk Evaluation 674
Table 6.1-4 2010 Actions categorized by responsible entity. 675
Table 6.2.1-1 Goals and Objectives for 2010 SSAHMP 676
Table 6.2.2-1 Mitigation Technique used for each hazard in Pennsylvania. 680
Table 6.2.4-1 Evaluation of 2010 mitigation actions. 686
Table 6.2.4-2 Summary of 2013 mitigation actions. 726
Table 6.3.1-1 County Participation in HM Toolkit Training Workshops. 761
Table 6.3.1-2 Number of Local Hazard Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2013 (PEMA). 764

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013). 767
Table 6.3.1-4 Summary of process used prioritize and select mitigation projects in Pennsylvania. 778
Table 6.4.3-1 Progress Report of SRL Strategy 786
Table 6.4.4-1 2013 State Planning Team Member Agencies and Organizations 789
Table 6.5-1 Mitigation Actions for which an AW-501 has been submitted and corresponding Source of Funding Summary for Pennsylvania Data from 01/01/2000 - 04/30/2013 790
Table 6.5-2 PEMA Mitigation Success Stories 791
Table 6.5-3 Key Mitigation Success since 2010. 792

List of Acronyms

Act 147	Pennsylvania Radiation Protection Act, 1984-147
Act 165	Pennsylvania Hazardous Material Emergency Planning and Response Act of 1990
Act 166	Pennsylvania Flood Plain Management Act of 1978
Act 167	Pennsylvania Stormwater Management Act of 1978
Act 227	Counterterrorism Planning, Preparedness and Response Act of 2002
Act 247	Pennsylvania Municipalities Planning Code Act of 1968
Act 78	Public Safety Emergency Telephone Act of 1990
ATV	All-Terrain Vehicle
BOF	Bureau of Forestry
BORM	Bureau of Recovery and Mitigation
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
CRS	Community Rating System
DCED	Pennsylvania Department of Community and Economic Development
DCNR	Pennsylvania Department of Conservation and Natural Resources
DEP	Pennsylvania Department of Environmental Protection
DFIRM	Digital Flood Insurance Rate Map
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
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
ICS	Incident Command System
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
MPO	Model Plan Outline
NCDC	National Climactic Data Center
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 STEEL	Mitigation action and project evaluation methodology using **P**olitical, **A**dministrative, **S**ocial, **T**echnical, **E**conomic, **E**nvironmental, and **L**egal considerations.
PA Tool	Commonwealth of Pennsylvania's All-Hazard Mitigation Tool
PACD	Pennsylvania Association of Conservation Districts
PAGs	Protective Action Guides
PHMC	Pennsylvania Historical and Museum Commission
PASDA	Pennsylvania Spacial 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
PEIRS	Pennsylvania Emergency Incident Reporting System
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PennFIRS	Pennsylvania Fire Information Reporting System
PHGA	Peak Horizontal Ground Acceleration
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
SOG	Commonwealth of Pennsylvania's All-Hazard Mitigation Planning Standard Operating Guide
SPT	State Planning Team
SRL	Severe Repetitive Loss
SSAHMP	State Standard All-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
TMI	Three mile island-remove
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

1. Introduction

1.1. Background

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

Since Pennsylvania's founding by William Penn, hazard mitigation has been an inherent value of the Commonwealth. In Pennsylvania, natural, technological 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. Through this system, the Commonwealth has created efforts to make communities safer and sustainable for future generations. The Pennsylvania Emergency Management Agency (PEMA) has been legislatively charged with coordinating Commonwealth government to prepare the State Standard All-Hazard Mitigation Plan (SSAHMP).

Across the United States, natural and human-made disasters have led to increasing levels of deaths, injuries, property damage, and interruption of business and government services. The time, money and effort needed to recover from these disasters exhausts resources, diverting attention from important public programs and private agendas. Since 1954 there have been fifty-two Presidential Disaster Declarations and ten Presidential Emergency Declarations in Pennsylvania.

Accordingly, the Pennsylvania Hazard Mitigation State Planning Team (SPT), composed of government agency leaders, academia and other organizations, has prepared this SSAHMP update. This all-hazard mitigation plan will guide the Commonwealth towards greater disaster resistance, while also respecting the character and needs of its local communities.

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 SSAHMP.

1.2. Purpose

This Hazard Mitigation Plan was developed for the purpose of:

- 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.
- Improving community resiliency following a disaster event.

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 SSAHMP has been prepared using federal guidance as well as best mitigation practices employed successfully in areas of the Commonwealth and throughout the nation. It is consistent with the goal of fostering the protection of health and well-being of Pennsylvania citizens. 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:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, as amended;
- Code of Federal Regulations (CFR), Title 44, Parts 79.4, 201 and 206; and
- Disaster Mitigation Act (DMA) of 2000, Public Law 106-390, as amended.

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

- Pennsylvania Emergency Management Services Code. Title 35, Pa C.S. Section 101.
- Pennsylvania Municipalities Planning Code of 1968, Act 247 as reenacted and amended by Act 170 of 1988.
- Pennsylvania Stormwater Management Act of October 4, 1978. P.L. 864, No. 167.

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

- FEMA 386-1: *Getting Started*. September 2002.
- FEMA 386-2: *Understanding Your Risks: Identifying Hazards and Estimating Losses*. August 2001.
- FEMA 386-3: *Developing the Mitigation Plan*. April 2003.
- FEMA 386-4: *Bringing the Plan to Life*. August 2003.
- FEMA 386-5: *Using Benefit-Cost Review in Mitigation Planning*. May 2007.
- FEMA 386-6: *Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning*. May 2005.
- FEMA 386-7: *Integrating Manmade Hazards into Mitigation Planning*. September 2003.
- FEMA 386-8: *Multijurisdictional Mitigation Planning*. August 2006.

- FEMA 386-9: *Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects*. August 2008.
- FEMA. *Local Mitigation Planning Handbook.* March 2013.
- FEMA. *Local Mitigation Plan Review Guide.* October 1, 2011.
- FEMA *National Fire Incident Reporting System 5.0: Complete Reference Guide*. January, 2008.
- FEMA Hazard Mitigation Assistance Unified Guidance. June 1, 2010.
- FEMA. Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials. March 1, 2013
- FEMA. Mitigation Ideas. A Resource for Reducing Risk to Natural Hazards. January 2013.

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

- PEMA Hazard *Mitigation Planning Made Easy!*
- PEMA Mitigation Ideas: *Potential Mitigation Measures by Hazard Type; A Mitigation Planning Tool for Communities*. March 6, 2009.
- PEMA Pennsylvania's *Hazard Mitigation Planning Standard Operating Guide*. July, 2010.
- 2012 Pennsylvania Threat and Hazard Identification and Risk Assessment. December 2012.

The following additional guidance document produced by the National Fire Protection Association (NFPA) was used to update this plan:

- NFPA 1600: *Standard on Disaster/Emergency Management and Business Continuity Programs*. 2007

Please note that that hazard mitigation falls within PEMA's Bureau of Recovery and Mitigation (BORM). PEMA's work is both guided by and regulated by additional federal and state guidance, including Federal Emergency Management Agency's (FEMA) Logistics Capability Assessment Tool; FEMA Comprehensive Preparedness Guidance 101; the Federal Critical Infrastructure Protection Act; the Patriot Act; Department of Homeland Security Directives; Presidential Directives 5 and 8; CFR Titles 10, 29, and 49; and the Pennsylvania State Emergency Operations Plan.

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.

As part of the process of implementing the mitigation planning provisions of the Stafford Act, FEMA prepared Interim Final Rules regarding hazard mitigation planning on February 26, 2002; October 1, 2002; October 28, 2003; September 13, 2004; and October 31, 2007. The Final Rule (the Rule) was published in the Federal Register on September 16, 2009, as 44 CFR Parts 59, 61, 78, 79, 80, 201, and 206. The Rule that became effective on October 16, 2009 clearly establishes the mitigation planning criteria for states and local communities.

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 SSAHMP 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

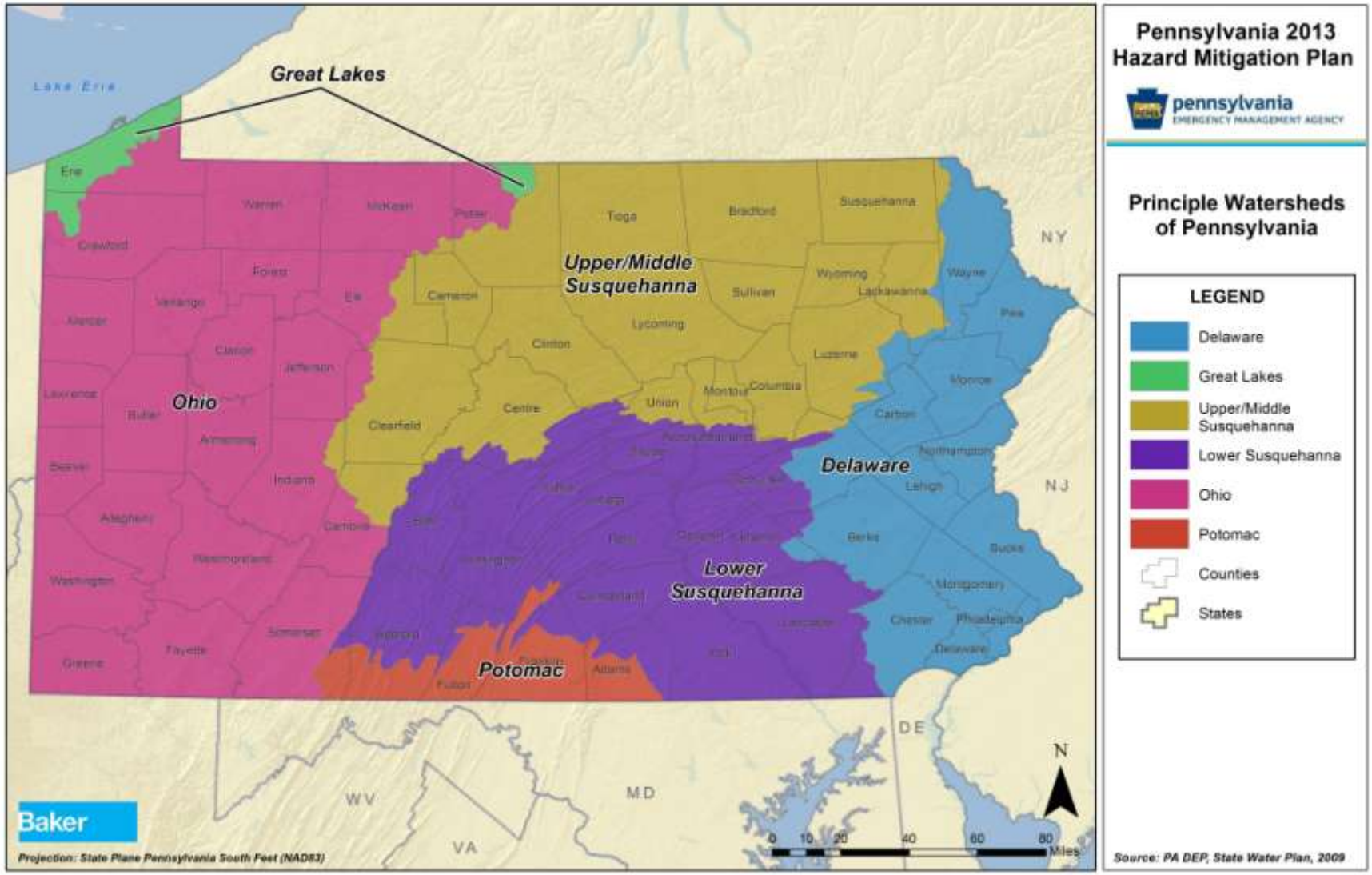
2.1. Geography and Environment

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, Pennsylvania shares a border with Maryland, New Jersey, Delaware, and West Virginia. It is bordered on the east by New Jersey and part of New York. The western border of the state is shared by 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: 57 miles of shoreline along the Delaware Estuary and 51 miles of coastline along Lake Erie (PADEP, 2010). 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 principle watersheds are shown in Figure 2.1-1.

Figure 2.1-1 Major Watersheds in Pennsylvania (PA DEP, 2009).



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.

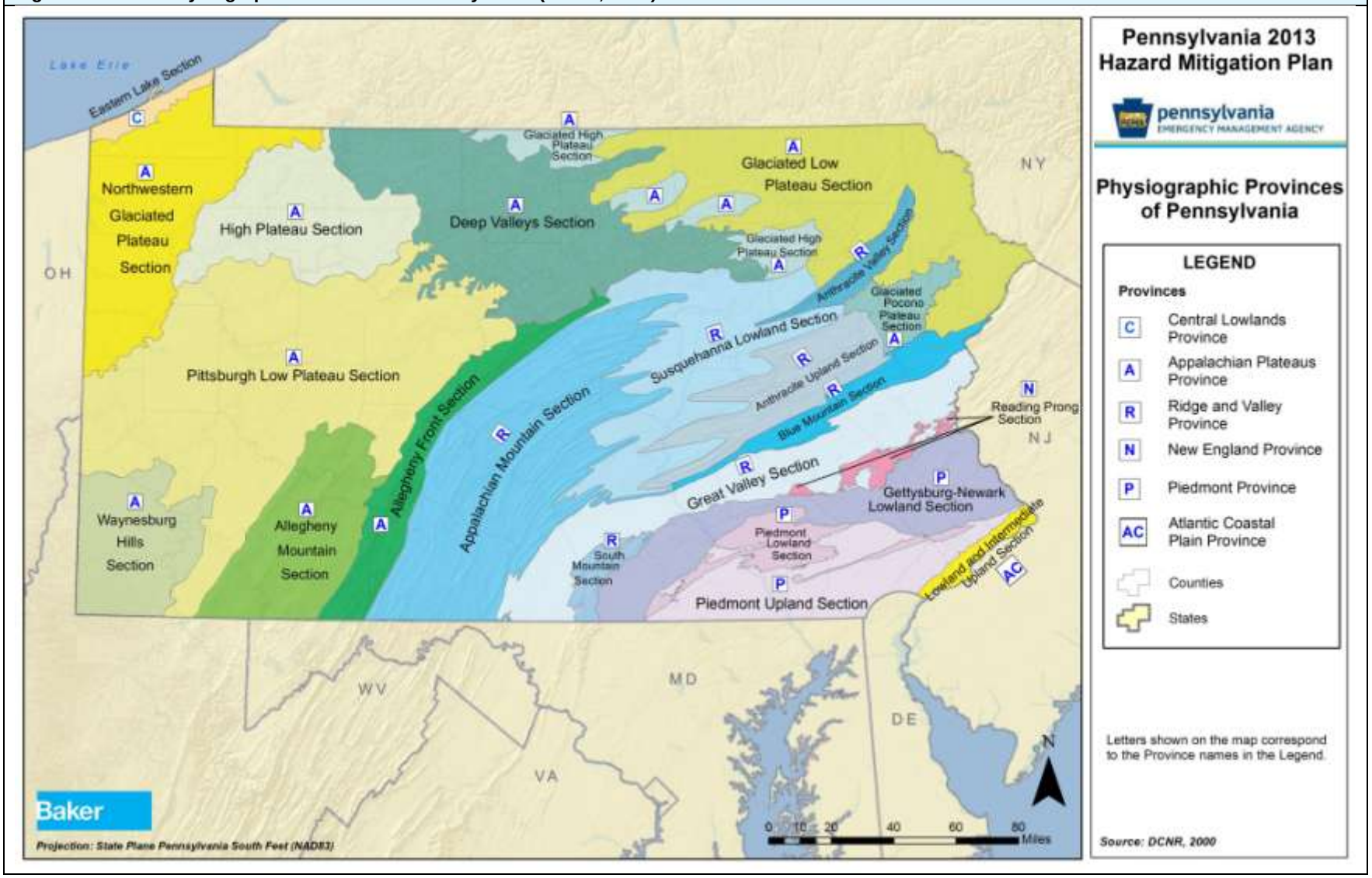
Mean annual precipitation is 40 inches, and seasonal snowfall is normally about 50 inches. The greatest amounts occur in the northern regions, where some areas average more than 80 inches annually. Fields are usually snow covered three fourths of the time during the winter season.

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. At 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, 2000).



2.2. State Facts

Before the area which is now present-day Pennsylvania was settled by the Europeans, it was first inhabited by groups of Native Americans. The largest tribes inhabiting the area were the Delaware, the Susquehannock, the Shawnee, and the Iroquois Confederacy. By the 1600's, early 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. It was in 1681 that the Commonwealth of Pennsylvania was formally founded by William Penn (Pennsylvania General Assembly, 2010).

Throughout history, agriculture has been a leading industry in Pennsylvania. Primary crops were wheat, corn, rye, hemp, and flax. 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 20th overall in agricultural production (USDA, 2007). In 2008 Pennsylvania ranked 3rd in the nation for total certified and exempt organic farm sales. (USDA 2010)

Industries such as iron and steel production were once prominent in Pennsylvania. Furthermore, textiles, leathermaking, lumbering, oil and coal production, shipbuilding, publishing, and tobacco and paper manufacturing also prospered in the 1800s and early 1900s in Pennsylvania. With the decline of some of those 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.

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. Additionally, Pennsylvania contains 117 state parks and several of the best museums in the country including the Philadelphia Museum of Art and the Carnegie Museums in Pittsburgh.

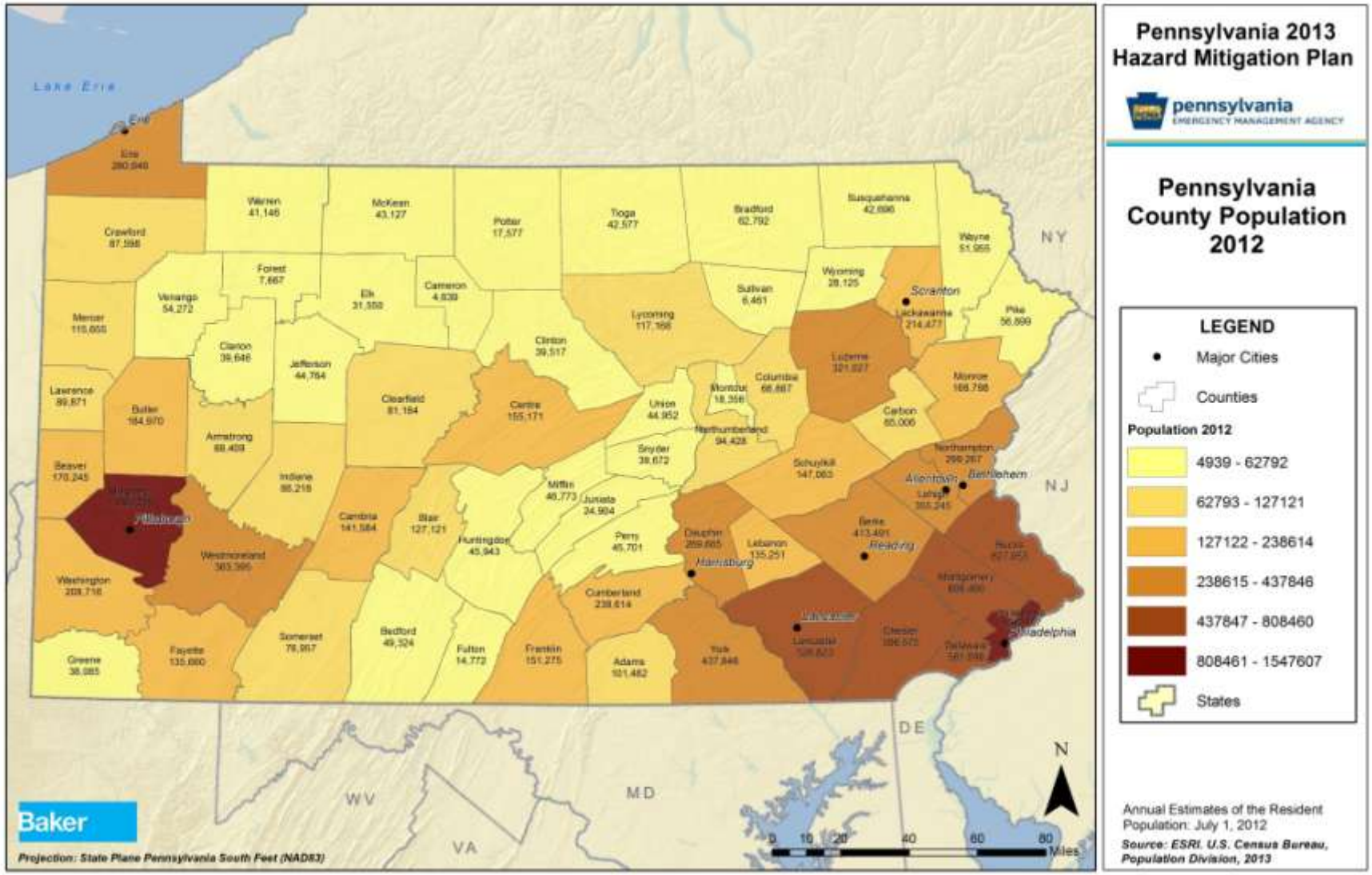
2.3. Population and Demographics

Pennsylvania contains 67 counties and 2,566 municipalities. The state's capital is Harrisburg. According to the 2010 U.S. Census, the population of Pennsylvania is 12,702,379 which ranks 6th among states in terms of total population. Table 2.3-1 depicts the 2010 Census county populations while Figure 2.3-1 shows population estimates for 2012. Population trends are described in Section 4.4.

Table 2.3-1 Summary of 2010 census populations for each county in Pennsylvania.

COUNTY	2010 CENSUS POPULATION	COUNTY	2010 CENSUS POPULATION
Adams	101,407	Lackawanna	214,437
Allegheny	1,223,348	Lancaster	519,445
Armstrong	68,941	Lawrence	91,108
Beaver	170,539	Lebanon	133,568
Bedford	49,762	Lehigh	349,497
Berks	411,442	Luzerne	320,918
Blair	127,089	Lycoming	116,111
Bradford	62,622	McKean	43,450
Bucks	625,249	Mercer	116,638
Butler	183,862	Mifflin	46,682
Cambria	143,679	Monroe	169,842
Cameron	5,085	Montgomery	799,874
Carbon	65,249	Montour	18,267
Centre	153,990	Northampton	297,735
Chester	498,886	Northumberland	94,528
Clarion	39,988	Perry	45,969
Clearfield	81,642	Philadelphia	1,526,006
Clinton	39,238	Pike	57,369
Columbia	67,295	Potter	17,457
Crawford	88,765	Schuylkill	148,289
Cumberland	235,406	Snyder	39,702
Dauphin	268,100	Somerset	77,742
Delaware	558,979	Sullivan	6,428
Elk	31,946	Susquehanna	43,356
Erie	280,566	Tioga	41,981
Fayette	136,606	Union	44,947
Forest	7,716	Venango	54,984
Franklin	149,618	Warren	41,815
Fulton	14,845	Washington	207,820
Greene	38,686	Wayne	52,822
Huntingdon	45,913	Westmoreland	365,169
Indiana	88,880	Wyoming	28,276
Jefferson	45,200	York	434,972
Juniata	24,636	***PA TOTAL***	***12,702,379***

Figure 2.3-2 Map displaying distribution by county of 2012 census populations estimates throughout Pennsylvania (Census, 2013).



The most populous county in the Commonwealth is Philadelphia County, which is conterminous with the City of Philadelphia, with a 2010 Census population of 1,526,006. Cameron County, with a population of 5,085, is the least populated county according to the 2010 Census. 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 2010 Census population of 305,702. Figure 2.3-3 shows population density throughout the Commonwealth based on the Census 2007-2011 five year estimates.

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 naturally will experience greater loss during hazard events.

The age of populations can also 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 39.7 with 22.1 percent of the population under 18 years of age and 15.4 percent 65 years or older. According to the Pennsylvania Department of Community and Economic Development (DCED) 2010 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 2.3-2 Age Distribution and Median Age of County Populations, 5-Year Estimates 2007-2011 (Census, 2013).

COUNTY	Age Under 5	Age 5 – 17	Age 65+	Median Age
Adams	5,644	17,106	15,534	40.8
Allegheny	63,271	180,657	205,694	41.2
Armstrong	3,646	10,727	12,665	4
Beaver	8,887	26,283	31,564	43.9
Bedford	2,590	8,274	9,374	4
Berks	25,422	72,756	58,968	39.1
Blair	7,314	19,755	22,321	42.0
Bradford	3,754	10,600	10,854	42.8
Bucks	34,332	110,363	89,499	41.5
Butler	10,144	31,399	13,736	40.9
Cambria	7,307	21,147	27,122	43.4
Cameron	213	793	1,078	47.4
Carbon	3,474	10,162	11,418	43.4
Centre	6,660	17,697	17,043	28.4
Chester	31,184	92,361	62,856	39.0
Clarion	2,072	5,860	6,550	39.3
Clearfield	4,162	12,805	14,294	42.5
Clinton	2,163	5,915	6,387	38.9

Table 2.3-2 Age Distribution and Median Age of County Populations, 5-Year Estimates 2007-2011 (Census, 2013).

COUNTY	Age Under 5	Age 5 – 17	Age 65+	Median Age
Columbia	3,167	9,441	10,675	39.3
Crawford	5,083	14,982	14,586	41.3
Cumberland	12,544	35,954	36,102	40.1
Dauphin	16,680	45,338	36,559	39.1
Delaware	33,653	96,978	79,644	38.7
Elk	1,544	5,241	6,067	44.4
Erie	16,717	47,385	40,561	38.5
Fayette	6,893	21,308	24,806	43.1
Forest	193	819	1,377	42.4
Franklin	9,821	25,639	24,258	40.1
Fulton	922	2,518	2,519	41.6
Greene	1,910	5,769	5.887	41.1
Huntingdon	2,425	6,737	7,250	40.8
Indiana	4,435	12,468	13,744	38.1
Jefferson	2,594	7,214	8,214	42.9
Juniata	1,521	4,318	4,057	40.6
Lackawanna	11,559	32,501	38,083	42.0
Lancaster	35,267	93,730	75,674	37.9
Lawrence	4,896	14,664	17,106	43.3
Lebanon	8,343	22,280	22,336	40.8
Lehigh	21.542	60,785	51,069	39.2
Luzerne	16,455	48,352	57,593	42.5
Lycoming	6,541	18,012	18,968	40.9
McKean	2,321	7,007	7,357	41.3
Mercer	6,000	19,418	21,447	42.6
Mifflin	2,965	7,915	8,491	42.4
Monroe	8,762	32,286	21,210	39.7
Montgomery	46,946	135,992	119,243	40.4
Montour	978	2,978	3,338	43.7
Northampton	16,164	49,103	45,949	40.5
Northumberland	5,217	14,024	17,401	42.9
Perry	2,730	7,952	6,146	40.9
Philadelphia	100,524	245,449	185,513	33.5
Pike	2,842	10,783	8,980	42.7
Potter	1,005	2,949	3,359	44.4
Schuylkill	7,673	22,195	26,942	42.9
Snyder	2,380	6,529	5,983	38.7
Somerset	3,662	11,655	14,496	44.2

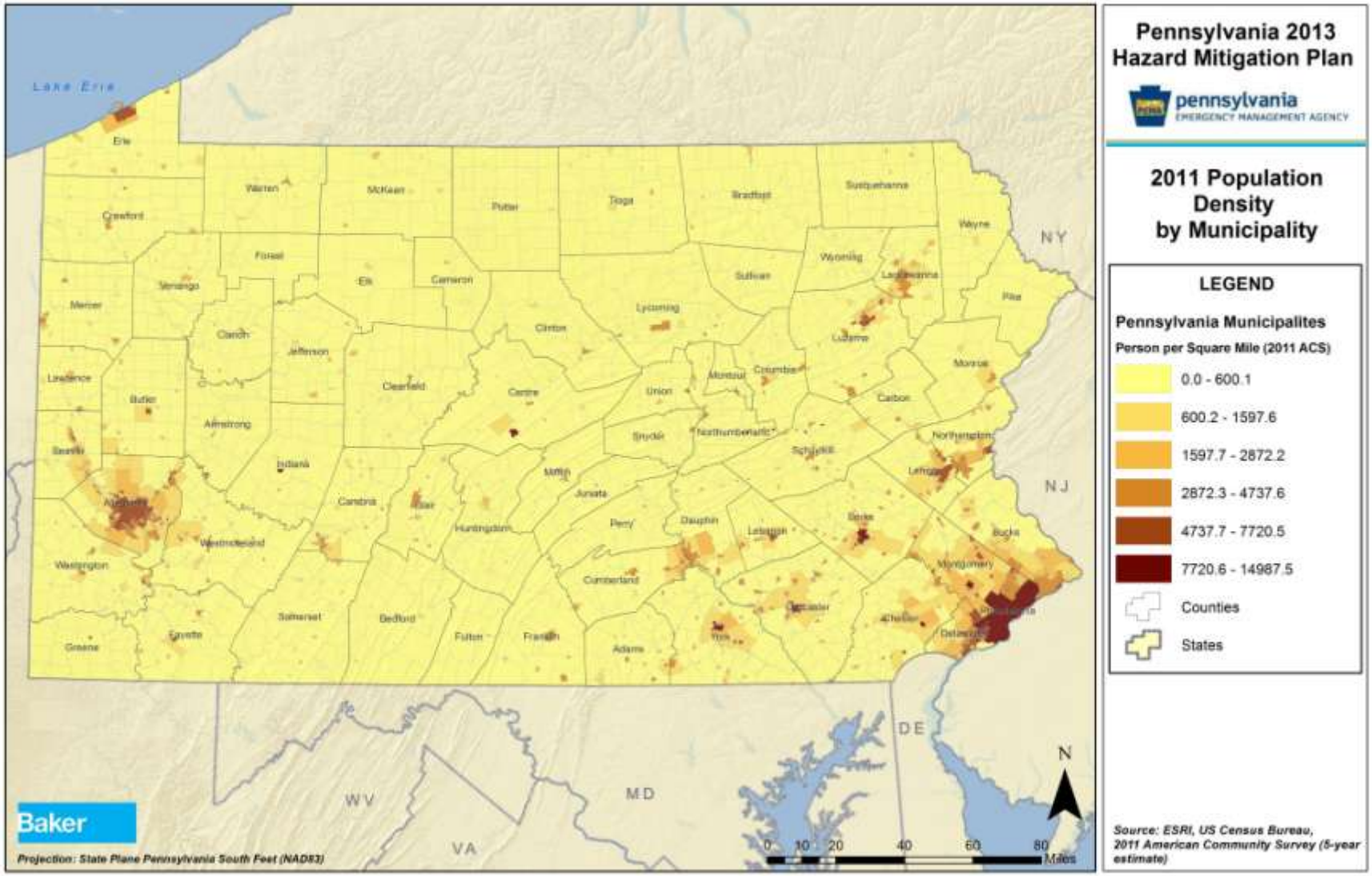
Table 2.3-2 Age Distribution and Median Age of County Populations, 5-Year Estimates 2007-2011 (Census, 2013).

COUNTY	Age Under 5	Age 5 – 17	Age 65+	Median Age
Sullivan	258	804	1,564	49.4
Susquehanna	2,171	7,151	7,696	44.6
Tioga	2,218	6,493	7,437	42.0
Union	2,164	6,107	6,666	38.2
Venango	3,090	8,921	9,750	44.1
Warren	2,092	6,683	7,741	44.7
Washington	10,662	32,387	36,182	43.3
Wayne	2,275	8,037	9,948	45.2
Westmoreland	17,638	55,739	68,388	44.8
Wyoming	1,517	4,696	4,462	41.5
York	26,609	75,332	59,969	39.8
PA TOTAL	***727,677***	***2,075,678***	***1,944,573***	***39.7***

There are an estimated 5,579,275 housing units in the state, ninety percent of which are occupied with the remaining ten percent being vacant. The median value of an owner occupied home in the state is 163,200 (U.S. Census, 2007-2011).

The median income for households in Pennsylvania is $51,651. This is almost equal to the national median household income of $52,762. However, 12.6% of the Commonwealth's residents live in poverty compared to the national average of 14.3% for the United States (U.S. Census, 2007-2011). While lower 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. Eighty-three percent of the Pennsylvania population is White, 11 percent is Black or African American, and just over three percent is American Indian, Alaska Native, Asian, Native Hawaiian, Pacific Islander or some other race (U.S. Census, 2012).

Figure 2.3-3 Pennsylvania 2007-2011 Population Density (ESRI, 2011).



2.4. 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 almost eight million acres of farmland and over 63,000 farms throughout the Commonwealth. Over 425,000 acres of this farmland (~5.4%) is permanently preserved, thus protecting it from development and helping to maintain the rural character of the Commonwealth (Center for Rural Pennsylvania, 2013).

When Pennsylvania was first settled, land was predominantly forest-covered. 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). The Allegheny National Forest is located in northwestern Pennsylvania and covers more than 500,000 acres.

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 also 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. 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 4.4.

Pennsylvania land use and development is 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 2.4-2). The Commonwealth has over 22,000 state-owned bridges and approximately 6,400 bridges on locally-owned roads. Pennsylvania contains over 5,000 miles of railway and 130 public-use airports, six of which are international airports (AirNav, 2010). Furthermore, there are three major ports in Pennsylvania: 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 2010 State Land Use and Growth Management Report, the pace of development was

greater than population growth in Pennsylvania until the nationwide recession in 2008. During the 1990s, the total number of acres developed in Pennsylvania increased by 53.6 percent, from approximately 1,193,420 acres to 1,832,704 acres, while Pennsylvania's population grew by only 3.4%. Between 2007 and 2009 new residential building permits declined 46%, while subdivision and land development activities were down 83% from 2008 to 2010.

As a percentage of total land area, Pennsylvania's developed land area (urban or built-up land use/land cover classification) increased by 131.4% between the 1992–2005 inventory period. Between 1990 and 2007, Pennsylvania's population grew by 4.6 percent versus its housing growth rate of 10.9 percent (PAGC 2010). This housing growth rate is an important factor that was considered and is why building numbers and its replacement values were analyzed for all-hazards.

Pennsylvania has over 83,000 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 1,239 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 2.4-1 Map of land cover throughout Pennsylvania (PASDA 2007).

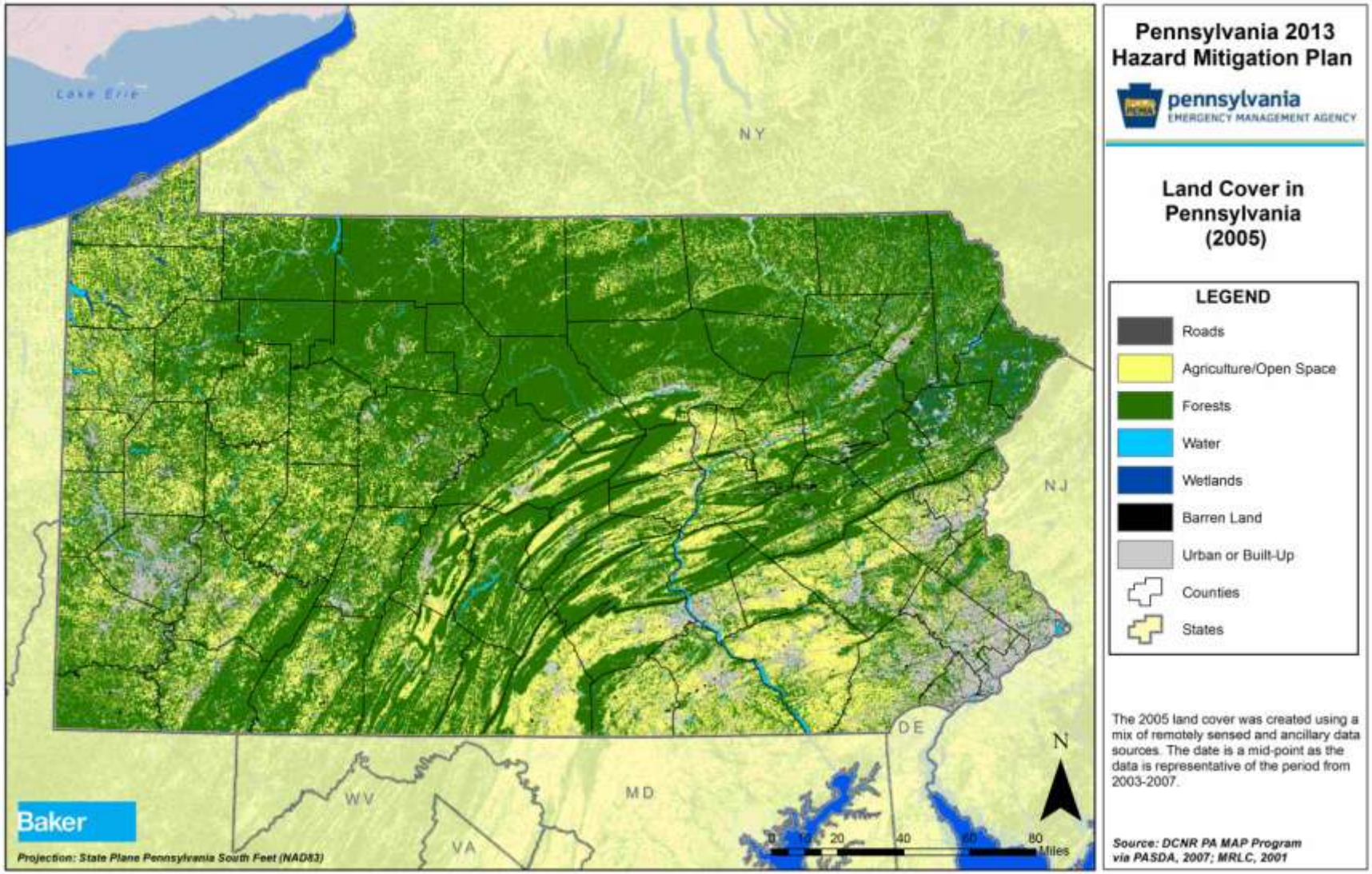


Figure 2.4-2 Major Highways in Pennsylvania (PennDOT, 2013).

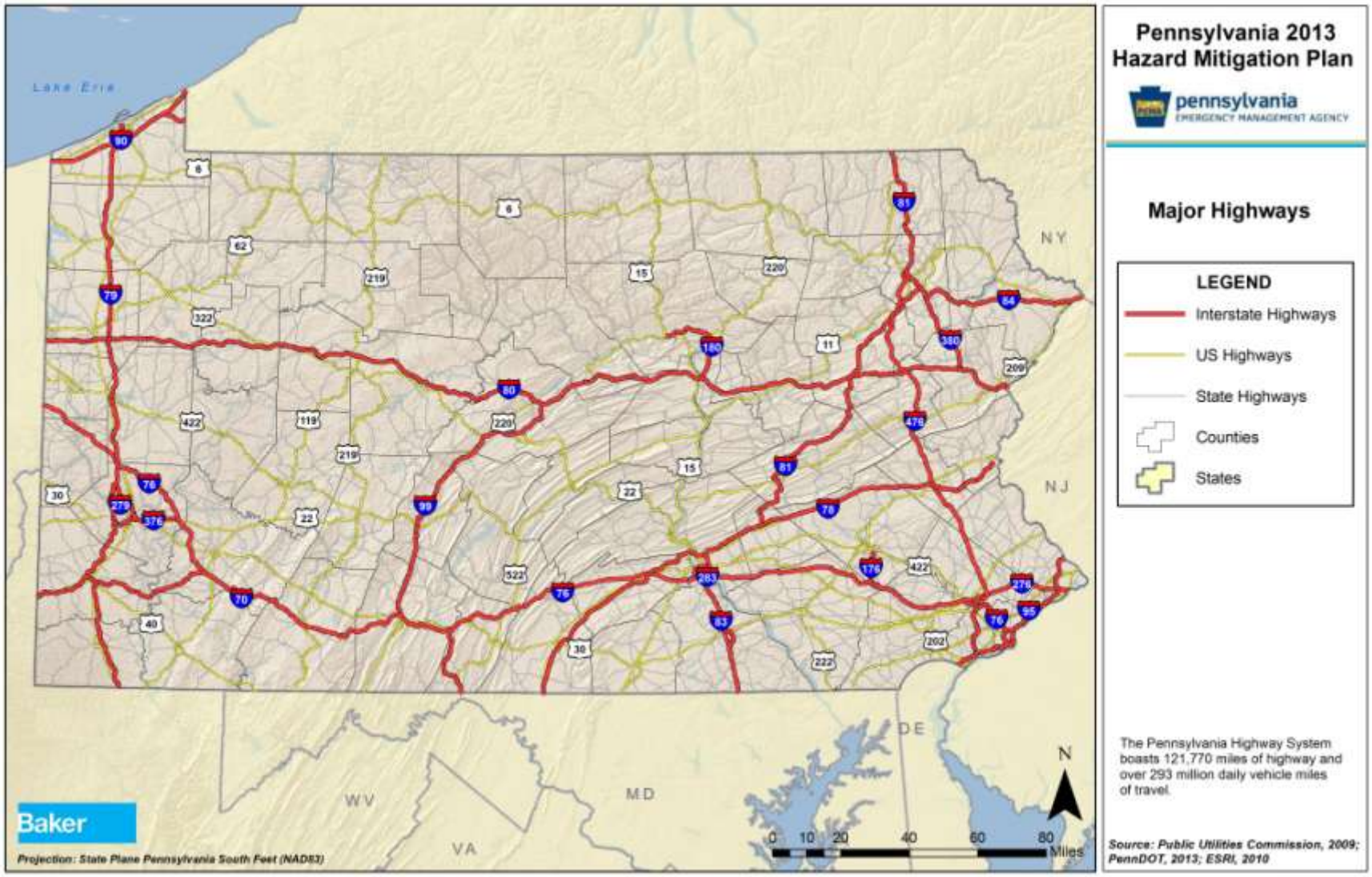
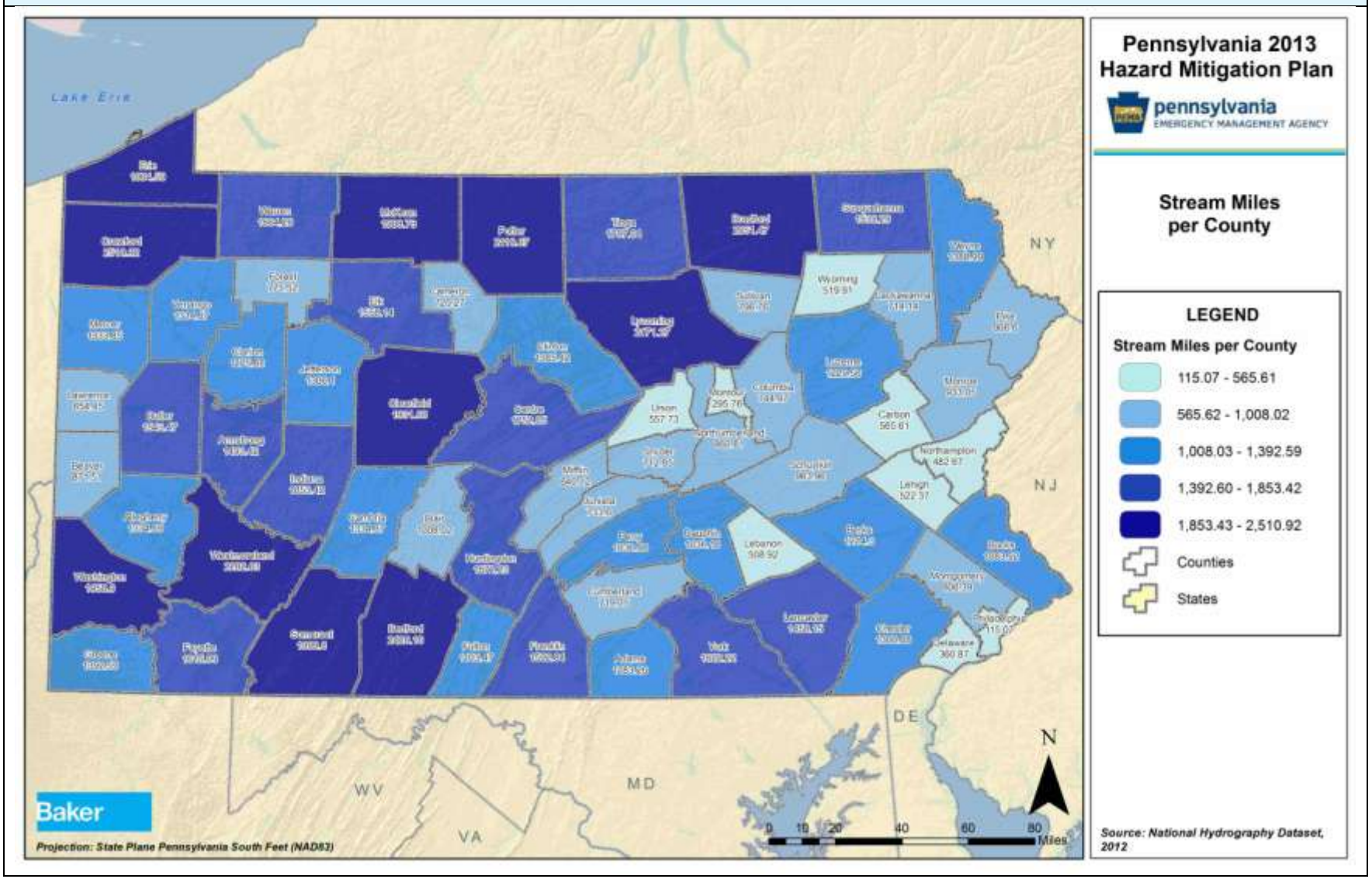


Figure 2.4-3 Stream miles per county (National Hydrography Dataset, 2012).



2.5. 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 for the 2007 and 2010 plans were reviewed and incorporated as appropriate. State-wide data sets were used to do spatial analysis that could more robustly address risk than just researching disasters in the 3 years in the years between plans.

The assessment began with a review of all the local hazard mitigation plans available in the Commonwealth. Hazards covered in county and university hazard mitigation plans are summarized in Section 4.1. County plan risk analysis also informs hazard based risk analysis throughout Section 4.3. Since the local level plans use varying levels of detail and data sources, state-wide data sources where sought from the SPT and research. Sources included national, commonwealth and county databases, published materials, Geographic Information System (GIS) data and raw data from a number of commonwealth and federal agencies. Potential losses for local and state risk assessments within this SSAHMP were obtained using the best available data for each hazard. For some hazards, the measure of vulnerability and potential losses did not change from the 2010 SSAHMP. Data sources used for this update are covered in the Standard Operating Guide, so that local plans may begin to use the same data sources as the state plan and analysis throughout the Commonwealth will become more standardized (see Appendix D for full list).

In order to assess the vulnerability of different jurisdictions to the hazards, data on past occurrences of damaging hazard events was gathered. So that one could compare the distribution of events between different hazards, the same data sources were used when possible in creating hazard profile maps. For a number of historic natural-hazard events, the National Climatic Data Center (NCDC) database was utilized. NCDC is a division of the US Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Information on hazard events is compiled by NCDC from data gathered by the National Weather Service (NWS), another division of NOAA. NCDC then presents it on their website in various formats. The data used for this plan came the US Storm Events database, which "documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce" (NOAA, 2006). Since the 2010 plan, NCDC slightly altered their reporting system and its capabilities. Previously, the data was accessible via an online user interface that pre-aggregated like hazards with similar descriptions (for example: strong winds, thunderstorm winds, TSTRM WIND were grouped). Now, however, NCDC only releases data from 1996 via the online interface. Instead, NCDC now releases information from 1950-present in the form of a downloadable database. Events were summarized by grouping like hazard descriptions together by the project team, so the total number of events may be different than seen in the 2010 SSAHMP. However, every effort was made to properly categorize events in the database. The NCDC database was downloaded in June 2013.

While the NCDC data was entirely comprised of natural hazards information, PEMA provided additional database information that focused more on the human-made hazards through the Pennsylvania Emergency Incident Reporting System (PEIRS). PEIRS is the principal crisis

management software that PEMA uses to provide up-to-date information as an event unfolds through the response and recovery phases for PEMA staff and partners. PEIRS establishes standard reporting criteria, consolidates reporting requirements, and identifies PEMA as the single point of contact for an incident that requires immediate reporting. PEIRS provides reporting criteria for county emergency management coordinators, communications centers, 911 centers, commercial and industrial facilities, volunteer agencies and Commonwealth and federal agencies. This criterion is used to report emergency incidents which may affect the safety, health, or welfare of citizens of the Commonwealth, result in major property damage, preclude the operation or use of essential public facilities, and require multijurisdictional response to the emergency incident. When applicable, PEIRS incident data spanning 1/1/2001 - 6/1/2009 was used in the plan update. Although PEIRS data proved valuable, primarily in the human-made hazards section, data limitations exist in that the reporting system is not mandatory, which could lead to under-reporting. PEIRS information was used in the following hazard profile sections; Civil Disturbance, Terrorism, Urban Fire and Explosion, and Utility Interruption.

After June 2009, PEMA moved to a new reporting system, WebEOC. WebEOC was PEMA's main incident reporting platform from June 2009-Fall 2012. Like PEIRS, WebEOC was used to report emergency incidents, but WebEOC categories are not as robust as those under PEIRS. As a result, these incident reports had limited use in the 2013 SSAHMP; WebEOC data has been incorporated into the Civil Disturbance profile. Since Fall 2012, PEMA has been migrating to Knowledge Center Incident Management Software; at this time, incidents managed by Knowledge Center are not available for inclusion in this plan.

As previously stated, an attempt was made to provide consistency in reporting information. Population data used throughout this plan was based off of the 2010 US Census and the 2011 American Community Survey. These two different Census products were used concurrently because the 2010 (and future Decennial) 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 SSAHMP, particularly in Sections 4.3.5.8 & 4.4, 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 SSAHMP 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 2012 reporting year, this data is not yet available for use. As a result, this SSAHMP uses the 2007 Census, as was the case in the 2010 SSAHMP.

As expected with the number and diversity of hazards being profiled, the sources of data used within this SSAHMP 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

majority of identifying hazard vulnerability and determining potential loss estimation. 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 numerous 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.

Although the advancement in quality and availability of GIS data has been positive in recent years, data limitations still remain. Perhaps most conspicuously, there is still no inundation areas available in GIS format, so identifying critical facilities within those areas was not feasible. Similar scenarios exist for levees, where only partial levee Protection Areas have been digitized in GIS format, so additional methods of analysis were performed to cover all areas in proximity to a levee. However, the number of levee protected areas digitized between 2010 and 2013 grew. Also, landslide inventory maps from the late 1970s and early 1980s exist for parts of Pennsylvania that depict exact locations of past landslide occurrences, however without those locations digitized in GIS format, other alternatives to identify vulnerable areas were done on a broader scale. Nevertheless, as time advances, the voids of incomplete data sets found in this plan will hopefully be filled. For instance there are several actions focused on gathering better data for future updates in Section 6.2.4, including Action 1-7a that focuses on improving access to dam inundation maps. Until that time, the techniques used to identify vulnerability and determine potential loss estimates in this SSAHMP were performed with the best available datasets. It should be noted that information contained in the datasets is subject to change and it is acknowledged that additional datasets not included in the 2013 SSAHMP may be available. Nonetheless, every effort was made to use the best available, most current information to conduct the risk assessment and vulnerability analysis for Pennsylvania.

The data selection for completing state facility vulnerability assessment and loss estimation is described in detail in Section 4.1, so that the information on data selection is next to information on the methodology used for vulnerability assessment and loss estimation.

3. Planning Process

3.1. Update Process and Participation Summary

The Planning Process was the leading force in building the SSAHMP. 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 lead 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, public outreach sessions were conducted throughout the Commonwealth to both educate Pennsylvania residents and local officials on hazard mitigation planning in Pennsylvania and gather input for the plan update.

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 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 SSAHMP 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 is still a top priority for the 2013 update.

The update process is described in the first sub-section of Sections 3 through 7. Table 3.1-1 summarizes key changes conducted in the 2013 update of the 2010 plan and, for contrast, explains the 2010 update of the 2007 SSAHMP.

Table 3.1-1 Summary of updates of the SSAHMP	
PLAN SECTION	**SUMMARY OF UPDATE**
SUMMARY OF THE 2010 UPDATE OF THE 2007 SSAHMP	
1. Introduction	Information that was contained in the Preface of the 2007 SSAHMP 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 SSAHMP 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 SSAHMP in order to re-focus the plan on mitigation and follow FEMA hazard mitigation planning guidance more closely. In the 2010 SSAHMP, this base information serves as summary of the Commonwealth prior to describing how hazards impact the Commonwealth.
3. Planning Process	Previous hazard mitigation planning efforts described in the 2007 SSAHMP 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 SSAHMP were profiled in the 2010 SSAHMP. 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 of 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 SSAHMP was re-summarized and expanded to address Update Process Summary, State Capability Assessment, and Local Capability Assessment. Sub-sections within the 2010 SSAHMP 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 SSAHMP was re-summarized and expanded to address Update Process Summary, State Mitigation Strategy, and Local Mitigation Strategy. Sub-sections within the 2010 SSAHMP more closely follow FEMA guidance for hazard mitigation planning.

Table 3.1-1 Summary of updates of the SSAHMP

PLAN SECTION	SUMMARY OF UPDATE
7. Plan Maintenance	Information that was in section 1.6 and 1.7 of the 2007 SSAHMP 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 SSAHMP was re-summarized and addressed in Section 8 of the 2010 SSAHMP.
SUMMARY OF THE 2013 UPDATE OF THE 2010 SSAHMP	
Introduction	Information that was contained in the Preface of the 2010 SSAHMP was reviewed for correctness and for updates to the legislative and policy framework of hazard mitigation planning in the US and specific to Pennsylvania.
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 SSAHMP, this base information serves as summary of the Commonwealth and provides overall context for the risk assessment and mitigation strategy portions of the plan.
Planning Process	Previous hazard mitigation planning efforts described in the 2007 and 2010 SSAHMP 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.
Risk Assessment	All hazards identified in the 2010 SSAHMP were profiled in the 2013 SSAHMP. 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 SSAHMP

PLAN SECTION	SUMMARY OF UPDATE
Capability Assessment	The 2013 SSAHMP 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.
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.
Plan Maintenance	Information that was in the 2010 SSAHMP was reviewed and updated as needed to reflect new plan maintenance procedures and schedules. Special emphasis was given to the integration of the SSAHMP into future planning efforts in the Commonwealth.
Plan Adoption	Information in Section 8 of the 2010 SSAHMP was reviewed and revised as necessary in the 2013 SSAHMP.

Documentation of the Planning Process Prior to 2007

PEMA was designated as the lead agency for the Commonwealth of Pennsylvania 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 SSAHMP.

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 SSAHMP 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 SSAHMP 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 SSAHMP 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 SSAHMP 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 SSAHMP.
- 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 III 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 SSAHMP 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 & Healthsystem 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 SSAHMP 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	
Department of Military and Veterans Affairs		X	
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 SSAHMP 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 SSAHMP:

- 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 SSAHMP 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 re-focus the plan on mitigation and follow guidance provided from FEMA for hazard mitigation planning more closely. The *Pennsylvania 2010 SSAHMP* 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 SSAHMP 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 SSAHMP:

- 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 III
- 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 SSAHMP 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.

The process used to update the 2013 SSAHMP is described in the remaining elements of Section 3.

3.2. State Planning Team

The SPT brought together by PEMA for the 2013 plan in many ways built on the 2010 SPT and the strong Silver Jackets participation in Pennsylvania. Similar to the 2010 update process, PEMA used the 2013 update as an opportunity to re-engage stakeholders. 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 meeting on March 20th, 2013 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.
- Identify mitigation and funding opportunities.
- Review and evaluate the SSAHMP.

Attendees at the SPT meetings included representatives from 39 different agencies, organizations, county and city government, and one business. Additionally, the SPT meetings were attended and supported by the Baker/Delta consultant team. 22 of the agencies that participated in 2010 also participated in 2013. There were 11 new agencies, organizations and local governments represented in 2013. The majority of the new attendees came from different state level organizations. New types of participants for 2013 included federal, county, and non-profit business representatives, including Salvation Army and the County Commissioners Association of Pennsylvania. Several agencies and organizations sent multiple representatives to one meeting; the average attendance at each meeting was 32 people. 0 shows the agencies and organization that were represented at each meeting. The majority of the SPT members are representatives from state agencies. 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 3.2-1 Summary of agencies participating on the State Planning Team in 2013.

ATTENDEES REPRESENTED	KICK-OFF MEETING	RISK ASSESSMENT MEETING	MITIGATION SOLUTIONS WORKSHOP
Clearfield County	X	X	X
County Commissioners Association of Pennsylvania		X	
Department of Agriculture	X		X
Department of Community and Economic Development	X	X	
Department of Conservation and Natural Resources			X
Department of Corrections	X		
Department of Environmental Protection (Including the Bureau of Radiation Protection)	X	X	X
Department of General Services		X	
Department of Health	X	X	X
Department of Insurance	X	X	X
Department of Labor and Industry	X	X	X
Department of Military and Veterans Affairs	X		
Department of Public Welfare			X
Department of State	X		
Division of Facilities and Property Management	X		
Federal Emergency Management Agency, Region III	X	X	X
Governor's Office of Homeland Security		X	
Keystone Emergency Management Association			X
Millersville University		X	X
Northampton County			X
Office of Administration	X		
Penn State Capital College (Police Department)	X		X
Pennsylvania Department of Transportation	X	X	X
Pennsylvania State System of Higher Education	X	X	X
Pennsylvania Emergency Management Agency	X	X	X
Pennsylvania Housing Finance Agency	X	X	X
Pennsylvania Treasury	X	X	
Pennsylvania Turnpike Commission	X	X	
PENNVEST	X	X	X
Philadelphia Office of Emergency Management	X		
Salvation Army		X	
United States Army Corps of Engineers	X*	X	X
United States Department of Homeland Security (including Office of Infrastructure Protection)	X	X	X

Table 3.2-1 Summary of agencies participating on the State Planning Team in 2013.

ATTENDEES REPRESENTED	KICK-OFF MEETING	RISK ASSESSMENT MEETING	MITIGATION SOLUTIONS WORKSHOP
United States General Services Administration		X	
United States Geological Survey – Pennsylvania Water Science Center	X	X	
Michael Baker Jr., Inc. and Delta Development Group	X	X	X
*USACE representative Jason Miller met with Baker team members Sarah Bowen and Shelley Hull and PEMA representative, Ernie Szabo for an individual kick-off meeting at the beginning of the project.			

The United States Army Corp of Engineers (USACE) Silver Jackets Initiative was a key part of the 2013 SPT. 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 SSAHMP 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.

For the 2010, the SPT was broken into 4 sub-committees with the intent that the sub-committees continue to work between triennial plan updates. However, with the success of the interagency and interdisciplinary Silver Jackets, sub-committees were superfluous for the 2013 planning process. Instead, the combination of Silver Jackets team members in combination with professional organizations provided the backbone of the 2013 SPT. This allowed the SPT to discuss matters holistically when reviewing the risk assessment, developing the mitigation strategy, and guiding the direction of the plan update.

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 2-5c in the 2013 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 2013 planning process.* Groups that were invited but did not attend a SPT meeting include: 10,000 Friends of Pennsylvania, Allegheny County Department of Emergency Services, American Red Cross, Appalachian Regional Commission, Bard College, Chesapeake Bay Commission, City of DuBois PA, College of Agricultural Sciences – Penn State University, County of Lycoming, CRA, Cumberland County EMA, Delaware River Basin Commission, Delaware Valley Planning Commission, Department of Aging, Department of Education, Governor's Office of General Counsel, National Weather Service, North Central Regional Planning Commission, Northeastern Pennsylvania Alliance, Northern Tier Regional

Planning and Development Commission, Northwestern Regional Planning Commission, Office of the Budget, Office of the State Fire Commissioner, Ohio River Valley Water Sanitation Commission, PA Fish & Boat Commission, Penn State Harrisburg Police Department, Pennsylvania Association of Boroughs, Pennsylvania Association of Township Supervisors, Pennsylvania Association of Zoning Officials, Pennsylvania Chapter of APA, Pennsylvania Climatology Office, Pennsylvania Game Commission, Pennsylvania Human Relations Commission, Pennsylvania League of Cities and Municipalities, Pennsylvania Municipal Authorities Association, Pennsylvania Office of Attorney General, Pennsylvania Public Utility Commission, Pennsylvania State Police, SEDA – Council of Governments, Southern Alleghenies Planning and Development Commission, Southwestern Regional Planning Commission, Susquehanna River Basin Commission, The Pennsylvania Chamber of Business and Industry, United States Fish & Wildlife, Upper Delaware Council, USDA Rural Development, and the Community Affairs and Development Pennsylvania Department of Community and Economic Development.

Though these agencies did not attend SPT meetings several were involved in other forums. The Penn State University College of Agricultural hosted an Aquatic Invasive Species Workshop where the SSAHMP was highlighted. Statewide advertising of the plan update was also accomplished through publishing an advertisement in several newspapers across the state. Lastly, some of the departments that could not attend did request to receive presentation materials about the plan update so that they could remain current about the Commonwealth's initiative.

3.3. Meetings and Documentation

During the period between the 2010 and 2013 SSAHMP updates PEMA continued to:

- Compile, analyze, review and assist in implementing approved local hazard mitigation plans.
- Publish research documents and other agency initiatives into the Risk Assessment and Capability Assessment portions of the Plan.
- Review and evaluate the performances of the intended system of integration of local plans into the SSAHMP.
- Coordinate mitigation funding.
- Work with FEMA on plan implementation, especially in the wake of several Disaster Declarations.
- Work through the Silver Jackets to enhance flood mitigation across agencies and levels of government.
- Host the three PEMA regional Hazard Mitigation Officers meet 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.
- Address plan maintenance by BORM staff on an as needed basis.

As stated in the beginning of Section 3.1, the planning process was prioritized in the 2013 SSAHMP update. Meetings, presentations and WebEx Forums were held throughout the update process to engage a variety of stakeholders, and the public participation element of SSAHMP engagement was completely overhauled. This section summarizes the meetings that were held to engage stakeholders and provide input into developing a strong SSAHMP submission for 2013.

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 SSAHMP.

January 2013, PEMA selected a consultant team led by Michael Baker Jr. Inc. (Baker) to update the SSAHMP, supported by Delta Development Group Inc. The update process formally began in February 2013 as PEMA and its consultants began planning and project management for completing the SSAHMP update. Table 3.3-1 outlines meetings, forums, and other trainings associated with the planning process for the 2013 update. The first Kick-off meeting with PEMA senior staff took place on February 15, 2013. The calendar concludes on July 31, 2013, after the Red Team Review and the final public outreach session in northwest Pennsylvania. Though not shown on the calendar coordination and meetings between PEMA, FEMA Region III, stakeholders, and the consultant are expected between August and plan adoption.

Meetings throughout the process were introduced and moderated by the SHMO. The consultant team supported the SHMO by providing presentations. At all meetings, there were multiple opportunities for input from attendees.

Table 3.3-1 SSAHMP Meeting and Project Calendar

SSAHMP PROJECT CALENDAR

February

Sun	Mon	Tue	Wed	Thurs	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	12	14	15 **BORM Kickoff Meeting** 10am-12pm, JFO	16
17	18	19	20	21 **Table at Learning from Sandy: Is Philadelphia prepared for the next natural disaster?** 6 PM to 8:30 PM The Academy of Natural Sciences of Drexel University - 1900 Benjamin Franklin Pkwy, Philadelphia	22 **SPR Call** (May announce SSAHMP process)	23
24	25	26	27	28		

March

Sun	Mon	Tue	Wed	Thurs	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	12	14	15	16
17	18 **FEMA Kick-Off Meeting** 10am-12pm, FEMA Region III, Philadelphia	19	20 **SPT Kickoff Meeting** PEMA HQ Room # 230	21	22	23
24	25	26	27	28	29	30
31						

Table 3.3-1 SSAHMP Meeting and Project Calendar

Sun	Mon	Tue	Wed	Thurs	Fri	Sat
April						
	1	2 **Region III SHMO Conference** PEMA HQ	3 **Region III SHMO Conference** PEMA HQ	4	5 **USACE Kick-off Meeting and teleconference with PEMA** 11 AM – 12 PM 1818 Market Street, Suite 3110 Philadelphia, PA	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24 **SPT Risk Assessment Review Meeting** PEMA HQ Room # 230	25	26	27
28	29	30				
May						
			1	2 **Hazard Mitigation Informational Meeting** York County, PA	3 **Southwest Region Public Outreach** California University	4
5	6	7 **USACE Silver Jackets Meeting Nonstructural Floodproofing Workshop** Workshop - 1:00-4:00 PM, Public Session - 7:00-9:00 PM, Towanda FD Banquet Hall 101 Elm St. Towanda, PA	8 **USACE Silver Jackets Meeting Nonstructural Floodproofing Workshop** Workshop - 1:00-4:00 PM, Public Session - 7:00-9:00 PM, Plymouth Armory 150 Market St. Plymouth, PA	9 **USACE Silver Jackets Meeting Nonstructural Floodproofing Workshop** Workshop - 1:00-4:00 PM, Public Session - 7:00-9:00 PM, Caldwell Consistory 150 Market St. Bloomsburg, PA	10	11
12	13	14 **Brief at PEMA Super Quarterly Training** Lancaster Host Resort & Conference Center, 2300 Lincoln Hwy East, Lancaster, PA	15	16	17	18
19	20	21 **SPT Mitigation Solutions Review Meeting** PEMA HQ Room # 230	22	23	24	25
26	27 **Holiday**	28	29	30	31	

Table 3.3-1 SSAHMP Meeting and Project Calendar

Sun	Mon	Tue	June Wed	Thurs	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11 **South Central Outreach Session: Women's Transportation Seminar Luncheon** Registration at 11:45 AM Radisson Hotel 1150 Camp Hill Bypass Camp Hill, PA	12	13 **Northeast Region Public Outreach Session: Nurture Nature Center** 3:00 PM- 7:00 PM Nurture Nature Center 518 Northampton St. Easton, PA	14	15
16	17 **County Outbrief Webinar** Webex 10 AM – 11 AM	18	19 **North Central Region Public Outreach Session** 8:30 AM- 2:30 PM PA Sea Grant Aquatic Invasive Species Workshop Plants, Pathogens, and Algae Penn State University Forest Resources Building Room 106 State College, PA 16803 **County Outbrief Webinar** Webex 1 PM – 2 PM	20	21	22
23	24	25	26	27	28	29
30						

Table 3.3-1 SSAHMP Meeting and Project Calendar

Sun	Mon	Tue	July Wed	Thurs	Fri	Sat
	1	2	3	4 **Holiday**	5	6
7	8 **Southwest Outreach Session: Stormwater Management Planning Committee Joint Meeting for Allegheny County** 6:30PM - 8:30PM O'Hara Township Municipal Building Public Meeting Room (325 Fox Chapel Road Pittsburgh, PA 15283)	9 **Southwest Outreach Session: Carnegie Science Center** 10 AM - 5 PM Carnegie Science Center One Allegheny Ave Pittsburgh, PA 15212	10 **Southwest Outreach Session: Carnegie Science Center** 10 AM - 5 PM Carnegie Science Center One Allegheny Ave Pittsburgh, PA 15212	11	12	13
14	15	16 **Red Team Review of Draft SSAHMP** 9 AM – 3 PM PEMA HQ – Room 180	17 **Red Team Review of Draft SSAHMP** 9 AM – 3 PM PEMA HQ – Room 180	18 **Southeast Outreach Session: Table at GRID Soak It Up!** 6 PM to 8:30 PM The Academy of Natural Sciences of Drexel University - 1900 Benjamin Franklin Pkwy, Philadelphia	19	20
21	22	23	24	25	26 **Northwest Outreach Session: Discover Presque Isle Nature Program** 11 AM – 4 PM Presque Isle State Park Erie, PA	27
28	29	30	31			

Table 3.3-1 SSAHMP Meeting and Project Calendar

Sun	Mon	Tue	August Wed	Thurs	Fri	Sat
				1	2	3
4	5	6 **Red Team Review of Draft SSAHMP** **1 PM – 4 PM** PEMA HQ – Room 230	7	8	9	10
11	12	12	14	15 **SSAHMP Delivered to FEMA**	16	17
18	19	20 **SSAHMP Review with FEMA** PEMA HQ – Room 315	21 **SSAHMP Review with FEMA** PEMA HQ – Room 315	22 **SSAHMP Review with FEMA** PEMA HQ – Room 315	23 **SSAHMP Review with FEMA** PEMA HQ – Room 315	24
25	26	27	28	29	30	31

State Planning Team Meetings

There were three SPT meetings throughout the planning process, and the SPT was continually engaged via email. They were also emailed information to review and evaluate and were requested to review the draft SSAHMP in July. More detailed descriptions of the three SPT meetings follow. Prior to the SPT meetings, a preliminary kick-off meeting with FEMA and PEMA occurred to discuss overall direction and goals for the 2013 update.

FEMA Kick-off Meeting on March 18, 2013

A planning meeting on March 18th, 2013, brought together FEMA Region III, PEMA, and the consultant team to set goals and define direction for the *Pennsylvania 2013 SSAHMP.* The FEMA branches and divisions of Risk Analysis, Floodplain Management, Hazard Mitigation Assistance, Historic Preservation, and Long Term Community Recovery were all represented in the meeting. DCED attended part of the meeting by conference call.

FEMA requested to see mitigation success stories highlighted in the 2013 update, in order to showcase the recent examples of where mitigation has taken place and the positive impact it can make for individuals and communities as a whole. The other major component FEMA desired to see in the plan for 2013 was more comprehensive descriptions of capabilities for state agencies beyond PEMA. They recognize that the many state agencies are already engaged in mitigation and disaster planning, response, and recovery, and want to include their competence and areas of expertise within the plan. PEMA also wanted to see THIRA integrated into the plan update, in order to best complement the recent risk assessment for the Commonwealth of Pennsylvania.

SPT Kick-off Meeting on March 20, 2013

The planning process for the *Pennsylvania 2013 SSAHMP* was initiated for the SPT with a Kick-off Meeting on March 20, 2013. Federal requirements for state-level hazard mitigation plans were explained to all stakeholders in attendance. The role of PEMA and the SPT were defined. The SPT was introduced to the new plan website where communication and documentation of the process is accessible to the team and the public.

All meeting attendees were asked to complete a *Contact Information Sheet,* a *Strengths Weaknesses Opportunities and Threats (SWOT) Analysis Worksheet, a Data Requests Worksheet*; and an *Evaluation of Identified Hazards and Risks Worksheet*. The *Contact Information Sheet* gathered information to reach attendees and invite new representatives attendees identified would be helpful in future meetings. The *SWOT Analysis, Data Requests* and *Evaluation of Identified Hazards and Risk Worksheets* gathered information that supported the SSAHMP update.

The SPT divided into four groups to guide discussion at the meeting: Risk Assessment, Structural, Land Use, and Education and Outreach. These groups completed the *SWOT Analysis* of their respective topics. As a group, the SPT developed priorities and expressed specific concerns that they'd like to address in the 2013 plan update. Their top priorities included aging infrastructure, cyber-attack, internet disruption, food and water contamination,

and threats to the natural food chain. For more information on how the SPT contributed to the development of the 20103 Risk Assessment, please see Section 4.1.

Copies of the mitigation actions from the 2010 plan were distributed to agencies for the actions they were responsible for working towards or for funding. SPT members were asked to review the actions to provide information on progress and to decide whether each action should be included in the 2013 update. Most of these established actions were determined to be continuing or ongoing in nature and were managed by the DEP, DCNR, the Department of Labor and Industry, the Office of the State Fire Commissioner, and USACE. This progress on mitigation actions is discussed in Section 6.

The SPT went through the *SWOT Analysis Worksheet* together; the commonalities amongst their responses are shown in Figure 3.3-2 below.

Figure 3.3-2 *SWOT Analysis Worksheet*, March 20, 2013

SPT Risk Assessment Meeting on April 24, 2013

The Risk Assessment meeting began with an overview of the requirements for risk analysis within the SSAHMP. The main focus of the meeting was reviewing the risk assessment on the 17 natural hazards and 9 human-made hazards covered in the 2010 plan. The SPT was asked to determine whether the level of risk has changed or if more detail is necessary for any of the existing hazards and to decide if there are any new hazards that should be added to the 2013 update. Baker presented an overview of the THIRA, discussing the hazards included, the differences between the two planning mechanisms. Attendees completed *Addressing New and*

Changing Hazards Worksheets to help determine whether and how to include new hazards identified during the first SPT meeting in the SSAHMP update.

Based on the input on these forms from the SPT, the following decisions were made for completing Risk Assessments in Section 4:

- Climate change was incorporated into existing hazard profiles as an exacerbating effect
- Internet Interruption was be covered within the Utility Interruption profile
- Lock failure was be covered in the Dam Failure profile
- Mass food/Animal feed contamination will be profiled separately in a new hazard profile
- Modify/expand the existing invasive species profile

The SPT also completed a *Consequence Analysis Survey* to evaluate how various systems operated during one of the more recent disaster events they've experienced. The Consequence Analysis Survey Worksheet was created to tie in and explain the EMAP standards. The meeting concluded with a capability assessment. The SPT members were also given a *Capability Assessment Worksheet* to better describe their agency's unique set of capabilities. This information was compiled and is included in Capability Assessment Section 5.3.1.2.

SPT Mitigation Solutions Meeting on May 21st, 2013

The Mitigation Solutions meeting began with a review of the hazards that would be profiled based on the SPT's input. The SPT agreed that the 25 original hazards plus one new profile and expansion of several existing profiles would present a comprehensive reflection of the hazards impacting Pennsylvania for the 2013 update.

The main focus this meeting was to review and update the 2010 SSAHMP goals, objectives, and actions to reflect the state of mitigation in 2013. Much of the meeting was spent updating the Commonwealth's mitigation strategy. As a large group, the SPT agreed that some of the 2010 goals should be revised, but most should remain in the plan.

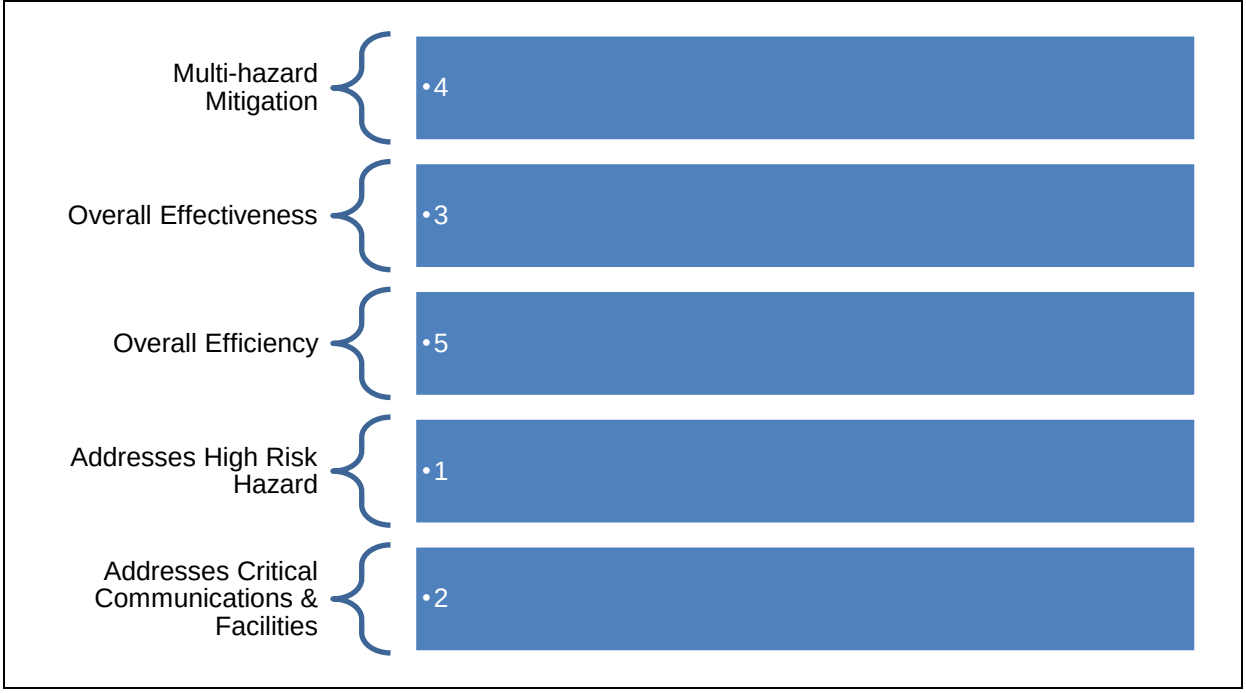
Attendees completed *Mitigation Strategy Evaluation forms* to guide the process of reviewing the goals and objectives developed for the last plan update in 2010. The SPT was asked to indicate whether they'd like to continue, change, or delete each goal or objective, to provide an explanation for their response, and to provide the current status of the goal or objective. The results of groups discussion and the forms was to continue all Goals.

The SPT members also responded to Part II of the *Mitigation Strategy Evaluation* form. The majority felt it was at least somewhat important for the 2013 SSAHMP to focus more on natural system protection in Pennsylvania. The types of natural systems protection mitigation actions the SPT felt would be most effective at reducing vulnerability in Pennsylvania were Storm Water Management, Wetland restoration and preservation, sediment and erosion control, and conservation easements. Though a small portion of the SPT felt that the team is on target for adequately addressing risk with the mitigation strategy for the plan, the majority thought the SPT should consider shifting the focus to more adequately address risk. All meeting attendees felt that the SPT is generally moving in the right direction in terms of mitigation strategy.

When asked to provide additional information about which hazard(s) the SPT felt may require more focus in the mitigation strategy moving forward, the responded that utility interruption requires more focus for this plan update. The SPT members were split on whether they felt their agency/organization has the capability to accomplish their assigned mitigation actions. Nearly 40% responded that they are capable and near the same amount responded that they need additional support to act on the mitigation strategy. The remaining SPT members indicated that they would face challenges in implementing the actions, but were capable of doing so. In regards to plan maintenance, 50% of the SPT felt that in the future, mitigation actions should be evaluated by sub-committees, and about 25% of participants suggested fewer planned meetings and more correspondence via email in order to increase the effectiveness of the process.

SPT members were also asked to rank the following 5 potential mitigation action prioritization methodology criteria in order of importance (1 being most important and 5 being least important). Their responses are shown in Figure 3.3-6 below.

Figure 3.3-3 Commonwealth Agency consequence scores on systems during disaster events, May 21, 2013



The actions were formatted and compiled by the consultant team after the meeting. Then they were distributed to the SPT via email for review and evaluation using PA STEEL (see Sections 6.2.3 and 6.2.4 for more detailed discussion of methodology and results).

County Meetings

County emergency management officials, hazard mitigation officers, and planners were provided the opportunity to participate in the HMP update process by attending Outbrief Webinars. Meetings presented to the County staff covered similar topics to the SPT meetings, typically in a shorter format.

County Outbrief Webinars – June 17, 2013 & June 19, 2013

Several topics were covered during the Webinars. County participants were requested to fill out an online survey posted on the plan update website directly following the Webinar. An overview of the planned changes to the Risk Assessment, Mitigation Strategy, and Capability Assessment sections of the plan were presented to the County representatives. The feedback from the County staff was that the selected hazards were appropriate. Counties were informed that the full Risk Assessment presentation was available upon request. The Mitigation Solutions Workshop was summarized briefly focusing on goals. Attendees confirmed that the 5 goals selected covered their priories at the County level as well. Each attendee reviewed the Public Outreach Session schedule and was asked to advertise and get the word out to their respective communities about the public sessions. The participants were asked to share feedback or any success stories they have for the mitigation actions developed for the 2010 plan update. Plan integration was highlighted briefly, reminding County representatives to review how hazards are addressed in their comprehensive plans. The project schedule and next steps were shared with the attendees to conclude the webinar. A total of 31 counties participated in the webinar on June 17th, and 13 counties participated on June 19th.

Table 3.3-2 Summary of updates of the SSAHMP Summary of County Outbrief Webinar Participation

Participating Counties				
June 17, 2013				
Allegheny	Crawford	Juniata	Montgomery	Venango
Armstrong	Cumberland	Lancaster	Montour	Warren
Bradford	Delaware	Lawrence	Perry	Washington
Cambria	Fayette	Luzerne	Potter	Wayne
Carbon	Greene	Mercer	Somerset	Westmoreland
Clarion	Huntingdon	Mifflin	Susquehanna	York
Columbia				
June 19, 2013				
Allegheny	Carbon	Franklin	Monroe	Westmoreland
Beaver	Chester	Indiana	Schuylkill	
Bucks	Clarion	Jefferson	Tioga	

Public Outreach Sessions

For the 2010 plan update, public forums were held throughout the Commonwealth to inform the public of the plan and to gather input for the update. Unfortunately, these meetings were poorly attended, so the Consultant chose to take a different tact for the 2013 update. This time, public outreach was largely conducted by attending planned events or meetings related to Hazard Mitigation in each of the six regions of Pennsylvania including the Northwest, Southwest, North Central, South Central, Northeast, and Southeast portions of the Commonwealth. For the Northeast region, the consultant planned an open house event at the engaging Nurture Nature Center in Easton, Pennsylvania, but similar to past public forums, this event was poorly attended. For the Southwest region, the consultant hosted a table at the Carnegie Science Center as well as attended Watershed Planning Advisory Committee meetings to gain input and better educate the public on the hazard mitigation planning process. The goal was to select established events and engaging venues to go to the public, instead of expecting the public to attend public forums solely focused on hazard mitigation. All Pennsylvania residents contacted during the sessions were asked to provide comments and given the opportunity to take home the following materials:

- Flyer advertising State Plan Update website, online survey, and Photo Competition
- Public Outreach Survey
- ReadyPA Family Emergency Plan form
- ReadyPA Preparedness brochure
- FEMA Unified Hazard Mitigation Assistance Program brochure

The purpose of the survey was to gather information to jump start public outreach related actions in the Mitigation Strategy of the plan update. The survey was available in hard copy at all events, as well as online on the State Plan Update website: http://www.pemahmp.com.

South Central Public Outreach Session - WTS Luncheon June 11, 2013

The consultant attended a WTS luncheon in Harrisburg, PA focused on an update from ACEC on the State Transportation Innovation Council and the current status of deliberations on state transportation funding legislation. During registration for the event, Baker distributed public outreach surveys and flyers for the plan website, including information about the photo contest and online version of the survey. Before the keynote speaker, Baker presented a brief spotlight of the state plan update by sharing the progress, timeline, and the connection to transportation.

North East Public Outreach Session – Public Meeting at Nurture Nature Center June 13, 2013

A public meeting was held at the Nurture Nature Center in Easton, Pennsylvania to gather input from residents for the plan update. An interactive version of the public outreach survey was presented where attendees could use live voting devices and see the results for each question instantly. A mitigation opportunities map was available for residents to draw their visions for mitigation projects on a state map of Pennsylvania. As shown in the figure below, attendees also had the opportunity to share their opinion of which hazards occur most frequently verses those that have the greatest impact.

Figure 3.3-4 Frequency vs. Impact chart Station at Nurture Nature Center Meeting, June 13, 2013.

Attendees could also vote on which hazards they see as top priority in Pennsylvania. Unfortunately due severe storm warning the evening of the meeting, attendance was lower than expected.

North Central Public Outreach Session – PA Sea Grant Aquatic Invasive Species Identification Workshop June 19, 2013

The consultant attended an Aquatic Invasive Species Identification Workshop in State College, PA which focused on aiding field staff in using the Pennsylvania Field Guide to Aquatic Invasive Species to identify specimens accurately. During lunch copies of the Invasive Species hazard profile from the 2010 plan were available for meeting attendees to look over as well as public outreach surveys and flyers advertising the state plan website, photo contest, and online version of the public survey. Several speakers presented on current problem species, but a presentation from The Nature Conservancy on an online database called iMapInvasives introduced a new resource for invasive species data. Baker presented a spotlight of the plan update and distributed flyers and surveys for the meeting attendees at the workshop.

Figure 3.3-5 iMapInvasives geographic information sharing system, June 13, 2013.

South West Public Outreach Session – WPAC meeting July 8, 2013

The consultant attended the Region 2 meeting for the Watershed Planning Advisory Committee in Pittsburgh, PA where maps were presented and reviewed for the Act 167 Storm water Management Plan that is currently under development for the area. Baker and FEMA presented briefly on the state plan update and on new FEMA online resources. Public outreach surveys and flyers advertising the plan update website, photo contest and online survey were provided for all meeting attendees. Though Baker planned on attending the Wednesday night meeting for Regions 1 and 3, the meeting was canceled due to heavy rains and subsequent flooding of roadways in the Pittsburgh area on Wednesday, July 10, 2013.

Figure 3.3-6 Presentation on State Plan Update at the WPAC meeting, July 8, 2013.

South West Public Outreach Sessions – Carnegie Science Center, July 9-10, 2013

The consultant hosted a table in the lobby of the Carnegie Science Center on July 9th and 10th, 2013. They gave residents the opportunity to take home family emergency preparedness guides, flyers, and informational pamphlets from PEMA, as well as posters, flyers, activity worksheets, and river gage magnets provided by the Nurture Nature Center's Focus on Floods project. Public outreach surveys and flyers for the plan update website were also available for the public to take home.

Figure 3.3-7 Table at the Carnegie Science Center, July 9-10, 2013.

Visitors at the science center could also participate in an interactive experiment to demonstrate how floods occur. The experiment involved two containers, one with a house made of Legos, to represent residential areas, and the other filled with absorbent sponges to represent soil, or grassland. When water was poured over each, ponding occurred with the Lego house, whereas the sponges absorbed the water. The consultant team explained the importance of re-envisioning what we build along and near rivers, streams, or large bodies of water in Pennsylvania in order to reduce the impacts of flooding.

Figure 3.3-8 Flooding demonstration at the Carnegie Science Center, July 9-10, 2013.

South East Public Outreach Sessions – Grid Alive Urban Sustainability Forum at the Academy of Natural Sciences, July 18, 2013

The consultant hosted a table at the July Urban Sustainability Forum at the Academy of Natural Sciences in Philadelphia, PA. Residents had the opportunity to take home family emergency preparedness guides, flyers, and informational pamphlets from PEMA, as well as posters, flyers, activity worksheets, and river gage magnets provided by the Nurture Nature Center's Focus on Floods project. The consultant offered public outreach surveys and flyers for the plan update website for the public to take home as well. The theme of the July forum focused on Grid Alive, which is a local publication focused on sustainability in the Greater Philadelphia region. Residents of both Philadelphia, Montgomery and other surrounding counties stopped by the table to learn about the plan update and to sign up to receive important information regarding the update process.

North West Public Outreach Sessions – Nature Awareness Program at Discover PI, July 26, 2013

Figure 3.3-9 Flooding demonstration at the Nature Awareness Program at the Discover Presque Isle Event, July 26, 2013.

The consultant hosted a table as part of the Nature Awareness Program of the Discover PI event at Presque Isle State Park in Erie, PA. They gave residents the opportunity to take home family emergency preparedness guides, flyers, and informational pamphlets from PEMA, as well as posters, flyers, activity worksheets, and river gage magnets provided by the Nurture Nature Center's Focus on Floods project. Public outreach surveys and flyers for the plan update website were also available for the public to take home. A flooding demonstration was conducted at the event to educate local residents about floodplain management.

Figure 3.3-10 Demonstration showing the importance of floodplain management at the Nature Awareness Program at the Discover Presque Isle Event, July 26, 2013.

Additional Meetings

Numerous meetings and communications were held throughout the planning process to gather information to update the plan. The PEMA PM and Baker PM met in person or via phone nearly weekly to ensure that the aggressive update schedule was met. PEMA senior staff was informed of the schedule and plan to complete the SSAHMP update at the PEMA Project Kick-off on February 15. 2013. From May 7-9, 2013, the USACE led workshops in Towanda, Plymouth, and Bloomsburg, PA that PEMA, DCED, and FEMA Region III attended to provide an overview of the Silver Jackets initiative and to share information on nonstructural flood proofing techniques. The consulting team also conducted trainings across the state of Pennsylvania on behalf of the Pennsylvania American Planning Association Chapter entitled *Land Use Planning Matters: Planning for Disaster Resilient Communities*. Meetings were held on the following dates and each respective location:

- May 22, 2013 - Chester County Public Safety Training Campus, Coatesville, PA
- May 29, 2013 – Monroe County Public Safety Center, Stroudsburg, PA
- June 4, 2013 – Township of Upper St. Clair, PA
- June 5, 2013 – Old Lycoming Fire Hall, Williamsport, PA
- October 20, 2013 – Hilton Harrisburg, PA (Upcoming event)

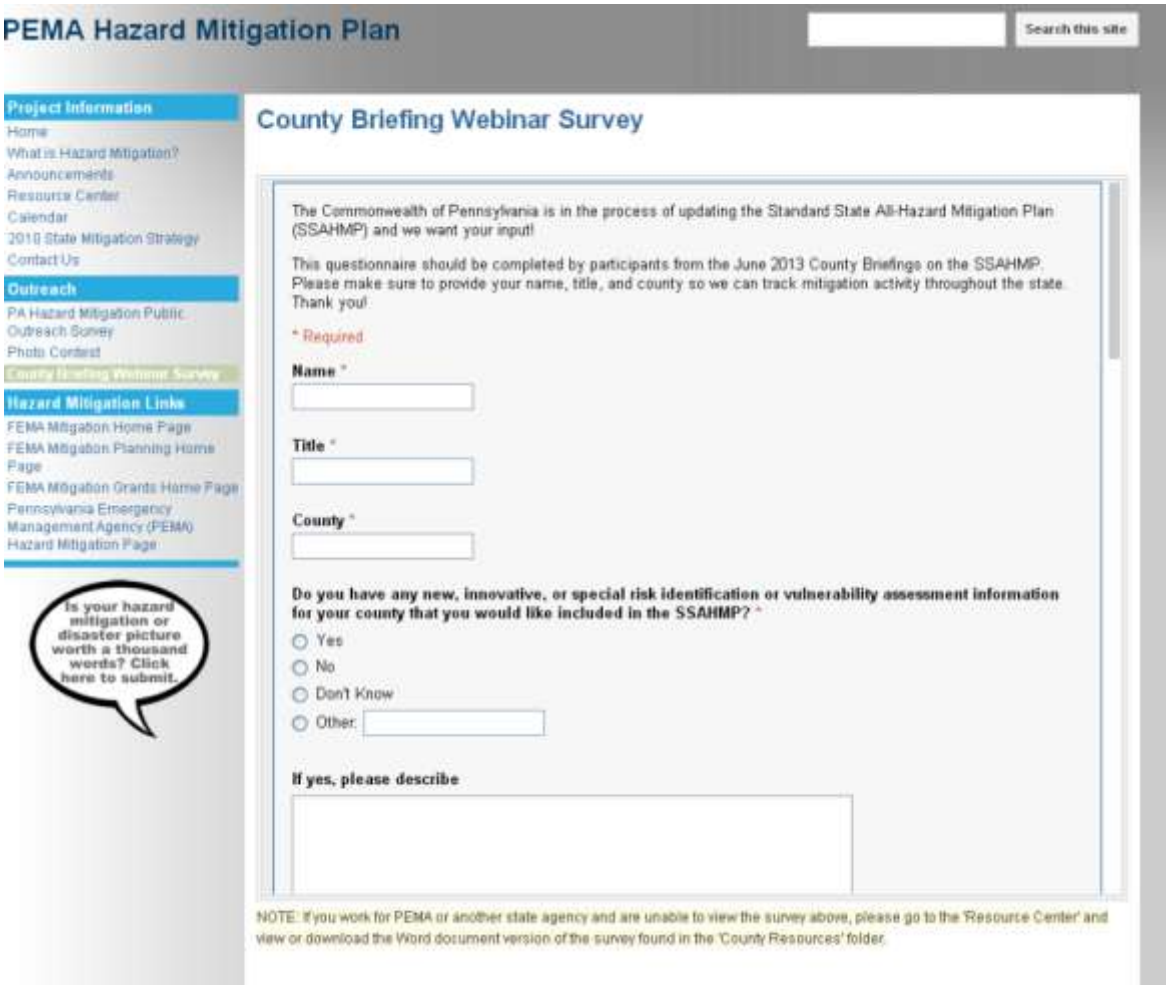
Active participants from the SPT and from County staff joined the consultant team for a Red Team Review on July 16 and 17, 2013. The Red Team included 3 different PEMA bureaus and departments, DEP, USACE, DCED, DGS, Northampton County, and Baker. The Red Team spent a two days reviewing the plan in detail and recommending revisions to strengthen the entire plan, especially the Mitigation Strategy. Additional copies of the Red Team Review drafts of the SSAHMP where providing to Director Cannon, Chief Full and Deputy Director Full for review.

The SSAHMP was posted for stakeholder and public review on August 15, 2013. Comments were addressed along with comments received by FEMA after the formal submission by Director Cannon on August 15, 2013. See Appendix C for documentation of comments and recommendations.

3.4. Public & Stakeholder Participation

Public and stakeholder participation complimented the SPT efforts by reaching out to county and local government and the general public. The meetings that the general public and stakeholders attended were summarized in Section 3.3. All 67 counties in the Commonwealth were invited to participate in the Webinar sessions, and 40 counties took part in the webinars. The counties that did not participate in the County Outbrief Webinar were Adams, Bedford, Berks, Blair, Butler, Cameron, Centre, Clearfield, Clinton, Dauphin, Elk, Erie, Forest, Fulton, Lackawanna, Lebanon, Lehigh, Lycoming, McKean, Northampton, Northumberland, Philadelphia, Pike, Snyder, Sullivan, Union, and Wyoming Counties. At the conclusion of the webinar, each participant was asked to complete an online survey, which is shown in the figure below. Out of the 40 counties who participated, 15 responded to the online survey, in addition to Centre County, who did not attend either webinar but did respond to the survey online.

Figure 3.4-1 Online County Briefing Webinar Survey, http://www.pemahmp.com/county-survey



The following flyer was distributed by email, posted online, and handed out in person at SPT meetings and public outreach sessions.

Figure 3.4-2 Flyer for Online Public Outreach Survey and Photo Contest

The Pennsylvania Association of Floodplain Managers helped spread word about the plan update with a spotlight on their website and by posting a flyer detailing the public outreach sessions planned for each region of Pennsylvania.

Figure 3.4-3 Online Outreach on PAFPM Website, http://www.pafpm.org

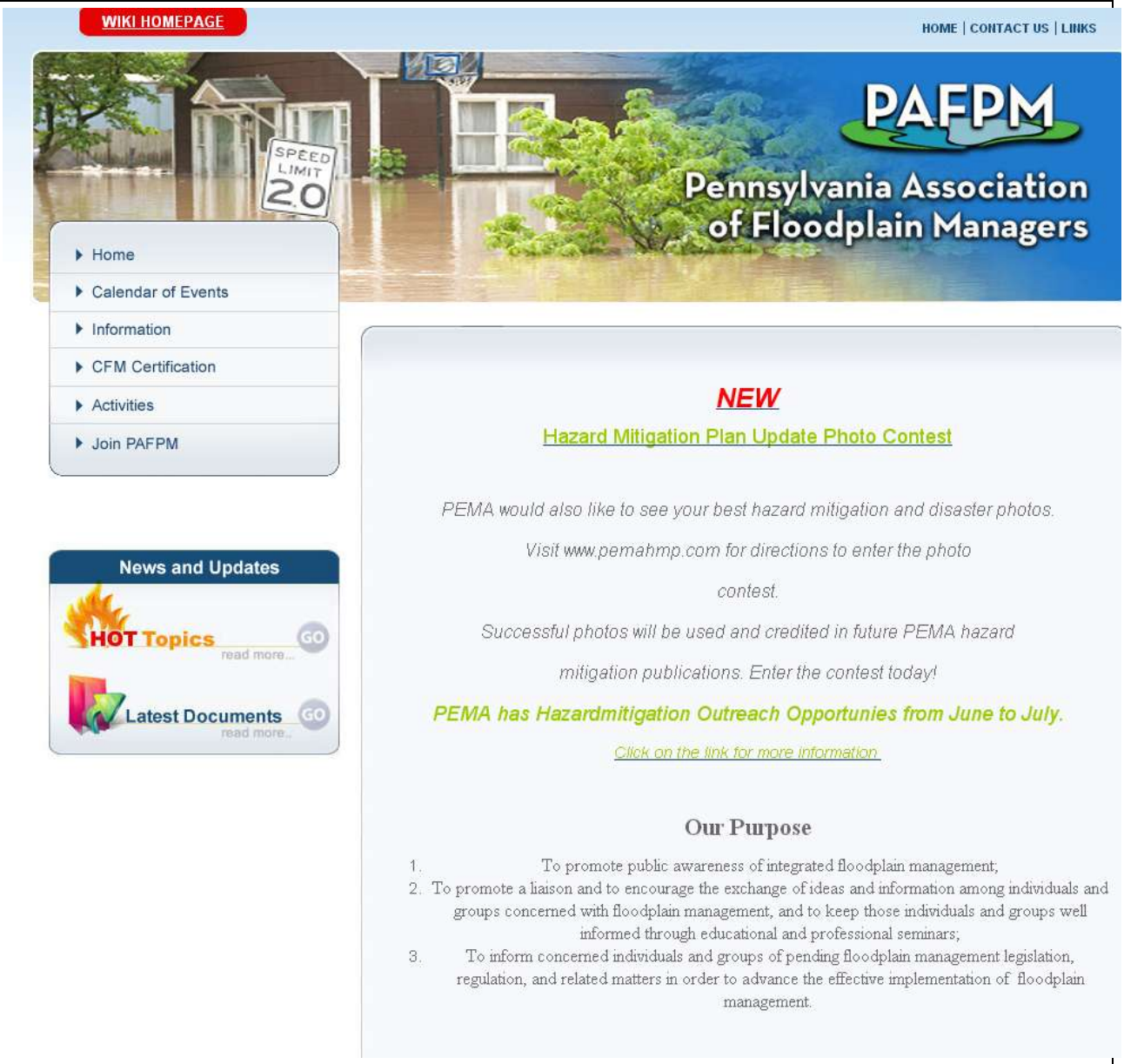


Figure 3.4-4 Outreach Calendar and Event Information Posted on PAFPM Website, http://www.pafpm.org/TDE_CMS/database/userfiles//OutreachSessions_Table.pdf

pennsylvania
EMERGENCY MANAGEMENT AGENCY

PA State Standard Hazard Mitigation Plan - Public Outreach Sessions

Region	Date	Time	Event Description	Location	Link
Northwest	7/26/2013	12:00 PM - 4:00 PM	**Discover Presque Isle Nature Awareness Program** - The Pennsylvania Emergency Management Agency (PEMA) will host a table at the Discover Presque Isle event to seek public input on the State Hazard Mitigation Plan Update. The event will give residents in northwest Pennsylvania an opportunity to inform the plan and to become better prepared for disasters. Check out the plan website at: *http://www.pemahmp.com/*	*Presque Isle State Park 301 Peninsula Dr #1 Erie, PA 16505*	http://www.discoverpa.com/events/discover-presque-isle/
North central	6/19/2013	8:30 AM - 2:30 PM	**PA Sea Grant Aquatic Invasive Species Workshop: Plants, Pathogens, & Algae** - Early detection of aquatic invasive species (AIS) is extremely important for locating new infestations before they have a chance to become established and spread. Pennsylvania Sea Grant developed Pennsylvania's Field Guide to Aquatic Invasive Species to help agency biologists, water conservation officers and others working in Pennsylvania waters to quickly and accurately identify new AIS infestations. The purpose of the workshop is to train field staff on using the AIS field guide, and provide practice in identifying several AIS threatening Pennsylvania. *Baker will present spotlight of the plan update and host an information/outreach table at the event.*	*Penn State University Forest Resources Bldg Room 106 State College, PA16803*	http://www.paseagrant.org/wp-content/uploads/2012/07/AIS-workshop-announcement.pdf
Northeast	6/13/2013	3:00 PM - 7:00 PM	**Public Open House for the 2013 Standard State All-Hazard Mitigation Plan Update** - The Pennsylvania Emergency Management Agency (PEMA) is sponsoring an open house event to seek public input on the State Hazard Mitigation Plan Update. The open house meeting gives everyone an opportunity to inform the plan and for communities to become better prepared for disasters. All including residents, local officials, industry, and academia are encouraged to attend. Check out the plan website at: *http://www.pemahmp.com/*	*Nurture Nature Center 518 Northampton Street Easton, PA 18042*	http://nurturenaturecenter.org/events-calendar/
South central	6/11/2013	11:45 AM - 1:30 PM	**WTS Update from ACEC on State Transportation Innovation Council** - Eric Madden, Executive Vice President of the American Council of Engineering Councils - Pennsylvania, will be joining us to discuss the State Transportation Innovation Council (STIC) operation, processes, and progress to date. Come learn of the new initiatives that have already gone through the STIC! More on the STIC is available here. WTS representatives of the STIC and Technical Advisory Groups (TAGs) will also be present to collect your innovative ideas. Know of another state that uses different methods than Pennsylvania? Know of a new technology? Have an idea to improve project delivery? Initiative submission forms will be available for completion at the program. Please Register by June 9th at http://www.wtsevents.org/chapter/Central-Pa/. Lunch is provided. Cost is $20 for members, $25 for Public Sector, $30 for non-members. *Baker will present spotlight of the plan update and host an information/outreach table at the event.*	*Radisson Hotel 1150 Camp Hill Bypass Camp Hill, PA 17011*	http://www.wtsinternational.org/centralpennsylvania/
Southwest	7/8/2013 & 7/10/2013	6:30 PM - 8:30 PM (both meetings)	**Watershed Planning Advisory Committee (WPAC) Meeting for Region 2 and Meeting for Regions 1&3** - *Baker will highlight the plan and host an information/outreach table at each event.*	*Municipal Building Public Meeting Room (325 Fox Chapel Road Pittsburgh, PA 15238)*	http://www.google.com/calendar/render?eid=OGduc09SZ3Zb3Z0bC4ZmFqZjdrdTB2aTgzemFrZ2kJAYWxsZWdoZW55Y291bnR5c3dtcC5tb20&ctz=America/New_York&pli=1&sf=true&output=xml https://www.google.com/calendar/render?eid=b2w3ZjFjdXZhM2kwIDY2bDR2c2lWIjhpMiQgYmFrZSAYWxsZWdoZW55Y291bnR5c3dtcC5tb20&ctz=America/New_York&sf=true&output=xml
	7/9/2013 & 7/10/2013	10:00 AM - 5:00 PM	**Carnegie Science Center** - *Baker will host an information/outreach table in the lobby of the science center to engage the public about the plan and to obtain feedback from Southwest Pennsylvania residents.*	*Carnegie Science Center One Allegheny Ave Pittsburgh, PA 15212*	http://www.carnegiesciencecenter.org/

The Nurture Nature Center advertised the open house meeting on their website calendar as well as on their Facebook page.

Figure 3.4-5 Online Outreach on Nurture Nature Website, http://www.nurturenaturecenter.org /ai1ec_event/public-open-house-for-the-2013-standard-state-all-hard-mitigation-plan-update

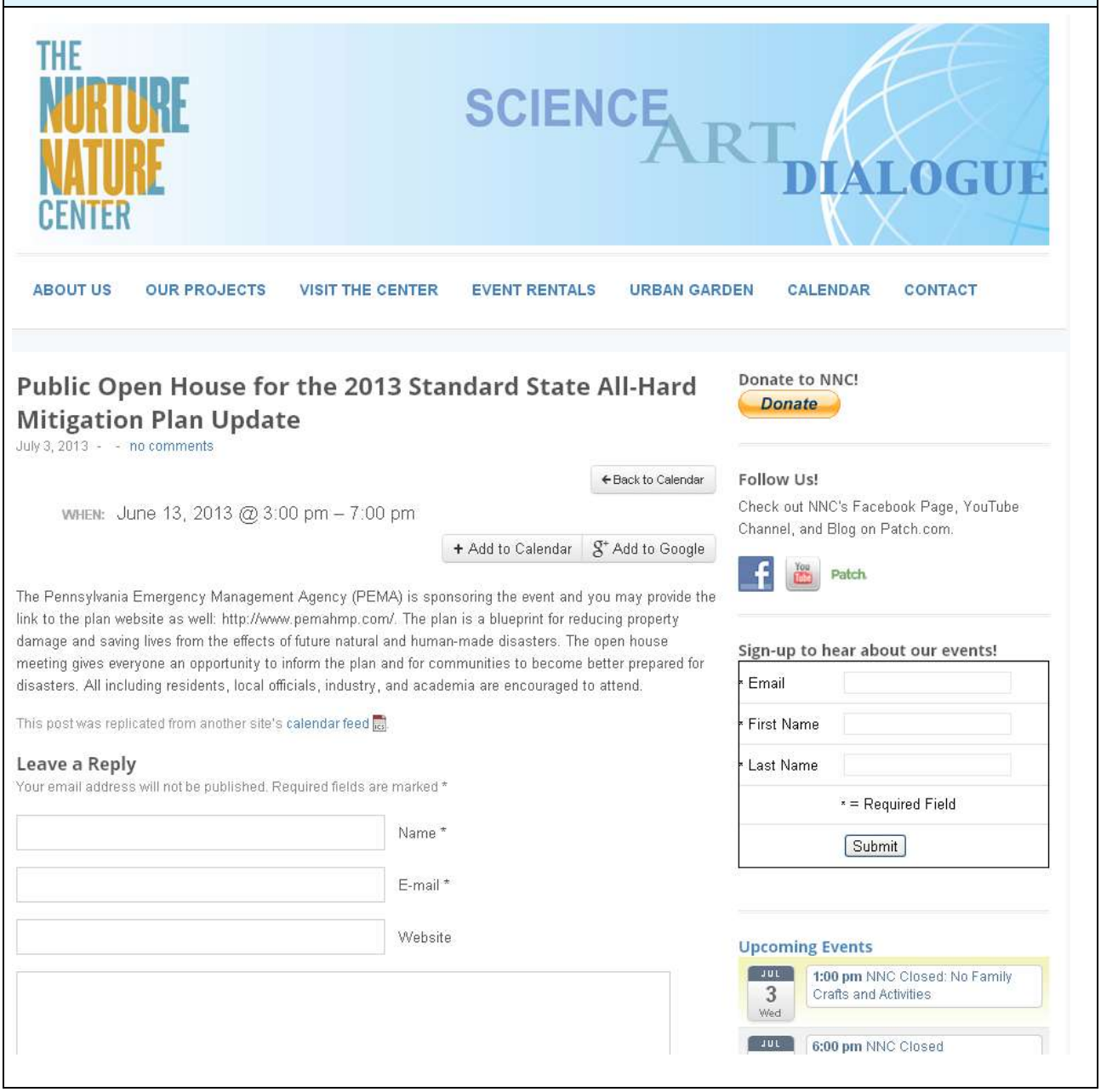


Figure 3.4-6 Online Outreach on Nurture Nature Facebook Page, http://www.facebook.com/nurturenaturecenter

The American Planning Association (APA) Pennsylvania Chapter also advertised the state plan update on their website by including the SPT meetings and public outreach sessions on their chapter calendar online.

Figure 3.4-7 Online Outreach on APA Website, http://planningpa.org/event/3969/

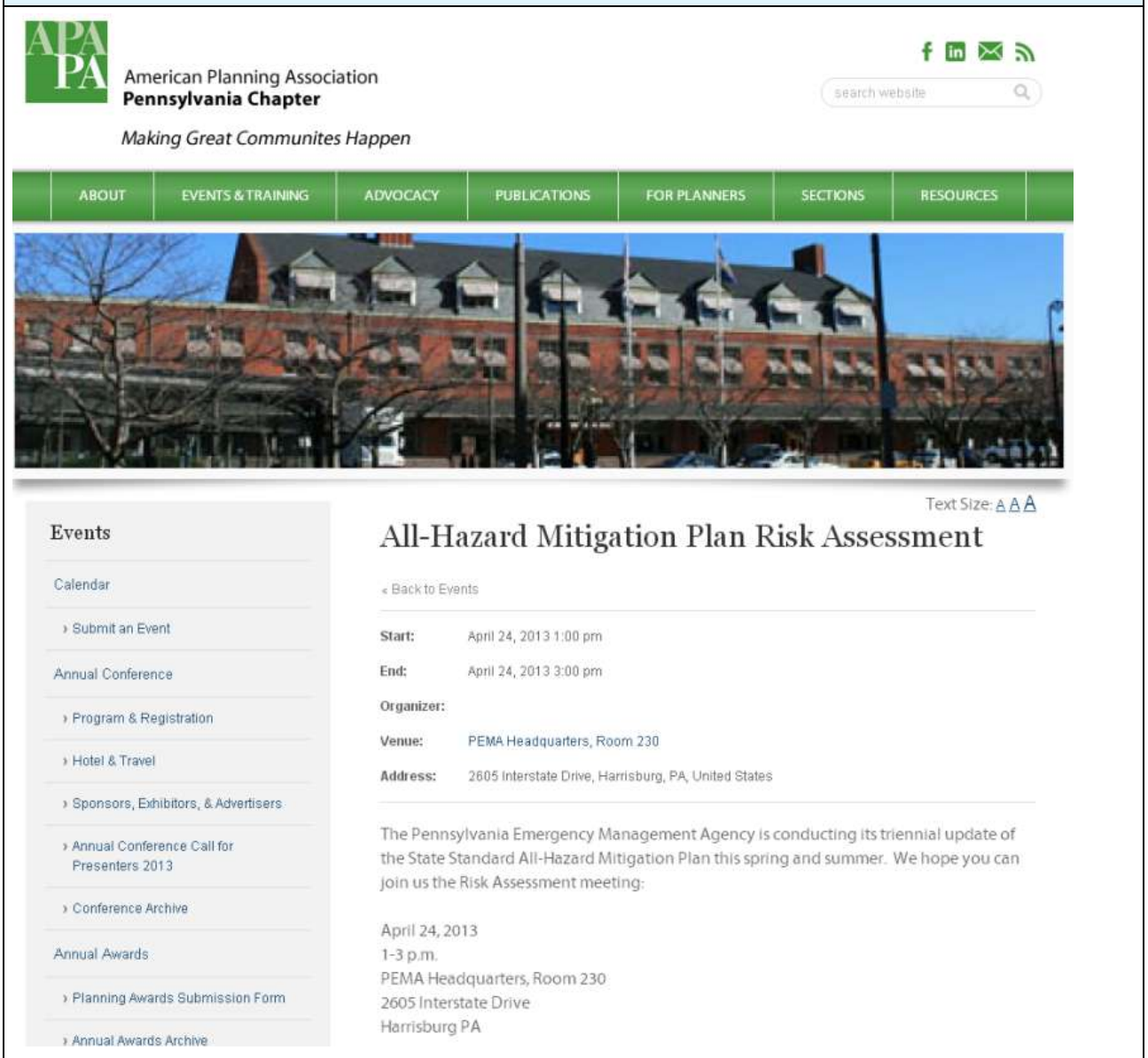


Figure 3.4-8 Online Outreach on APA Website for Open House at Nurture Nature Center, http://planningpa.org/event/open-house-at-nurture-nature-center/

American Planning Association
Pennsylvania Chapter

Making Great Communites Happen

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Open House at Nurture Nature Center

« Back to Events

Start: June 13, 2013 3:00 pm
End: June 13, 2013 7:00 pm
Organizer: Pennsylvania Emergency Management Agency
Venue: Nurture Nature Center
Address: 518 Northampton Street, Easton, PA, 18042, United States

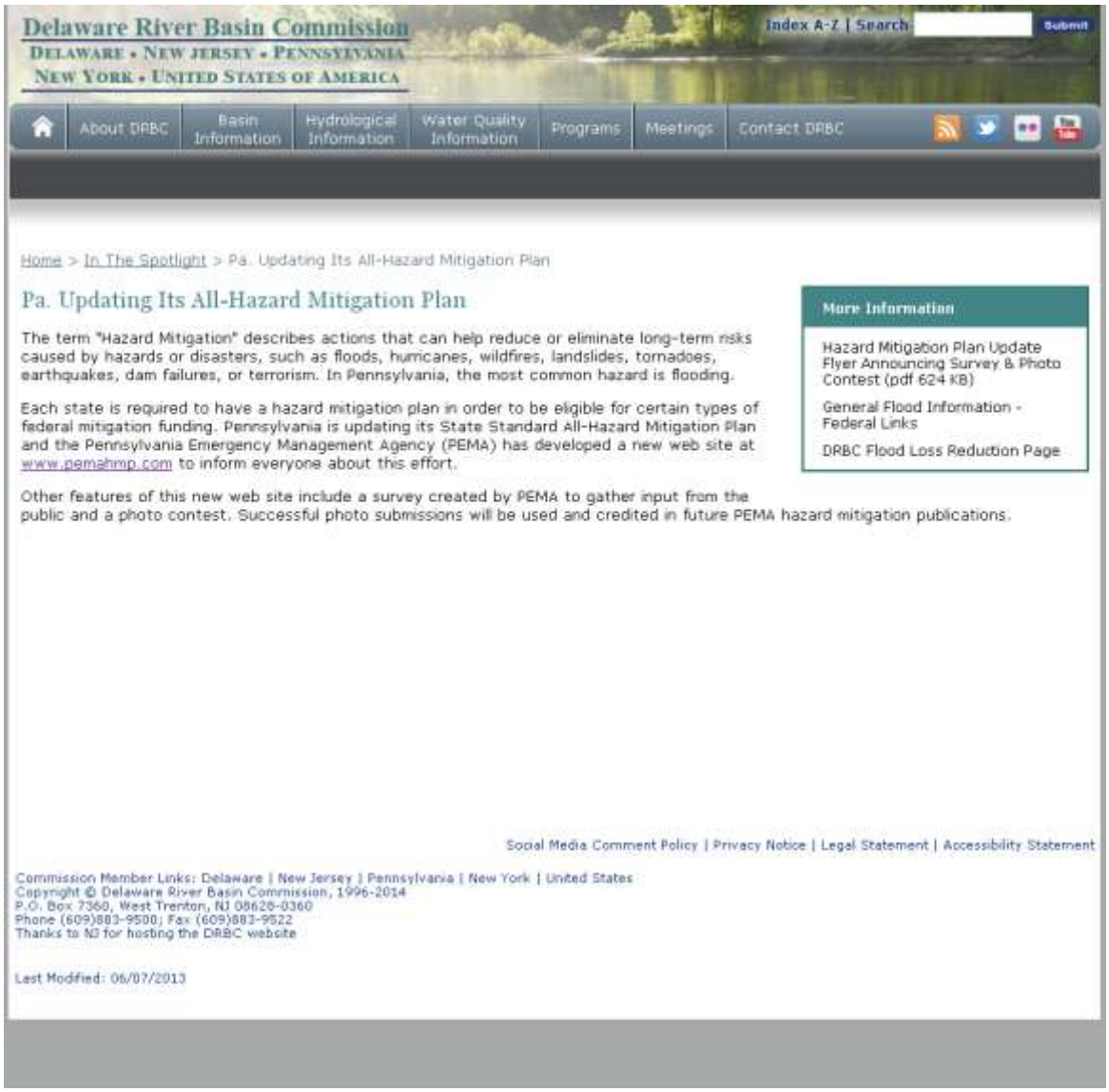
PEMA is hosting an open house to gather public input for the State Hazard Mitigation Plan Update at the Nurture Nature Center in Easton. All are welcome to attend. To learn more about this place and to take a quick hazard mitigation survey please visit www.pemahmp.com.

Date: Thursday, June 13, 2013
Time: 3:00 PM – 7:00 PM
This is an open house. Feel free to come and stay for as long or as short as you please.
Location: Nurture Nature Center, 518 Northampton Street, Easton, PA 18042

Figure 3.4-9 Online Outreach on APA Website for Land Use Planning Matters Training, http://planningpa.org/event/apa-pa-event-land-use-planning-matters-4/

The Delaware River Basin Commission (DRBC) highlighted the state plan update on their website and also posted the flyer along with useful flood links on the same page.

Figure 3.4-10 Online Outreach on DRBC Website for SSAHMP Update, http://www.state.nj.us/drbc/home/spotlight/approved/20130607_PaMitigationPlan.html



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Home > In The Spotlight > Pa. Updating Its All-Hazard Mitigation Plan

Pa. Updating Its All-Hazard Mitigation Plan

The term "Hazard Mitigation" describes actions that can help reduce or eliminate long-term risks caused by hazards or disasters, such as floods, hurricanes, wildfires, landslides, tornadoes, earthquakes, dam failures, or terrorism. In Pennsylvania, the most common hazard is flooding.

Each state is required to have a hazard mitigation plan in order to be eligible for certain types of federal mitigation funding. Pennsylvania is updating its State Standard All-Hazard Mitigation Plan and the Pennsylvania Emergency Management Agency (PEMA) has developed a new web site at www.pemahmp.com to inform everyone about this effort.

Other features of this new web site include a survey created by PEMA to gather input from the public and a photo contest. Successful photo submissions will be used and credited in future PEMA hazard mitigation publications.

More Information

Hazard Mitigation Plan Update Flyer Announcing Survey & Photo Contest (pdf 624 KB)

General Flood Information - Federal Links

DRBC Flood Loss Reduction Page

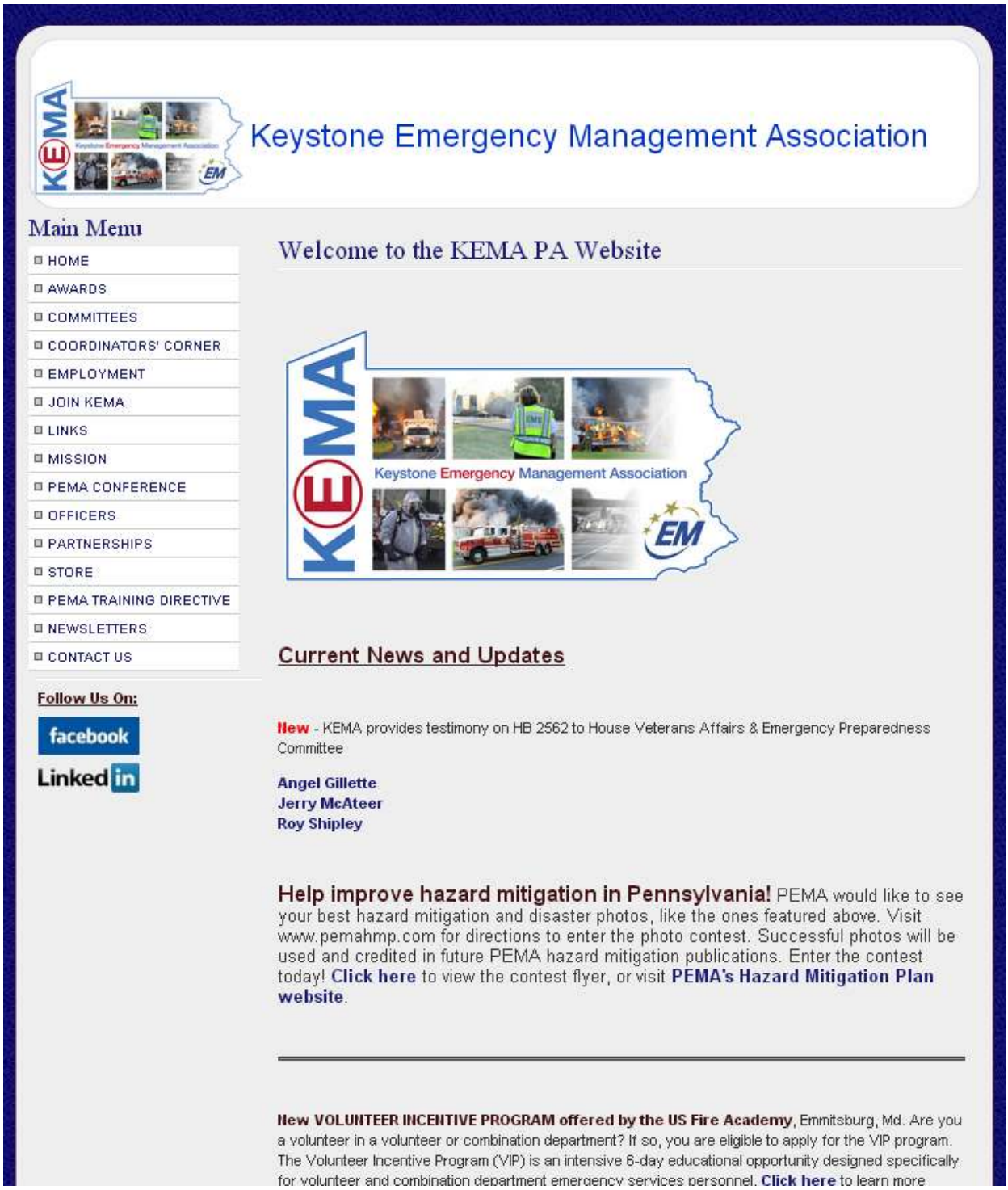
Social Media Comment Policy | Privacy Notice | Legal Statement | Accessibility Statement

Commission Member Links: Delaware | New Jersey | Pennsylvania | New York | United States
Copyright © Delaware River Basin Commission, 1996-2014
P.O. Box 7360, West Trenton, NJ 08628-0360
Phone (609)883-9500; Fax (609)883-9522
Thanks to NJ for hosting the DRBC website

Last Modified: 06/07/2013

The Keystone Emergency Management Association (KEMA) advertised the state plan update on their website. KEMA posted the flyer and also provided a link to the 2013 plan update website.

Figure 3.4-11 Online Outreach on KEMA Website for SSAHMP Update, http://www.kema-pa.org/

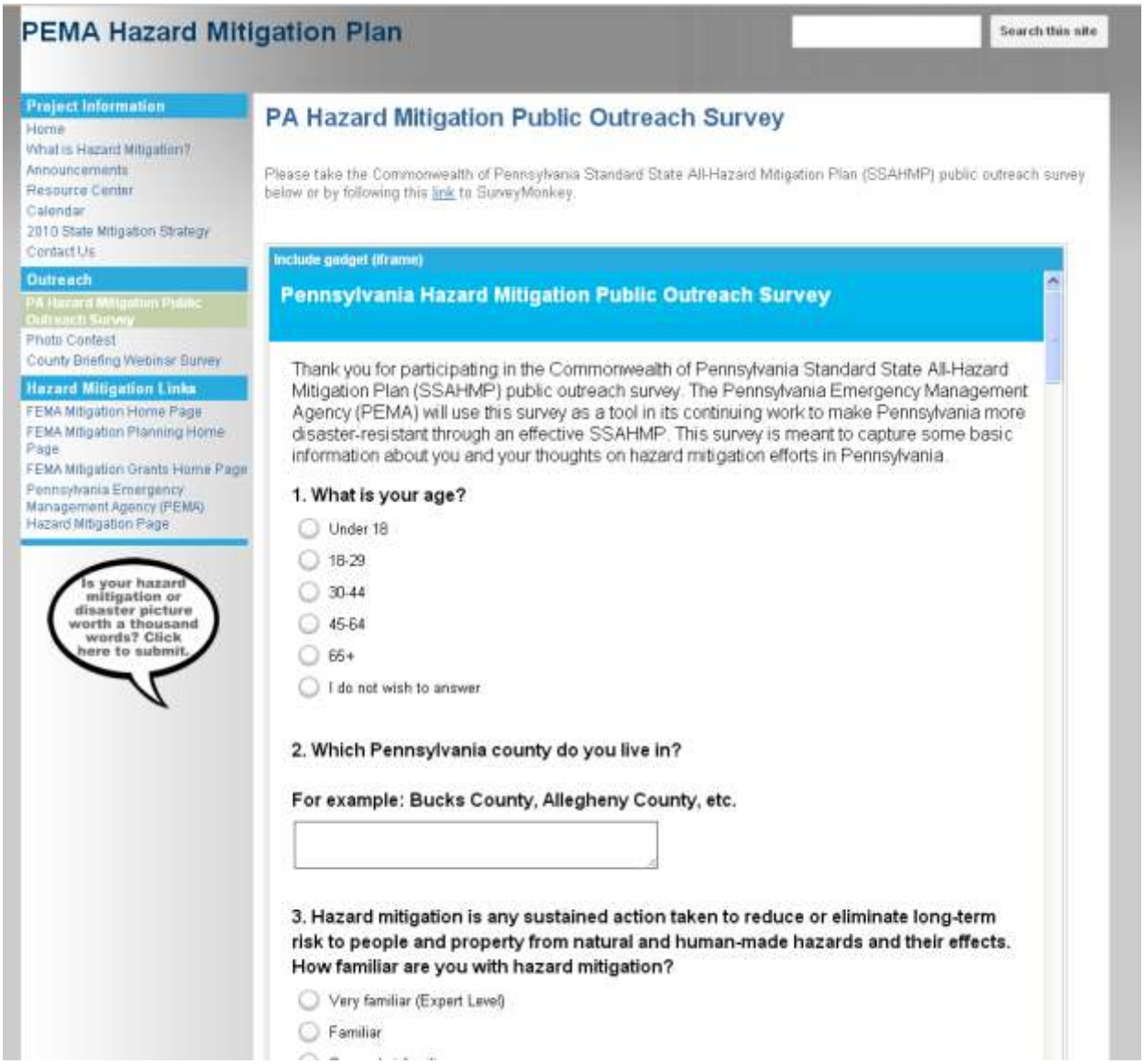


The Public Outreach Sessions were advertised online, by email to the SPT, and by word of mouth. The advertisements from newspapers and websites are included in Appendix C. Additionally, the flyer provided in Figure 3.4-4 shows the location, date, and time for each of the Public Forums was used to advertise the forums. This flyer was distributed to the SPT and emailed to the County emergency managers.

The Public Outreach Sessions that were held throughout the Commonwealth were effective in reaching additional community level officials. For example, the consultant team met with Allegheny County planners and local emergency management staff at the WPAC meeting in Pittsburgh. Attendees at public outreach sessions varied by event, as each session had an independent focus. Though the general public made up a majority of the events, public officials, state agency employees, and science, engineering and planning professionals attended several sessions. Due to the shift in venue and focus of the public outreach sessions, greater numbers of general public residents were informed about the plan. The online survey also allowed for increased participation from Pennsylvania residents outside of the SPT or County officials who typically contribute to the plan update process.

Online Public Outreach Survey

Figure 3.4-12 PA Hazard Mitigation Public Outreach Survey on 2013 Plan Update website, http://www.pemahmp.com/pa-mitigation-general-public-outreach-survey



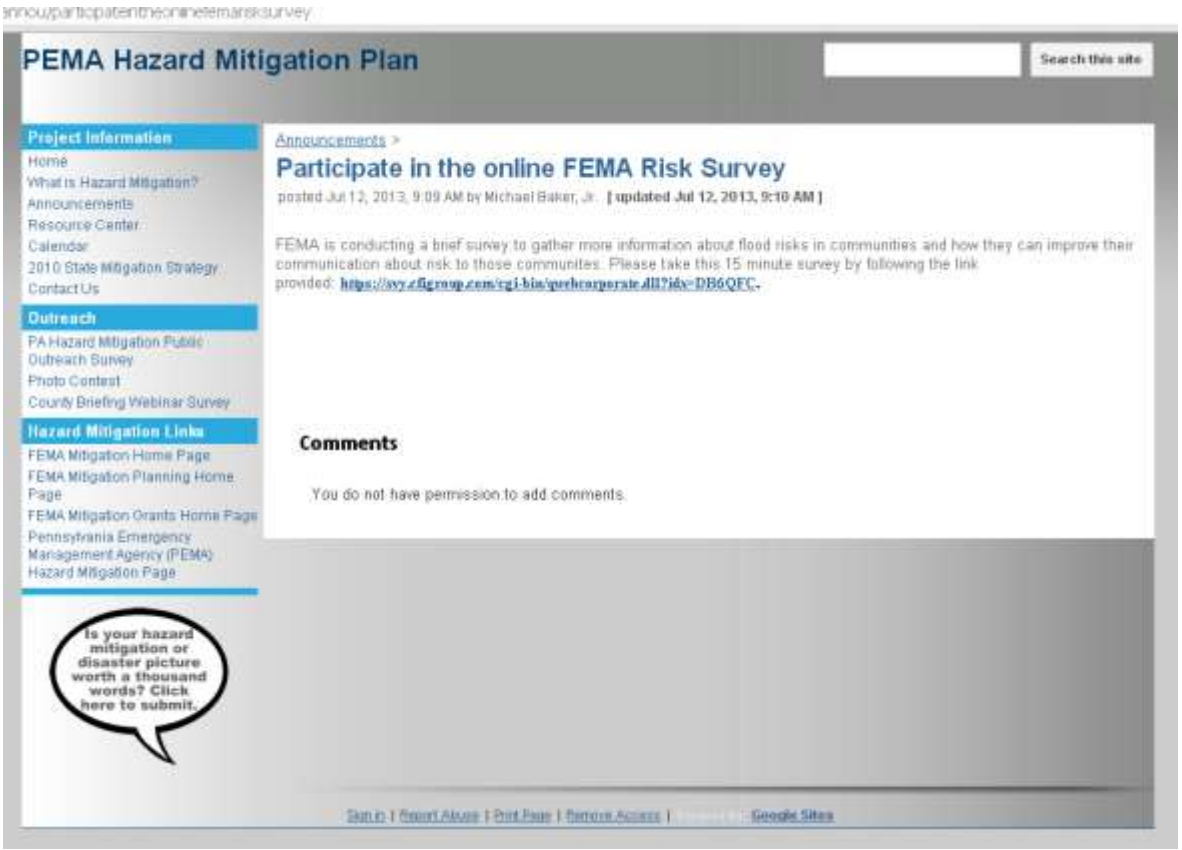
Sixty-three people participated in the PA Hazard Mitigation Public Outreach Survey posted on the state plan update website. Most participants were between the ages of 45 and 64 and the majority live in Allegheny, Beaver or Cumberland Counties. Most people shared that they were at least somewhat familiar with hazard mitigation. Most participants have been impacted by utility interruptions, winter storms, flooding, wind storms, and tropical storms. When asked which hazards are most important for Pennsylvania to focus it mitigation efforts on in the SSAHMP, flood was the front runner, followed by winter storm, utility interruption, and Tornado, wind storm. Not surprisingly, this aligns well with the rankings and priorities in the risk assessment

section of the plan. Transportation accidents were indicated to be of greatest concern amongst human-made hazards.

When asked about mitigation success stories, most people heard about successes through news media. They indicated that the most effective way to reach them to encourage their involvement in hazard mitigation would be through public notices via email, from their peers, Facebook, or through notices in the local newspaper. Survey participants also noted that they prefer contributing input through questionnaires, email, or submitting feedback through a website. Of the survey takers, over 70% are not currently signed up for AlertPA, do not have an emergency plan prepared, and do not have a disaster supply kit prepared. Most people said they would be willing to spend more money on a home that is more disaster resilient in the range of $1000 to $5000 plus. The most popular incentives survey takers selected that would motivate them to take steps to better protect their homes and families were tax breaks and insurances discounts. The full results of the survey are shown in Appendix C.

PEMA also advertised a survey conducted by FEMA, aimed at gathering data on flood risks in communities and what improvements can be made to better communicate risk to those vulnerable communities. Figure 3.4-13 below shows the announcement posted on the state plan update website for FEMA's online survey.

Figure 3.4-13 Announcement of FEMA online survey on 2013 Plan Update website, http://www.pemahmp.com/annou/participateintheonlinefemarisksurvey



A list of stakeholders from the public outreach sessions was gathered, as many of the organizations/venues that hosted meetings or events requested to see the finished plan. This list will be used to distribute the draft SSAHMP to additional stakeholders for review. The purpose of all outreach efforts was to build relationships and set-up a framework that could evolve into a true ongoing hazard mitigation movement across the Commonwealth. The outreach was intended to strengthen the SSAHMP as a living, evolving plan. Part of this framework involves creating a contact sheet or contact database of professional networks, both public and private. For more information on the continued public involvement in this plan, see Section 7.3.

4. Risk Assessment

4.1. Update Process Summary

At the SPT Kick-off meeting, the SPT reviewed the list of hazards profiled in the 2010 SSAHMP, evaluating and identifying potential new hazards, changes in risk, potential enhancements, and new/changed data. The SPT identified lock failures, cyber-terrorism, internet outages, climate change, invasive species, and mass food and animal feed contamination as new/emerging risks in Pennsylvania. 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 decided how to tackle these risks. Climate change has been incorporated as a potential factor in future probability and range of magnitude for hazards it is expected to have an impact on, like drought, hurricane, and temperature extremes. Lock failure is now combined with dam failures, as they both represent a structural failure that has the potential for large-scale, velocity-fueled flooding. It was decided that invasive species should be expanded to include more recent management information and risk species. More information has been added to the terrorism profile to cover cyber-terrorism/cyber-attack, while internet outages have been added to utility interruptions. One new hazard has been added to the plan, Mass Food and Animal Feed Contamination. A summary of the 26 hazards identified and profiled for the 2010 SSAHMP is provided in Table 4.1-1 along with historical information regarding whether the hazard was profiled in the 2004, 2007, and 2010 SSAHMPs. This table shows an increase in the number of hazards identified and profiled in Pennsylvania since 2004.

Table 4.1-1 List of hazards identified and profiled in the 2004, 2007, and 2010 Pennsylvania SSAHMPs.

HAZARD	YEAR PROFILED			
	2004	2007	2010	2013
Coastal Erosion	Yes	Yes	Yes	Yes
Drought	Yes	Yes	Yes	Yes
Earthquake	Yes	Yes	Yes	Yes
Extreme Temperature	Yes	Yes	Yes	Yes
Flood, Flash Flood, Ice Jam	Yes	Yes	Yes	Yes
Hailstorm	Yes	Yes	Yes	Yes
Hurricane, Tropical Storm, Nor'easter	No	No	Yes	Yes
Invasive Species	No	No	Yes	Yes
Landslide	Yes	Yes	Yes	Yes
Lightning Strike	Yes	Yes	Yes	Yes
Pandemic	No	Yes	Yes	Yes
Radon Exposure	Yes	Yes	Yes	Yes
Subsidence, Sinkhole	Yes	Yes	Yes	Yes
Tornado, Wind Storm	Yes	Yes	Yes	Yes
Wildfire	Yes	Yes	Yes	Yes
Winter Storm	Yes	Yes	Yes	Yes

Table 4.1-1 List of hazards identified and profiled in the 2004, 2007, and 2010 Pennsylvania SSAHMPs.

HAZARD	YEAR PROFILED			
	2004	2007	2010	2013
Civil Disturbance	Yes	Yes	Yes	Yes
Dam Failure	Yes	Yes	Yes	Yes
Environmental Hazards	Yes	Yes	Yes	Yes
Levee Failure	No	No	Yes	Yes
Mass Food and Animal Feed Contamination	No	No	No	Yes
Nuclear Incident	Yes	Yes	Yes	Yes
Terrorism	Yes	Yes	Yes	Yes
Transportation Accident	Yes	Yes	Yes	Yes
Urban Fire and Explosion	Yes	Yes	Yes	Yes
Utility Interruption	Yes	Yes	Yes	Yes

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

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

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 occurrence is often the most challenging. The likelihood of a hazard event occurring is usually expressed in terms of annual probability. Certain hazards (e.g. floods) have undergone more detailed study than others; therefore, annual probabilities are readily available. However, probability information may be lacking for other hazards. In those 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

In each Jurisdictional Vulnerability Assessment section 4.3.X.6, the counties that profiled and did not profile each hazard in their HMP are listed. The decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. Other indicators of risk include past occurrence and future occurrence. County identification of risk, past occurrence, and future occurrence data sets often do not match exactly. For instance, a county may not profile a

hazard because the hazard is viewed as minimal to no risk. However, state-wide datasets may show one past occurrence several decades ago and a probability of the hazard impacting the county in the future. When the hazard was identified as present in a county in state-wide past occurrence and future occurrence datasets, it typical has risk identified in the jurisdictional vulnerability assessments and loss estimates. Data used in the Commonwealth's SSAHMP risk analysis was gathered from reputable sources and should be viewed as providing a complementary profile of risk. Each piece of data provides a slightly different yet valuable aspect of risk.

4.1.1. THIRA and SSAHMP Relationship

For the purposes of this SSAHMP, *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 what was included in the 2010 SSAHMP. 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 SSAHMP. Data sources have been updated to include the best available information (see Section 2.5), but for the most part, all information from previous versions of the SSAHMP has been included or updated in the 2013 SSAHMP, unless otherwise indicated.

The SSAHMP Risk Assessment complements the 2012 Pennsylvania Threat and Hazard Identification and Risk Assessment completed by PEMA to meet the requirements of CPG 201. The THIRA, along with the State Homeland Security Strategy, is a complementary planning processes that focus on identifying key gaps and accomplishments in core capabilities. Table 4.1.1-1 compares the THIRA and the SSAHMP.

Table 4.1.1-1 Comparison between SSAHMP and THIRA

SSAHMP AND HIRA	SSHS AND THIRA
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 mentioned in Section 5.5, the THIRA is an important planning mechanism to integrate into the SSAHMP. The THIRA process was used to develop and/or revise worst-case scenarios, and its ranking is referenced in each hazard profile (see Table 4.1.7-1). There was also some discussion amongst the planning team as to whether the SSAHMP should only cover natural hazards while the THIRA should cover man-made hazards. However, the SPT decided to keep

the plans as separate but complementary mechanisms to maintain the Commonwealth's all-hazards approach to mitigation.

4.1.2. State Facility Loss Estimation and Data Limitations

As was the case in 2010, in 2013 PEMA requested the Department of General Services (DGS) inventory of all state owned and leased buildings. This list included 16,126 facilities and, like in 2010, had limited locational information. Nearly 9,000 (upwards of 56%) of facilities had no address information at all, and 6,533 did not have a unique address. The gaps in the address information collected in the DGS database meant that the facilities could not be mapped without extensive survey work that is not complete at this time. A significant portion of the DGS data is facilities such as state park cabins and lean-to's, restrooms, and salt domes. Given the type and function of many facilities on the list Commonwealth leaders must determine the prudent use of future expenditures to provide unique addresses or latitude/longitude points for all these state owned and operated facilities. Mapping is required to complete spatial analysis to determine vulnerability and loss estimates by hazard.

While valuable and promising for future SSAHMP updates, the DGS data fields are incomplete for addresses and several fields related to risk analysis. In order to be mapped in GIS the DGS data would need to have unique addresses provided for each of the inventoried properties; nearly 9,000 of the properties listed in DGS's inventory have no address information at all, and there are also a number of properties without specific address information (i.e. "1 mile south of Shippingport"). Collecting locational information this could require extensive physically survey work, since the agencies have not provided address information. Gathering this information was an action in the 2010 SSAHMP. Staff members from DGS reported the following progress. Currently, all state agencies, even those not under the jurisdiction of the Governor's Office, are being asked to supply DGS with information on the location and status of every one of their facilities. Using a pre-defined data template, DGS is seeking data in 79 distinct fields from each state entity to complete a statewide inventory. The fields most helpful for future hazard mitigation plans include:

- Agency
- County
- Facility Name
- Area
- Number of floors
- Contact information
- Physical address (latitude/longitude)
- Mailing address
- Construction type
- Owned or leased
- Appraisal value
- Building value
- Content value
- Land value
- In floodplain
- Nearest stream

- Sewage type
- Water supply
- Sprinkler system
- Fire alarm
- Fire detection system

This is a monumental data collection task, but DGS estimates that there will be a complete, GIS-ready inventory of state owned and leased facilities by 2016. This information is reflected in the associated mitigation action regarding collecting data on state facilities.

Although data gaps were present, the overarching data being captured is important and can effectively contribute to hazard mitigation planning. DGS catalogues information such as identifying whether a facility falls within a flood zone, if it has a fire alarm, a sprinkler system, if it is leased or owned, as well as specifying the facility's building use and construction type, among other pieces of information. All of this information is related to risk and security of Commonwealth facilities, which, in turn, impacts hazards in terms of vulnerability and mitigation planning. As the data becomes more complete in the future it will be used for vulnerability assessment and loss estimation in future SSAHMP updates. Table 4.1.2-1 shows the data on-hand at DGS is promising for future SSAHMP updates and mitigation efforts in general.

Table 4.1.2-1 Overview of Risk Related Information Collected by Department of General Service

AGENCY	IN FLOODPLAIN*	HAS FIRE ALARM*	HAS SPRINKLER SYSTEM*	LEASED BUILDINGS	TOTAL BUILDINGS	FLOODPLAIN BUILDING REPLACEMENT COSTS*
Agriculture	0	0	0	5	43	$0
Attorney General	0	0	0	14	14	$0
Banking and Securities	0	0	0	3	3	$0
Civil Service Commission	0	0	0	2	2	$0
Community and Economic Development	0	0	0	4	4	$0
Conservation & Natural Resources	513	647	562	7	4,814	$28,097,926
Corrections	0	0	0	14	1,329	$0
Education	0	9	0	1	3	$0
Environmental Protection	5	23	0	23	101	$0
Ethics Commission	0	0	0	1	1	$0
Executive Offices	0	0	0	7	7	$0
Fish & Boat Commission	0	16	1	0	661	$0
Game Commission	3	646	2		1093	$0
General Services	0	0	0	12	219	$0

Table 4.1.2-1 Overview of Risk Related Information Collected by Department of General Service

AGENCY	IN FLOODPLAIN*	HAS FIRE ALARM*	HAS SPRINKLER SYSTEM*	LEASED BUILDINGS	TOTAL BUILDINGS	FLOODPLAIN BUILDING REPLACEMENT COSTS*
Governor's Office	0	0	0	3	3	$0
Health	0	0	0	65	65	$0
Historical & Museum Commission	53	471	13		516	$0
Insurance	0	0	0	2	2	$0
Labor & Industry	0	13	1	78	95	$0
Liquor Control Board	1	1	1	0	3	$0
Military Affairs	0	0	0	0	1203	$0
PA Emergency Management Agency	0	5	5	2	18	$0
PA Gaming Control Board	0	0	0	5	5	$0
PA Infrastructure Investment	0	0	0	1	1	$0
PA Municipal Retirement Board	0	0	0	1	1	$0
PA Port Authorities	0	0	0	1	1	$0
Probation & Parole	0	0	0	26	26	$0
PSERS	0	0	0	8	8	$0
Public Utility Commission	0	0	0	1	1	$0
Public Welfare	0	0	0	93	939	$0
Revenue	0	0	0	22	22	$0
State Department	0	0	0	3	3	$0
State Employees' Retirement Sys	0	0	0	7	7	$0
State Police	0	0	0	104	104	$0
State System of Higher Education	0	0	0	0	2	$0
Thaddeus Stevens College of Technology	0	0	0	0	23	$0
Transportation	0	0	0	5	4784	$0
Percent of all Agency Facilities	**3.57%**	**11.35%**	**3.63%**	**3.22%**	**100%**	**$28,097,926**

Disclaimer: Total building counts and replacement costs listed in this table are under-reported due to blank or incomplete values in the data received. A 0 does not necessarily mean there are no facilities or floodplain replacement costs for a given agency; it more frequently represents a data gap.
**Denotes an estimate based on 2010 DGS data.*

Specifically, when investigating the 575 facilities classified as falling within the Floodplain, 512 of those facilities are associated with the Bureau of State Parks (under DCNR). According to the facility's Building Use classification, the state park facilities primarily consist of site amenities (i.e. bathrooms), maintenance buildings, cabins, sheds, parking and concessions; typically deemed less critical in terms of vulnerability to essential facilities and loss estimation. The remaining 63 non-DCNR facilities would have higher replacement costs and are associated with building uses such as museums, housing and historical sites. Based on currently collected data flood prone facilities overall appear to be 4% throughout the Commonwealth's state owned or operated list, while the threat to facilities with high replacement costs is lower than 1%. As the DGS database becomes more complete it will be valuable to risk assessment in future plan updates.

4.1.3. State Critical Facility Vulnerability Assessment and Loss Estimation Methodology and Sources

Without a complete set of Commonwealth owned and leased facilities, the 2013 SSAHMP instead evaluates the vulnerability and losses of the state's critical infrastructure/critical facilities. It was determined that state facility vulnerability assessment and loss estimation would focus on critical facilities because these properties would cause the biggest impact to the Commonwealth if damaged during a disaster. Since these facilities are critical to Commonwealth operations they are also a mitigation priority. The decision to focus risk analysis on critical facilities matches efforts of DGS; DGS focuses its emergency-related planning and mitigation on State owned, operated, and leased facilities that meet the definition of critical facilities. More information on the available data sets that support the decision for state facility vulnerability assessment and loss estimation to focus on critical facilities follows.

The Governor's Office of Homeland Security (GOHS) manages Pennsylvania's Homeland Security Infrastructure (HSIP) program and its list of priority sites. While not all of these entities are owned or operated by the state, they are all considered critical in some way to the daily functioning of the Commonwealth. The HSIP sites fall under the National Infrastructure Protection Plan (NIPP). The NIPP is a national data call to identify critical buildings and infrastructure whose disruption could cause nationally or regionally catastrophic effect. This data call is conducted in accordance with the Implementing the 9/11 Commission Recommendations Act of 2007, which requires the Secretary of Homeland Security to "establish and maintain a single classified prioritized list of systems and assets…that the Secretary determines would, if destroyed or disrupted, cause national or regional catastrophic effects." The HSIP sites are largely driven by Continuity of Operations (COOP) planning efforts, and the HSIP sites have the potential for mass casualties, significant economic consequences, and severe degradation of national security capabilities. The HSIP list includes 767 sites; of these sites, 39 do not have locations recorded and, as a result, cannot be mapped or included in the GIS analysis of state facility vulnerability. In general, these sites with unknown locations were electric/energy substations and transportation entities that do not have a single site, like the Schuylkill Expressway.

GOHS's data includes all identified Level 1, 2, 3, and 4 critical infrastructure/critical facilities for Pennsylvania. GOHS uses the same definitions for levels of critical infrastructure/critical facilities as DHS which follow:

- **Level 1**: Those systems and assets, whether physical or virtual, so vital that the incapacity or destruction of such may have a severe debilitating impact on the security, economy, public health or safety, environment, or any combination of these matters, to the Federal Government. An attack or disruption at a site that would cause:
  - 5000 immediate deaths
  - $75 Billion in damages
  - Cause a 3 month evacuation
  - Have a severe impact on the security or intelligence gathering capabilities of the US Government
- **Level 2:** Those systems and assets, whether physical or virtual, so vital that the incapacity or destruction of such may have a debilitating impact on the security, economy, public health or safety, environment, or any combination of these matters, to the Federal Government. An attack or disruption at a site that would cause:
  - 2500 immediate deaths
  - $25 Billion in damages
  - Cause a 1 month evacuation
  - Have a significant impact on the security or intelligence gathering capabilities of the US Government
- **Level 3**: Those systems and assets, whether physical or virtual, so vital that the incapacity or destruction of such may have a debilitating impact on the security, economy, public health or safety, environment, or any combination of these matters, to the Commonwealth. An attack or disruption at a site that would cause:
  - 1250 immediate deaths
  - $10 Billion in damages
  - Cause a 1 week evacuation
  - Have a significant impact on the Law enforcement, intelligence gathering or emergency management capabilities of the Commonwealth of Pennsylvania.
- **Level 4**: Those systems and assets, whether physical or virtual, so vital that the incapacity or destruction of such may have a debilitating impact on the security, economy, public health or safety, environment, or any combination of these matters, to any Pennsylvania County. An attack or disruption at a site that would cause consequences that concern Counties based on their own particular situation.

GOHS is in the process of updating the critical infrastructure/critical facilities and their update is due to be completed by August 2014. While data from GOHS is being developed, the SSAHMP complemented the existing data. While the current HSIP sites are indeed critical, they do not include all facilities essential for the functioning of Commonwealth communities. In particular, the HSIP list did not capture public schools (which often double as shelter spaces), fire departments, police departments, or smaller hospitals, but PEMA considers these types of locations to be critical. GOHS is initiating a scope of work to gather every school, police station, fire house, hospital, Red Cross shelter, County EOC, PANG and Reserve Armories, and all 911

Centers in the Commonwealth by August 2014. Until this data collection and validation is complete, the list of HSIP sites was augmented with all Pennsylvania public schools, all fire departments, all police departments, and all hospitals because of their key roles during a disaster event. The total number of critical facilities is 6,061.

Replacement values for the critical facilities come from two key sources. Many replacement values came from DGS. If a critical facility was found to be on the DGS list, its replacement value was used. When a critical facility was not found on the DGS list, alternative replacement values were obtained from Comprehensive Data Management System (CDMS), a component of Hazards United States Multi-Hazard (HAZUS-MH) software. Not all critical facilities were given a replacement value, though, because many of them are private facilities whose replacement value is unknown. Since specific facility names could not be listed in this plan for security reasons, facilities are grouped by the sector they belong to (a descriptive type) in order to convey general comprehension towards vulnerability and loss estimates. These critical facility types are listed in Table 4.1.3-1, in addition to identifying data origin and methodology for applying a replacement value when available. It is important to note that in some categories, like infrastructure and military and defense, the list includes only facilities considered critical according to the criteria listed in Appendix F, not all infrastructure or all military and defense operations in the Commonwealth.

A list of all critical facilities, identifying the facility name, address, county location, latitude and longitude and replacement value (if available) can be found in Appendix E – Critical Facilities. It should be noted that no information on age of structures was obtained. Therefore, no certainty could be made on knowing which structures are new when comparing critical facilities from previous plans.

Table 4.1.3-1 Summary of critical facility data by facility type.

CRITICAL FACILITY TYPE	ORIGIN OF CRITICAL FACILITY DATA	REPLACEMENT VALUE NOTES
Agriculture	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value
Banking	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value
Chemical	GOHS	All facilities are privately owned and were not assigned a replacement value
Commercial Facilities	GOHS	All facilities except one are privately owned and were not assigned a replacement value. One facility assigned a value from DGS.
Communications	GOHS	All facilities are privately owned and were not assigned a replacement value
Critical Manufacturing	GOHS	All facilities are privately owned and were not assigned a replacement value
Dams	GOHS	Replacement value not available for federal facilities because they are not under the jurisdiction of DGS.
Defense Industrial Base	GOHS	All facilities are privately owned and were not assigned a replacement value
Education	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value
Emergency Services	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value
Energy	GOHS	Replacement values from CDMS used.
Fire Stations (non-HSIP)	PEMA	Replacement values from CDMS used.
Government Facilities	GOHS	DGS values were used where facilities were also on DGS lists. However, not all facilities had replacement values assigned.
Healthcare & Public Health	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value.
Hospital (Non-HSIP)	Dept. of Health	Replacement values added from CDMS.

Table 4.1.3-1 Summary of critical facility data by facility type.

CRITICAL FACILITY TYPE	ORIGIN OF CRITICAL FACILITY DATA	REPLACEMENT VALUE NOTES
Information Technology	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value
Manufacturing	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value
National Monuments & Icons	GOHS	No replacement values available.
Nuclear Reactors, Materials & Waste	GOHS	Replacement values not available; all facilities are privately held.
Police Departments (Non-HSIP)	PEMA	Replacement values added from CDMS.
Postal & Shipping	GOHS	Replacement values not available; all facilities are privately held.
School (Non-HSIP)	Dept. of Education	Each school assigned an identical replacement value – the average of all schools' replacement values – from CDMS.
Transportation	GOHS	DGS values were used where facilities were also on DGS lists. Privately owned facilities were not assigned a replacement value
Water	GOHS	Standard replacement value from CDMS assigned to each facility.

An overall summary of critical facilities can be seen from Table 4.1.3-2. For individual facility name and location, please see *Appendix E – Critical Facilities*.

Table 4.1.3-2 Summary of critical facility types.

CRITICAL FACILITY TYPE	COUNT	CRITICAL FACILITY TYPE	COUNT
Agriculture	106	Government Facilities	41
Banking	26	Healthcare & Public Health	40
Chemical	13	Hospital (Non-HSIP)	237
Commercial Facilities	59	Information Technology	4
Communications	5	Manufacturing	1
Critical Manufacturing	3	National Monuments & Icons	6
Dams	31	Nuclear Reactors, Materials & Waste	7
Defense Industrial Base	20	Police (Non-HSIP)	1,191
Education	139	Postal & Shipping	8
Emergency Services	91	School (Non-HSIP)	1,480
Energy	55	Transportation	75
Fire Departments (Non-HSIP)	2,386	Water	37

A snapshot of the critical facility's jurisdictional location and replacement values can be seen within Table 4.1.3-3. The county having the most critical facilities is Allegheny with 706, followed by Westmoreland (274) and Luzerne (251). The counties with the most critical facilities tend to be places with higher populations with many individual municipalities in them – and thus, many fire departments, police departments, and public schools. Forest and Cameron Counties have the fewest facilities with 2. Allegheny also has the highest replacement value for critical facilities of all counties with over $6 billion. Similar trends follow that of counties with larger number of critical facility counts, in that those counties tend to have high replacement value amounts. However, please note the limitations on gathering replacement values for critical facilities discussed in Table 4.1.3-1; these county-by-county replacement values are a broad estimate.

Table 4.1.3-3 Summary of critical facilities per county and their total replacement value.

COUNTY	CRITICAL FACILITIES	REPLACEMENT VALUE ($)	COUNTY	CRITICAL FACILITIES	REPLACEMENT VALUE ($)
Adams	50	$169,604,000	Lackawanna	162	$1,040,541,732
Allegheny	706	$6,341,835,345	Lancaster	147	$599,609,144
Armstrong	94	$851,308,032	Lawrence	70	$552,396,704
Beaver	159	$1,256,504,744	Lebanon	106	$708,339,268
Bedford	38	$361,176,692	Lehigh	81	$660,836,000
Berks	148	$1,254,907,685	Luzerne	251	$1,572,188,420
Blair	84	$699,815,380	Lycoming	92	$695,237,380
Bradford	79	$551,424,036	McKean	50	$301,813,352
Bucks	125	$208,144,209	Mercer	88	$714,740,048
Butler	105	$1,275,381,899	Mifflin	28	$27,250,000
Cambria	144	$855,199,388	Monroe	33	$290,794,853
Cameron	7	$22,336,668	Montgomery	204	$961,523,123
Carbon	66	$392,786,692	Montour	16	$41,420,000
Centre	70	$787,451,380	Northampton	85	$329,398,000
Chester	124	$961,750,335	Northumberland	96	$531,393,032
Clarion	37	$264,434,684	Perry	23	$142,572,000
Clearfield	88	$750,474,700	Philadelphia	122	$1,898,279,388
Clinton	45	$582,121,775	Pike	27	$107,977,340
Columbia	79	$757,024,845	Potter	19	$24,634,000
Crawford	85	$729,085,704	Schuylkill	208	$797,697,380
Cumberland	69	$439,946,698	Snyder	85	$137,776,000
Dauphin	189	$3,780,102,061	Somerset	13	$622,584,372
Delaware	140	$921,411,479	Sullivan	44	$60,252,004
Elk	21	$160,599,344	Susquehanna	50	$224,020,680
Erie	69	$485,488,482	Tioga	16	$341,573,356
Fayette	122	$964,400,724	Union	85	$22,890,000
Forest	5	$4,142,000	Venango	48	$400,836,028
Franklin	40	$48,614,000	Warren	46	$407,543,352
Fulton	14	$136,518,676	Washington	150	$1,468,913,768
Greene	38	$393,809,352	Wayne	43	$252,126,016
Huntingdon	47	$399,092,028	Westmoreland	274	$2,242,856,128
Indiana	68	$1,326,491,218	York	30	$188,386,012
Jefferson	46	$390,925,360	Unknown/Multiple Counties	11	No Replacement Value Available
Juniata	15	$10,682,000	***Grand Total***	***6,061***	***$47,153,872,49***

4.1.4. Overview of HAZUS Loss Estimation Methodology

For the purposes of this SSAHMP, *vulnerability* describes how exposed jurisdictional or state critical facility assets are to a particular hazard event. In addition to the hazard profile information provided for each hazard, a vulnerability assessment and estimate of potential losses is included on a jurisdictional and state facility basis. These sections are intended to identify which jurisdictions and state facilities are most threatened by each hazard. Results from HAZUS-MH – the FEMA risk assessment software - were used to complete these sections for flood, earthquake, and hurricane wind hazards. As stated, the official name of HAZUS-MH is Hazards U.S. Multi-Hazard. However, for simplicity the term referencing the risk assessment software will be referred to as a HAZUS within the body of this SSAHMP.

This SSAHMP employed Level 2 HAZUS analysis for floods, earthquakes, and hurricane winds. As opposed to a Level 1 analysis using only default data, a Level 2 analysis incorporates some kind of more recent, up-to-date, or specific data for inclusion in the hazard models. The Level 2 data incorporated into this SSAHMP's analysis is updated demographic data. HAZUS's default databases still use the Census 2000 data, and as seen in Section 2.3, Pennsylvania's population has grown since 2000, and its racial and economic characteristics have changed. Using up-to-date Census information allows the model to have more realistic results for how many people will be impacted by hazard events. The demographics updated include population, households, group quarters, male population by age, female population by age, and population by race at both the Census tract and block level. Additionally, income, housing tenure by housing type, housing vacancy by housing tape, age of structures, average cash rent, median home value, and educational enrollment were updated at the Census tract level only because this data is no longer available at the Census block level. In addition, for earthquakes and hurricanes (which use tract-level data), the SSAHMP leverages HAZUS data aggregated by FEMA Region IV that that includes updates to the following fields:

- hzBldgCountOccupT – 2010 building count estimated for Res1, Res 2 and Res3A-F. From HSIP, Com6, Edu1, Edu2, and Gov2 where estimated as well.
- hzExposureOccupT – Building Exposure estimated for Res1, Res 2 and Res3A-F. From HSIP, Com6, Edu1, Edu2, and Gov2 where estimated as well.
- hzExposureContentOccupT – Content Exposure estimated for Res1, Res 2 and Res3A-F. From HSIP, Cm6, Edu1, Edu2, and Gov2 where estimated as well.
- hzSqFootageOccupT - Square footage estimated for Res1, Res 2 and Res3A-F. From HSIP, Com6, Edu1, Edu2, and Gov2 where estimated as well.

Throughout the SSAHMP, the term "Level 2 Database" will be used to reference the Pennsylvania State Tract and Block geodatabases that have been updated with more recent demographic data.

4.1.5. Non-HAZUS Vulnerability and Loss Estimation Methodology and Summary

A key measure of jurisdictional vulnerability is the value of assets statewide that are exposed to hazards. Although asset value does not directly quantify vulnerability, it is nevertheless an important component in any risk calculation as a general indicator of potential loss. Table 4.1.5-1 shows the total value of structural and content assets for all counties in Pennsylvania

extracted from the HAZUS Level 2 database discussed above by Census tract for several building occupancy type classes (e.g. residential, agricultural, etc.) while Table 4.1.5-2 shows the total number of buildings by building type, also from HAZUS. For those hazards where HAZUS simulations were performed, this information is used in combination with other data such as damage functions and probabilities to determine the amount of damage that can be expected under various event scenarios. Values were used as the basis for assessing jurisdictional vulnerability in more general terms for those hazards which HAZUS simulations were not performed including: extreme temperature, landslide, lightning strike, radon exposure, subsidence, tornado, wildfire, winter storm, environmental hazards, levee failure, nuclear incidents, transportation accidents, and urban fire and explosion.

GIS data from data sources described in Section 2.5 was used to assess jurisdictional and state facility vulnerability for other hazards where HAZUS analysis was not performed. Where data is available, an attempt was made to identify the number and type of critical facilities which are located within hazardous areas. The exact approach to identifying these facilities and quantifying potential loss values varies by hazard and is discussed further in Table 4.2.2-2.

Table 4.1.5-1 Summary of structural and content asset values for all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes.

COUNTY	TOTAL BUILDINGS	RESIDENTIAL (THOUSANDS $)	COMMERCIAL (THOUSANDS $)	INDUSTRIAL (THOUSANDS $)	AGRICULTURAL (THOUSANDS $)	RELIGIOUS (THOUSANDS $)	GOVERNMENT (THOUSANDS $)	EDUCATIONAL (THOUSANDS $)	TOTAL BUILDING & CONTENT EXPOSURE (THOUSANDS $)
Adams	82,567	15,995,922	1,476,144	726,815	148,841	219,368	140,436	655,596	19,363,122
Allegheny	706,960	135,994,027	27,381,347	5,575,277	234,431	2,170,535	1,173,929	8,077,265	180,606,811
Armstrong	74,120	12,056,178	1,372,278	501,367	98,716	226,536	182,361	457,693	14,895,129
Beaver	121,767	23,596,988	3,556,645	1,245,072	70,396	426,564	309,671	1,229,478	30,434,814
Bedford	50,448	7,356,238	713,807	307,745	64,756	149,963	100,858	315,399	9,008,766
Berks	227,614	45,756,650	6,075,101	3,174,607	271,867	624,726	382,235	2,925,073	59,210,259
Blair	87,558	14,089,689	2,296,434	641,095	68,578	279,432	179,123	789,582	18,343,933
Bradford	52,912	7,734,846	788,938	228,655	59,125	85,254	131,186	234,762	9,262,766
Bucks	321,764	87,045,356	11,793,108	3,975,932	265,568	843,443	450,166	3,750,137	108,123,710
Butler	124,040	24,251,499	3,502,176	1,229,827	163,903	381,039	258,362	1,377,726	31,164,532
Cambria	102,381	16,418,399	2,679,225	1,034,499	49,337	344,604	280,574	939,950	21,746,588
Cameron	40,596	6,126,933	470,517	349,567	7,725	57,562	97,106	94,266	7,203,676
Carbon	79,071	15,434,400	1,321,462	395,167	38,906	146,236	150,990	474,498	17,961,659
Centre	104,050	17,305,156	2,024,847	428,357	76,944	282,566	168,750	2,751,915	23,038,535
Chester	261,350	70,316,982	10,486,117	3,324,343	471,629	867,551	463,357	3,930,618	89,860,597
Clarion	51,547	7,956,777	861,238	328,047	36,798	123,471	114,689	477,764	9,898,784
Clearfield	76,155	11,492,487	1,382,741	559,875	33,192	213,762	177,333	438,647	14,298,037
Clinton	66,908	10,339,331	848,122	344,836	26,811	135,699	155,408	596,267	12,446,474
Columbia	63,122	10,276,779	1,291,710	508,428	56,178	159,768	179,391	725,224	13,197,478
Crawford	74,467	11,403,375	1,545,019	955,508	85,225	223,330	152,230	594,383	14,959,070
Cumberland	154,407	29,636,492	4,651,516	1,149,463	154,835	596,989	728,362	2,103,853	39,021,510
Dauphin	163,526	30,134,058	5,203,927	890,605	100,288	678,618	871,545	1,907,025	39,786,066
Delaware	281,319	69,744,575	9,592,235	1,610,279	121,653	856,198	457,938	4,473,594	86,856,472
Elk	42,147	6,693,486	633,230	627,190	12,852	73,889	91,563	155,182	8,287,392

Table 4.1.5-1 Summary of structural and content asset values for all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes.

COUNTY	TOTAL BUILDINGS	RESIDENTIAL (THOUSANDS $)	COMMERCIAL (THOUSANDS $)	INDUSTRIAL (THOUSANDS $)	AGRICULTURAL (THOUSANDS $)	RELIGIOUS (THOUSANDS $)	GOVERNMENT (THOUSANDS $)	EDUCATIONAL (THOUSANDS $)	TOTAL BUILDING & CONTENT EXPOSURE (THOUSANDS $)
Erie	141,924	23,810,010	4,361,770	1,711,867	92,723	603,848	202,982	1,948,880	32,732,080
Fayette	108,993	17,030,533	2,094,541	675,374	47,697	335,610	235,043	1,072,846	21,491,644
Forest	32,605	4,897,269	252,948	178,788	9,831	48,446	58,982	98,566	5,544,830
Franklin	95,764	16,091,643	1,703,600	710,434	163,305	289,154	145,605	1,074,576	20,178,317
Fulton	25,440	3,858,965	318,610	122,795	44,515	74,412	42,895	180,376	4,642,568
Greene	32,453	5,071,857	487,491	208,007	15,328	84,867	106,597	279,215	6,253,362
Huntingdon	59,376	9,729,793	864,435	284,685	99,610	159,181	118,705	407,965	11,664,374
Indiana	80,594	12,611,252	1,508,633	565,577	56,214	238,307	159,238	1,174,425	16,313,646
Jefferson	57,165	9,045,074	941,689	488,287	38,683	129,945	124,076	273,281	11,041,035
Juniata	41,698	6,496,301	500,020	205,398	69,263	114,052	87,830	231,822	7,704,686
Lackawanna	147,658	25,352,377	4,612,972	1,344,322	52,353	320,675	305,386	1,545,385	33,533,470
Lancaster	264,197	52,223,259	7,529,544	3,306,044	426,020	940,125	416,035	3,204,564	68,045,591
Lawrence	61,583	10,016,285	1,504,646	592,366	45,569	202,691	143,740	532,866	13,038,163
Lebanon	95,572	18,231,110	2,566,936	952,202	173,892	295,314	211,468	706,880	23,137,802
Lehigh	218,320	45,990,557	7,489,003	1,933,524	172,873	581,527	352,043	3,216,503	59,736,030
Luzerne	217,160	37,446,818	5,504,613	1,968,178	128,049	485,758	517,042	1,901,594	47,952,052
Lycoming	95,351	14,710,063	1,969,820	840,050	80,708	272,859	195,617	830,574	18,899,691
McKean	42,505	6,516,539	676,385	414,231	16,069	91,519	106,671	271,309	8,092,723
Mercer	82,676	13,439,417	1,973,297	1,064,858	65,361	281,356	157,935	859,736	17,841,960
Mifflin	44,344	6,902,395	748,072	240,853	64,700	139,404	92,814	302,194	8,490,432
Monroe	134,818	28,907,107	2,262,013	591,625	48,179	207,887	178,821	1,317,409	33,513,041
Montgomery	484,549	125,296,669	20,613,755	5,560,544	295,675	1,702,576	666,495	6,730,766	160,866,480
Montour	28,852	4,832,295	864,336	269,935	35,005	72,727	77,143	190,488	6,341,929
Northampton	181,973	40,866,439	4,595,443	1,643,753	89,367	486,274	309,429	2,387,583	50,378,288

Table 4.1.5-1 Summary of structural and content asset values for all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes.

COUNTY	TOTAL BUILDINGS	RESIDENTIAL (THOUSANDS $)	COMMERCIAL (THOUSANDS $)	INDUSTRIAL (THOUSANDS $)	AGRICULTURAL (THOUSANDS $)	RELIGIOUS (THOUSANDS $)	GOVERNMENT (THOUSANDS $)	EDUCATIONAL (THOUSANDS $)	TOTAL BUILDING & CONTENT EXPOSURE (THOUSANDS $)
Northumberland	73,299	12,206,143	1,737,857	721,832	65,996	199,980	190,241	477,809	15,599,858
Perry	69,098	12,935,010	1,060,610	227,575	85,386	183,199	221,537	507,276	15,220,593
Philadelphia	778,715	149,681,419	29,469,523	5,043,682	97,377	3,245,983	863,712	12,874,475	201,276,171
Pike	70,552	15,019,289	711,325	160,675	12,965	82,133	89,761	458,250	16,534,398
Potter	47,754	7,109,847	572,642	236,846	27,448	75,956	116,389	130,493	8,269,621
Schuylkill	114,197	20,051,185	2,224,357	1,136,859	119,440	338,059	387,673	784,631	25,042,204
Snyder	37,714	6,437,714	570,938	470,107	49,035	100,869	87,483	352,856	8,069,002
Somerset	78,459	12,470,244	1,570,220	537,286	67,610	220,611	182,775	610,355	15,659,101
Sullivan	24,267	3,888,059	180,067	77,461	25,530	39,117	53,242	57,231	4,320,707
Susquehanna	40,383	6,532,105	528,792	158,043	37,795	54,187	93,815	307,456	7,712,193
Tioga	36,021	5,208,822	542,567	144,858	39,767	68,553	91,997	286,653	6,383,217
Union	52,167	8,792,409	1,087,664	556,612	59,641	153,332	110,813	512,588	11,273,059
Venango	68,877	10,527,054	1,427,841	509,563	58,284	215,073	141,142	391,365	13,270,322
Warren	50,670	7,721,734	985,905	431,111	32,341	141,587	116,572	290,534	9,719,784
Washington	143,661	27,562,586	3,792,163	1,239,820	64,153	456,044	332,026	1,336,457	34,783,249
Wayne	77,652	14,533,100	854,004	211,902	31,837	107,938	132,956	393,339	16,265,076
Westmoreland	265,845	48,387,644	6,807,534	2,461,273	109,203	795,879	531,386	2,791,578	61,884,497
Wyoming	45,521	7,817,598	788,948	200,508	50,602	56,564	102,608	444,565	9,461,393
York	244,090	47,666,410	5,999,179	2,932,986	216,334	743,632	555,786	2,445,974	60,560,301
Total	***8,505,308***	***1,651,079,022***	***238,804,592***	***73,445,252***	***6,300,287***	***25,604,313***	***16,812,069***	***95,669,585***	***2,107,715,120***

Table 4.1.5-2 Summary of total buildings in all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes.

COUNTY	TOTAL BUILDINGS	TOTAL RESIDENTIAL BUILDINGS	TOTAL COMMERCIAL BUILDINGS	TOTAL INDUSTRIAL BUILDINGS	TOTAL AGRICULTURAL BUILDINGS	TOTAL RELIGIOUS BUILDINGS	TOTAL GOVERNMENT BUILDINGS	TOTAL EDUCATIONAL BUILDINGS
Adams	82,567	76,331	3,547	1,417	704	311	176	81
Allegheny	706,960	663,642	29,603	8,084	1,253	2,632	1,148	598
Armstrong	74,120	69,668	2,723	843	290	295	218	83
Beaver	121,767	113,590	5,266	1,614	338	557	294	108
Bedford	50,448	47,266	1,748	641	348	227	162	56
Berks	227,614	211,356	10,014	3,593	1,191	827	402	231
Blair	87,558	82,161	3,499	972	259	374	208	85
Bradford	52,912	50,961	1,149	318	135	135	166	48
Bucks	321,764	297,887	15,529	5,483	1,164	950	427	324
Butler	124,040	115,073	5,564	1,961	583	480	275	104
Cambria	102,381	95,797	4,155	1,215	295	488	336	95
Cameron	40,596	39,001	947	337	55	103	132	21
Carbon	79,071	75,036	2,523	867	229	202	165	49
Centre	104,050	98,441	3,483	996	384	393	235	118
Chester	261,350	241,400	12,672	4,256	1,269	948	465	340
Clarion	51,547	49,085	1,490	447	159	171	151	44
Clearfield	76,155	72,169	2,457	749	186	296	223	75
Clinton	66,908	63,757	1,890	586	172	210	218	75
Columbia	63,122	59,281	2,372	702	285	231	205	46
Crawford	74,467	68,900	3,068	1,357	532	321	197	92
Cumberland	154,407	143,036	6,973	2,060	695	738	720	185
Dauphin	163,526	151,798	7,601	1,791	497	846	830	163
Delaware	281,319	263,410	12,391	3,331	574	936	398	279
Elk	42,147	40,113	1,192	505	81	118	108	30

Table 4.1.5-2 Summary of total buildings in all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes.

COUNTY	TOTAL BUILDINGS	TOTAL RESIDENTIAL BUILDINGS	TOTAL COMMERCIAL BUILDINGS	TOTAL INDUSTRIAL BUILDINGS	TOTAL AGRICULTURAL BUILDINGS	TOTAL RELIGIOUS BUILDINGS	TOTAL GOVERNMENT BUILDINGS	TOTAL EDUCATIONAL BUILDINGS
Erie	141,924	131,713	6,447	2,165	551	657	244	147
Fayette	108,993	102,716	4,002	1,110	268	486	312	99
Forest	32,605	31,593	563	227	58	69	72	23
Franklin	95,764	89,375	3,623	1,320	706	400	217	123
Fulton	25,440	23,810	800	330	259	116	87	38
Greene	32,453	30,547	1,136	341	124	134	140	31
Huntingdon	59,376	56,310	1,677	572	331	218	173	95
Indiana	80,594	75,905	2,850	929	281	313	219	97
Jefferson	57,165	54,141	1,840	593	189	172	156	74
Juniata	41,698	39,761	1,027	383	195	132	122	78
Lackawanna	147,658	138,155	6,623	1,743	241	466	316	114
Lancaster	264,197	243,993	11,955	4,544	1,641	1,147	454	463
Lawrence	61,583	57,344	2,626	864	252	279	160	58
Lebanon	95,572	88,533	4,291	1,426	629	395	213	85
Lehigh	218,320	202,374	10,795	3,103	744	752	369	183
Luzerne	217,160	203,927	8,868	2,527	485	683	531	139
Lycoming	95,351	89,375	3,700	1,138	391	414	237	96
McKean	42,505	40,418	1,278	427	87	128	134	33
Mercer	82,676	76,805	3,590	1,182	397	398	195	109
Mifflin	44,344	41,822	1,453	471	214	178	122	84
Monroe	134,818	129,232	3,515	1,270	261	268	202	70
Montgomery	484,549	449,583	23,693	7,052	1,371	1,756	611	483
Montour	28,852	27,011	1,116	314	187	101	85	38
Northampton	181,973	170,005	7,975	2,464	499	597	310	123
Northumberland	73,299	69,019	2,667	768	255	295	212	83

Table 4.1.5-2 Summary of total buildings in all counties in Pennsylvania extracted from HAZUS for residential, commercial, industrial, agricultural, religious, government, and educational building occupancy type classes.

COUNTY	TOTAL BUILDINGS	TOTAL RESIDENTIAL BUILDINGS	TOTAL COMMERCIAL BUILDINGS	TOTAL INDUSTRIAL BUILDINGS	TOTAL AGRICULTURAL BUILDINGS	TOTAL RELIGIOUS BUILDINGS	TOTAL GOVERNMENT BUILDINGS	TOTAL EDUCATIONAL BUILDINGS
Perry	69,098	65,182	2,256	719	367	237	246	91
Philadelphia	778,715	737,616	29,901	6,138	527	3,125	732	676
Pike	70,552	68,508	1,307	441	80	106	84	26
Potter	47,754	45,830	1,124	348	129	131	160	32
Schuylkill	114,197	106,527	4,647	1,504	504	498	407	110
Snyder	37,714	35,614	1,183	451	164	126	108	68
Somerset	78,459	73,299	3,091	1,014	387	338	243	87
Sullivan	24,267	23,293	534	182	115	58	73	12
Susquehanna	40,383	38,869	865	318	91	86	122	32
Tioga	36,021	34,345	990	274	146	112	121	33
Union	52,167	48,726	2,061	658	274	210	148	90
Venango	68,877	64,490	2,560	914	339	300	194	80
Warren	50,670	47,845	1,643	607	175	206	141	53
Washington	143,661	134,368	5,807	1,912	444	648	375	107
Wayne	77,652	75,211	1,489	520	116	137	141	38
Westmoreland	265,845	249,559	10,505	3,321	608	1,047	575	230
Wyoming	45,521	43,572	1,160	396	140	92	124	37
York	244,090	226,978	10,368	3,848	1,134	952	585	225
Total	***8,505,308***	***7,972,458***	***341,457***	***104,953***	***28,034***	***31,752***	***18,331***	***8,323***

4.1.6. 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 Commonwealth 2013 SSAHMP incorporates information from local risk assessments, including which counties profile which hazards, and any hazard ranking provided at the local level. Table 4.1.6-1 summarizes the results of this review for counties; discussion of these results is provided in the jurisdictional vulnerability sections for each hazard.

Table 4.1.6-1 Summary of hazards profiled in county HMPs throughout Pennsylvania.

HAZARD	NUMBER OF COUNTIES WHICH PROFILED HAZARD	RANKING
Flood, Flash Flood, Ice Jam	67	1
Tornado	65	2
Drought	64	3
Winter Storm	64	3
Environmental Hazard	54	5
Wildfire	51	6
Dam Failure	51	6
Earthquake	50	8
Landslide	50	8
Transportation Accidents	46	10
Subsidence/ Sinkhole	39	11
Utility Interruption	37	12
Hurricane, Tropical Storm,	32	13
Nuclear Incident	32	13
Terrorism	31	15
Urban Fire and Explosion	29	16
Pandemic	27	17
Civil Disturbance	19	18
Radon Exposure	18	19
Levee Failure	17	20
Extreme Temperature	12	21
Lightning Strike	12	21
Hailstorm	10	23
Invasive Species	4	24
Coastal Erosion	1	25
Mass Food and Animal Feed Contamination	0 (New hazard for 2013)	26

* Each hazard is ranked by the total number of county HMPs which identify the individual hazard.

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. While the university plans have not been updated since the 2010 SSAHMP, PASSHE has a new grant agreement in place using PDM funds and is in the process of contracting to update those plans. In the meantime, though, these universities have participated in their local county plans – for example, Bloomsburg University submitted mitigation actions for the Columbia County HMP, and its vulnerability is discussed in the county risk assessment. A summary of the hazards included in risk assessments for the fourteen available university HMPs is provided in Table 4.1.6-2. There are seventeen total hazards evaluated in the university HMPs; fourteen of which are considered by every institution to have potential impact. Note that all hazards identified in county and university HMPs throughout Pennsylvania are included in the risk assessment for the SSAHMP.

Table 4.1.6-2 Summary of hazards profiled in university HMPs throughout Pennsylvania.

HAZARD	UNIVERSITY														RANK *
	BLOOMSBURG UNIVERSITY	CALIFORNIA UNIVERSITY OF PENNSYLVANIA	CHEYNEY UNIVERSITY	CLARION UNIVERSITY	EAST STROUDSBURG UNIVERSITY	EDINBORO UNIVERSITY	INDIANA UNIVERSITY OF PENNSYLVANIA	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."

4.1.7. Risk Ranking Methodology and Risk Factor Analysis

At the conclusion of the risk assessment, all 26 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 and information collected through development of the hazard profiles and vulnerability assessments included in Section 4.3. The RF approach produces numerical values that allow identified hazards to be ranked against one another; the higher the RF value, the greater the hazard risk.

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 in the Pennsylvania 2010 SSAHMP.

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.

The RF ranking system is not that same as the ranking system used in the Pennsylvania THIRA. While the hazards listed in these two planning mechanisms are similar the THIRA must account for a threat component. The Pennsylvania THIRA also breaks out hazards in terms of natural, technological, and human caused. Threats and hazards were evaluated based on likelihood and vulnerability.

Likelihood was rated on a scale of 1 - 5 where 1 indicates unlikely occurrence and 5 indicates very high likelihood or imminent occurrence within the Commonwealth. The vulnerability of the Commonwealth to each threat and hazard 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.

Once the survey was completed by all the THIRA/SPR Stakeholder workgroup participants, the scores for likelihood and vulnerability were averaged across all of the responses and then added together for each threat and hazard. This resulted in a total score for each threat and hazard with a value between 1 and 10. The threats and hazards were prioritized on a scale from 1-10 where a 9-10 (Very High); 7-8 (High); 5-6 (Medium); 3-4 (Low); and 1-2 (Very Low). THIRA/SPR workgroup developed consensus that threats and hazards with a total score of 7 or higher represented concern for the Commonwealth, as shown in Table 4.1.7-1.

Worse “probable” case scenarios were developed for the hazards of concern. These scenarios were developed in order to create events that would stress the core capabilities as defined in the National Preparedness Goal and Comprehensive Preparedness Guide 201: Threat and Hazard Identification and Risk Assessment Guide (CPG 201). By stressing capabilities the workgroup participants were able to identify gaps in core capabilities to guide further planning and investment justifications. The overall goal of the THIRA process is evaluate the Commonwealth’s capabilities for addressing all-hazards events across the 5 Mission Areas: Prevention, Protection, Mitigation, Response, and Recovery.

Table 4.1.7-1 THIRA hazard Rankings.

THREAT/HAZARD	SCORE	THREAT/HAZARD	SCORE
Flood, Flash Flood, Ice Jam	9	HazMat/ Chemical release	6
Hurricane, Tropical Storm, Nor’easter	8	Lightning Strike	6
Winter Storm	8	Transportation Accident	6
Animal Disease	7	Urban Fire and Explosion	6
Cyber Incidents	7	Aircraft as Weapon	5
Dam Failure	7	Armed Attack	5

Table 4.1.7-1 THIRA hazard Rankings.

THREAT/HAZARD	SCORE	THREAT/HAZARD	SCORE
Drought	7	Biological Attack (non-food)	5
Nuclear Incident	7	Chemical Attack (non-food)	5
Pandemic/ Infectious Disease	7	Earthquake	5
Tornado, Windstorm	7	Invasive Species	5
Utility Interruption	7	Levee Failure	5
Terrorism	6	Space Weather	5
Biological/Chemical (Food)	6	Wildfire	5
Civil Disturbance	6	Landslide	4
Environmental Hazards	6	Radon Exposure	4
Explosive Devices	6	Avalanche	3
Extreme Temperature	6	Coastal Erosion	3
Hailstorm	6		

RF values were obtained by assigning varying degrees of risk to five categories for each of the 26 hazards profiled in the 2013 SSAHMP. 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 given hazard event. 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. 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.

Table 4.1.7-2 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**	

Using this methodology, Table 4.1.7-3 lists the Risk Factor calculated for each of the 26 potential hazards from high to low identified in the 2013 SSAHMP. Results show that levee failure and subsidence and sinkhole hazards are the lowest risk hazards in terms of overall potential impact on the Commonwealth while winter storm, flood, flash flood, and ice jam, and hurricane, tropical storm, and nor'easter hazards are considered most significant.

This plan also references the calculated risk factor for all counties that have incorporated the risk factor methodology into their jurisdictional vulnerability assessments, beginning with fourteen Local Hazard Mitigation Plan updates in 2010. Average values from counties which have calculated Risk Factors are included in the jurisdictional vulnerability section for each hazard. These jurisdictional averages can be compared to the Commonwealth assessment results provided in Table 4.1.7-3. These updated calculated risk factors will be incorporated into the Commonwealth's Hazard Mitigation Plan during each year's plan review and maintenance session.

Table 4.1.7-3 Ranking results by hazard for Pennsylvania using the Risk Factor methodology.

HAZARD NATURAL(N) OR MAN-MADE(M)	RISK ASSESSMENT CATEGORY					RISK FACTOR (RF)
	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	
Flood, Flash Flood, Ice Jam (N)	4	3	3	4	3	3.4
Winter Storm (N)	4	2	4	2	3	3.1
Utility Interruption (M)	4	2	2	4	2	2.8
Hurricane, Tropical Storm, Nor'easter (N)	2	3	3	1	4	2.6
Dam Failure (M)	1	3	2	4	4	2.4
Nuclear Incident (M)	1	3	2	4	4	2.4
Transportation Accident (M)	4	1	2	4	1	2.4
Wildfire (N)	4	1	2	3	2	2.4
Environmental Hazard (M)	3	2	2	2	2	2.3
Extreme Temperature (N)	4	1	2	1	3	2.3
Coastal Erosion (N)	4	1	1	1	4	2.2
Landslide (N)	4	1	1	4	1	2.2
Lightning Strike (N)	4	1	1	4	1	2.2
Tornado, Wind Storm (N)	3	2	1	4	1	2.2
Invasive Species (N)	2	2	2	1	4	2.1
Radon Exposure (N)	3	1	2	1	4	2.1
Civil Disturbance (M)	3	1	1	4	2	2
Drought (N)	2	1	3	1	4	2
Pandemic (N)	2	1	3	1	4	2
Terrorism (M)	1	3	1	4	2	2
Earthquake (N)	2	2	1	4	1	1.9
Hailstorm (N)	3	1	1	4	1	1.9
Urban Fire and Explosion (M)	2	2	1	4	1	1.9
Levee Failure (M)	1	2	1	3	3	1.7
Mass Food/Animal Feed Contamination (M)	1	2	2	2	2	1.7
Subsidence, Sinkhole (N)	3	1	1	2	1	1.7

4.2. Hazard Identification

4.2.1. Table of Presidential Disaster Declarations

Pennsylvania's disaster history helps provide direction on the identification of hazards and their significance. PEMA maintains a historical log of all disasters that have occurred in the Commonwealth dating back to 1955. These disasters typically were declared either at the federal level by a Presidential Disaster or Emergency Declaration or by the Small Business Administration or at the state level with a Gubernatorial Disaster Declaration or Proclamation. 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 significant disaster declarations.

There are two thresholds for disaster declarations established under the Stafford Act: a state and a county threshold. These thresholds are based on a formula that uses the population of the jurisdiction (as recorded in the Census) times $3.27 per capita for counties and $1.30 per capita for the state. In Pennsylvania, the statewide threshold is $16.5 million. State and county thresholds must be simultaneously attained for a Presidential disaster declaration to be issued.

Table 4.2.1-1 displays the Presidential Disaster and Emergency Declarations that have affected Pennsylvania from 1955-2013 from most recent to oldest event.

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

DATE	EVENT	AFFECTED AREAS
January 2013	Hurricane Sandy	Bedford, Bucks, Cameron, Dauphin, Forest, Franklin, Fulton, Huntingdon, Juniata, Monroe, Northampton, Philadelphia, Pike, Potter, Somerset, Sullivan, Wyoming
October 2012 (Emergency Declaration)	Proclamation of Emergency – Hurricane Sandy	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, Lawrence, Lebanon, Lehigh, Luzerne, Lycoming, McKean, Mercer, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Pike, Potter, Schuylkill, Snyder, Somerset, Statewide, Sullivan, Susquehanna, Tioga, Union, Venango, Warren, Washington, Wayne, Westmoreland, Wyoming and York
September 2011 (Emergency Declaration)	Proclamation of Emergency – Remnants of Tropical Storm Lee	Adams, Bedford, Berks, Blair, Bradford, Bucks, Cambria, Carbon, Centre, Chester, Clinton, Clinton, Columbia, Cumberland, Dauphin, Delaware, Franklin, Fulton, Huntingdon, Juniata, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Lycoming, Mifflin, Monroe, Montgomery, Montour, Northumberland, Northampton, Perry, Philadelphia, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Wyoming, York

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

DATE	EVENT	AFFECTED AREAS
September 2011	Remnants of Tropical Storm Lee	Adams, Bedford, Berks, Bradford, Bucks, Chester, Columbia, Dauphin, Huntingdon, Juniata, Lackawanna, Lancaster, Lebanon, Luzerne, Lycoming, Mifflin, Montgomery, Montour, Northampton, Northumberland, Perry, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne, Wyoming, and York
September 2011	Hurricane Irene	Bucks, Chester, Delaware, Lehigh, Luzerne, Monroe, Montgomery, Northampton, Philadelphia, Pike, Sullivan, Susquehanna, Wayne, and Wyoming
August 2011 (Emergency Declaration)	Proclamation of Emergency – Hurricane Irene	Bucks, Chester, Delaware, Lehigh, Luzerne, Montgomery, Monroe, Northampton , Philadelphia, Pike, Sullivan, Wayne, Wyoming
July 2011	Severe Storms and Flooding	Bradford, Lycoming, Sullivan, Tioga, and Wyoming
April, 2010 (Emergency Declaration)	Severe Winter Storm	Adams, Allegheny, Armstrong, Beaver, Bedford, Blair, Butler, Cambria, Chester, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Lancaster, Lebanon, Perry, Philadelphia, Somerset, Westmoreland, and York Counties
June, 2006	Proclamation of Emergency - Flooding	Adams, Armstrong, Bedford, Berks, Blair, Bradford, Bucks, Carbon, Centre, Chester, Clinton, Columbia, Cumberland, Dauphin, Delaware, Franklin, Fulton, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Lycoming, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Pike, Potter, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne, Wyoming and York Counties
November, 2006	Proclamation of Emergency - Flooding	Bradford, Lackawanna, Luzerne, Schuylkill, Sullivan, Susquehanna, Wayne and Wyoming Counties
April, 2005	Severe Storms, Flooding, and Mudslides	Bradford, Bucks, Columbia, Lackawanna, Luzerne, Monroe, Northampton, Pike, Susquehanna, Wayne and Wyoming Counties
September, 2005 (Emergency Declaration)	Proclamation of Emergency - Hurricane Katrina	All 67 counties - Proclamation of Emergency to Render Mutual Aid and to Receive and House Evacuees
August, 2004	Multiple Storm Systems	Delaware, Montgomery and Philadelphia Counties
September, 2004	Tropical Depression Ivan	Allegheny, Armstrong, Beaver, Bedford, Blair, Bradford, Bucks, Butler, Cameron, Carbon, Centre, Chester, Clarion, Clinton, Clearfield, Columbia, Crawford, Cumberland, Dauphin, Delaware, Franklin, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lawrence, Lebanon, Lehigh, Luzerne, Lycoming, Mifflin, Monroe, Montour, Montgomery, Northampton, Northumberland, Perry, Philadelphia, Pike, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Washington, Wayne, Westmoreland, Wyoming and York Counties

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

DATE	EVENT	AFFECTED AREAS
September, 2004	Tropical Depression Frances	Bedford, Beaver, Blair, Crawford, Erie, Huntingdon, Lawrence, Warren and Washington Counties
February, 2003 (Emergency Declaration)	Severe Winter Storm	Adams, Bedford, Berks, Blair, Cambria, Carbon, Chester, Clinton, Columbia, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Juniata, Lancaster, Lebanon, Lehigh, Lycoming, Mifflin, Montour, Montgomery, Northampton, Northumberland, Perry, Philadelphia, Schuylkill, Snyder, Somerset, Union, Washington, Westmoreland, and York Counties
August, 2003	High Winds and Heavy Rains	Crawford, Forest, Lackawanna, Mercer, McKean, Potter, Tioga, Venango, Warren, Wayne and Wyoming Counties
September, 2003	Hurricane Isabel/Henri	Statewide
June, 2001	Flash Flood (Tropical Storm Allison)	Bucks, Montgomery and Berks Counties
August, 1999	Flash Flooding	McKean and Juniata Counties
September, 1999	Hurricane Floyd	All 67 counties
September, 1999	Flash Flooding (Tropical Depression Dennis)	Dauphin, Lycoming, Northumberland, Snyder and Union Counties
June, 1998	Severe Storms/Tornadoes	Allegheny, Beaver, Berks, Chester, Delaware, Lancaster, McKean, Monroe, Montgomery, Northumberland, Philadelphia, Pike, Somerset, Susquehanna, Tioga and Wyoming Counties
January, 1996	Severe Winter Storms	Adams, Allegheny, Armstrong, Beaver, Bedford, Berks, Blair, Bradford, Bucks, Cambria, Cameron, Carbon, Centre, Chester, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Delaware, Elk, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lancaster, Lebanon, Lehigh, Lycoming, Luzerne, McKean, Mifflin, Monroe, Montgomery, Montour, Northampton, Northumberland, Perry, Philadelphia, Pike, Potter, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Wayne, Westmoreland, Wyoming and York Counties - Public Assistance; All 67 counties declared for Individual Assistance
January, 1996	Flooding	All counties
June, 1996	Flooding	Adams, Beaver, Bedford, Bucks, Cambria, Crawford, Franklin and Huntingdon Counties
July, 1996	Flooding	Armstrong, Blair, Cambria, Clarion, Clearfield, Crawford, Greene, Indiana, Jefferson, Mercer and Venango Counties
September, 1996	Flooding	Cumberland, Huntingdon, Juniata, Mifflin, Montgomery and Perry Counties
November, 1996	Flooding	Tioga County
January, 1994	Severe Winter Storms	All 67 counties (Centre County also received SBA - EIDL)

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

DATE	EVENT	AFFECTED AREAS
March, 1993 (Emergency Declaration)	Blizzard	All 67 counties
May, 1986	Flood	Allegheny County
July, 1986	Flood	Lancaster County
May, 1985	Tornado	Erie, Crawford, Warren, McKean, Mercer, Venango, Forest, Butler, Beaver, Clearfield, Lycoming, Union and Northumberland Counties
September, 1985	Flood	Lackawanna, Luzerne, Susquehanna, Wayne, Wyoming and Carbon Counties
November, 1985	Flood	Allegheny, Fayette, Greene, Somerset, Washington and Westmoreland Counties
August, 1984	Flood	Armstrong, Allegheny, McKean, Westmoreland, Bedford, Blair and Somerset Counties
February, 1982	Flash Flood/ Ice Jam	Venango County (Oil City)
June, 1981	Flash Flood	Venango, Clarion, Mercer, Jefferson and Crawford Counties
June, 1980	Tornado	Armstrong and Westmoreland Counties
August, 1980	Flash Flood	Armstrong, Butler and Clarion Counties
April, 1978	Fire	Monroe County (East Stroudsburg)
January, 1977 (Emergency Declaration)	Gas Shortage/ Severe Winter Weather	Beaver, Cambria, Carbon, Clarion, Clearfield, Crawford, Erie, Fayette, Indiana, Jefferson, Lawrence, Luzerne, Mercer, Potter, Schuylkill, Somerset, Tioga, Venango, Washington, Wayne and Westmoreland Counties
July, 1977	Flash Flood	Bedford, Cambria, Clearfield, Crawford, Indiana, Jefferson, Somerset and Westmoreland Counties
July, 1976	Flood	Tioga County
October, 1976	Flood	Adams, Bradford, Columbia, Cumberland, Dauphin, Franklin, Juniata, Lackawanna, Lancaster, Lebanon, Luzerne, Mifflin, Northumberland, Perry, Schuylkill, Snyder, Sullivan, Susquehanna, Wayne, Wyoming and York Counties
September, 1975	Flood (Eloise)	Adams, Berks, Bradford, Centre, Clinton, Columbia, Cumberland, Dauphin, Franklin, Juniata, Lackawanna, Lancaster, Lebanon, Luzerne, Lycoming, Mifflin, Montour, Northampton, Perry, Potter, Schuylkill, Snyder, Sullivan, Susquehanna, Tioga, Union, Wayne, Wyoming and York Counties
August, 1974 (Emergency Declaration)	Flash Flood	Westmoreland County
July, 1973	Flood	Berks, Bucks, Chester, Columbia, Delaware, Lancaster, Monroe, Montgomery, Northampton and Wayne Counties
June, 1972	Flood (Agnes)	All 67 counties
September, 1972	Flood	Indiana County

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

DATE	EVENT	AFFECTED AREAS
September, 1971	Flood	Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties
July, 1969 (Emergency Declaration)	Flash Flood	Monroe County
August, 1969	Flood	Carbon, Monroe and Schuylkill Counties
August, 1965	Drought	Delaware River Basin
September, 1963	Drought	Numerous Communities Statewide
January, 1959	Mine Flood	Luzerne County (Pittston)
March, 1956	Flood	Warren and Venango Counties
May, 1956	Flood	Western counties
August, 1956	Flood	Beaver, Greene and Washington
August, 1955	Flood (Diane)	Northeastern counties
October, 1954	Flood (Hazel)	Southwestern counties

In addition to these Presidentially-declared disasters, 45 disaster events warranted Gubernatorial Disaster Declarations in addition to the Presidential Declarations, shown in Table 4.2.1-2.

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations

DATE	EVENT	AFFECTED AREAS
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 $2,00,000 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

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations

DATE	EVENT	AFFECTED AREAS
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
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

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations

DATE	EVENT	AFFECTED AREAS
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
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

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations

DATE	EVENT	AFFECTED AREAS
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)

Table 4.2.1-2 Pennsylvania Gubernatorial Disaster Emergency Declarations or Proclamations		
DATE	**EVENT**	**AFFECTED AREAS**
February, 1958	Heavy Snow	Berks, Bucks, Chester, Dauphin, Delaware, Lancaster, Lebanon, Lehigh, Montgomery, Northampton and York Counties and the City of Philadelphia
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 80 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**
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
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

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance

DATE	EVENT	AFFECTED AREAS
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
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

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance

DATE	EVENT	AFFECTED AREAS
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
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

Table 4.2.1-3 Pennsylvania Disaster Events Receiving Small Business Administration Loan Assistance		
DATE	**EVENT**	**AFFECTED AREAS**
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.

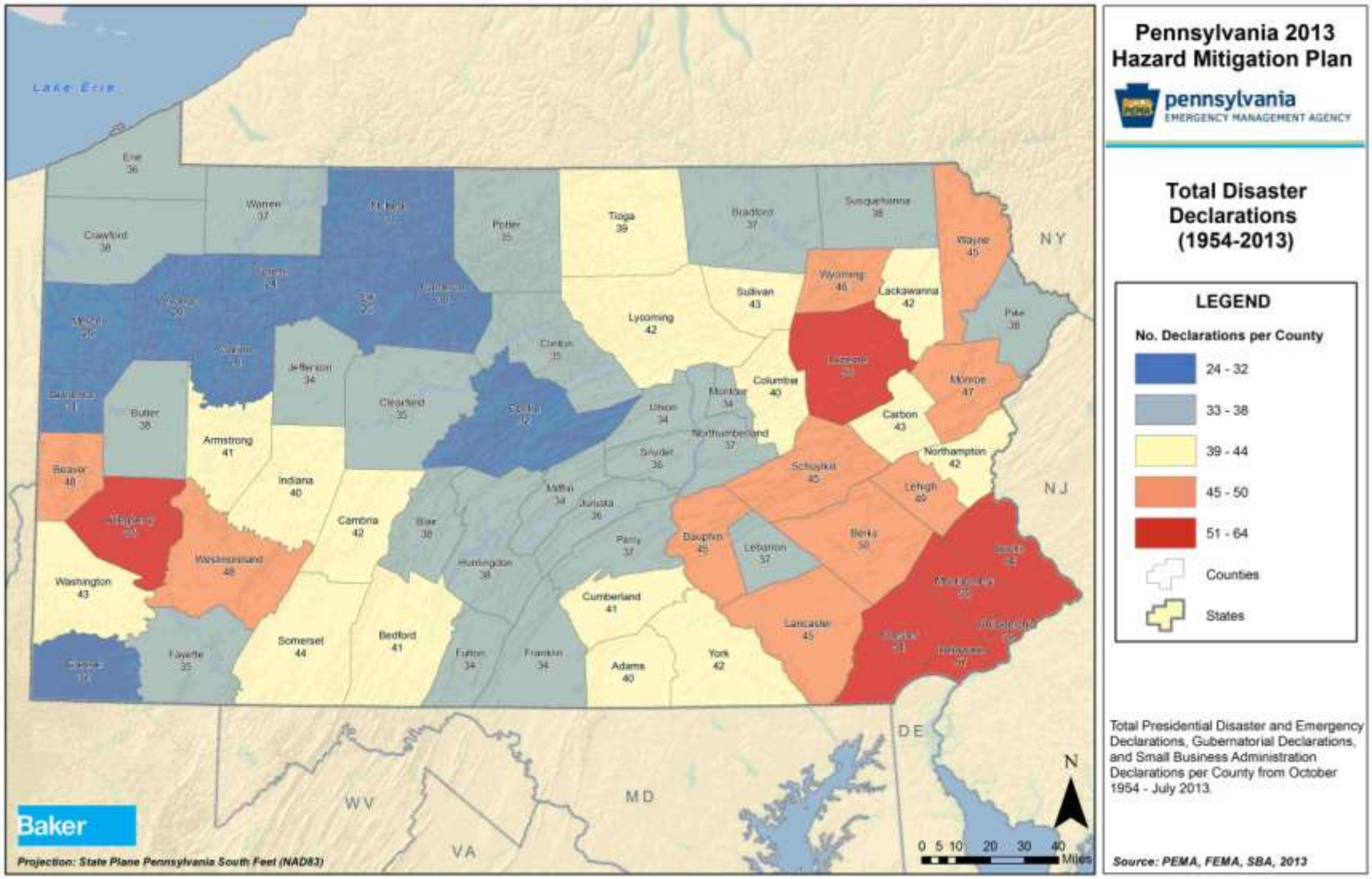
Table 4.2.1-4 Disaster events where no declaration occurred.		
DATE	**TYPE**	**AFFECTED AREAS**
June, 1980	Fire	Indiana County (Indiana Borough)
June, 1980	High Winds/Hail	York County
August, 1980	Flash Flood	Allegheny
January, 1979	Flood	Lackawanna, Lebanon, Lehigh, Luzerne, Mifflin and Montgomery Counties
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

Table 4.2.1-4 Disaster events where no declaration occurred.

DATE	TYPE	AFFECTED AREAS
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 disaster declarations have been located in the Commonwealth's most densely populated areas in the eastern half of the Pennsylvania as well as areas surrounding Pittsburgh. As was the case in 2010, Bucks County continues to have the most declared disasters with a total of 64 declarations; Allegheny, Berks, Chester, Delaware, Luzerne, Montgomery, and Philadelphia Counties have also experienced over 50 disaster declarations, as shown in Figure 4.2.1-1. Each county in Pennsylvania has experienced at least 24 declared Presidential, Gubernatorial, and/or SBA disaster declarations, with the lower numbers of declared disasters occurring in northwest and central Pennsylvania.

Figure 4.2.1-1 Total Presidential disaster declarations in Pennsylvania by county between 1954 and 2013.



4.2.2. Summary of Hazards

Using previous disaster declaration history, the 2004, 2007, and 2010 SSAHMPs, County HMPs, and input from the SPT (as described in Section 2.1), the 26 hazards selected for profiling in the 2013 SSAHMP are provided in Table 4.2.2-1 along with hazard descriptions. The Figure number for the first map where this hazard is display is provided for each mapped hazard; please note that many hazards have multiple maps found in each profile and the Table of Figures provides a comprehensive list of all maps and other figures in the SSAHMP. All hazards that were profiled in the 2010 plan were also profiled in 2013. One new hazard has been added to the Commonwealth's risk assessment: Mass Food and Animal Feed Contamination. The definitions of these hazards and the standard list of hazards for Pennsylvania was developed form the 2007 edition of the National Fire Protection Association's *NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs* in addition to hazards identified in existing HMPs in Pennsylvania; these definitions are also included in the Commonwealth of Pennsylvania's All-Hazard Mitigation Planning and Project Identification Toolkit (HM Toolkit) as an appendix to the SOG.

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
NATURAL	
Coastal Erosion 1st Map: Figure 4.3.1-1	Coastal erosion is a natural coastal process in which sediment outflow exceeds sediment inflow at a particular location. These sediments are typically transported from one location to another by wind, waves, currents, tides, wind-driven water, waterborne ice, runoff of surface waters, or groundwater seepage. Depending on the location and processes in place, coastal erosion can take place very slowly, whereby the shoreline shifts only inches to a foot per year; or more rapidly, whereby changes can exceed ten feet per year. Intense storms and human interference can result in avulsive events where large portions of a beach or dune are washed away by strong currents and large waves. With the exception of portions of Erie County, coastal erosion is not a hazard for communities in Pennsylvania. (FEMA, 1997).
Drought 1st Map: Figure 4.3.2-2	Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. This hazard is of particular concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely impact these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses. (National Drought Mitigation Center, 2006).

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
Earthquake 1st Map: Figure 4.3.3-1	An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area. Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking which is dependent upon amplitude and duration of the earthquake. (FEMA, 1997).
Extreme Temperature 1st Map: Figure 4.3.4-1 for Minimum Temp. and Figure 4.3.4-2 for Maximum Temp.	Extreme cold temperatures drop well below what is considered normal for an area during the winter months and often accompany winter storm events. Combined with increases in wind speed, such temperatures in Pennsylvania can be life threatening to those exposed for extended periods of time. Extreme heat can be described as temperatures that hover 10°F or more above the average high temperature for a region during the summer months. Extreme heat is responsible for more deaths in Pennsylvania than all other natural disasters combined (Lawrence County, PA SSAHMP,
Flood, Flash Flood, Ice Jam 1st Map: Figure 4.3.5-2	Flooding is the temporary condition of partial or complete inundation on normally dry land and it is the most frequent and costly of all hazards in Pennsylvania. Flooding events are generally the result of excessive precipitation. General flooding is typically experienced when precipitation occurs over a given river basin for an extended period of time. Flash flooding is usually a result of heavy localized precipitation falling in a short time period over a given location, often along mountain streams and in urban areas where much of the ground is covered by impervious surfaces. The severity of a flood event is dependent upon a combination of stream and river basin topography and physiography, hydrology, precipitation and weather patterns, present soil moisture conditions, the degree of vegetative clearing as well as the presence of impervious surfaces in and around flood-prone areas. (NOAA, 2009). Winter flooding can include ice jams which occur when warm temperatures and heavy rain cause snow to melt rapidly. Snow melt combined with heavy rains can cause frozen rivers to swell, which breaks the ice layer on top of a river. The ice layer often breaks into large chunks, which float downstream, piling up in narrow passages and near other obstructions such as bridges and dams. All forms of flooding can damage infrastructure (USACE, 2007).

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
Hailstorm 1st Map: Figure 4.3.6-1	In addition to flooding and severe winds, hail is another potential damaging product of severe thunderstorms. Hailstorms occur when ice crystals form within a low pressure front due to the rapid rise of warm air into the upper atmosphere and the subsequent cooling of the air mass. 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 greater than 0.75 inches in diameter (FEMA, 1997). The size of hailstones is a direct function of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft is a function of the intensity of heating at the Earth's surface. Damage to crops and vehicles are typically the most significant impacts of hailstorms. Areas in eastern and central Pennsylvania typically experience less than 2 hailstorms per year while areas in western Pennsylvania experience 2-3 annually.
Hurricane, Tropical Storm, Nor'easter 1st Map: Figure 4.3.7-2	Hurricanes, tropical storms, and nor'easters are classified as cyclones and are any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise (in the Northern Hemisphere) and whose diameter averages 10-30 miles across. While most of Pennsylvania is not directly affected by the devastating impacts cyclonic systems can have on coastal regions, many areas in the state are subject to the primary damaging forces associated with these storms including high-level sustained winds, heavy precipitation, and tornadoes. Areas in southeastern Pennsylvania could be susceptible to storm surge and tidal flooding. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season (June through November). (FEMA, 1997).
Invasive Species	An invasive species is a species that is not indigenous to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These species can be any type of organism: plant, fish, invertebrate, mammal, bird, disease, or pathogen. Infestations may not necessarily impact human health, but can create a nuisance or agricultural hardships by destroying crops, defoliating populations of native plant and tree species, or interfering with ecological systems (Governor’s Invasive Species Council of Pennsylvania, 2009).
Landslide 1st Map: Figure 4.3.9-1	A landslide is the downward and outward movement of slope-forming soil, rock, and vegetation reacting to the force of gravity. Landslides may be triggered by both natural and human-caused changes in the environment, including heavy rain, rapid snow melt, steepening of slopes due to construction or erosion, earthquakes, and changes in groundwater levels. Mudflows, mudslides, rockfalls, rockslides, and rock topples are all forms of a landslide. Areas that are generally prone to landslide hazards include previous landslide areas, the bases of steep slopes, the bases of drainage channels, developed hillsides, and areas recently burned by forest and brush fires. (Delano & Wilshusen, 2001).

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
Lightning Strike 1st Map: Figure 4.3.10-1	Lightning is a discharge of electrical energy resulting from the build-up of positive and negative charges within a thunderstorm. The flash or "bolt" of light usually occurs within clouds or between clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000°F. On average, 89 people are killed each year by lightning strikes in the United States. Within Pennsylvania, the annual average number of thunder and lightning events a given area can expect ranges between 40-70 events per year (FEMA, 1997).
Pandemic and Infectious Disease	A pandemic occurs when infection from of a new strain of a certain disease, to which most humans have no immunity, substantially exceeds the number of expected cases over a given period of time. Such a disease may or may not be transferable between humans and animals. (Martin & Martin-Granel, 2006).
Radon Exposure 1st Map: Figure 4.3.12-2	Radon is a cancer-causing natural radioactive gas that you can't see, smell, or taste. It is a large component of the natural radiation that humans are exposed to and can pose a serious threat to public health when it accumulates in poorly ventilated residential and occupation settings. According to the EPA, radon is estimated to cause about 21,000 lung cancer deaths per year, second only to smoking as the leading cause of lung cancer (EPA 402-R-03-003: EPA Assessment…, 2003). An estimated 40% of the homes in Pennsylvania are believed to have elevated radon levels (Pennsylvania Department of Environmental Protection, 2009).
Subsidence, Sinkhole 1st Map: Figure 4.3.13-1	Subsidence is a natural geologic process that commonly occurs in areas with underlying limestone bedrock and other rock types that are soluble in water. Water passing through naturally occurring fractures dissolves these materials leaving underground voids. Eventually, overburden on top of the voids causes a collapse which can damage structures with low strain tolerances. This collapse can take place slowly over time or quickly in a single event, but in either case. Karst topography describes a landscape that contains characteristic structures such as sinkholes, linear depressions, and caves. In addition to natural processes, human activity such as water, natural gas, and oil extraction can cause subsidence and sinkhole formations. (FEMA, 1997).

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
Tornado, Wind Storm 1st Map: Figure 4.3.14-1	A wind storm can occur during severe thunderstorms, winter storms, coastal storms, or tornadoes. Straight-line winds such as a downburst have the potential to cause wind gusts that exceed 100 miles per hour. Based on 40 years of tornado history and over 100 years of hurricane history, FEMA identifies western and central Pennsylvania as being more susceptible to higher winds than eastern Pennsylvania. (FEMA, 1997). A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touch down briefly, but even small, short-lived tornadoes can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size, and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Waterspouts are weak tornadoes that form over warm water and are relatively uncommon in Pennsylvania. Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002). Based on NOAA Storm Prediction Center Statistics, the number of recorded F3, F4, & F5 tornadoes between 1950-1998 ranges from <1 to 15 per 3,700 square mile area across Pennsylvania (FEMA, 2009). A water spout is a tornado over a body of water (American Meteorological Society, 2009).
Wildfire 1st Map: Figure 4.3.15-2	A wildfire is a raging, uncontrolled fire that spreads rapidly through vegetative fuels, exposing and possibly consuming structures. Wildfires often begin unnoticed and can spread quickly, creating dense smoke that can be seen for miles. Wildfires can occur at any time of the year, but mostly occur during long, dry hot spells. Any small fire in a wooded area, if not quickly detected and suppressed, can get out of control. Most wildfires are caused by human carelessness, negligence, and ignorance. However, some are precipitated by lightning strikes and in rare instances, spontaneous combustion. Wildfires in Pennsylvania can occur in fields, grass, brush, and forests. 98% of wildfires in Pennsylvania are a direct result of people, often caused by debris burns (PA DCNR, 1999).
Winter Storm 1st Map: Figure 4.3.16-1	Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility and disrupt transportation. The Commonwealth of Pennsylvania has a long history of severe winter weather. (NOAA, 2009).
HUMAN-MADE	

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.	
PROFILED HAZARDS	**DESCRIPTION**
Civil Disturbance	Civil disturbance hazards encompass a set of hazards emanating from a wide range of possible events that cause civil disorder, confusion, strife, and economic hardship. Civil disturbance hazards include the following: • **Famine**; involving a widespread scarcity of food leading to malnutrition and increased mortality (Robson, 1981). • **Economic Collapse, Recession**; Very slow or negative growth, for example (Economist, 2009). • **Misinformation**; erroneous information spread unintentionally (Makkai, 1970). • **Civil Disturbance, Public Unrest, Mass Hysteria, Riot**; group acts of violence against property and individuals, for example (18 U.S.C. § 232, 2008). • **Strike, Labor Dispute**; controversies related to the terms and
Dam Failure 1st Map: Figure 4.3.18-1	A dam is a barrier across flowing water that obstructs, directs, or slows down water flow. Dams provide benefits such as flood protection, power generation, drinking water, irrigation, and recreation. Failure of these structures results in an uncontrolled release of impounded water. Failures are relatively rare, but immense damage and loss of life is possible in downstream communities when such events occur. Aging infrastructure, hydrologic, hydraulic and geologic characteristics, population growth, and design and maintenance practices should be considered when assessing dam failure hazards. The failure of the South Fork Dam, located in Johnstown, PA, was the deadliest dam failure ever experienced in the United States. It took place in 1889 and resulted in the Johnstown Flood which claimed 2,209 lives (FEMA, 1997). Today there are approximately 3,200 dams and reservoirs throughout Pennsylvania (Pennsylvania Department of Environmental Protection, 2009).
Environmental Hazards 1st Map: Figure 4.3.19-1 for Coal, Figure 4.3.19-3 for Conventional Wells, and Figure 4.3.19-4 for Un-conventional Wells	Environmental hazards are hazards that pose threats to the natural environment, the built environment, and public safety through the diffusion of harmful substances, materials, or products. For the purposes of the SSAHMP, environmental hazards include the following: • **Hazardous material releases** at fixed facilities or in transit; including toxic chemicals, infectious substances, biohazardous waste, and any materials that are explosive, corrosive, flammable, or radioactive (PL 1990-165, § 207(e)). • **Coal mining incidents**; including the release of the release of harmful chemical and waste materials into water bodies or the atmosphere, explosions, fires, and other hazards and threats to life safety stemming from mining (Environmental Protection Agency, Natural Disaster PSAs, 2009). • **Oil and gas well incidents**; including the release of the release of harmful chemical and waste materials into water bodies or the atmosphere, explosions, fires, and other other hazards and threats to life safety stemming from oil and gas extraction(Environmental Protection Agency, Natural Disaster PSAs, 2009).

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
Levee Failure 1st Map: Figure 4.3.20-1	A levee is a human-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding (Interagency Levee Policy Review Committee, 2006). Levee failures or breaches occur when a levee fails to contain the floodwaters for which it is designed to control or floodwaters exceed the height of the constructed levee. 51 of Pennsylvania's 67 counties have been identified as having at least one levee (FEMA Region III, 2013).
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, 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. 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 (CDC, 2013). Contamination usually occurs accidentally during the production/preparation process but can also be the result of intentional acts.
Nuclear Incident 1st Map: Figure 4.3.22-1	Nuclear incidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public to radiation (FEMA, 1997). Nuclear accidents/incidents can be placed into three categories: 1) Criticality accidents which involve loss of control of nuclear assemblies or power reactors, 2) Loss-of-coolant accidents which result whenever a reactor coolant system experiences a break or opening large enough so that the coolant inventory in the system cannot be maintained by the normally operating make-up system, and 3) Loss-of-containment accidents which involve the release of radioactivity. The primary concern following such an incident or accident is the extent of radiation, inhalation, and ingestion of radioactive isotopes which can cause acute health effects (e.g. death, burns, severe impairment), chronic health effects (e.g. cancer), and psychological effects. (FEMA, 1997).
Terrorism	Terrorism is use of force or violence against persons or property with the intent to intimidate or coerce. Acts of terrorism include 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). Increasingly, cyber-attacks have become a more pressing concern for governments across America.

Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
Transportation Accident 1st Map: Figure 4.3.24-1	Transportation accidents can result from any form of air, rail, water, or road travel. It is unlikely that small accidents would significantly impact the larger community. However, certain accidents could have secondary regional impacts such as a hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are present. (Research and Innovative Technology Administration, 2009). Traffic congestion in certain circumstances can also be hazardous. Traffic congestion is a condition that occurs when traffic demand approaches or exceeds the available capacity of the road network. This hazard should be carefully evaluated during emergency planning since it is a key factor in timely disaster or hazard response, especially in areas with high population density. (Federal Highway Administration, 2009).
Urban Fire and Explosion 1st Map: Figure 4.3.25-1	An urban fire involves a structure or property within an urban or developed area. For hazard mitigation purposes, major urban fires involving large buildings and/or multiple properties are of primary concern. The effects of a major urban fire include minor to significant property damage, loss of life, and residential or business displacement. Explosions are extremely rapid releases of energy that usually generate high temperatures and often lead to fires. The risk of severe explosions can be reduced through careful management of flammable and explosive hazardous materials. (FEMA, 1997).

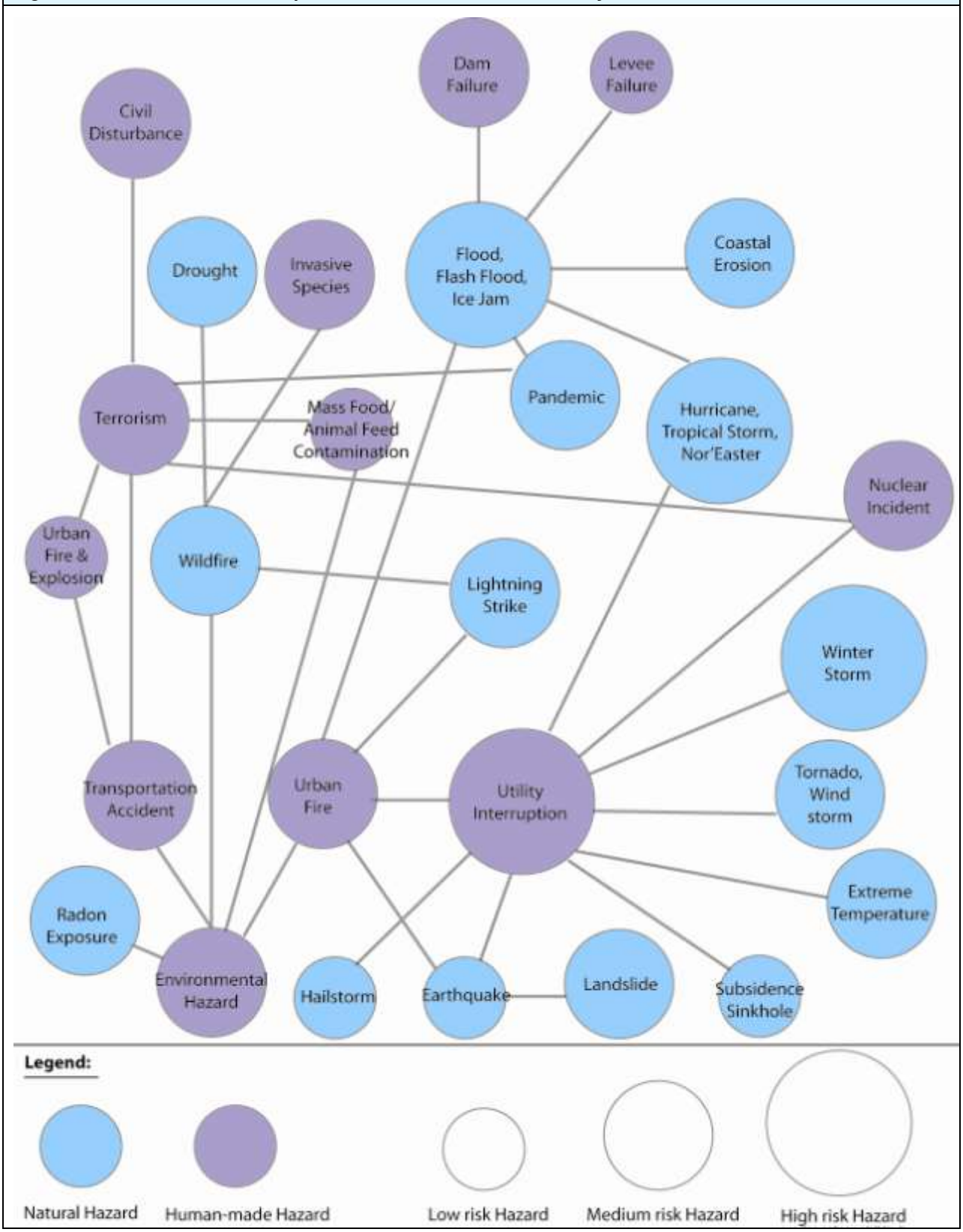
Table 4.2.2-1 List of hazards profiled in the 2013 Pennsylvania SSAHMP with associated descriptions.

PROFILED HAZARDS	DESCRIPTION
Utility Interruption Liquid Pipeline Figure 4.3.26-1Gas Pipeline Figure 4.3.26-2	Utility interruption hazards are hazards that impair the functioning of important utilities in the energy, telecommunications, public works, and information network sectors. Utility interruption hazards include the following: • **Geomagnetic Storms**; including temporary disturbances of the Earth's magnetic field resulting in disruptions of communication, navigation, and satellite systems (National Research Council et al., 1986). • **Fuel or Resource Shortage**; resulting from supply chain breaks or secondary to other hazard events, for example (Mercer County, PA, 2005). • **Electromagnetic Pulse**; originating from an explosion or fluctuating magnetic field and causing damaging current surges in electrical and electronic systems (Institute for Telecommunications Sciences, 1996). • **Information Technology Failure**; due to software bugs, viruses, or improper use (Rainer Jr., et al, 1991). • **Ancillary Support Equipment**; electrical generating, transmission, system-control, and distribution-system equipment for the energy industry (Hirst & Kirby, 1996). • **Public Works Failure**; damage to or failure of highways, flood control systems, deepwater ports and harbors, public buildings, bridges, dams, for example (United States Senate Committee on Environment and Public Works, 2009). • **Telecommunications System Failure**; Damage to data transfer, communications, and processing equipment, for example (FEMA, 1997) • **Transmission Facility or Linear Utility Accident**; liquefied natural gas leakages, explosions, facility problems, for example (United States Department of Energy, 2005)

Several hazards including avalanche; building or structure collapse; disorientation; drowning; dust and sand storm; expansive soils; tsunami; volcano; and war and criminal activity were not profiled in 2004, 2007, or 2010. Each of these hazards either overlapped significantly with hazards profiled (e.g. building or structure collapse and war and criminal activity) or were not considered by the SPT to have notable effects on the Commonwealth. The SPT also determined that a number of new or emerging concerns, like internet interruption, cyber-attacks, and lock failures should be added as components of existing hazard profiles, and that climate change should be discussed in the SSAHMP as an exacerbating or contributing factor to a number of hazards.

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 4.2.2-2 Inter-relationships between hazard events in Pennsylvania.



An overview of potential losses for vulnerable structures can be garnered from Table 4.2.2-2. This table represents all hazards identified in the 2013 SSAHMP. Specifically, the table provides a snapshot of the number of structures potentially at risk from a hazard and the estimated costs to replace those structures. It is important to note that while entire building estimates were used to estimate loss, entire buildings are seldom destroyed by disasters unless catastrophic events were to occur. Therefore Table 4.2.2-2 tends to err on the side of overestimating damage so that mitigation is prioritized. Planning for catastrophic loss allows for better preparedness for less than catastrophic loss.

It is also important to note that due to the diversity of hazards being profiled, not all hazards were able to identify clear-cut vulnerable structures or obtain potential building replacement costs (i.e. Pandemic). A summary of the methodology in identifying potential losses to vulnerable structures is presented in the table; additional detail regarding the analysis is available in each hazard profile in Section 4.3. Hazards containing sub-hazards were listed separately since the loss estimation analysis was different for each (i.e. Environmental Hazards).

Please note that the values obtained for critical facilities and the methodology for obtaining building exposure values for jurisdictional loss estimates was presented in Section 4.1. For a complete analysis of a structure's vulnerability and potential loss to a hazard, the individual hazard profile should be examined.

Table 4.2.2-2 Overview of vulnerable structures and loss estimates per hazard.

HAZARDS	POTENTIAL CRITICAL FACILITIES IMPACTED	POTENTIAL BUILDINGS IMPACTED	STATE LOSS ESTIMATES (REPLACEMENT VALUE)	JURISDICTIONAL LOSS ESTIMATES (VALUE OF BUILDING EXPOSURE)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Civil Disturbance	47	1,649,201	$1,753,675,818	$421,669,048,000	Brick-and-mortar facilities classified as Government Facilities or National Monuments and Icons were chosen for state facility loss estimation. Because of their national, state and regional importance and based on frequent targets of civil unrest, structures located in Philadelphia, Allegheny and Dauphin counties were considered most vulnerable for jurisdictional loss estimates.
Coastal Erosion	0	265	$0	$65,702,800	Structures and critical facilities located within the 100-year Bluff Recession Hazard Areas defined by DEP's Coastal Zone Management Program and Erie County.
Dam Failure	*NA*	*NA*	*NA*	*NA*	Not enough information to provide a logical analysis.
Drought	106	*NA*	*NA*	$5,808,803,000*	*Because drought primarily impacts agricultural production, jurisdiction loss estimates based off of the market value of all agricultural products, not structures. Critical facilities most vulnerable are those in the agriculture sector.
Earthquake	2,924	5,117,233	$19,762,562,079	$1,369,615,349,000	Brick-and-mortar structures within the "moderate" earthquake zone of Pennsylvania or within 17.5 feet of a historical earthquake epicenter.
Environmental Hazards (Coal Mine Incidents)	*1478*	1,201,095	$11,178,301,357	$256,170,362,000	Brick-and-mortar structures located within 1.5 miles of an active or abandoned coal mine.
Environmental Hazards (HazMat Releases)	4983	4,705,231	$35,843,635,910	$1,203,857,553,000	Brick-and-mortar structures located within one quarter mile of major Interstate, U.S., and Pennsylvania highways and rail lines and within 1.5 miles of hazardous materials sites extracted from CDMS.

Table 4.2.2-2 Overview of vulnerable structures and loss estimates per hazard.

HAZARDS	POTENTIAL CRITICAL FACILITIES IMPACTED	POTENTIAL BUILDINGS IMPACTED	STATE LOSS ESTIMATES (REPLACEMENT VALUE)	JURISDICTIONAL LOSS ESTIMATES (VALUE OF BUILDING EXPOSURE)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Environmental Hazards (Conventional Oil & Gas Well Incidents)	1,183	1,339,654	$10,221,885,008	$289,281,688	Brick-and-mortar structures located within 1000 yards of an active or abandoned conventional oil or gas well.
Environmental Hazards (Marcellus/Other Shale Oil & Gas Well Incidents)	77	116,434	$713,482,640	$22,967,280,000	Brick-and-mortar structures located within 1000 yards of an active, inactive, or plugged unconventional oil or gas well.
Extreme Temperature (Cold)	961	587,380	$2,638,974,248	$112,592,068,000	Brick-and-mortar structures located in zones experiencing an average minimum temperature of below 35 degrees
Extreme Temperature (Heat)	979	1,079,439	$2,267,740,062	$292,785,458,000	Brick-and-mortar structures located in zones experiencing an average maximum temperature above 64 degrees.
Flood, Flash Flood, Ice Jam	370	627,772	$1,853,267,443	$155,197,631,000	Brick-and-mortar structures falling within the 1%-Annual-Chance-Flood zone.
Hailstorm	106	NA	$19,757,877	$5,808,803,000*	*Because hailstorms primarily impact agricultural production, jurisdiction loss estimates based off of the market value of all agricultural products, not structures. Critical facilities most vulnerable are those in the agriculture sector, include both food growers and food manufacturers.
Hurricane, Tropical Storm, Nor'easter	1,161	3,046,561	$6,867,999,216	$892,769,009,000	Brick-and-mortar structures falling within the 12 & 18 percent hurricane probability zones.
Invasive Species	106	NA	$19,757,877	$5,808,803,000*	*Because invasive species primarily impact agricultural production, jurisdiction loss estimates based off of the market value of all agricultural products, not structures. Critical facilities most vulnerable are those in the agriculture sector.

Table 4.2.2-2 Overview of vulnerable structures and loss estimates per hazard.

HAZARDS	POTENTIAL CRITICAL FACILITIES IMPACTED	POTENTIAL BUILDINGS IMPACTED	STATE LOSS ESTIMATES (REPLACEMENT VALUE)	JURISDICTIONAL LOSS ESTIMATES (VALUE OF BUILDING EXPOSURE)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Landslide	3,211	3,291,555	$24,789,223,523	$746,357,246,000	Brick-and-mortar structures located within 'Combo-High' and 'High' zones of landslides as defined by USGS.
Levee Failure	288	138,872	$1,559,284,911	$32,344,645,000	Brick-and-mortar structures and Critical Facilities located within a 2,000 foot buffer from a Levee or in a levee protected area (Please see Section 4.3.20 for further discussion on why a buffer methodology was selected).
Lightning Strike	1,631	2,739,805	$10,692,310,083	$827,223,054,000	Brick-and-mortar structures located within counties having the highest number of lightning events during the years 1950-2013.
Mass Food and Animal Feed Contamination	NA	NA	NA	NA	Not enough information to provide a logical analysis.
Nuclear Incident	299	417,774	$1,819,008,224	$114,542,145,000	Brick-and-mortar structures located within the 10-mile EPZ. Additionally, food and agriculture critical facilities located within the 50-mile EPZ, where radiation does not harm buildings but can contaminate food.
Pandemic and Infectious Disease	NA	NA	NA	NA	Not enough information to provide a logical analysis.
Radon Exposure	5,674	1,568,036	$6,800,000	$1,881,643,440,000	Brick-and-mortar structures within zip codes with average radon readings of greater than 4pCi/L. Used average radon mitigation system cost of $1,200 and applied it to 20% of the buildings.
Subsidence, Sinkhole	803	811,610	$6,262,828,204	$195,193,657,000	Brick-and-mortar structures located on top of limestone and carbonite bedrock areas.
Terrorism	NA	NA	NA	NA	Not enough information to provide a logical analysis.

Table 4.2.2-2 Overview of vulnerable structures and loss estimates per hazard.

HAZARDS	POTENTIAL CRITICAL FACILITIES IMPACTED	POTENTIAL BUILDINGS IMPACTED	STATE LOSS ESTIMATES (REPLACEMENT VALUE)	JURISDICTIONAL LOSS ESTIMATES (VALUE OF BUILDING EXPOSURE)	METHODOLOGY FOR IDENTIFYING VULNERABLE STRUCTURES AND POTENTIAL LOSSES
Tornado & Wind Storm	4,320	6,127,881	$32,255,517,320	$1,579,087,105,000	Brick-and-mortar structures located within a 5-mile buffer from historic tornado touchdown locations (F1 or greater).
Transportation Accident (air)	5,300	7,147,553	$40,551,632,447	$1,840,809,772,000	Brick-and-mortar structures falling within five miles of both public and private airports and heliports with at least one runway.
Transportation Accident (highway)	3,500	2,237,617	$22,476,249,752	$571,392,096,000	Brick-and-mortar structures located within one quarter mile of Interstate and U.S. Highways.
Transportation Accident (rail)	2,190	1,691,825	$12,776,400,116	$426,615,724,000	Brick-and-mortar structures located within one quarter mile of rail lines.
Urban Fire and Explosion	1,879	2,464,194	$14,260,359,516	$620,706,349,000	Vulnerability thresholds for Pennsylvania counties densities that also have more than 60% percent or more of residential structures older than 50 years.
Utility Interruption	6,061	NA	$47,153,872,495	NA	While unlikely that a utility interruption would cause damage to a critical facility beyond a short-term loss in power, HVAC systems, and/or productivity, the total replacement cost of all state critical facilities was chosen.
Wildfire	1,538	3,304,698	$9,464,720,342	$866,027,399,000	Brick-and-mortar structures located within High 'Hazard" Risk wildfire municipalities.
Winter Storm	345	424,799	$2,675,883,338	$90,144,883,000	Brick-and-mortar structures located in zones averaging over 70 inches of snow per year.

The hazard with the most critical facilities impacted was utility interruption, which may potentially impact all of the critical facilities, though unlikely to impact them all at once or force their complete replacement. Similarly, the hazard with the second highest number of critical facilities potentially impacted is radon exposure, approximately 94% of all critical facilities. However, radon exposure does not force as high a replacement cost the average cost of a mitigation system according to the EPA is only Additional hazards capturing higher concentrations of critical facilities are radon exposure, hazardous materials releases (Environmental Hazard), Tornados and Earthquakes, all with over 5,000 facilities. With the exception of radon exposure, all of the previously mentioned hazards having higher critical facility counts had the highest replacement value estimates for critical facilities.

The analysis does seem to indicate that, in general, the greater the number of facilities exposed to a hazard, so too are the costs associated towards that structure should it be impacted. In terms of overall structures potentially impacted, air accidents, hazardous materials releases, and tornado and windstorms round out the top five hazards with the potential to impact critical facilities the most. All three of the transportation accident types having high numbers of impacted structures and high loss estimates indicate that the transportation network within Pennsylvania traverses through more urbanized areas, where higher concentrations of people and structures exist.

DCED's State Land Use and Growth Management Reports indicate that a comparison of Pennsylvania's land use/land cover data with major surface transportation features reveals a striking relationship between suburban and rural development patterns and highways. These development patterns radiate outward from core urban hubs along major transportation corridors, demonstrating the cause-effect relationship between land use and highway transportation systems. Notable hub-and-spoke development patterns are clearly visible around Pittsburgh, Philadelphia, Harrisburg, Lancaster, York, Williamsport, Allentown-Bethlehem-Easton, Scranton/Wilkes-Barre, Reading, Altoona and Johnstown. This appears to be the correlation for such high vulnerability associated with the Transportation Accidents hazard.

4.3. Hazard Profiles and Vulnerability Analysis NATURAL HAZARDS

4.3.1. Coastal Erosion

4.3.1.1. Location and Extent

There are two areas in Pennsylvania which are subject to potential coastal erosion hazards; the Lake Erie and Delaware River shorelines (Figure 4.3.1-1). The Lake Erie shoreline in Pennsylvania stretches 76.6 miles across the northern border of Erie County. It includes the highest bluffs anywhere on the Lake Erie shore and Presque Isle, the only significant coastal depositional feature on the south shore of the lake. Presque Isle 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 in front of bluffs, five to one hundred-eighty feet high (PADEP, 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.

The Delaware River is tidally influenced from the southern reaches of Delaware County, PA to Trenton, NJ (a distance of approximately 135 miles) and is therefore subject to coastal or wetland erosion. However, 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. While detailed structure inventories have not been performed, these structures greatly reduce erosion hazards along most of the Delaware River shoreline. Lake Erie is the area of primary concern for coastal erosion hazards and is therefore the focus of the risk assessment.

Figure 4.3.1-1 Map identifying areas where coastal erosion hazards are present in Pennsylvania (ESRI, 2010).

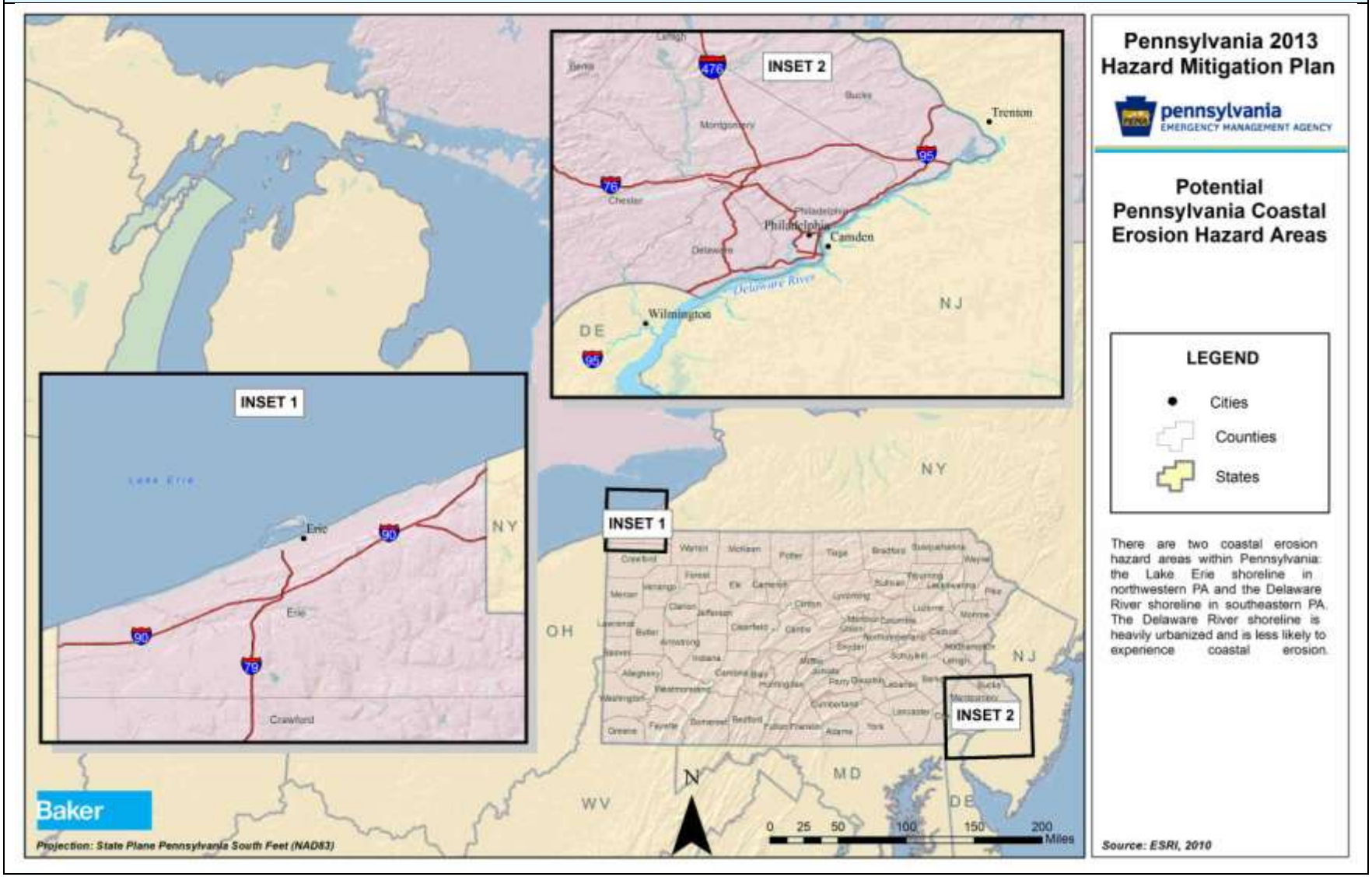
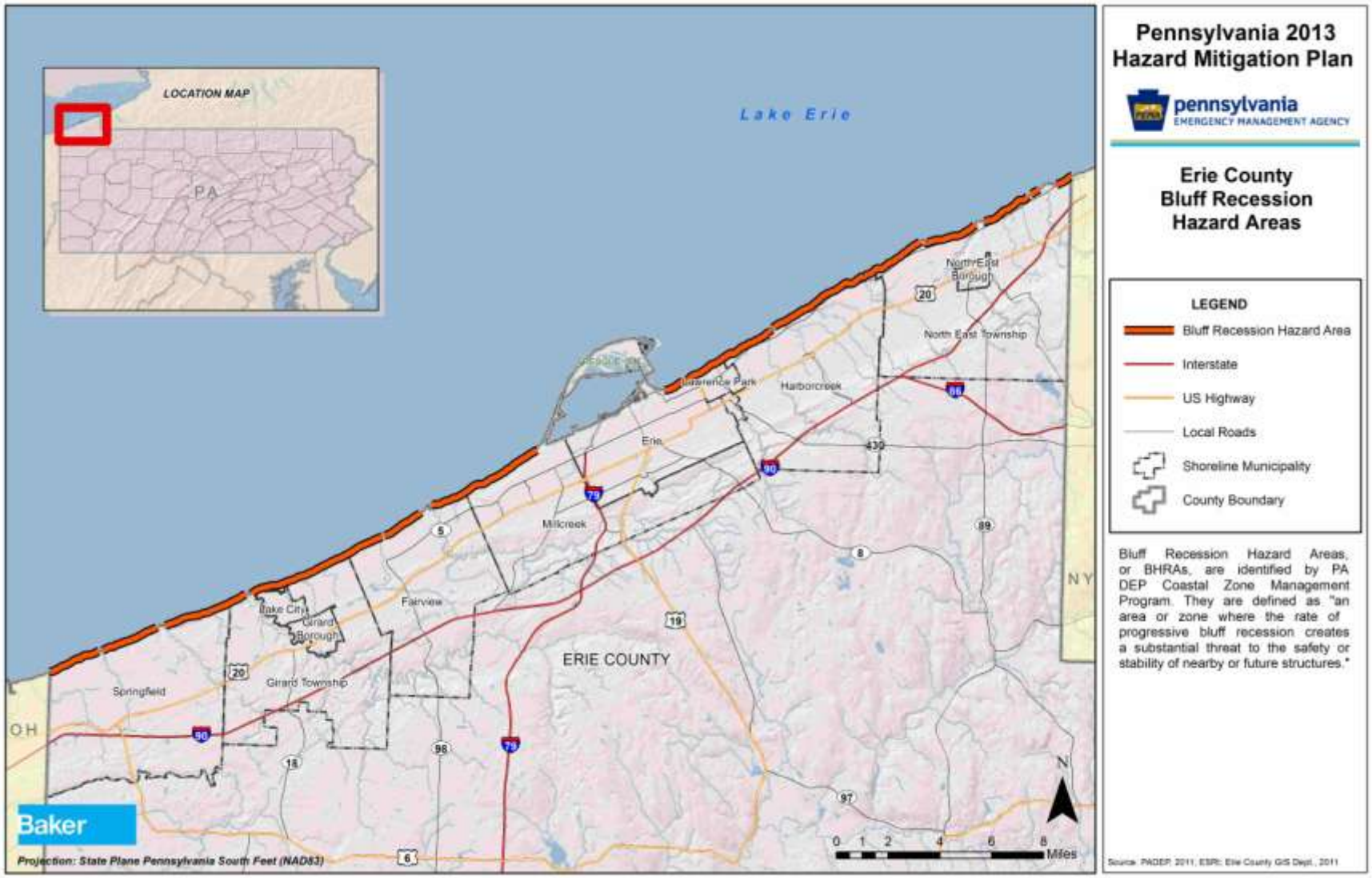


Figure 4.3.1-2 identifies Bluff Recession Hazard Areas (BRHAs) identified by the Pennsylvania Department of Environmental Protection Coastal Zone Management Program. BRHAs are defined in Section 3 of the Bluff Recession and Setback Act as "an area or zone where the rate of progressive bluff recession 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* (PADEP, 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 (PADEP, 2011).

The BRHAs determine where along the shoreline development will be subject to Minimum Bluff Setback Distances. Sections of shoreline which 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 4.3.1-2 Bluff Recession Hazard Areas along the Lake Erie Shoreline (PADEP, 2011)

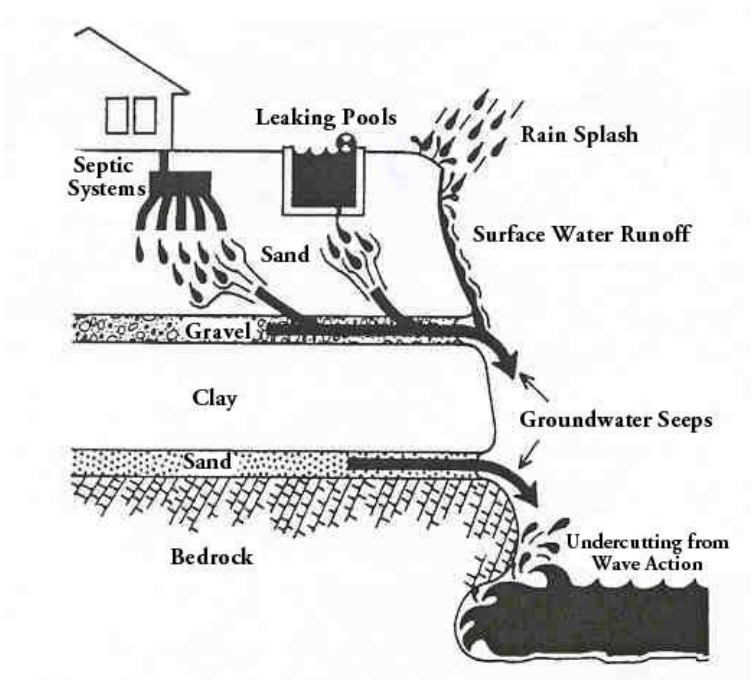


4.3.1.2. Range of Magnitude

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, but other factors that affect rate of change include surrounding land use, storm impacts, vegetative cover, soil type, depth of unconsolidated soils, hydrology, bedrock geology, slope gradient, offshore bathymetry and human activity. Figure 4.3.1-3 illustrates both the natural and human-induced processes which influence bluff recession rates of change.

Bluff instability often occurs as a result of 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. Erosion of the bluffs may be accelerated by groundwater seepage, surface water runoff, and human activity or changes in land use that would alter the hydrology or vegetation on a site.

Figure 4.3.1-3 Diagram showing many of the natural and human-induced processes which influence result in coastal erosion along the Lake Erie shoreline.



In beach and dune areas such as Presque Isle, wind-driven waves, especially during periods of high lake levels, can inundate natural protective beaches and allow water and damaging waves to reach the back beach areas. During prolonged periods of inundation, large quantities of beach material can be moved offshore. It is during these periods that the greatest threat of property damage and site instability occurs.

Much of Lake Erie and its beaches and bluffs are frozen during winter, inhibiting the formation of storm waves and reducing erosion. However, during ice formation in early winter and during the spring thaw, ice processes can accelerate erosion and recession. The spring rains, snowmelt,

and low evaporation rates cause Lake Erie's average water level in June to be more than 30 centimeters 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.

Lake Erie is the shallowest of the Great Lakes, reaching a maximum depth of 210 feet in the eastern basin. The lake topography coupled with changing water levels can have extreme effects on the shoreline. Because the lake is shallow, the effects of storm driven waves are amplified. The axis of the lake runs from southwest to northeast, corresponding to the direction of prevailing winds. Strong winds can push water toward one end of Lake Erie (setup) and may create a difference in elevation of over 15 feet. When the wind stops, the water will rebound creating a seiche effect which causes the water to move back and forth across the lake. Strong winds or northeasters can also be a problem, driving storm waves opposite of their normal path. Elevated water levels associated with these seiche events can result in significant erosion events.

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 and south of designated hazard areas can result in damage or complete destruction of property and public infrastructure as well as threats public health and safety. 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, dating back to the 1970s. Figure 4.3.1-5 shows an example of a collapsed retaining structure.

Figure 4.3.1-4 Photograph of large avulsive event along the Lake Erie, PA shoreline (USGS, 2009 and the Pennsylvania Coastal Resource Management Program.

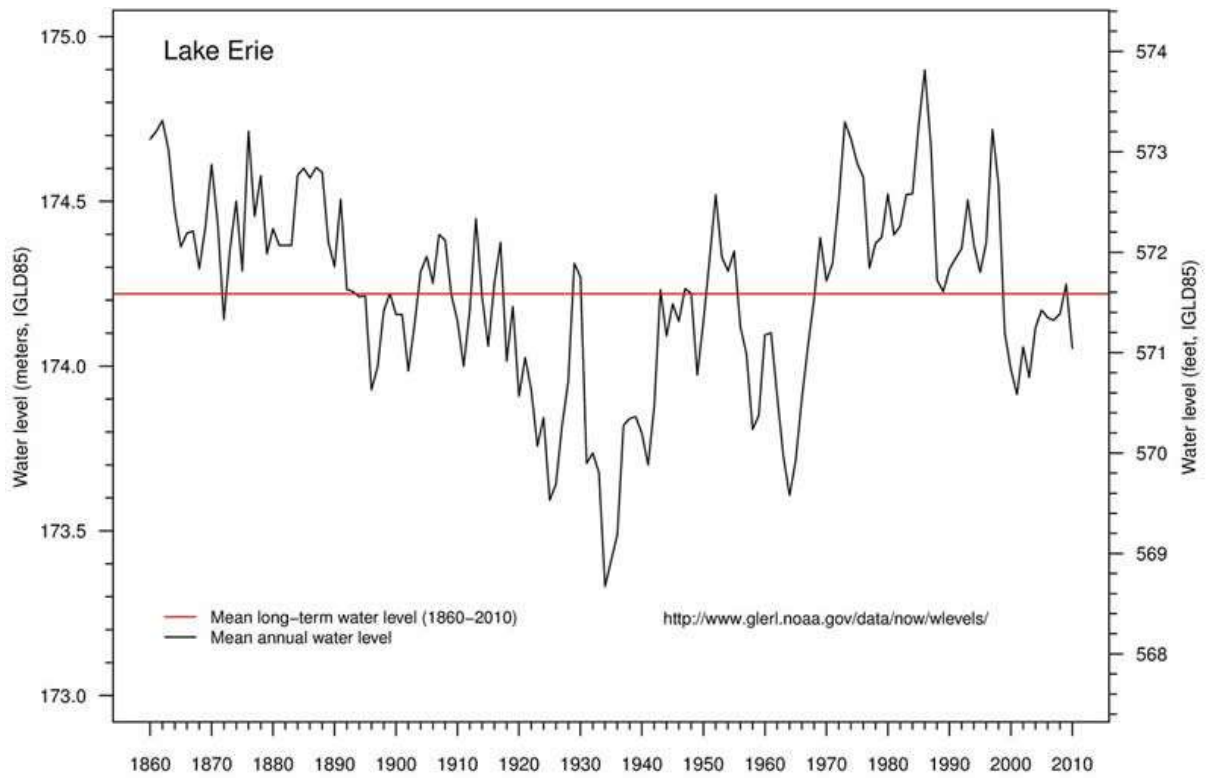
Figure 4.3.1-5 Photograph of collapsed retaining wall structure along the Lake Erie, PA shoreline (PADEP, 2011).

A cycle of bluff erosion generally begins with high lake levels and direct wave erosion of the base of the bluff. This steepens the total bluff profile, and a variety of mass movement processes lead to progressive failure of the upper bluff face. These are basically landslide processes and include topple and fall of blocks of jointed diamict, liquefaction and flow of well-sorted silts and sands, and slump of blocks of sediment held together by tree roots. Groundwater seepage from the face of the bluff is an important factor in many of the bluff-face processes. Grain-by-grain erosion of sand and silt in some cases leads to development of large soil pipes. These can be twenty feet in diameter and can extend into the bluff face for tens of feet. When the roof of a pipe collapses, large embayments in the top of the bluff result.

Accumulation of material at the toe of the bluff provides some protection from further retreat at the toe, but the colluvial sediment can be quickly removed by storm waves at times of high lake level. Significant erosional waves typically occur during spring and fall storms. Winter storms may have more energy, but ice build-up protects the shore from erosion.

Lake levels significantly influence erosion and bluff recession rates. Periods of rising lake levels resulted in increased erosion rates. Glacial isostatic rebound may still be a small factor in changing lake levels, but most modern lake-level changes are attributable to climatic factors. Long-term changes are caused by variations in precipitation and evapo-transpiration rates. Figure 4.3.1-6 shows average annual lake levels for the period 1860-2010. Lake levels have varied on the order of five feet over this time period. The droughts of the 1930's and 1960's are clearly reflected in the lake levels. Between 1987 and 1989, the lake level dropped to near its long-term average. An annual cycle and short-term changes related to weather also affect the lake level.

Figure 4.3.1-6 Lake Erie water levels between 1860 and 2009 (NOAA GLERL, 2011).

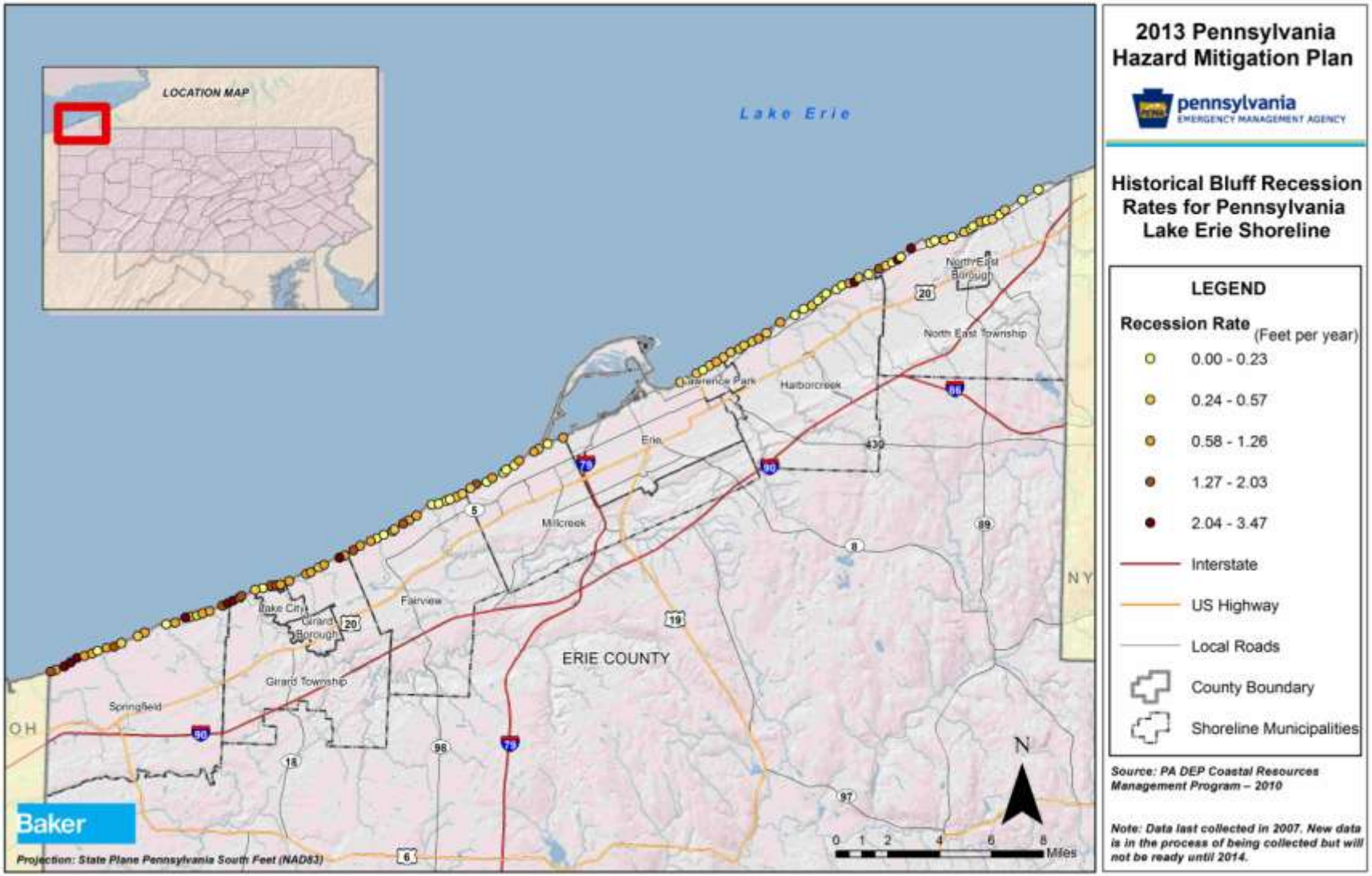


The most severe erosion events occur when lake levels are at their highest. This is reflected in the fact that 1987 and 1998 erosion events referenced in Section 4.3.1.3 correspond with lake level peaks shown in Figure 4.3.1-6. The worst-case scenario for an erosion event would be an abrupt increase in lake levels of up to one meter lasting for several years in succession.

4.3.1.3. Past Occurrence

The long-term average recession rate based on 125 fix control point monuments for the Pennsylvania Lake Erie Coastal Zone is 0.75 ft/yr; however, during the past two decades of monitoring, losses of up to twenty feet in a single year have been observed (Hapke et al., 2009 and Pennsylvania Sea Grant, 2002). Figure 4.3.1-4 displays historical bluff recession rates along the Pennsylvania Lake Erie shoreline. Erosion and recession rates are spatially variable and temporally episodic. This is evident by the fact that very low retreat rates have been measured at certain control points, while rates in immediately adjacent areas are much higher. A study performed by the U.S. Geological Survey in cooperation with the Pennsylvania Coastal Resources management Program divided the Pennsylvania Lake Erie shoreline into two areas along which recession rates were calculated (Hapke et al., 2009). Using data from 1938-2006, the study area extending southwest of Presque Isle had an average rate of recession of 0.98 +/- 0.33 ft/yr. Using data from 1938-1998, the study area extending northeast of Presque Isle had an average rate of recession of 0.66 +/- 0.33 ft/yr. A maximum rate of 3.28 +/- 0.33 ft/yr was measured in each study area, both occurring in predominantly agricultural areas.

Figure 4.3.1-7 Historical erosion rates along the Pennsylvania Lake Erie Shoreline (PADEP, 2007).



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 these events by the DEP, Coastal Resources Management Program (PA DEP, 1987). This data is from 1987 and a more recent study is not available at this time. No significant long-term trends or short-term erosion events have been identified for the Delaware River shoreline.

Table 4.3.1-1 Summary of the impact of damages caused by high water levels on 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 Pennsylvania Coastal Resources Management Program, have assessed shoreline damage statistics and the costs of protection. Shore structure inventories have also been prepared in recent years, some of which are ongoing. 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.

The long-term average historical recession rate based on 130 fixed control point monuments for the Pennsylvania Lake Erie Coastal Zone is 1.0 ft/yr. Figure 4.3.1-6 displays historical long-term bluff recession rates along the Pennsylvania Lake Erie shoreline as of 2007. Field surveys are being performed through 2011 to update the control point monument data; this data is expected to be ready for release in 2014.

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 ft. (ECDPS, 2011).

Historical recession data is valuable for long-term planning purposes. However, historical rates are spatially variable and temporally episodic. During the past two decades of monitoring, losses of up to twenty feet in a single year have been observed (Hapke *et al*., 2009). In addition, low retreat rates have been measured at certain control points, while rates in immediately adjacent areas are much higher. Therefore, the limitations of historical rates must be recognized and data must be used appropriately for purposes of evaluating risk.

4.3.1.4. Future Occurrence

The geological processes along the Lake Erie shoreline are continuous, but rates of change vary as a result of the natural and human-caused influences previously described. Future shoreline erosion and bluff recession can be considered *highly likely*; as defined by the Risk Factor Methodology probability criteria. However, rates of change will vary over time, primarily as a function of changing lake levels. Historical rates described in Section 4.3.1.3 serve as best estimates of future changes. Additionally, FEMA is in the process of completing a Great Lakes Coastal Flood Study which will also address coastal erosion as it relates to flood hazards for the Lake Erie Coastline in Pennsylvania. The estimated completion date of this study is 2016.

4.3.1.5. Environmental Impacts

In the absence of development, the environmental impacts of coastal erosion are minimal. It is a geological process through which shorelines naturally evolve. However, if erosion occurs in the vicinity of development or infrastructure, impacts may include the release of chemically hazardous (e.g. heating fuels) or biohazardous materials (e.g. sewage), or contamination of beaches with construction materials (i.e. asphalt, siding, lumber, shingles, etc…).

4.3.1.6. Jurisdictional Vulnerability Assessment

As previously mentioned, Erie County is the only jurisdiction in the Commonwealth which 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 as a result of bluff recession and coastline erosion. The PADEP Coastal Resources Management Program 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 (1.27 ft/yr) among all jurisdictions monitored (PADEP, 2007). However, it is important to note that vulnerability is ultimately dependent on development density in the vicinity of receding shorelines. For more information on vulnerability for specific municipalities, see *Tentative Bluff Recession Hazard Area Designations* at: http://www.dep.state.pa.us/river/reference/brha.htm.

One out of 67 counties in Pennsylvania (Erie County) identifies coastal erosion as a hazard. The Erie County HMP has not calculated a risk factor value for coastal erosion at this time. The State Risk Factor for Coastal Erosion is 2.2 while the Pennsylvania THIRA ranks coastal

erosion as a 3 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

4.3.1.7. State Facility Vulnerability Assessment

No state facilities fall within 500 feet of the Lake Erie shoreline or within the BHRA for Lake Erie, so the vulnerability impact is low. However, Presque Isle State Park is located on Lake Erie's Shoreline. In 2008, PA DCNR was awarded an L-PDM grant to undergo flood mitigation and coastal erosion mitigation in the Park. This investment of $990,000 has reduced the overall vulnerability of this unique state park and recreation space.

4.3.1.8. Jurisdictional Loss Estimation

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 4.3.1-2 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 example, Girard Township (200 ft.), Lake City Borough (150 ft.), and Fairview Township (100 ft.) (ECDPS, 2011).

For purposes of this risk assessment, an investigation of properties located within a 100-year bluff recession hazard area was performed. Based on nearby historical recession rates, properties located within BRHAs that are considered at risk from bluff recession over the next 100 years were identified. 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. 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 level) or human influences (e.g. construction of shore protection structures) which will alter future recession rates are not considered.
- Control point monuments are typically located every 1,650 ft. 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 which 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 since 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 a building is located on 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 present development only.

Table 4.3.1-3 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

Table 4.3.1-3 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
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 put into place 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 evapo-transpiration.

The PADEP Coastal Zone Management Program provides funding as well as technical assistance for projects located within the 76.6 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.

4.3.1.9. State Facility Loss Estimation

No state facilities fall within 500 feet of the Lake Erie shoreline, so potential loss estimates are low. However, 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 there.

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 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. PEMA has primary responsibility for managing droughts with direct support from PADEP. According to *Drought Management in Pennsylvania* (2102), PEMA and PADEP 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, Drought Watches are invoked when three or more drought indicators are present for a county or group of counties. The focus 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 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. At

- **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 fifteen 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.

- **Local Water Rationing:** Although not a drought phase, local municipalities may, with the approval of the PA Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. These individual water rationing plans, authorized through provisions of 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 Commonwealth uses five indicators to assess drought conditions: 1) Precipitation Deficits, 2) Stream Flows, 3) Groundwater Levels, 4) Soil Moisture, and 5) Reservoir Storage.

Precipitation Deficits

The earliest indicators of a potential drought are precipitation deficits (measured as the departure from normal, 30 year average precipitation), because it is rainfall that provides the basis for both our ground and surface water resources. The National Weather Service has long-term monthly averages of precipitation for each county. These averages are updated at the end of each decade, based upon the most recent 30 years, and are considered "normal" monthly precipitation. Each month, the total cumulative precipitation values in each county, for periods ranging from three to 12 months, are compared against the normal values for the same periods. Totals that are less than the normal values represent deficits, which are then converted to percentages of the normal values. Table 4.3.2-1 lists the drought conditions that are indicated by various precipitation deficit percentages.

Table 4.3.2-1 Precipitation deficit drought indicators for Pennsylvania (PADEP, 2012)

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

After precipitation, stream flows provide the next earliest indication of a developing drought. Stream flows typically lag one to two months behind precipitation in signaling a drought. The U.S. Geological Survey maintains a network of stream gages across the state, shown in Figure 4.3.2-1. The DEP currently uses 73 of these gages, equipped with satellite communication transmitters, as its drought monitoring network. Similar to precipitation, long-term 30-day average stream flow values have been computed for each of the stream gages, but rather than using only the past 30 years, the entire period of record for each gage is used. 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 Streamgage locations and period of record (USGS, 2009).

Drought status is determined from stream flows based on *exceedances*, rather than percentages, as are used for precipitation. Exceedances are similar 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. For stream flows, the 75-, 90-, and 95-percent exceedance 30-day average flows are used as indicators for drought watch, warning and emergency.

Groundwater Levels

Groundwater is usually the third indicator of a developing drought. Groundwater typically lags two to three months behind precipitation, largely because of the storage effect. According to the PADEP Water Management about 80 trillion gallons of groundwater is stored throughout Pennsylvania enough to cover the entire state with more than eight feet of water. Therefore, precipitation deficits can accumulate for several months before the resultant lack of groundwater recharge becomes clearly evident in groundwater levels.

The USGS also maintains a network of groundwater monitoring wells, just recently upgraded to at least one well in each county. Groundwater is used to indicate drought status in a manner similar to stream flows. Groundwater level exceedances of 75, 90 and 95 percent are used to indicate watch, warning and emergency status. 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: http://waterdata.usgs.gov/pa/nwis/uv/?site_no=402643075150501&PARAmeter_cd=72019.

Soil Moisture

Soil moisture information is provided by the National Oceanic and Atmospheric Administration in the form of the *Palmer Drought Severity Index* (PDSI). The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions which measures dryness based on recent precipitation and temperature (see Table 4.3.2-2). Based on a number of meteorological and hydrological factors, it is compiled weekly by the Climate Prediction Center of the National Weather Service.

Table 4.3.2-2 Palmer Drought Severity Index (PSDI) classifications (NDMC, 2009).

SEVERITY CATEGORY	PSDI VALUE	DROUGHT STATUS
Extremely wet	4.0 or more	*none*
Very wet	3.0 to 3.99	*none*
Moderately wet	2.0 to 2.99	*none*
Slightly wet	1.0 to 1.99	*none*
Incipient wet spell	0.5 to 0.99	*none*
Near normal	0.49 to -0.49	*none*
Incipient dry spell	-0.5 to -0.99	*none*
Mild drought	-1.0 to -1.99	*none*
Moderate drought	-2.0 to -2.99	Watch
Severe drought	-3.0 to -3.99	Warning
Extreme drought	-4.0 or less	Emergency

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 PADEP uses for drought monitoring. Depending on the total quantity of storage and the length of the refill period for the various reservoirs, PADEP uses varying percentages of storage draw down to indicate the three drought stages for each of the reservoirs.

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

4.3.2.3. Past Occurrence

A summary of declared drought status for each county in Pennsylvania between November, 1980 and February, 2008 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 2013. Using the

information provided in Section 4.2.1, two Presidential and seven Gubernatorial Declarations were issued as a result of drought events.

Table 4.3.2-3 Summary of declared drought status from 1980 to 2013 by county (PADEP, 2013).

COUNTY	TOTAL DROUGHT WATCHES	TOTAL DROUGHT WARNINGS	TOTAL DROUGHT EMERGENCIES
Adams	23	14	12
Allegheny	20	13	1
Armstrong	22	11	4
Beaver	25	11	1
Bedford	22	13	14
Berks	19	20	12
Blair	27	10	9
Bradford	28	10	8
Bucks	15	22	10
Butler	24	10	5
Cambria	25	12	9
Cameron	25	13	10
Carbon	17	16	16
Centre	24	14	10
Chester	18	18	14
Clarion	20	12	6
Clearfield	22	13	10
Clinton	24	14	9
Columbia	23	15	6
Crawford	26	8	6
Cumberland	24	14	11
Dauphin	27	12	9
Delaware	16	19	12
Elk	30	8	7
Erie	27	9	6
Fayette	20	9	5
Forest	27	8	4
Franklin	24	13	10
Fulton	26	11	12
Greene	26	9	5
Huntingdon	23	14	8
Indiana	25	11	6
Jefferson	19	11	6
Juniata	26	15	7
Lackawanna	16	15	12
Lancaster	23	16	10

Table 4.3.2-3 Summary of declared drought status from 1980 to 2013 by county (PADEP, 2013).

COUNTY	TOTAL DROUGHT WATCHES	TOTAL DROUGHT WARNINGS	TOTAL DROUGHT EMERGENCIES
Lawrence	23	10	5
Lebanon	19	19	14
Lehigh	15	20	12
Luzerne	19	16	15
Lycoming	28	10	10
McKean	28	9	4
Mercer	27	10	4
Mifflin	25	13	7
Monroe	18	15	14
Montgomery	13	23	10
Montour	24	16	6
Northampton	15	20	14
Northumberland	22	17	6
Perry	25	15	9
Philadelphia	13	23	10
Pike	17	16	13
Potter	26	13	9
Schuylkill	18	17	20
Snyder	22	14	10
Somerset	21	9	9
Sullivan	27	11	6
Susquehanna	23	10	8
Tioga	26	10	8
Union	25	14	8
Venango	27	7	4
Warren	24	9	4
Washington	26	10	3
Wayne	17	14	14
Westmoreland	20	10	1
Wyoming	25	11	6
York	25	14	10

Figure 4.3.2-2 Number of emergency drought declarations in Pennsylvania by County between 1980 and 2013 (PADEP, 2013).

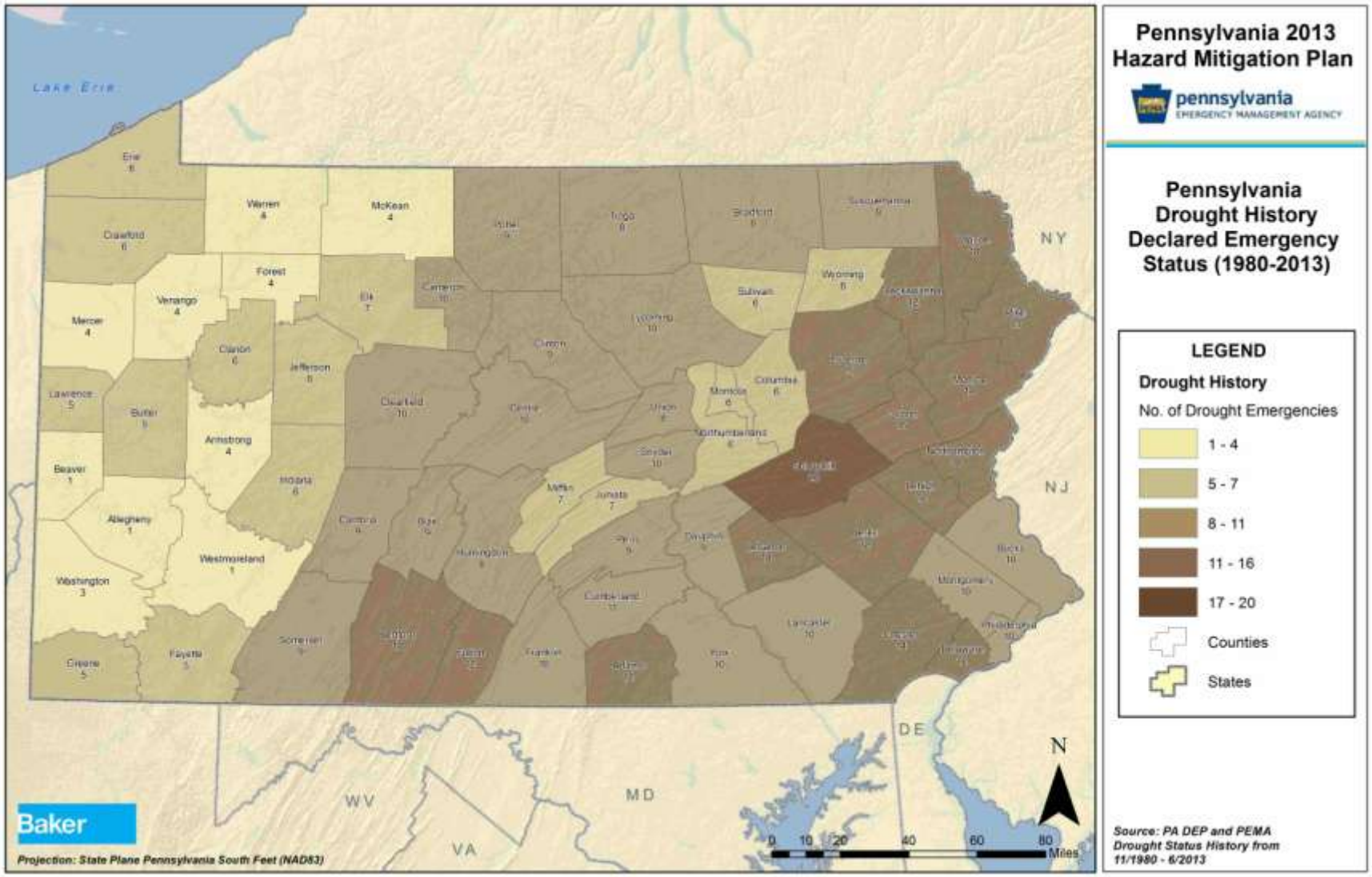


Figure 4.3.2-3 provides a summary of PDSI values for eight climate divisions throughout Pennsylvania for severe or extreme drought events experienced between January 1895 and May 2013. It is clear that periods of dry soil moisture conditions vary by region; however, several widespread (i.e. low PDSI values for multiple climate divisions) events have occurred. For example, between 1930 and 1932, most divisions reported extremely low PDSI values. This includes the South Central Climate Division which reported a PDSI value of -8.13 in January 1931.

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

POCONO MOUNTAINS CLIMATE DIVISION			EAST CENTRAL MOUNTAINS CLIMATE DIVISION		
DROUGHT PERIODS	DURATION	LOWEST PDSI	DROUGHT PERIODS	DURATION	LOWEST PDSI
9/1895 - 1/1896	5 months	-4.02 in 1/1896	11/1895 - 1/1896	3 months	-4.01 in 1/1896
12/1896 - 4/1897	5 months	-3.45 in 3/1897	11/1900 - 2/1901	4 months	-4.11 in 2/1901
11/1900 - 2/1901	4 months	-3.78 in 2/1901	8/1909 - 1/1910	6 months	-4.48 in 11/1909
8/1909 - 1/1910	6 months	-4.69 in 12/1909	7/1910 - 8/1910	2 months	-3.33 in 8/1910
7/1910 - 8/1910	2 months	-3.39 in 8/1910	10/1910 - 7/1911	10 months	-4.18 in 12/1910
10/1910 - 7/1911	10 months	-3.98 in 12/1910	10/1914 - 12/1914	3 months	-3.83 in 11/1914
10/1914 - 12/1914	3 months	-3.96 in 11/1914	11/1922 - 12/1922	2 months	-3.91 in 12/1922
10/1922 - 1/1924	16 months	-4.86 in 12/1922	5/1923 - 12/1923	8 months	-4.35 in 8/1923
8/1930 - 6/1931	11 months	-5.49 in 1/1931	8/1930 - 6/1931	11 months	-5.01 in 1/1931
10/1931 - 2/1932	5 months	-4.69 in 12/1931	9/1931 - 9/1932	13 months	-4.41 in 12/1931
11/1939 - 1/1940	3 months	-3.69 in 1/1940	11/1939 - 1/1940	3 months	-3.96 in 1/1940
10/1963 - 12/1963	3 months	-4.04 in 10/1963	9/1941 - 2/1942	6 months	-4.20 in 11/1941
7/1964 - 4/1966	22 months	-5.63 in 11/1964	9/1957 - 11/1957	3 months	-3.09 in 10/1957
6/1966 - 11/1966	6 months	-4.13 in 8/1966	8/1964 - 1/1966	18 months	-4.99 in 7/1965
1/1967 - 2/1967	2 months	-3.50 in 2/1967	6/1966 - 11/1966	6 months	-4.27 in 8/1966
12/1980 - 1/1981	2 months	-3.72 in 1/1981	1/1967 - 2/1967	2 months	-3.44 in 2/1967
8/1991 - 9/1991	2 months	-3.17 in 8/1991	8/1980 - 1/1981	6 months	-5.10 in 1/1981
8/1995 - 9/1995	2 months	-3.31 in 8/1995	3/1985 - 4/1985	2 months	-4.32 in 4/1985

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

			8/1991 - 4/1992	9 months	-3.58 in 2/1992
			7/1999 - 8/1999	2 months	-3.60 in 8/1999
SOUTHEASTERN PIEDMONT CLIMATE DIVISION			**UPPER SUSQUEHANNA CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
11/1895 - 1/1896	3 months	-3.71 in 1/1896	9/1895 - 1/1896	5 months	-4.84 in 1/1896
12/1900 - 2/1901	3 months	-4.09 in 2/1901	4/1896 - 4/1897	13 months	-4.17 in 8/1896
11/1909 - 1/1910	3 months	-3.89 in 12/1909	6/1900 - 2/1901	9 months	-5.03 in 2/1901
10/1910 - 3/1911	6 months	-3.73 in 12/1910	10/1908 - 3/1909	6 months	-5.19 in 12/1908
8/1923 - 12/1923	5 months	-3.61 in 8/1923	5/1909 - 9/1911	29 months	-7.25 in 12/1909
8/1930 - 6/1931	11 months	-5.22 in 1/1931	8/1913 - 9/1913	2 months	-3.17 in 9/1913
11/1941 - 1/1942	3 months	-3.18 in 11/1941	10/1914 - 1/1915	4 months	-4.91 in 11/1914
11/1949 - 1/1950	3 months	-3.56 in 1/1950	3/1915 - 7/1915	5 months	-3.81 in 4/1915
8/1957 - 11/1957	4 months	-3.85 in 11/1957	11/1916 - 5/1917	7 months	-3.72 in 4/1917
6/1963 - 8/1963	3 months	-3.53 in 8/1963	4/1921 - 2/1922	11 months	-3.99 in 10/1921
8/1964 - 2/1965	7 months	-4.13 in 11/1964	4/1922 - 5/1922	2 months	-3.60 in 5/1922
4/1965 - 3/1966	12 months	-4.56 in 12/1965	9/1922 - 3/1924	19 months	-5.65 in 12/1922
6/1966 - 8/1966	3 months	-4.76 in 8/1966	8/1929 - 9/1929	2 months	-3.44 in 8/1929
4/1969 - 5/1969	2 months	-3.25 in 5/1969	7/1930 - 4/1932	22 months	-7.35 in 2/1931
7/1999 - 8/1999	2 months	-3.47 in 7/1999	8/1932 - 9/1932	2 months	-4.00 in 9/1932
11/2001 - 5/2002	7 months	-4.73 in 2/2002	6/1955 - 7/1955	2 months	-3.88 in 7/1955
7/2002 - 9/2002	3 months	-4.00 in 8/2002	7/1962 - 8/1962	2 months	-3.09 in 8/1962
			10/1963 - 12/1963	3 months	-3.83 in 10/1963
			9/1964 - 9/1965	13 months	-5.64 in 12/1964
			7/1966 - 2/1967	8 months	-4.17 in 8/1966

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

			10/1988 - 4/1989	7 months	-4.06 in 1/1989
			6/1991 - 2/1992	9 months	-4.37 in 11/1991
LOWER SUSQUEHANNA CLIMATE DIVISION			**MIDDLE SUSQUEHANNA CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
11/1895 - 2/1896	4 months	-4.70 in 1/1896	9/1895 - 2/1896	6 months	-5.43 in 1/1896
4/1896 - 1/1897	10 months	-4.20 in 8/1896	4/1896 - 6/1897	15 months	-5.01 in 8/1896
10/1900 - 2/1901	5 months	-4.87 in 2/1901	10/1897 - 11/1897	2 months	-3.49 in 10/1897
12/1908 - 1/1909	2 months	-3.58 in 1/1909	5/1900 - 4/1901	12 months	-5.91 in 2/1901
8/1909 - 5/1910	10 months	-4.55 in 12/1909	6/1901 - 7/1901	2 months	-3.72 in 7/1901
10/1910 - 7/1911	10 months	-4.44 in 7/1911	11/1908 - 3/1909	5 months	-4.84 in 1/1909
10/1914 - 12/1914	3 months	-3.90 in 11/1914	5/1909 - 7/1911	27 months	-6.53 in 12/1909
10/1922 - 12/1923	15 months	-4.35 in 12/1922	9/1914 - 1/1915	5 months	-4.83 in 11/1914
6/1925 - 9/1925	4 months	-4.02 in 9/1925	4/1915 - 7/1915	4 months	-3.51 in 5/1915
5/1926 - 7/1926	3 months	-3.45 in 7/1926	11/1916 - 7/1917	9 months	-4.09 in 5/1917
7/1930 - 4/1932	22 months	-6.73 in 1/1931	11/1918 - 4/1919	6 months	-3.53 in 4/1919
8/1932 - 9/1932	2 months	-3.47 in 9/1932	10/1920 - 1/1921	4 months	-3.21 in 11/1920
10/1941 - 2/1942	5 months	-3.62 in 11/1941	3/1921 - 4/1924	38 months	-6.72 in 12/1922
11/1964 - 1/1965	3 months	-3.30 in 12/1964	3/1925 - 1/1926	11 months	-4.48 in 9/1925
6/1965 - 9/1965	4 months	-3.79 in 7/1965	3/1926 - 9/1926	7 months	-4.63 in 7/1926
11/1965 - 1/1966	3 months	-4.07 in 12/1965	12/1928 - 3/1929	4 months	-3.88 in 3/1929
5/1966 - 8/1966	4 months	-5.70 in 8/1966	7/1929 - 10/1929	4 months	-4.23 in 8/1929
7/1991 - 2/1992	8 months	-3.66 in 7/1991	12/1929 - 9/1932	34 months	-7.58 in 1/1931
7/1999 - 8/1999	2 months	-3.56 in 7/1999	7/1934 - 8/1934	2 months	-3.35 in 8/1934
11/2001 - 8/2002	10 months	-5.62 in 2/2002	11/1939 - 1/1940	3 months	-4.19 in 1/1940

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

			10/1941 - 11/1941	2 months	-3.08 in 11/1941
			11/1953 - 1/1954	3 months	-3.18 in 1/1954
			10/1964 - 2/1965	5 months	-3.88 in 11/1964
			5/1965 - 9/1965	5 months	-4.48 in 7/1965
			7/1966 - 8/1966	2 months	-3.95 in 8/1966
			12/1980 - 1/1981	2 months	-4.03 in 1/1981
			7/1991 - 2/1992	8 months	-3.91 in 11/1991
			8/1995 - 9/1995	2 months	-3.61 in 9/1995
CENTRAL MOUNTAINS CLIMATE DIVISION			**SOUTH CENTRAL MOUNTAINS CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
8/1895 - 10/1896	15 months	-5.57 in 1/1896	9/1895 - 8/1896	12 months	-5.68 in 1/1896
12/1896 - 4/1897	5 months	-3.53 in 1/1897	10/1897 - 11/1897	2 months	-3.61 in 10/1897
10/1897 - 11/1897	2 months	-3.57 in 10/1897	5/1900 - 7/1901	15 months	-5.92 in 2/1901
11/1899 - 1/1900	3 months	-3.12 in 11/1899	10/1901 - 11/1901	2 months	-3.92 in 11/1901
5/1900 - 1/1902	21 months	-6.12 in 12/1900	11/1904 - 2/1905	4 months	-3.62 in 12/1904
5/1905 - 7/1905	3 months	-3.09 in 5/1905	4/1905 - 6/1905	3 months	-3.07 in 5/1905
10/1908 - 3/1909	6 months	-5.70 in 12/1908	11/1908 - 3/1909	5 months	-4.69 in 12/1908
5/1909 - 7/1911	27 months	-6.45 in 12/1909	8/1909 - 7/1911	24 months	-5.41 in 12/1909
9/1914 - 1/1915	5 months	-4.82 in 11/1914	9/1914 - 12/1914	4 months	-4.50 in 11/1914
3/1915 - 6/1915	4 months	-4.10 in 4/1915	4/1915 - 5/1915	2 months	-3.38 in 4/1915
4/1917 - 5/1917	2 months	-3.11 in 5/1917	3/1921 - 10/1921	8 months	-3.86 in 7/1921
4/1921 - 2/1922	11 months	-4.39 in 7/1921	6/1922 - 11/1923	18 months	-6.19 in 12/1922
5/1922 - 11/1923	19 months	-6.71 in 12/1922	4/1925 - 9/1925	6 months	-4.41 in 9/1925

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

8/1925 - 9/1925	2 months	-3.84 in 9/1925	5/1926 - 7/1926	3 months	-3.83 in 7/1926
4/1926 - 7/1926	4 months	-4.04 in 7/1926	7/1930 - 8/1931	14 months	-8.17 in 1/1931
7/1930 - 6/1931	12 months	-7.60 in 12/1930	10/1931 - 2/1932	5 months	-3.92 in 11/1931
11/1931 - 12/1931	2 months	-3.75 in 11/1931	8/1932 - 9/1932	2 months	-3.83 in 9/1932
8/1939 - 9/1939	2 months	-3.60 in 8/1939	11/1953 - 2/1954	4 months	-4.41 in 2/1954
11/1939 - 2/1940	4 months	-3.96 in 1/1940	8/1963 - 12/1963	5 months	-4.61 in 10/1963
11/1949 - 12/1949	2 months	-3.32 in 11/1949	11/1964 - 12/1964	2 months	-3.43 in 12/1964
6/1963 - 8/1963	3 months	-3.11 in 8/1963	6/1965 - 1/1966	8 months	-4.85 in 12/1965
10/1963 - 12/1963	3 months	-3.82 in 10/1963	6/1966 - 2/1967	9 months	-4.87 in 1/1967
10/1964 - 2/1965	5 months	-4.64 in 12/1964	5/1969 - 6/1969	2 months	-3.29 in 5/1969
6/1965 - 9/1965	4 months	-3.66 in 7/1965	7/1991 - 6/1992	12 months	-4.70 in 11/1991
7/1966 - 8/1966	2 months	-3.73 in 8/1966	12/1998 - 2/1999	3 months	-4.22 in 12/1998
7/1991 - 6/1992	12 months	-4.50 in 12/1991	7/1999 - 8/1999	2 months	-3.69 in 7/1999
8/1995 - 9/1995	2 months	-3.85 in 9/1995	10/2001 - 4/2002	7 months	-5.31 in 2/2002
11/1998 - 12/1998	2 months	-4.34 in 12/1998	7/2002 - 8/2002	2 months	-3.53 in 8/2002
6/1999 - 1/2000	8 months	-4.31 in 8/1999			
7/2001 - 8/2001	2 months	-3.45 in 8/2001			
SOUTHWEST PLATEAU CLIMATE DIVISION			**NORTHWEST PLATEAU CLIMATE DIVISION**		
DROUGHT PERIODS	**DURATION**	**LOWEST PDSI**	**DROUGHT PERIODS**	**DURATION**	**LOWEST PDSI**
7/1895 - 8/1896	14 months	-5.36 in 1/1896	6/1895 - 2/1896	9 months	-5.20 in 11/1895
10/1897 - 11/1897	2 months	-3.65 in 10/1897	4/1896 - 6/1896	3 months	-4.24 in 5/1896
11/1899 - 1/1900	3 months	-3.06 in 1/1900	8/1899 - 2/1900	7 months	-4.29 in 11/1899
4/1900 - 5/1901	14 months	-5.25 in 2/1901	4/1900 - 6/1902	27 months	-5.14 in 12/1900
10/1901 - 1/1902	4 months	-4.19 in 11/1901	10/1908 - 3/1909	6 months	-5.59 in 12/1908

Table 4.3.2-4 Summary of PDSI values for periods of two or months of severe or extreme drought across eight climate divisions in Pennsylvania (NRCC, 2013).

11/1904 - 7/1905	9 months	-3.89 in 12/1904	8/1909 - 1/1910	6 months	-4.34 in 12/1909
10/1908 - 3/1909	6 months	-5.32 in 12/1908	3/1910 - 12/1910	10 months	-4.22 in 8/1910
9/1909 - 12/1909	4 months	-4.15 in 12/1909	5/1911 - 7/1911	3 months	-4.12 in 7/1911
3/1910 - 12/1910	10 months	-4.20 in 8/1910	11/1914 - 12/1914	2 months	-3.70 in 11/1914
2/1911 - 3/1911	2 months	-3.20 in 3/1911	6/1921 - 10/1921	5 months	-3.71 in 7/1921
5/1911 - 7/1911	3 months	-4.29 in 7/1911	9/1922 - 12/1923	16 months	-4.81 in 12/1922
4/1915 - 5/1915	2 months	-3.37 in 4/1915	8/1930 - 2/1933	31 months	-7.07 in 2/1931
8/1922 - 11/1923	16 months	-5.53 in 12/1922	7/1933 - 6/1935	24 months	-6.60 in 7/1934
8/1925 - 9/1925	2 months	-3.89 in 9/1925	9/1936 - 11/1936	3 months	-3.44 in 9/1936
7/1930 - 12/1931	18 months	-7.38 in 1/1931	4/1941 - 6/1941	3 months	-3.64 in 5/1941
5/1932 - 2/1933	10 months	-4.43 in 9/1932	11/1953 - 2/1954	4 months	-4.07 in 12/1953
5/1934 - 7/1934	3 months	-4.01 in 7/1934	12/1960 - 1/1961	2 months	-3.85 in 1/1961
11/1939 - 1/1940	3 months	-4.00 in 1/1940	10/1963 - 2/1964	5 months	-3.90 in 10/1963
10/1953 - 7/1954	10 months	-5.18 in 12/1953	7/1991 - 3/1992	9 months	-4.81 in 11/1991
9/1963 - 2/1964	6 months	-4.23 in 12/1963	5/1992 - 6/1992	2 months	-3.67 in 6/1992
7/1965 - 9/1965	3 months	-3.68 in 8/1965			
7/1966 - 2/1967	8 months	-3.72 in 1/1967			
10/1968 - 11/1968	2 months	-3.08 in 10/1968			
8/1991 - 2/1992	7 months	-4.19 in 10/1991			
5/1992 - 6/1992	2 months	-3.54 in 6/1992			

Instrumental records of drought for the United States extend back approximately 100 years. These records capture the major 20th century droughts, but are too short to assess the reoccurrence of major droughts such as those of the 1930s and 1950s. 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.

Data from a variety of paleoclimate sources document drought conditions across North America over the last 10,000 years. These records, with decade to century resolution, document extended periods of extremely dry conditions in different regions of North America. This paleoclimatic record of past droughts is considered by scientists as a better guide than what is provided by the instrumental record alone of what we should expect in terms of the magnitude and duration of future droughts. For example, paleoclimatic data suggest that droughts as severe at the 1950s drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future. The paleoclimatic record also indicates that droughts of a much greater duration than any in 20th century have occurred in parts of North American as recently as 500 years ago. These data indicate 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.

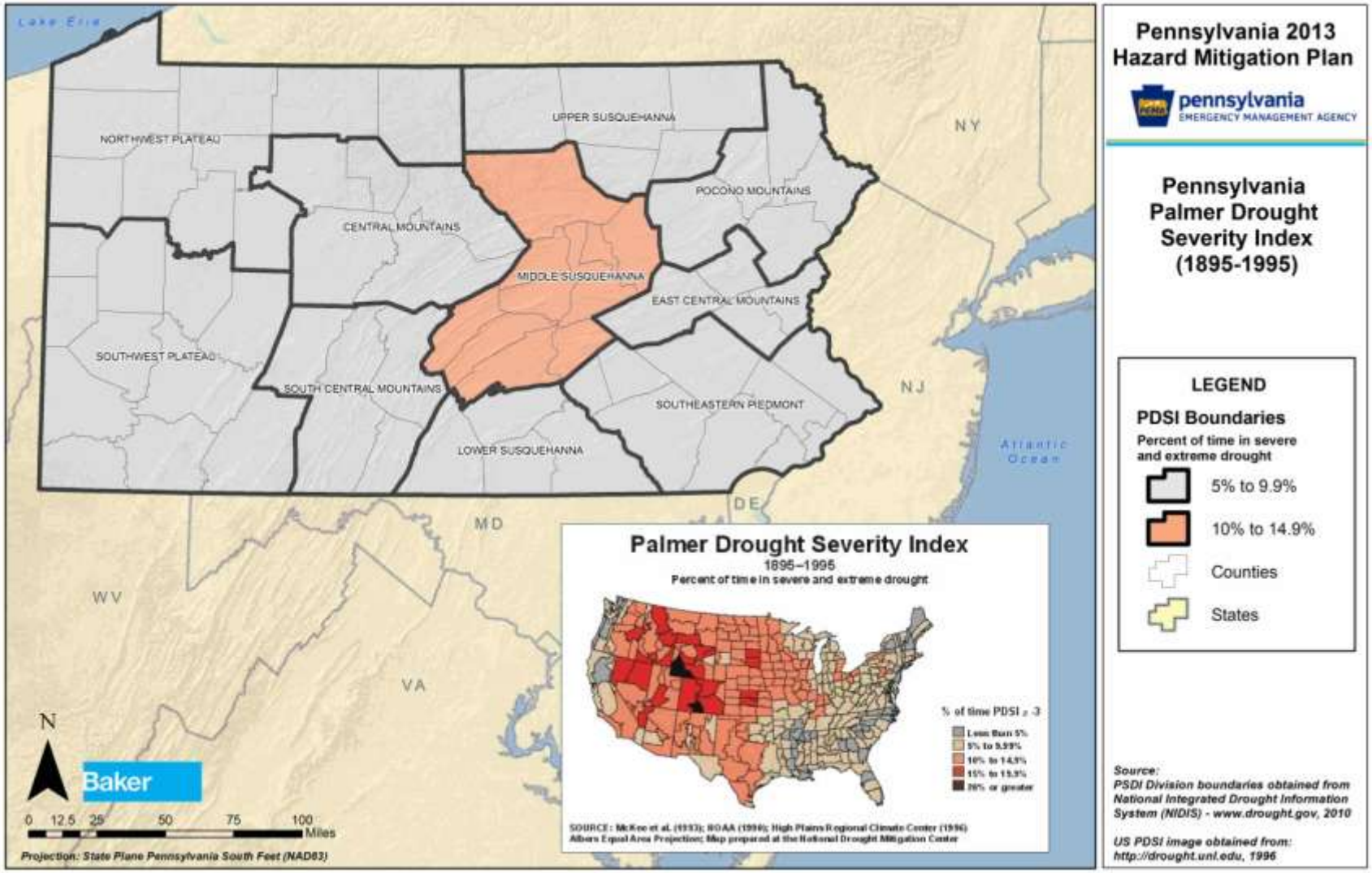
4.3.2.4. Future Occurrence

It is difficult to forecast the severity and frequency of future drought events in Pennsylvania. However, two important studies were performed which provide suggest probability of future occurrence. A study by Sheffield and Wood (2007) shows that there has been relatively little change in PDSI values over the 50-year period ending in 2004. This research is interpreted to indicate that soil moisture and drought conditions can be relatively equivalent to the average PDSI values experienced over the period 1954 to 2004. In addition, based on data from 1895 to 1995, Pennsylvania can be divided into ten PDSI areas (see Figure 4.3.2-3). Each of these areas have been assigned a percent of time PDSI values are less than or equal to three – a value equivalent to a drought warning or drought emergency in Pennsylvania. Historically, nine of ten areas in the Commonwealth are under a drought warning or emergency 5-10% of the time while one area in central Pennsylvania is under a drought warning or emergency 10-15% of the time. Note that these conclusions are based on past occurrences over a relatively short record period which may not represent adequate statistical sampling.

Please note, the data in Figure 4.3.2-3 shows the percent of time sections of Pennsylvania were in severe and extreme drought over a 100 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 Eastern portion of the Commonwealth has a higher risk for

drought than the Western portion. 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 most of the Commonwealth being in severe or extreme drought less than 15% of the time, the probability of future droughts is considered *possible.*

Figure 4.3.2-3 Percent of time areas of the United States have PSDI values <= -3 (NDMC, 2009).



Uncertainty regarding the future occurrence of droughts exists due to the potential impacts of climate change. A number of climate model simulations for doubled carbon dioxide concentrations suggest an increased frequency of drought in mid-continent regions (e.g. Gregory et al., 1997) whereas other model simulations and recent decadal trends in the instrumental record suggest wetter conditions, at least in the short term, due to an intensification of the hydrologic cycle associated with warmer sea surface temperatures. Improved estimates of future drought events requires improvements in climate modeling and increased understanding of the processes underlying drought behavior exhibited in both the instrumental and the paleoclimate records.

4.3.2.5. Environmental Impacts

According to the National Drought Mitigation Center at the University of Nebraska-Lincoln (2013), environmental impacts of drought include:

- Damage to animal species in the form of reduced water and feed availability, degradation of fish and wildlife habitat, migration and concentration issues (too many or too few animals in a given area), stress to endangered species, and loss of biodiversity
- Lower water levels in reservoirs, lakes, and ponds
- Reduced stream flow
- Loss of wetlands
- Increased groundwater depletion, land subsidence, and reduced groundwater recharge
- Water quality impacts like salinity, water temperature increases, pH changes, dissolved oxygen, or turbidity
- Loss of biodiversity
- Loss of trees
- Increased number and severity of fires
- Reduced soil quality and erosion issues
- Increased dust or pollutants.

4.3.2.6. Jurisdictional Vulnerability Assessment

As a hazard, droughts primarily impact water supply and agricultural land. Areas of the Commonwealth that reply on private wells are more impacted by water supply reductions than areas of the Commonwealth on public water supply; frequently, these areas reliant on groundwater wells are more rural in nature. Table 4.3.5-5 shows the number of groundwater wells per county in Pennsylvania as reported to the Pennsylvania Groundwater Information System (2013). 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 Domestic water wells by county (PADEP, 2013).

COUNTY	TOTAL DOMESTIC WATER WELLS	COUNTY	TOTAL DOMESTIC WATER WELLS
Adams	12,204	Lackawanna	12,532
Allegheny	1,816	Lancaster	81,317
Armstrong	2,082	Lawrence	16,223
Beaver	14,598	Lebanon	20,034
Bedford	15,361	Lehigh	18,833
Berks	28,264	Luzerne	4,764
Blair	3,493	Lycoming	21,686
Bradford	8,273	McKean	2,283
Bucks	30,128	Mercer	8,478
Butler	18,229	Mifflin	7,441
Cambria	3,270	Monroe	44,742
Cameron	1,929	Montgomery	19,939
Carbon	23,180	Montour	3,166
Centre	12,807	Northampton	23,052
Chester	58,493	Northumberland	7,754
Clarion	1,673	Perry	16,341
Clearfield	8,197	Philadelphia	219
Clinton	7,739	Pike	8,831
Columbia	5,407	Potter	13,370
Crawford	7,766	Schuylkill	9,709
Cumberland	22,028	Snyder	7,787
Dauphin	2,433	Somerset	14,896
Delaware	2,654	Sullivan	1,005
Elk	21,294	Susquehanna	11,039
Erie	847	Tioga	19,269
Fayette	1,366	Union	5,047
Forest	30,187	Venango	2,906
Franklin	8,887	Warren	2,805
Fulton	14,682	Washington	5,835
Greene	7,707	Wayne	4,515
Huntingdon	3,588	Westmoreland	5,247
Indiana	6,523	Wyoming	3,917
Jefferson	7,401	York	36,814
Juniata	28,264	Unknown	20,289
GRAND TOTAL – REPORTED DOMESTIC WATER WELLS			***876,591***

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 2007 US Department of Agriculture Agricultural Census, in Pennsylvania, the top ten jurisdictions for agricultural production are as follows:

1. Lancaster County (18.5% of state total sales)
2. Chester County (9.5% of state total sales)
3. Berks County (6.3% of state total sales)
4. Franklin County (5.2% of state total sales)
5. Lebanon County (4.4% of state total sales)
6. Adams County (3.7% of state total sales)
7. York County (3.7% of state total sales)
8. Cumberland County (2.3% of state total sales)
9. Schuylkill (2.1% of state total sales)
10. Bradford County (2.1% of state total sales)

Beyond these agricultural counties, Table 4.3.2-6 lists which counties did and did not profile drought hazards, along with any ranking provided. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 40 counties which currently have calculated risk factor values for drought, the average value is 2.3; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for Drought is 2, while the Pennsylvania THIRA scored drought as a 7 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.2-6 Counties profiling drought hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.4
Allegheny	X		Medium	2.2
Armstrong	X		Not Ranked	No RF
Beaver	X		Medium	2.2
Bedford	X		Medium	2.2
Berks	X		Not Ranked	No RF
Blair		X		

Table 4.3.2-6 Counties profiling drought hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Bradford	X		Not Ranked	No RF
Bucks	X		Medium	2.1
Butler	X		Medium	2.2
Cambria	X		Medium	2.2
Cameron	X		Low	1.9
Carbon	X		Medium	2.2
Centre	X		High	2.5
Chester	X		Not Ranked	No RF
Clarion	X		Not Ranked	No RF
Clearfield	X		Low	1.8
Clinton	X		Medium	2.0
Columbia	X		Medium	2.2
Crawford	X		Medium	2.1
Cumberland	X		High	2.6
Dauphin	X		Not Ranked	No RF
Delaware	X		Medium	2.2
Elk	X		Medium	2.0
Erie	X		Medium	2.0
Fayette	X		Medium	2.0
Forest	X		Not Ranked	No RF
Franklin	X		Not Ranked	No RF
Fulton		X		
Greene	X		Medium	2.2
Huntingdon	X		Not Ranked	No RF
Indiana	X		Medium	2.3
Jefferson	X		Medium	2.4
Juniata	X		High	2.5
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Medium	2.2
Lawrence	X		Medium	2.2
Lebanon*	X		Not Ranked	8.0
Lehigh	X		Medium	2.2
Luzerne	X		Not Ranked	No RF

Table 4.3.2-6 Counties profiling drought hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Lycoming	X		High	2.8
McKean	X		Medium	2.2
Mercer	X		Medium	2.2
Mifflin	X		Not Ranked	No RF
Monroe	X		Medium	2.2
Montgomery	X		High	2.5
Montour*	X		Not Ranked	8.8
Northampton	X		Medium	2.2
Northumberland	X		High	2.5
Perry*	X		Not Ranked	15
Philadelphia**	X		Low	C
Pike	X		High	2.5
Potter	X		Not Ranked	No RF
Schuylkill	X		Not Ranked	No RF
Snyder	X		Medium	2.2
Somerset		X	Not Ranked	No RF
Sullivan	X		Not Ranked	No RF
Susquehanna	X		Medium	2.2
Tioga	X		Medium	2.2
Union	X		Not Ranked	No RF
Venango	X		Medium	2.2
Warren	X		Medium	2.2
Washington	X		Not Ranked	No RF
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Medium	2.2

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As indicated in Section 4.3.2.2, precipitation is a leading indicator of drought. Table 4.3.2-7 lists the average annual precipitation (in inches) per county for over a 30 year period according to

the DEP. The Commonwealth recognizes that the period of record of for this data is nearly twenty years old; therefore, precipitation normals shown Table 4.3.2-8 may not fully represent current climate conditions. Nonetheless, this is the best available data source for comprehensive precipitation normals on a county by county basis. The top five counties experiencing the lowest accumulation of precipitation are Tioga, Bradford, Beaver, Huntingdon, and Allegheny Counties.

Table 4.3.2-7 Annual precipitation normals by county for the period 1961 to 1990 (PADEP, 2010b).

COUNTY	PRECIPITATION DEPTH (inches)	COUNTY	PRECIPITIATION DEPTH (inches)	COUNTY	PRECIPITATION DEPTH (inches)
Adams	41.4	Elk	43.3	Montgomery	44.2
Allegheny	37.8	Erie	43.5	Montour	40.5
Armstrong	41.7	Fayette	42.5	Northampton	44
Beaver	36.9	Forest	43.3	Northumberland	40.9
Bedford	38	Franklin	40.9	Perry	39.8
Berks	45.9	Fulton	38.2	Philadelphia	44.1
Blair	39.2	Greene	39	Pike	42.6
Bradford	34.7	Huntingdon	37.5	Potter	40.2
Bucks	44.5	Indiana	45.5	Schuylkill	46
Butler	39.9	Jefferson	44	Snyder	41.9
Cambria	44.3	Juniata	39.8	Somerset	41.8
Cameron	42.8	Lackawanna	41.6	Sullivan	37.9
Carbon	46.3	Lancaster	40.9	Susquehanna	40.3
Centre	39.4	Lawrence	38.4	Tioga	34.5
Chester	44.2	Lebanon	42.5	Union	41.7
Clarion	44.1	Lehigh	45.2	Venango	43.1
Clearfield	41.2	Luzerne	41.3	Warren	44.3
Clinton	39.9	Lycoming	38.5	Washington	38.8
Columbia	41.1	McKean	43.9	Wayne	42.8
Crawford	43.3	Mercer	41.2	Westmoreland	42.3
Cumberland	39.1	Mifflin	39	Wyoming	37.9
Dauphin	40.8	Monroe	47.3	York	39.5
Delaware	43.9				

Normal precipitation estimates for the period 1971-2000 are available for National Weather Service offices and principal climatological stations through the NOAA publication, *Climatography of the U.S. No. 81*. In addition, precipitation normals for select cities throughout the Commonwealth for the period 1971-2000 are available (Table 4.3.2-9). Of the eight cities listed, Pittsburgh and Avoca, PA typically experience the lowest levels of precipitation annually.

Table 4.3.2-8 Monthly and annual precipitation normals from 1971 to 2000 for select cities in Pennsylvania (NOAA, 2009)

CITY	PRECIPITIATION DEPTH (inches)												
	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
Allentown, PA	3.50	2.75	3.56	3.49	4.47	3.99	4.27	4.35	4.37	3.33	3.70	3.39	45.17
Erie, PA	2.53	2.28	3.13	3.38	3.34	4.28	3.28	4.21	4.73	3.92	3.96	3.73	42.77
Harrisburg, PA	3.18	2.88	3.58	3.31	4.60	3.99	3.21	3.24	3.65	3.06	3.53	3.22	41.45
Middletown-Harrisburg International Airport	3.18	2.88	3.58	3.31	4.60	3.99	3.21	3.24	3.65	3.06	3.53	3.22	41.45
Philadelphia, PA	3.52	2.74	3.81	3.49	3.88	3.29	4.39	3.82	3.88	2.75	3.16	3.31	42.05
Pittsburgh, PA	2.70	2.37	3.17	3.01	3.80	4.12	3.96	3.38	3.21	2.25	3.02	2.86	37.85
Avoca, PA	2.46	2.08	2.69	3.28	3.69	3.97	3.74	3.10	3.86	3.02	3.12	2.55	37.56
Williamsport, PA	2.85	2.61	3.21	3.49	3.79	4.45	4.08	3.38	3.98	3.19	3.62	2.94	41.59

4.3.2.7. State Facility Vulnerability Assessment

Drought does not pose a direct threat to state critical facility buildings – it affects land and water supply. However, the Commonwealth identifies 106 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 critical facilities in this category by hindering production or an indirect effect by increasing the cost of food production inputs. Additionally, the Commonwealth owns bird and fish hatcheries that may be disproportionately impacted by a drought. A drought may also impact the 37 water-related critical facilities. Table 4.3.2-9 identifies where the 106 agricultural facilities are located throughout the state. Lancaster County has the most facilities with 18, followed by Dauphin County with 12 facilities.

Table 4.3.2-9 Number of State Critical Facilities per county that their primary sector is Agriculture.

COUNTY	NUMBER OF AGRICULTURE CRITICAL FACILITIES	COUNTY	NUMBER OF AGRICULTURE CRITICAL FACILITIES
Adams	5	Lancaster	18
Allegheny	4	Lebanon	3
Berks	8	Lehigh	1
Blair	2	Luzerne	1
Bradford	1	Lycoming	2
Bucks	1	Mercer	1
Cambria	1	Mifflin	1
Chester	3	Montgomery	3
Clearfield	1	Northampton	2
Columbia	2	Northumberland	5
Cumberland	4	Philadelphia	4
Dauphin	12	Schuylkill	4
Delaware	1	Snyder	2
Erie	3	Somerset	1
Fayette	1	Susquehanna	1
Franklin	1	Washington	1
Juniata	1	Westmoreland	1
Lackawanna	1	York	3

4.3.2.8. Jurisdictional Loss Estimation

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 4.3.2-10 enumerates each county's acreage of land contained in farms as well as the annual market value of all agricultural products sold, from 2007. As stated in Section 4.3.2.6., Lancaster, Chester, Berks, Franklin, Lebanon, Adams, York, Cumberland, Schuylkill, and Bradford counties are the counties most threatened by drought since they have the highest agricultural production; if a drought were to eliminate these counties' agricultural yield, total losses could top $3.3 billion. High farmland acreage generally indicates a larger market value in agricultural products sold.

Table 4.3.2-10 Estimated jurisdictional losses relating to agricultural production (USDA, Census of Agriculture, 2007).

COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Adams	174,595	$216,994,000
Allegheny	38,023	$9,514,000
Armstrong	122,275	$51,976,000
Beaver	67,075	$15,187,000

Table 4.3.2-10 Estimated jurisdictional losses relating to agricultural production (USDA, Census of Agriculture, 2007).

COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Bedford	210,990	$90,858,000
Berks	222,119	$367,840,000
Blair	87,434	$85,199,000
Bradford	266,635	$121,311,000
Bucks	75,883	$70,573,000
Butler	129,850	$38,664,000
Cambria	87,924	$23,168,000
Cameron	5,092	$828,000
Carbon	20,035	$8,944,000
Centre	148,464	$69,661,000
Chester	166,891	$553,290,000
Clarion	132,140	$21,958,000
Clearfield	62,721	$11,102,000
Clinton	56,626	$43,661,000
Columbia	122,621	$45,874,000
Crawford	232,093	$101,036,000
Cumberland	157,388	$132,803,000
Dauphin	89,533	$82,887,000
Delaware	4,361	$9,455,000
Elk	33,258	$3,717,000
Erie	173,125	$71,284,000
Fayette	140,688	$25,974,000
Forest	10,728	$3,106,000
Franklin	242,634	$304,450,000
Fulton	103,516	$38,038,000
Greene	150,203	$9,316,000
Huntingdon	148,289	$62,320,000
Indiana	187,711	$76,428,000
Jefferson	87,043	$25,317,000
Juniata	97,681	$91,658,000
Lackawanna	39,756	$16,216,000
Lancaster	425,336	$1,072,151,000
Lawrence	92,391	$35,639,000
Lebanon	113,486	$257,097,000
Lehigh	84,643	$72,059,000
Luzerne	66,577	$18,151,000
Lycoming	160,456	$53,381,000
McKean	41,466	$5,185,000

Table 4.3.2-10 Estimated jurisdictional losses relating to agricultural production (USDA, Census of Agriculture, 2007).

COUNTY	TOTAL ACRES OF LAND IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Mercer	171,860	$60,655,000
Mifflin	94,133	$86,818,000
Monroe	29,165	$7,819,000
Montgomery	41,908	$30,028,000
Montour	50,252	$36,193,000
Northampton	68,252	$31,762,000
Northumberland	147,660	$110,978,000
Perry	144,375	$105,052,000
Philadelphia	262	$487,000
Pike	27,569	$2,524,000
Potter	88,457	$31,377,000
Schuylkill	118,501	$124,752,000
Snyder	100,179	$109,041,000
Somerset	206,651	$83,152,000
Sullivan	27,821	$7,240,000
Susquehanna	158,218	$49,287,000
Tioga	184,108	$53,828,000
Union	63,795	$90,497,000
Venango	64,796	$11,796,000
Warren	99,582	$18,603,000
Washington	211,053	$28,649,000
Wayne	92,939	$29,428,000
Westmoreland	167,489	$58,437,000
Wyoming	77,957	$13,496,000
York	292,507	$212,634,000
TOTAL	***7,809,244***	***$5,808,803,000***

4.3.2.9. State Facility Loss Estimation

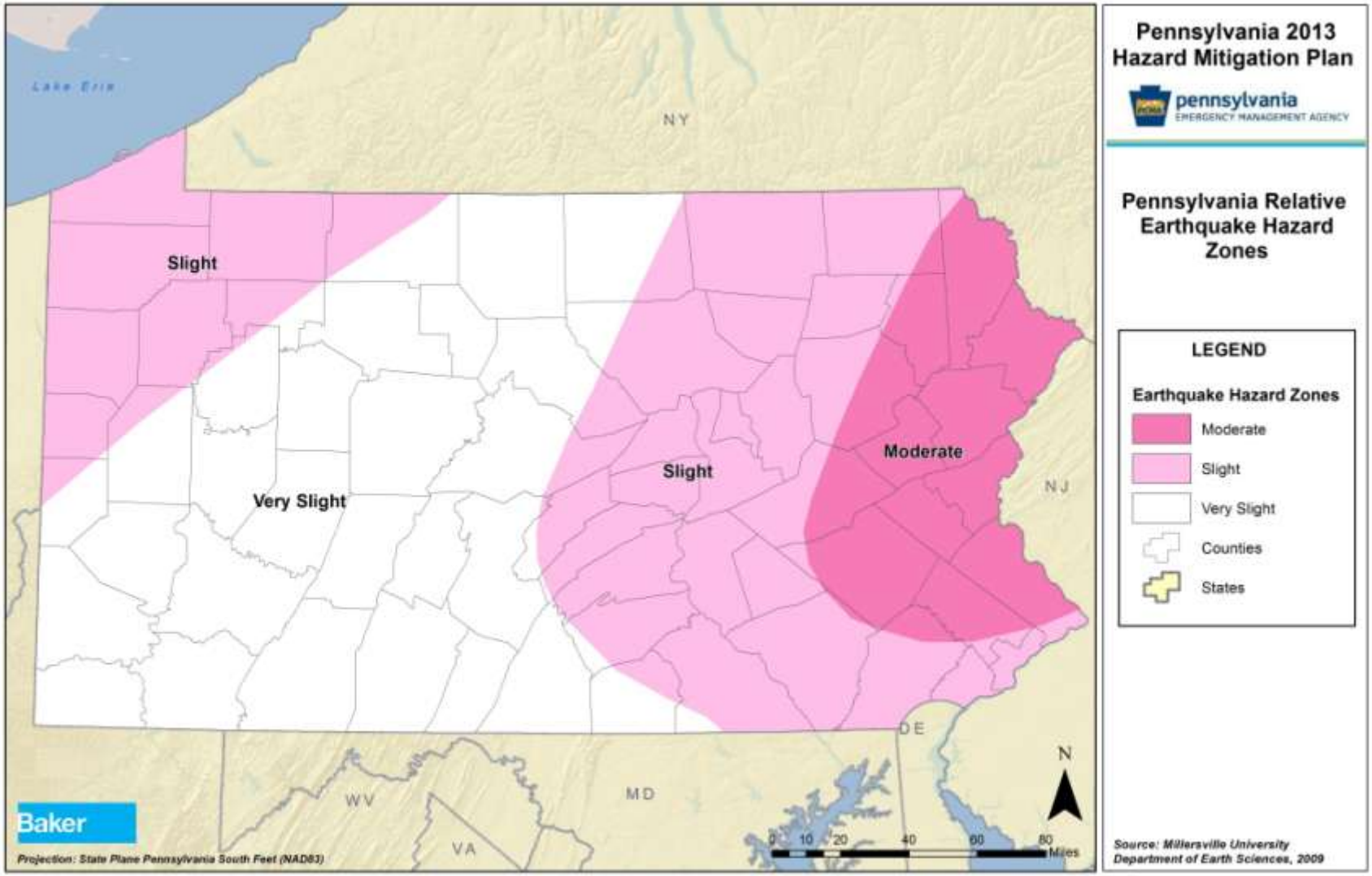
The vulnerable state critical facilities identified in Section 4.3.2.7 are agriculture-related facilities, all but three of which are privately held entities for which replacement values are unavailable. The three publicly held agriculture facilities are offices and laboratory space of the Department of Agriculture which are unlikely to face the direct impacts on drought seen by agricultural producers. While not critical, the state also owns a number of bird and fish hatcheries that may experience reduced yields in times of drought.

4.3.3. Earthquake

4.3.3.1. Location and Extent

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 (Armbruster and Scharnberger, 1986; Armbruster and Seeber, 1987). 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). Figure 4.3.3-1 shows the relative earthquake hazard zones in Pennsylvania identified by the Department of Earth Sciences at Millersville University. According to this map, earthquake hazards are "very slight" for most of the central to western portions of the Commonwealth. Eastern sections of Pennsylvania are in a moderate earthquake hazard zone.

Figure 4.3.3-1 Relative earthquake hazard zones of Pennsylvania (Millersville University Department of Earth Sciences, 2009).



Few precise data exist with regard to the focal depths of Pennsylvania earthquakes. The only reliable instrumental data, which comes from close-in studies of aftershocks in Lancaster County, indicate an average focal depth of about 3 miles. In Figure 4.3.3-2, some of the shocks that have relatively high epicentral intensities were felt over anomalously small areas, suggesting that these events were very shallow.

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 in the Pennsylvania region have not exceeded magnitudes greater than 6.0.

Table 4.3.3-1 Richter scale magnitudes and associated earthquake size effects.

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 100 kilometers 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 several hundred kilometers 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 shown in Table 4.3.3-2. The earthquakes that occur in Pennsylvania originate deep with the Earth's crust; not on an active fault. Therefore, little or no damage is typically expected.

Table 4.3.3-2 Modified Mercalli Intensity Scale with associated impacts.

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

Table 4.3.3-2 Modified Mercalli Intensity Scale with associated impacts.

SCALE	INTENSITY	DESCRIPTION OF EFFECTS	CORRESPONDING RICHTER SCALE MAGNITUDE
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
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

The worst-case earthquake event to have occurred in Pennsylvania was the Pymatuning Earthquake in 1998 (see Section4.3.3.3 for event summary). 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 100,000 people (World Nuclear Association, 2011).

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, Mo., in 1811-12, and the Charleston, S. C., earthquake of 1886. More recently, a magnitude 5.8 earthquake with an epicenter in rural Louisa County, VA 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.

Most earthquakes with epicenters inside Pennsylvania have been located in southeastern areas of the Commonwealth. However, the largest earthquake ever recorded in Pennsylvania was Pymatuning Earthquake which occurred on September 25, 1998. This earthquake had an epicenter in Jamestown, PA, near Pymatuning Lake, and measured a magnitude of 5.2 on the Richter Scale. Early damage reports suggested a maximum intensity of VI.

Figure 4.3.3-2 Map of earthquake epicenters in Pennsylvania (DCNR, 2004).

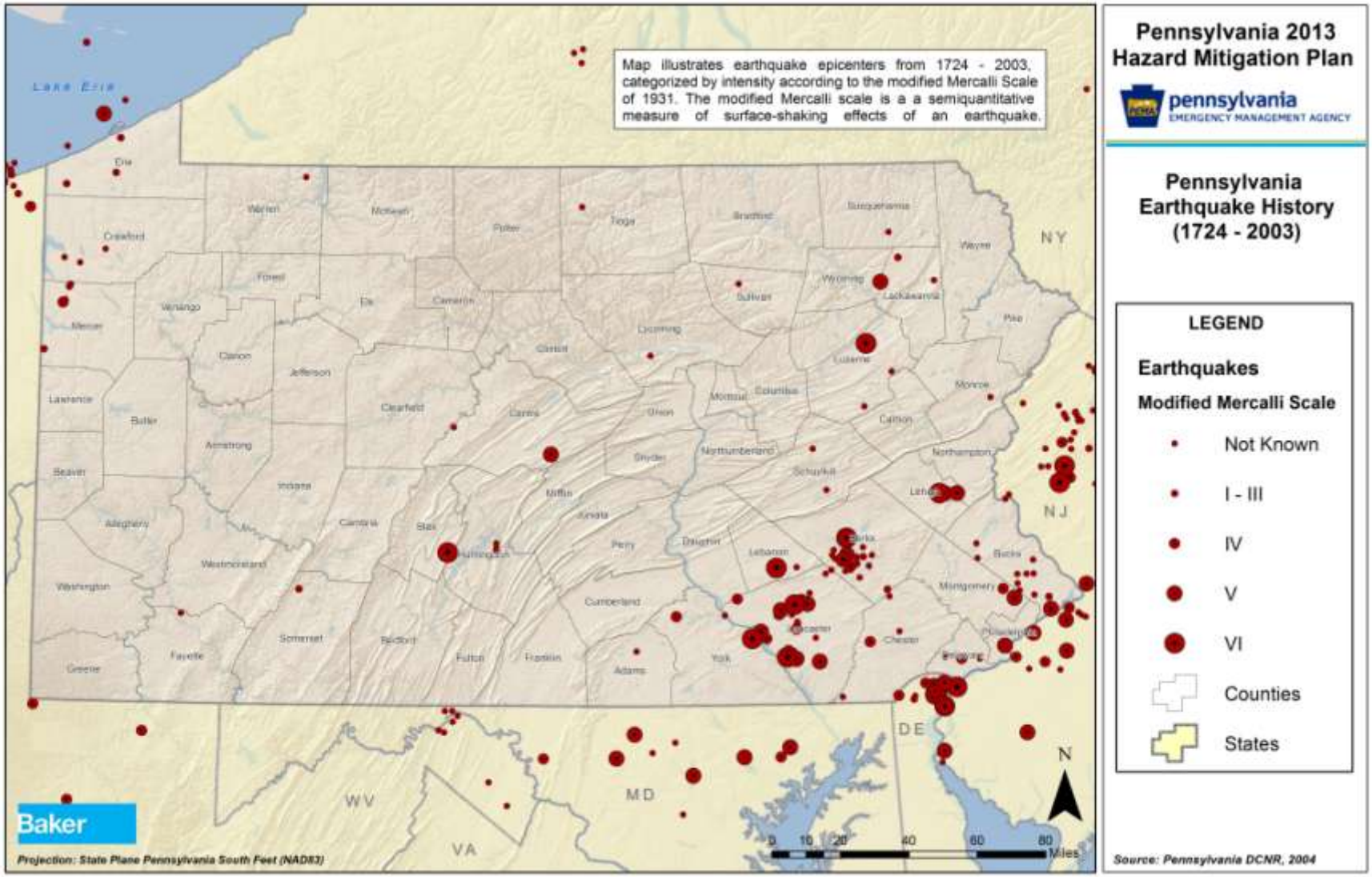


Table 4.3.3-3 Catalog of earthquakes with epicenters in Pennsylvania (DCNR, 2004).

DATE	NORTH LATITUDE (degrees)	WEST LONGITUDE (degrees)	MAGNITUDE	MAXIMUM INTENSITY	AREA (km^2)
08/16/1724	40.00	75.10	*unknown*	IV	*unknown*
12/19/1737	40.80	74.00	5.0	VII	200,000
12/17/1752	39.98	75.90	3.6	IV	*unknown*
11/27/1755	39.95	75.16	*unknown*	III	*unknown*
03/23/1758	39.95	75.16	*unknown*	III	*unknown*
03/22/1763	39.90	75.30	*unknown*	III	*unknown*
10/30/1763	40.00	75.10	*unknown*	IV	*unknown*
04/25/1772	39.95	75.16	*unknown*	II	*unknown*
11/22/1777	39.95	75.16	*unknown*	III	*unknown*
11/23/1777*	39.90	75.30	*unknown*	III	*unknown*
11/29/1780	39.95	75.16	*unknown*	III	*unknown*
01/11/1798	40.02	76.32	*unknown*	IV	*unknown*
03/17/1800	39.95	75.16	*unknown*	V	*unknown*
11/20/1800	40.12	76.39	4.1	V	*unknown*
11/29/1800	39.95	75.16	*unknown*	IV	*unknown*
01/27/1801	40.02	76.32	*unknown*	IV	*unknown*
11/12/1801	39.95	75.16	*unknown*	III	*unknown*
12/09/1811	39.95	75.16	*unknown*	III	*unknown*
12/16/1811*	39.95	75.16	*unknown*	III	*unknown*
03/19/1818	40.04	76.31	*unknown*	III	*unknown*
08/21/1820	40.03	76.50	3.4	V	*unknown*
05/04/1822	40.04	76.31	*unknown*	*unknown*	*unknown*
09/06/1829	40.04	76.31	*unknown*	III	*unknown*
02/05/1834	39.90	76.18	4.0	V	*unknown*
11/11/1840	40.00	75.10	*unknown*	V	*unknown*
11/14/1840*	39.95	75.16	*unknown*	*unknown*	*unknown*
09/15/1852	41.63	80.17	3.7	*unknown*	*unknown*
09/17/1865	39.90	76.30	*unknown*	*unknown*	*unknown*
11/07/1866	40.04	76.31	*unknown*	*unknown*	*unknown*
08/17/1873	41.20	80.50	*unknown*	III	*unknown*
05/31/1884	40.60	75.50	*unknown*	V	*unknown*
01/15/1885	40.30	76.30	*unknown*	*unknown*	*unknown*
03/09/1885	40.02	76.32	*unknown*	IV	*unknown*
09/27/1886	40.00	76.47	*unknown*	IV	*unknown*
09/29/1886*	40.17	76.63	*unknown*	IV	*unknown*
03/08/1889	40.00	76.55	4.3	VI	*unknown*
12/15/1890	41.41	80.39	2.9	II	*unknown*
05/28/1906	40.20	75.80	*unknown*	III	*unknown*
01/10/1907	41.20	77.10	*unknown*	*unknown*	*unknown*
05/31/1908	40.60	75.50	3.1	VI	*unknown*
09/27/1921	42.10	80.10	2.9	III	*unknown*
06/22/1928	40.60	75.50	*unknown*	III	*unknown*
11/05/1934	41.90	80.40	*unknown*	III	*unknown*
08/26/1936	41.40	80.40	2.9	IV	*unknown*

Table 4.3.3-3 Catalog of earthquakes with epicenters in Pennsylvania (DCNR, 2004).

DATE	NORTH LATITUDE (degrees)	WEST LONGITUDE (degrees)	MAGNITUDE	MAXIMUM INTENSITY	AREA (km^2)
03/25/1937	40.90	78.20	*unknown*	*unknown*	*unknown*
06/09/1937	40.34	75.93	*unknown*	II	*unknown*
07/15/1938	40.37	78.23	3.3	VI	*unknown*
09/27/1940	41.60	75.70	*unknown*	II	*unknown*
10/24/1942	41.00	75.20	3.4	*unknown*	*unknown*
02/05/1944	40.80	76.20	3.7	*unknown*	*unknown*
10/28/1946	41.50	76.60	3.6	*unknown*	*unknown*
03/20/1950	41.50	75.80	3.3	*unknown*	*unknown*
11/23/1951	40.60	75.50	3.3	IV	*unknown*
01/07/1954	40.42	76.02	3.2	VI	*unknown*
01/07/1954*	40.3	76	*unknown*	II	*unknown*
01/07/1954*	40.42	76.02	*unknown*	V	*unknown*
01/24/1954*	40.28	76.03	*unknown*	*unknown*	*unknown*
02/21/1954**	41.20	75.89	*unknown*	VII	*unknown*
02/24/1954**	41.20	75.89	*unknown*	VII	*unknown*
08/11/1954	40.33	76.02	3.3	IV	*unknown*
09/24/1954*	40.33	76.02	*unknown*	IV	*unknown*
01/20/1955*	40.33	76.02	*unknown*	IV	*unknown*
01/22/1960	41.50	75.50	3.4	*unknown*	*unknown*
09/15/1961	40.60	75.40	4.3	V	*unknown*
12/27/1961	40.50	74.75	3.3	V	*unknown*
03/02/1963**	41.50	75.80	3.4	V	*unknown*
02/13/1964**	40.38	77.96	3.3	*unknown*	*unknown*
05/12/1964	40.30	76.41	3.2	VI	*unknown*
10/08/1965	40.10	79.70	3.3	*unknown*	*unknown*
06/25/1972	40.30	75.90	*unknown*	*unknown*	*unknown*
12/08/1972	40.14	76.24	3.5	V	2,400
08/12/1973	40.30	75.90	*unknown*	*unknown*	*unknown*
04/27/1974**	40.97	75.91	3.2	*unknown*	*unknown*
07/16/1978	39.91	76.31	3.1	V	2,300
10/06/1978	42.14	76.32	3.0	VI	*unknown*
03/02/1980*	40.21	75.08	2.8	*unknown*	*unknown*
03/05/1980	40.19	75.16	3.5	IV	*unknown*
03/05/1980*	40.18	75.07	3.1	*unknown*	*unknown*
03/05/1980*	40.25	75.08	2.5	*unknown*	*unknown*
03/11/1980*	40.15	75.10	3.3	V	2,600
03/11/1980*	40.25	74.99	2.8	*unknown*	*unknown*
05/02/1980*	40.16	74.99	2.8	*unknown*	*unknown*
05/02/1980*	40.25	75.03	3.0	*unknown*	*unknown*
02/03/1982	40.21	79.05	2.6	III	*unknown*
05/12/1982	40.15	74.91	2.4	II	*unknown*
05/12/1982**	40.41	77.96	3.0	*unknown*	*unknown*
08/14/1982	41.71	75.75	1.8	*unknown*	*unknown*
04/19/1984*	39.94	76.36	2.9	*unknown*	*unknown*

Table 4.3.3-3 Catalog of earthquakes with epicenters in Pennsylvania (DCNR, 2004).

DATE	NORTH LATITUDE (degrees)	WEST LONGITUDE (degrees)	MAGNITUDE	MAXIMUM INTENSITY	AREA (km^2)
04/23/1984	39.92	76.36	4.1	V	77,000
04/23/1984*	39.95	76.32	4.1	*unknown*	*unknown*
05/10/1984	40.32	75.30	2.2	*unknown*	*unknown*
05/17/1984*	39.95	76.32	2.3	*unknown*	*unknown*
09/19/1984	40.06	76.30	*unknown*	III	*unknown*
04/14/1985	41.59	80.40	3.2	*unknown*	*unknown*
05/02/1986	39.92	76.36	2.5	IV	*unknown*
02/02/1989	40.38	75.30	*unknown*	*unknown*	*unknown*
03/30/1990	40.02	75.74	1.8	*unknown*	*unknown*
07/03/1990	40.29	76.12	1.7	*unknown*	*unknown*
12/14/1990	41.83	77.48	3.0	*unknown*	*unknown*
12/17/1990	41.95	80.12	2.5	III	*unknown*
04/17/1991**	40.39	77.96	2.5	*unknown*	*unknown*
08/15/1991	40.79	77.66	3.0	V	*unknown*
05/15/1992	40.57	75.13	1.6	*unknown*	*unknown*
05/10/1993	40.35	76.02	2.8	IV	*unknown*
05/11/1993*	40.35	76.02	2.0	*unknown*	*unknown*
05/11/1993*	40.35	76.02	2.3	V	*unknown*
05/11/1993*	40.35	76.02	1.6	*unknown*	*unknown*
05/11/1993*	40.35	76.02	2.2	*unknown*	*unknown*
05/13/1993*	40.35	76.02	*unknown*	*unknown*	*unknown*
05/18/1993*	40.28	76.00	2.0	*unknown*	*unknown*
05/18/1993*	40.35	76.02	2.1	IV	*unknown*
01/16/1994*	40.33	76.01	4.0	V	*unknown*
01/16/1994	40.33	76.04	4.6	VI	16,000
01/16/1994*	40.32	76.01	2.9	*unknown*	*unknown*
01/17/1994*	40.37	76.09	2.7	*unknown*	*unknown*
01/17/1994*	40.37	76.09	2.4	*unknown*	*unknown*
01/18/1994	40.19	76.23	2.6	*unknown*	*unknown*
03/24/1994	40.37	76.09	2.0	*unknown*	*unknown*
04/16/1994	40.31	75.96	2.3	*unknown*	*unknown*
05/07/1994*	40.31	76.04	2.5	*unknown*	*unknown*
05/18/1994	40.00	76.20	2.4	*unknown*	*unknown*
05/26/1994	39.95	77.19	2.8	*unknown*	*unknown*
05/31/1994*	40.34	76.00	2.4	*unknown*	*unknown*
07/03/1994*	40.35	75.88	2.0	*unknown*	*unknown*
07/03/1994*	40.33	76.09	2.3	*unknown*	*unknown*
01/08/1995	40.30	76.00	2.5	*unknown*	*unknown*
03/11/1995	40.10	76.40	2.7	IV	*unknown*
03/11/1995*	40.10	76.33	2.0	*unknown*	*unknown*
04/08/1995	40.35	76.10	2.6	*unknown*	*unknown*
06/04/1995	40.34	75.97	2.7	*unknown*	*unknown*
07/08/1995	41.95	79.04	2.4	*unknown*	*unknown*
08/17/1995	40.63	76.13	1.8	*unknown*	*unknown*

Table 4.3.3-3 Catalog of earthquakes with epicenters in Pennsylvania (DCNR, 2004).

DATE	NORTH LATITUDE (degrees)	WEST LONGITUDE (degrees)	MAGNITUDE	MAXIMUM INTENSITY	AREA (km^2)
02/03/1996	40.35	76.02	2.3	*unknown*	*unknown*
07/05/1996	39.91	76.49	2.6	*unknown*	*unknown*
07/07/1996	40.25	75.95	2.3	*unknown*	*unknown*
10/17/1996	39.75	76.06	2.2	*unknown*	*unknown*
10/28/1996	40.27	76.14	2.5	*unknown*	*unknown*
03/11/1997	40.31	74.99	1.6	*unknown*	*unknown*
06/16/1997	40.10	76.97	2.4	IV	*unknown*
06/17/1997*	40.10	76.97	1.6	*unknown*	*unknown*
11/14/1997	40.16	76.28	3.0	IV	*unknown*
11/16/1997*	40.17	76.29	1.8	*unknown*	*unknown*
09/25/1998	41.47	80.37	5.1	*unknown*	*unknown*
10/09/1998*	41.48	80.36	2.0	*unknown*	*unknown*
10/16/1998*	41.47	80.37	2.0	*unknown*	*unknown*
10/22/1998*	41.47	80.37	*unknown*	*unknown*	*unknown*
10/23/1998*	41.47	80.36	*unknown*	*unknown*	*unknown*
10/27/1998*	41.47	80.37	*unknown*	*unknown*	*unknown*
11/01/1998*	41.47	80.37	*unknown*	*unknown*	*unknown*
11/07/1998	41.57	80.31	2.3	*unknown*	*unknown*
04/18/1999	40.32	75.97	1.9	*unknown*	*unknown*
07/27/1999	40.17	75.79	*unknown*	*unknown*	*unknown*
10/22/1999	40.38	75.93	1.9	*unknown*	*unknown*
02/24/2000	41.12	75.75	2.3	*unknown*	*unknown*
03/22/2000	40.07	76.30	1.8	*unknown*	*unknown*
08/24/2000	40.10	76.70	1.9	*unknown*	*unknown*
10/05/2000	39.94	76.34	2.1	*unknown*	*unknown*
07/17/2001	39.94	76.34	1.8	*unknown*	*unknown*

Note: This table includes only earthquakes whose epicenters were located within Pennsylvania.

* Indicates a foreshock or aftershock event
** Indicates a mine collapse or quarry blast event

Table 4.3.3-3 was assembled from published and unpublished lists of historic earthquakes and from descriptions of earthquakes in professional journals and government reports. The rediscovery of ten previously forgotten Pennsylvania earthquakes by Armbruster and Seeber (1987) made a significant contribution to the catalog. Winkler's (1979, 1982) reviews of East Coast seismicity and the compilation of original newspaper accounts of Pennsylvania earthqu/akes by Abdypoor and Bischke (1982) were also helpful. The authors tabulated only those events having a maximum intensity of IV or more because the historic record is incomplete below this level, and because some of the shocks reported at level II or III are non-tectonic events such as quarry blasts or rock bursts (Scharnberger, 1988). Table 4.3.3-3 does not include strong local shocks experienced on February 21 and 24, 1954, which caused heavy damage in a five-block area of Wilkes-Barre, PA. Most seismologists now attribute these events to mine subsidence.

DCNR's earthquake records end in 2001, but a number of minor earthquakes have occurred in Pennsylvania and have been documented by USGS's Seismic Hazard Program, as shown in Table 4.3.3-4. This data indicates that recent earthquakes in Pennsylvania have generally been minor, with the highest magnitude being a 3.4. They have also been spatially concentrated in historically seismically active areas in south central Pennsylvania.

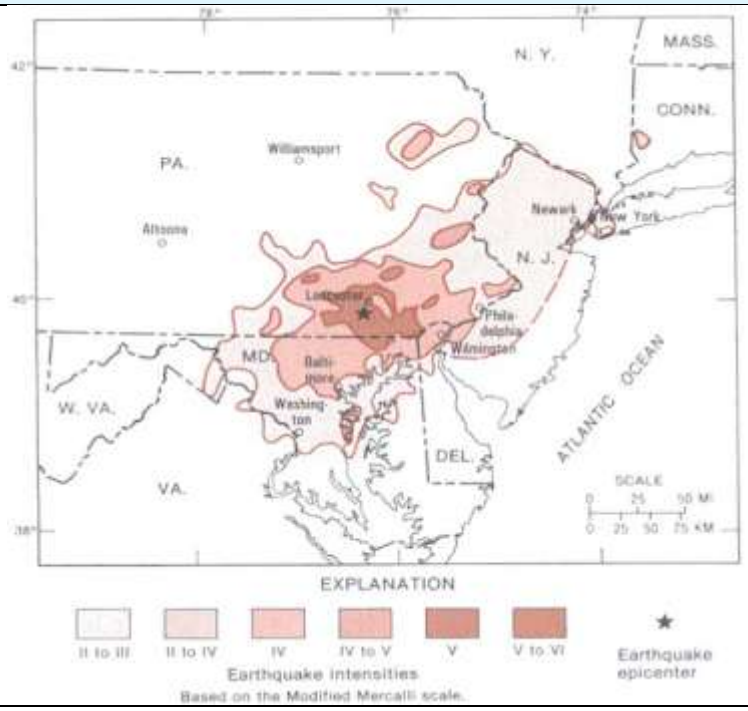
Table 4.3.3-4 Recent earthquakes with epicenters in Pennsylvania reported to USGS (USGS, 2013).

DATE	APPROXIMATE LOCATION	MAGNITUDE
11/4/2003	Reading	2.7
4/16/2006	Reading	1.0
4/17/2006	Reading	1.2
12/13/2006	Reading	2.5
1/3/2007	Meadville	2.5
4/20/2007	Reading	2.1
5/15/2007	Reading	2.1
10/05/2008	York	2.0
10/19/2008	Harrisburg	2.1
10/19/2008	Harrisburg	1.8
10/19/2008	Carlisle	1.7
10/20/2008	Carlisle	1.5
10/23/2008	York	1.2
12/27/2008	Lancaster	3.4
12/31/2008	Carlisle	0.0
4/22/2009	Carlisle	1.1
4/23/2009	Carlisle	2.4
4/24/2009	Carlisle	2.9
4/30/2009	Carlisle	2.0
5/11/2009	Carlisle	1.3
10/25/2009	Carlisle	2.6
10/25/2009	Carlisle	2.8
12/20/2009	Easton	2.3
6/3/2010	Harrisburg	2.9
12/10/2010	Meadville	2.7

Very few earthquakes having a maximum intensity of IV or higher have been centered in Pennsylvania 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.

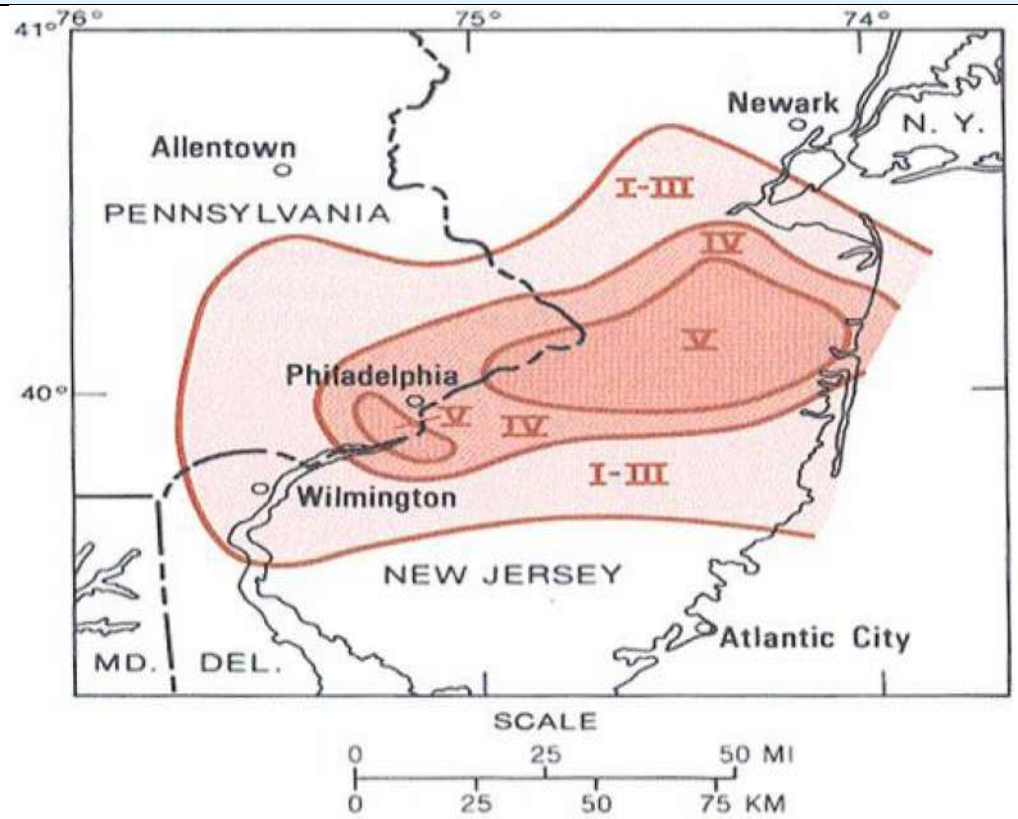
The most widely felt earthquake known to be centered in Pennsylvania occurred in the Lancaster area on April 23, 1984 (Armbruster and Seeber, 1987; Scharnberger and Howell, 1985). An isoseismal map for this event is included in Figure 4.3.3-3. More recently, an earthquake on January 16, 1994 measured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



Earthquake 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 northeasterly 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.

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).

On October 9, 1871, an earthquake having a maximum intensity of VII struck Wilmington, Del., 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, PA 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.

4.3.3.4. Future Occurrence

One way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. Peak horizontal ground acceleration (PHGA) measures the strength of ground movements in this manner. PHGA is the percent of *g* (acceleration due to gravity) experienced during the earthquake or the rate in change of motion of the earth's surface during an earthquake as a percent of the established rate of acceleration due to gravity. In general, an acceleration of 10- to 15-percent of gravity is associated with structural damage to ordinary buildings not specifically designed to resist earthquakes, although soil conditions at local sites are extremely important in controlling how much damage will occur as a consequence of a given amount of ground acceleration.

The first attempts to delineate seismic hazard in the United States were based on the historic records of the highest intensity earthquake ever experienced at individual localities. Using this concept, Algermissen (1969) placed Pennsylvania in a zone where relatively minor damage (intensity V to VI) is expected. Algermissen and others (1982) used probabilistic methods to map earthquake hazards in the United States. In southeastern Pennsylvania, the zone of highest seismic hazard in the state, they indicated that there is a 90-percent probability that maximum horizontal acceleration in rock of 10-percent of gravity will not be exceeded in a 50-year period. In comparison, for the same probability and exposure period, a maximum horizontal acceleration of about 60-percent of gravity characterizes high-risk areas along the San Andreas Fault in California.

A probabilistic hazard map is provided by the DCNR (2007) in Figure 4.3.3-6. The map shows contours which represent earthquake ground motions that have a 10-percent probability of exceedance over a 50-year period. PHGA values ranging from 10-14-percent are shown in eastern Pennsylvania. These values correspond to intensities of VII; such earthquakes can cause significant building damage. PGHA values of between six and eight, found in the rest of Pennsylvania, correspond to an intensity of VI. On the whole, the future probability of earthquakes can be considered *possible.*

Figure 4.3.3-6 Pennsylvania probabilistic earthquake hazard map. Contours represent PHGA values that have a 2-percent probability of being experienced over a 50-year period (PADCNR, 2007).

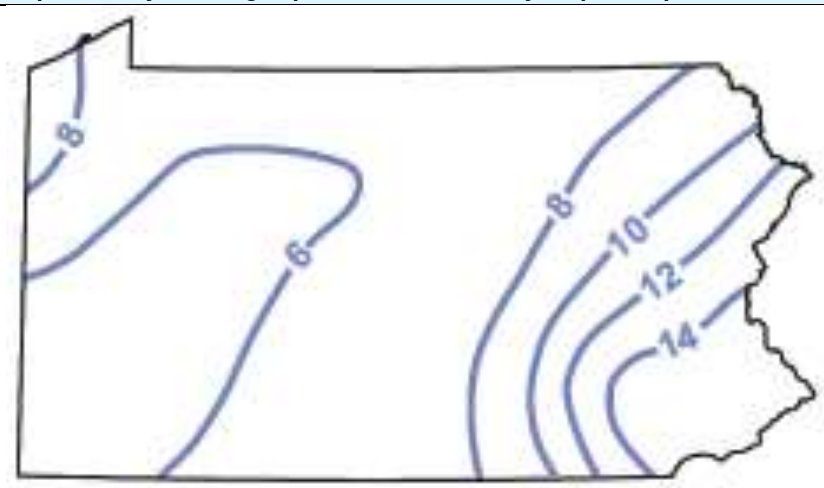
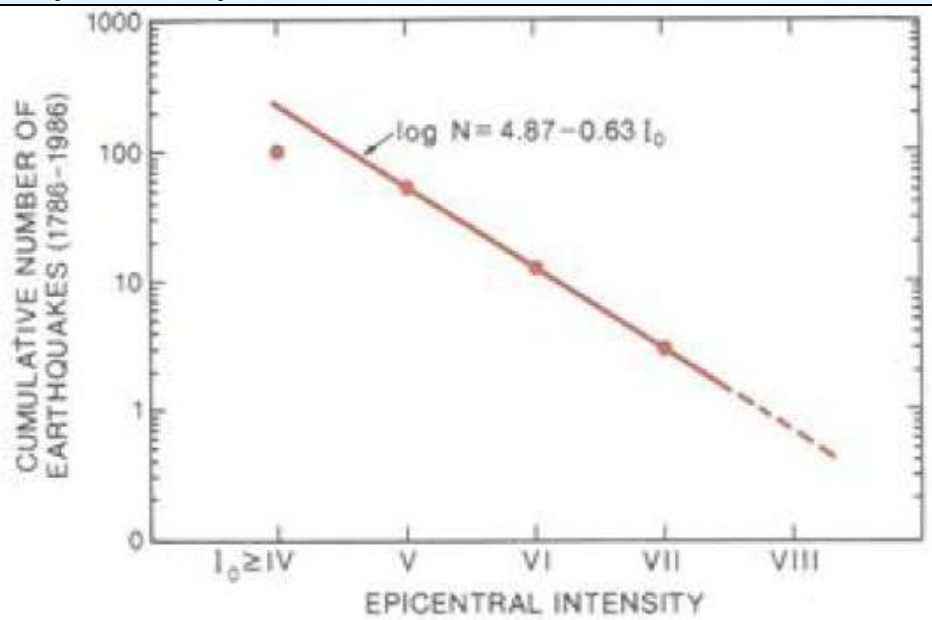


Figure 4.3.3-7 is a plot of the cumulative number (N) of earthquakes versus epicentral intensity (I_0) for the period 1786-1986 in the study region. The straight line (log N=4.87-0.63 I_0) has been fitted to the observed frequencies at the V, VI, and VII intensity levels. In regions where earthquake records have been kept for a long time, log N versus I_0 relationships are nearly linear over the range of higher intensities. In regions that have short-term histories, a linear log N relation is commonly assumed to extrapolate the frequencies of shocks larger than those that have actually been observed. The calculated frequency derived from the linear expression shown in the figure is more than twice the observed frequency at the intensity IV level. This discrepancy, the fact that the observed frequency falls below the calculated frequency, 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 (I_0) 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 historic time. Assuming that the expression for log N that has been derived may be extrapolated to higher intensities, it is estimated that, on average, three to four such events ($I_0 \geq$ VIII) will take place over 1,000 years. This result is similar to Algermissen's (1969) estimate of seismicity rates for the entire East Coast region (2.3 shocks per 100,000 km^2 [38,600 mi^2] with $I_0 \geq$ VIII over a 1,000-year period). 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 a record several centuries long of small and moderate Pennsylvania earthquakes to estimate the rate of occurrence of infrequent strong earthquakes 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 probably result in the discovery of many additional, previously unlisted earthquakes.

4.3.3.5. Environmental Impacts

Environmental impacts of earthquakes can be numerous, widespread and devastating, particularly if indirect impacts are considered. Some examples are shown below, but such impacts are rare to Pennsylvania:

- Induced tsunamis and flooding or landslides and avalanches
- Poor water quality
- Damage to vegetation
- Breakage in sewage or toxic material containments
- Secondary impacts including: train derailments and spillage of hazardous materials and utility interruption

4.3.3.6. Jurisdictional Vulnerability Assessment

Historically, earthquakes have occurred in eighteen of Pennsylvania's 67 counties. Additionally, as illustrated Figure 4.3.3-2, earthquakes have historically been concentrated in the southeastern and south central areas of the Commonwealth. Pennsylvania has three zones of earthquake hazard; jurisdictions that fall into the "moderate" zone can be considered vulnerable to future earthquake events. Using this analysis parameter, 43 of Pennsylvania's 67 counties are vulnerable to earthquake events.

In addition to the jurisdictions identified via GIS analysis, 51 out of 67 counties in Pennsylvania identify earthquakes as a hazard, as seen in Table 4.3.3-5. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile. When counties ranked hazards in local HMPs 'H' is listed for high rankings, 'M ' for medium, and 'L' for low. This ranking information was prepared separately by counties using different methodologies and criteria.

Of the seven counties which currently have calculated risk factor values for earthquake hazards, the average value is 1.6. The State Risk Factor for earthquake is 1.9, while the Pennsylvania THIRA scored earthquake as a 5 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.3-5 Counties profiling earthquakes with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny	X		Low	1.3
Armstrong		X		
Beaver	X		Medium	2.4
Bedford	X		Low	1.3
Berks	X		Not Ranked	No RF
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks	X		Low	1.7

Table 4.3.3-5 Counties profiling earthquakes with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Butler	X		Low	1.5
Cambria	X		Low	1.3
Cameron	X		Low	1.3
Carbon		X		
Centre		X		
Chester	X		Not Ranked	No RF
Clarion	X		Not Ranked	No RF
Clearfield	X		Low	1.3
Clinton		X		
Columbia	X		Low	1.3
Crawford		X		
Cumberland	X		Low	1.3
Dauphin		X		
Delaware	X		Low	1.5
Elk		X		
Erie	X		Medium	2.0
Fayette	X		Low	1.9
Forest	X		Not Ranked	No RF
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon	X		Not Ranked	No RF
Indiana	X		Low	1.8
Jefferson	X		Low	1.9
Juniata		X		
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Low	1.5
Lawrence		X		
Lebanon*	X		Not Ranked	1.0
Lehigh	X		Low	1.9
Luzerne	X		Not Ranked	No RF
Lycoming		X		
McKean	X		Low	1.3

Table 4.3.3-5 Counties profiling earthquakes with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Mercer	X		Low	1.5
Mifflin		X		
Monroe	X		Low	1.5
Montgomery	X		Low	2.3
Montour*	X		Not Ranked	1.0
Northampton	X		Low	1.9
Northumberland	X		Low	1.7
Perry*	X		Not Ranked	1.0
Philadelphia**	X		Low	C
Pike	X		Low	1.5
Potter	X		Not Ranked	No RF
Schuylkill		X		
Snyder	X		Low	1.7
Somerset		X		
Sullivan	X		Not Ranked	No RF
Susquehanna	X		Low	1.7
Tioga	X		Low	1.3
Union	X		Not Ranked	No RF
Venango	X		Low	1.5
Warren	X		Low	1.3
Washington	X		Not Ranked	No RF
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Low	1.6

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

The aforementioned vulnerable jurisdictions host a number of state critical facilities. Most of these state critical facilities are located in southeastern Pennsylvania, particularly in Luzerne, Montgomery, Lancaster, Berks,Bucks, and Delaware Counties. Table 4.3.3-6 provides a complete accounting of the number of state critical facilities vulnerable to earthquakes in each vulnerable county.

Table 4.3.3-6 Number of State Critical Facilities impacted by earthquakes located in each county.

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	38	Lancaster	146
Bedford	7	Lawrence	39
Berks	148	Lebanon	106
Blair	75	Lehigh	77
Bucks	124	Luzerne	240
Cambria	62	Mercer	75
Carbon	66	Mifflin	25
Centre	57	Monroe	33
Chester	123	Montgomery	202
Clinton	1	Northampton	83
Crawford	2	Perry	3
Cumberland	38	Philadelphia	117
Dauphin	55	Pike	26
Delaware	157	Schuylkill	62
Erie	140	Somerset	54
Fayette	64	Susquehanna	52
Franklin	12	Wayne	16
Greene	2	Westmoreland	43
Huntingdon	13	Wyoming	28
Indiana	31	York	27
Lackawanna	6		

4.3.3.7. State Facility Vulnerability Assessment

The vulnerability of state critical facilities was evaluated as facilities that were either within 17.5 miles of a previous earthquake event or that were located in the “moderate” earthquake hazard zone identified by researchers at Millersville University. Using these criteria, a total of 2,924 vulnerable critical facilities have been identified. As illustrated in Table 4.3.3-7, 1,204 vulnerable facilities are fire departments, and a further 640 vulnerable facilities are designated as police facilities. At least one critical facility from each category is vulnerable to earthquake hazards; most notably, 34 government facilities are located within earthquake hazard zones.

Table 4.3.3-7 State Critical Facilities vulnerable to earthquakes by Critical Facility Type.

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	75
Banking	18
Chemical	6
Commercial Facilities	42
Communications	3
Critical Manufacturing	3
Dams	13
Defense Industrial Base	15
Education	97
Emergency Services	45
Energy	22
Fire Departments (Non-HSIP)	1204
Government Facilities	34
Healthcare & Public Health	31
Hospital (Non-HSIP)	148
Information Technology	3
Manufacturing	1
National Monuments & Icons	6
Nuclear Reactors, Materials & Waste	3
Police (Non-HSIP)	640
Postal & Shipping	4
School (Non-HSIP)	462
Transportation	31
Water	18
TOTAL VULNERABLE CRITICAL FACILITIES	***2,924***

4.3.3.8. Jurisdictional Loss Estimation

Jurisdictional losses due to earthquakes will depend on the magnitude and intensity of the earthquake event. With higher magnitude earthquake events comes greater possibility for significant structural damage to buildings, roads, and other infrastructure. Philadelphia and Montgomery Counties are the most threatened jurisdictions with $201 and $160 billion in exposed buildings and contents, respectively. Jurisdictional loss estimates were identified at the tract level and aggregated at the county level to show the possible losses per county. The total dollar value of exposure in vulnerable jurisdictions tops $1.3 trillion. These potential losses are displayed in Table 4.3.3-8.

Table 4.3.3-8 Estimated jurisdictional losses due to earthquakes.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	53,826	$12,604,062
Bedford	12,883	$2,348,729
Berks	227,614	$59,210,259
Blair	66,561	$14,156,138
Bucks	321,764	$108,123,710
Cambria	50,612	$11,669,315
Carbon	79,071	$17,961,659
Centre	60,132	$14,861,568
Chester	261,350	$89,860,597
Clinton	2,479	$556,622
Crawford	40,481	$8,054,451
Cumberland	115,029	$30,363,013
Dauphin	135,742	$33,621,413
Delaware	281,319	$86,856,472
Erie	129,780	$30,454,807
Fayette	7,580	$1,327,978
Franklin	4,631	$984,863
Greene	8,054	$1,369,296
Huntingdon	30,513	$6,268,058
Indiana	12,330	$2,504,821
Juniata	7,820	$1,512,836
Lackawanna	147,658	$33,533,470
Lancaster	264,197	$68,045,591
Lawrence	31,519	$6,749,048
Lebanon	90,685	$22,046,975
Lehigh	218,320	$59,736,030
Luzerne	190,058	$42,702,861
Mercer	62,261	$13,464,728
Mifflin	30,033	$6,044,286
Monroe	134,818	$33,513,041
Montgomery	484,549	$160,866,480
Northampton	181,973	$50,378,288
Perry	20,194	$5,460,632
Philadelphia	778,715	$201,276,171
Pike	70,552	$16,534,398
Schuylkill	73,909	$16,673,756
Snyder	3,455	$596,574
Somerset	47,616	$10,156,910

Table 4.3.3-8 Estimated jurisdictional losses due to earthquakes.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Susquehanna	22,676	$4,411,807
Union	2,139	$388,344
Wayne	75,557	$15,861,133
Westmoreland	29,653	$6,223,366
Wyoming	32,416	$7,098,854
York	214,709	$53,181,939
TOTAL	**5,117,233**	**$1,369,615,349**

In addition to the aforementioned analysis, FEMA's HAZUS-MH loss estimation model was used to explore the potential damage of earthquake hazards in the Commonwealth using a Level 2 analysis incorporating new 2010 Census data and updated general building stock information that better reflect the demographics and building stock in Pennsylvania. This level of analysis is a rough estimate of damage to buildings, essential facilities, transportation systems, utility systems, and high potential loss facilities based on national data included in the HAZUS software. This analysis assumes a uniform soil type of D for all of Pennsylvania. Soil type D, according to the National Earthquake Hazards Reduction Program, is characterized as having a stiff soil profile with a soil sheer wave velocity of between 600 and 1,200 feet per second. Since soil types across Pennsylvania are not uniform, it would be preferable to incorporate more specific soil classifications for the Commonwealth. However, as stated in the HAZUS technical manual for earthquakes, more specific soil site classifications should be developed by a soil science expert or geologist and then entered into the HAZUS model. Currently, specific soil site classifications have not been developed for Pennsylvania according to the USGS and DCNR's Bureau of Geologic and Topographic Survey. As a result, the results presented here should be considered a broad estimate of statewide risk and statewide loss estimates. Action 2-3d in the 2013 Mitigation Action Plan seeks to develop this dataset for the 2016 SSAHMP. For more information on the HAZUS data and methodology used in the SSAHMP, see 4.1.4.

The risk of a significant earthquake event is not evenly distributed across the Commonwealth. To accurately analyze earthquake risk, six events representing the earthquake hazard zones in the Commonwealth as well as two events based on significant historical events were examined. This was done in order to understand the range of earthquake events possible statewide. The parameters selected for the earthquake HAZUS models were extracted from the 2007 and 2010 Commonwealth Hazard Mitigation Plans. This was done in order to enable more effective comparison of the change in risk and loss estimation from 2007-2013. The parameters were selected in 2007 according to studies conducted by the Millersville University Center for Disaster Research and Education (see Figure 4.3.3-1). These same parameters were repeated using HAZUS version 2.1, Level 2 analysis for this plan update. The decision to run three scenarios in 2007 close to the Reading Lancaster border was likely chosen due to this area having the largest volume of previous occurrences in the Commonwealth.

All of the models were conducted as arbitrary earthquake events using the Central and Eastern United States (CEUS) attenuation function. This attenuation function defines the way in which a seismic wave loses strength as it moves through earth and is regionally defined based on predominant soil composition. All events modeled except the Mercer County event are considered arbitrary events, meaning they are based on user-defined parameters rather than historical event parameters. These arbitrary events were modeled with magnitudes ranging from 5 to 6.1 in order to provide results that are reasonable given the fact that Pennsylvania has had only one earthquake of a magnitude of over 6.0 in its history. Table 4.3.3-9 illustrates the parameters for each event modeled.

Table 4.3.3-9 HAZUS earthquake model event parameters.

EVENT NAME	LATITUDE	LONGITUDE	MAGNITUDE	DEPTH
Philadelphia	39.95	-75.16	5	12
Reading/Lancaster	40.23	-76.37	5	10
Mercer County (historical)	41.49	-80.39	5.3	10
Indiana County	40.64	-79.28	6.1	15
Spring Township	40.33	-76.04	5	10
Minimum event magnitude for arbitrary events is 5; minimum event depth is 10 km.				

HAZUS model results reveal that there was more building damage and overall economic loss in events whose epicenters are located in more densely populated areas and in higher magnitude events. For example, even though the arbitrary event in Philadelphia was only a magnitude 5 earthquake, the model indicates over $21 billion in economic loss and nearly 342,400 buildings with at least moderate damage. Table 4.3.3-10 displays the potential losses to life, property, and the economy predicted for each event modeled. Figures 4.3.3-8 through 4.3.3-13 show the distribution of potential total economic losses for each HAZUS scenario. See *Appendix H – HAZUS Results Reports* for the full report on the HAZUS model results.

Table 4.3.3-10 Summary of earthquake losses predicted by HAZUS.

EVENT NAME	BUILDINGS AT LEAST MODERATELY DAMAGED	BUILDINGS DAMAGED BEYOND REPAIR	TOTAL ECONOMIC LOSS (MILLIONS)	BUILDING-RELATED ECONOMIC LOSS (MILLIONS)	SHELTER REQUIREMENT	INJURY ESTIMATES (2AM)	CASUALTY ESTIMATES (2AM)
Philadelphia	157,484	7,428	$21,240.78	$20,547.92	9,695	25	1
Reading/Lancaster	22,127	613	$2,412.75	$1,901.89	541	28	1
Mercer County (historical)	8,320	365	$973.9	$651.73	186	3	0
Indiana County	77,884	6,439	$8,528.48	$7,057.96	3,963	778	27
Spring Township	28,777	1,078	$3,535.51	$3,080.42	1,162	643	27

Figure 4.3.3-8 HAZUS Earthquake map for the Philadelphia event.

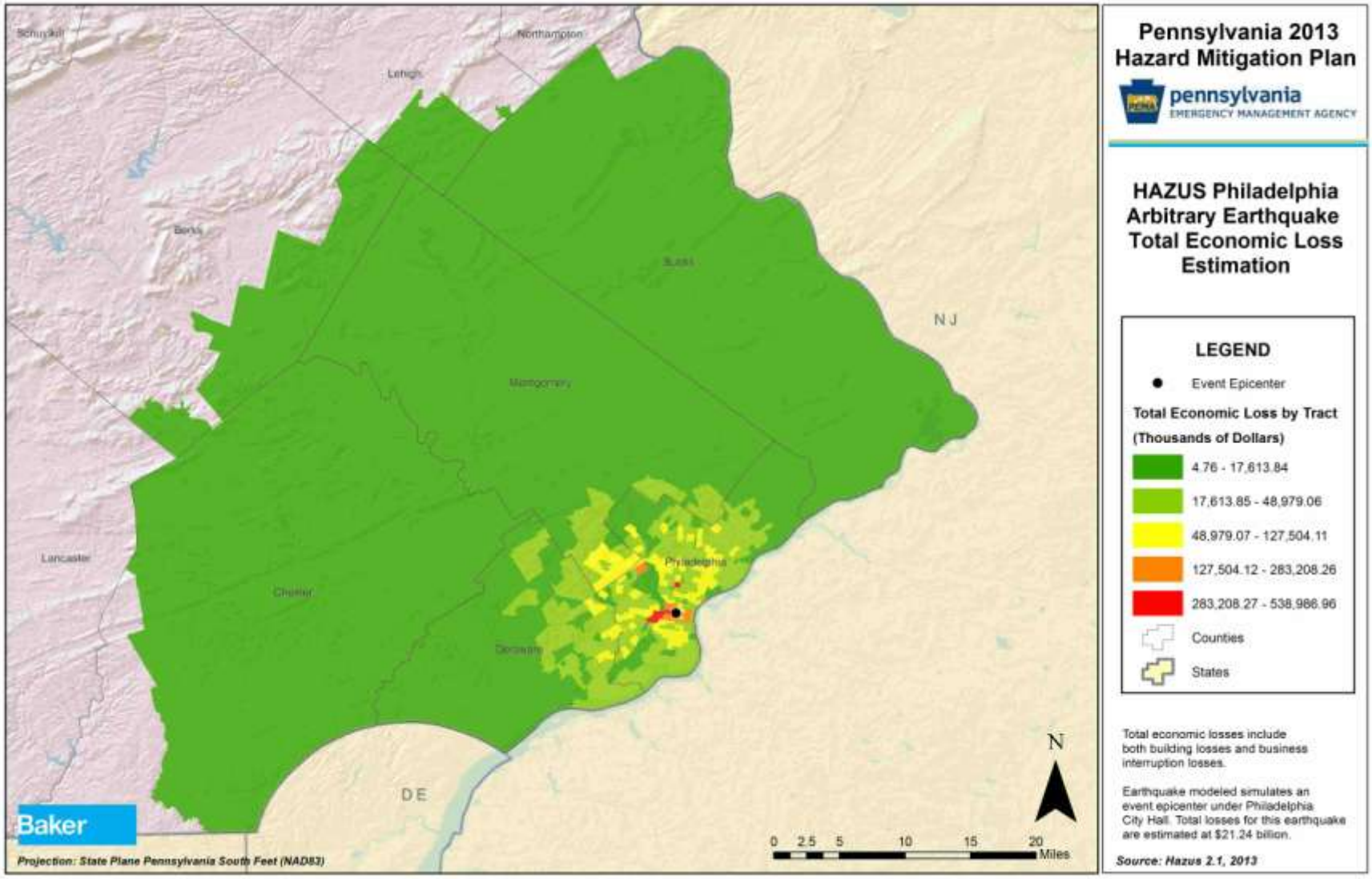


Figure 4.3.3-9 HAZUS Earthquake map for the Reading/Lancaster event.

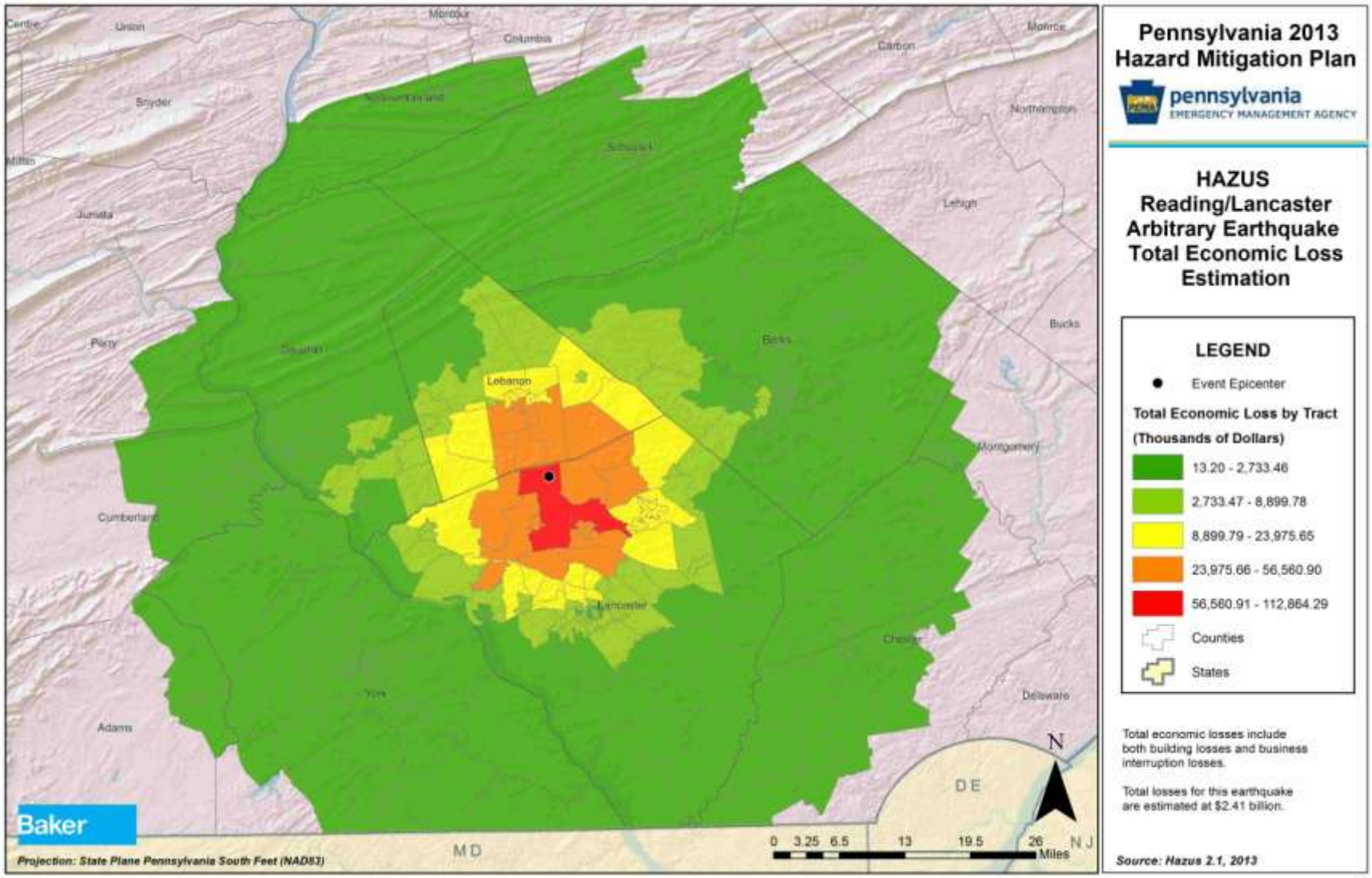


Figure 4.3.3-10 HAZUS Earthquake map for the Mercer County event (historical).

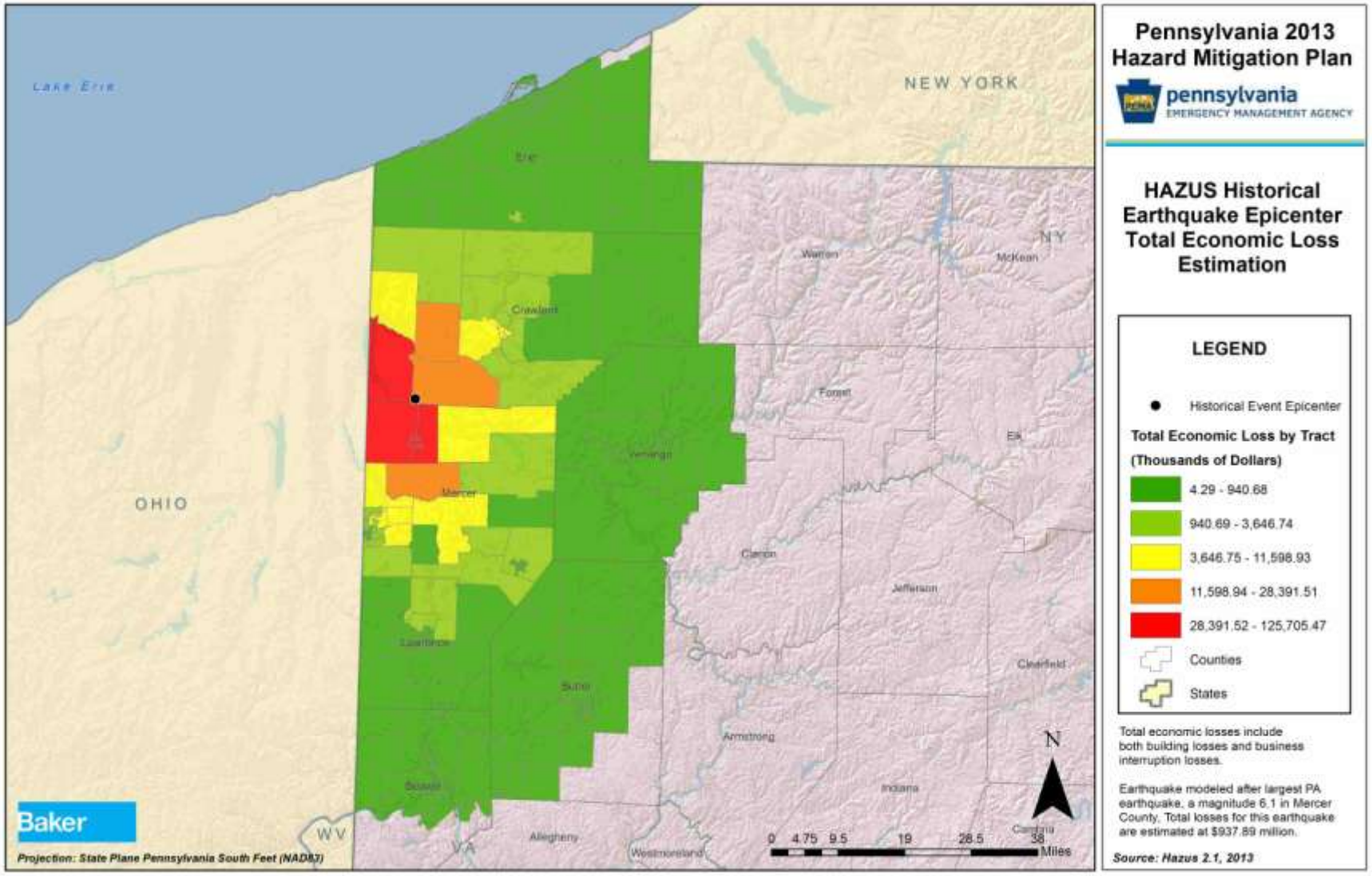


Figure 4.3.3-11 HAZUS Earthquake map for the Indiana County event.

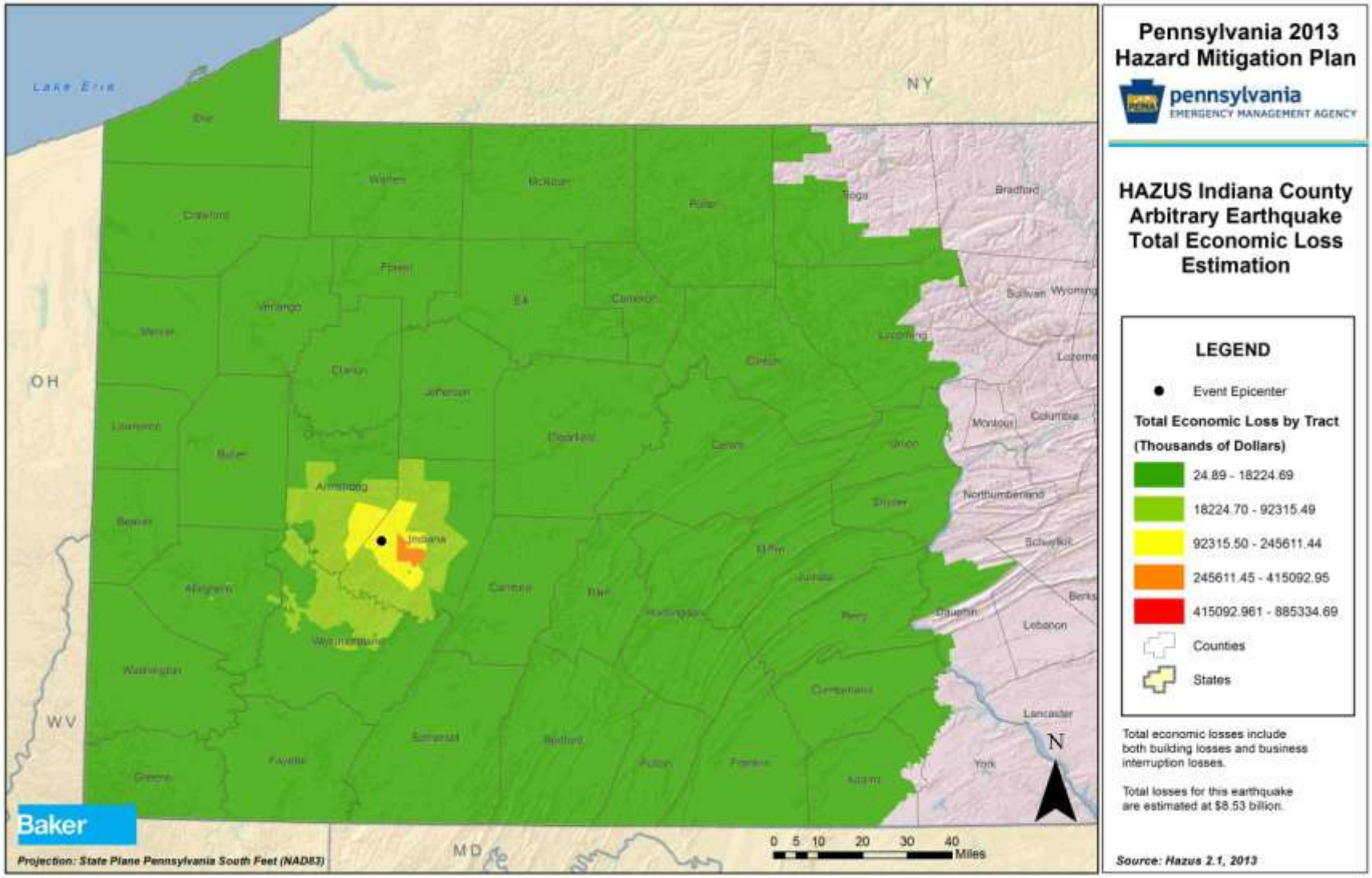
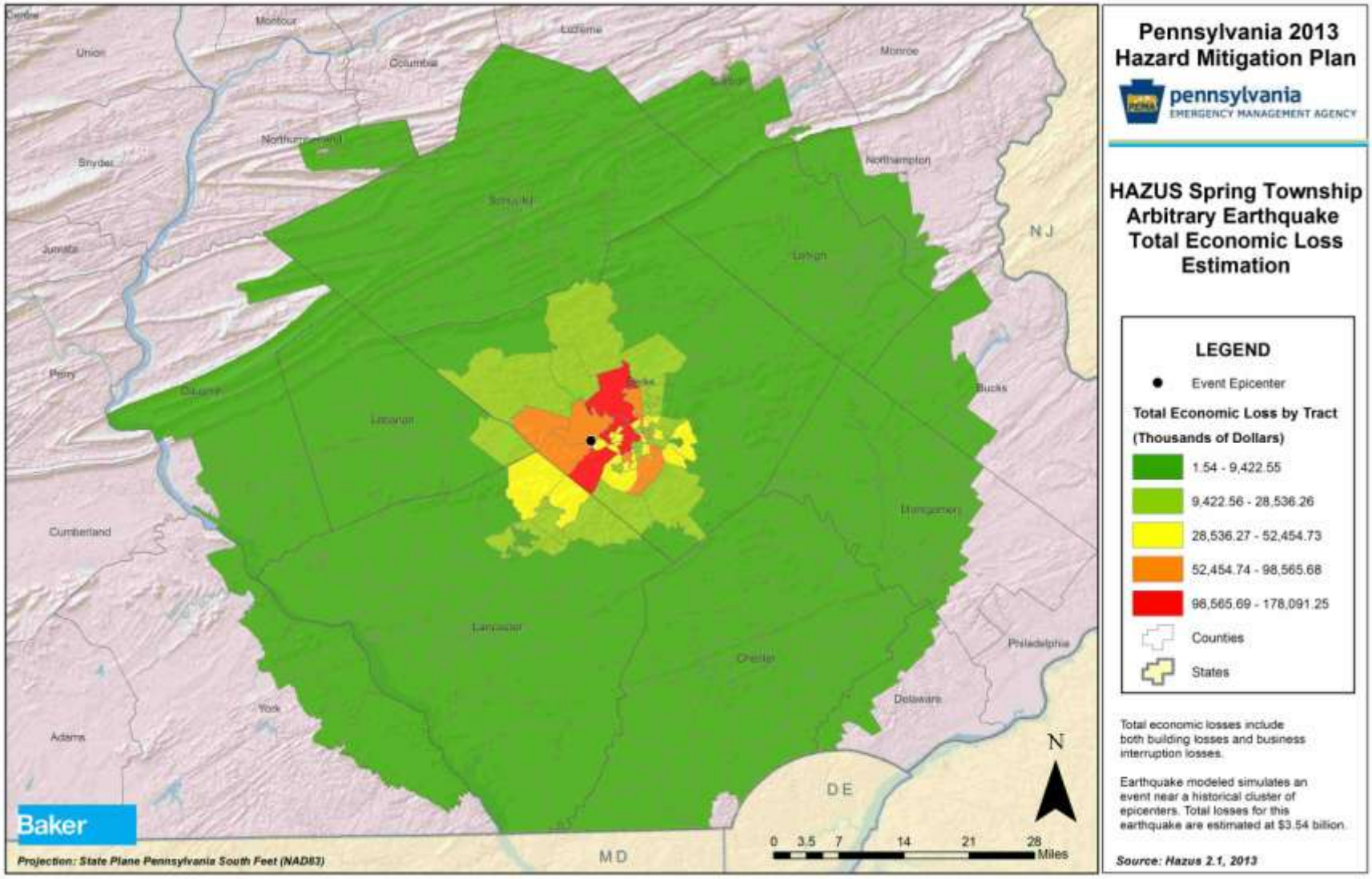


Figure 4.3.3-12 HAZUS Earthquake map for the Spring Township event.



4.3.3.9. State Facility Loss Estimation

State facilities will not experience uniform losses in earthquake events. The losses will depend on the level of damage to the facility, from cosmetic damage to total destruction of a structure. Additionally, replacement values are not available for all critical facilities. With the values available, the estimated replacement cost of all state critical facilities located in earthquake hazard zones is $19,762,562,079.00.

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 43°F in the north-central mountains to 55°F in the southeast. High temperatures of 90°F or above occur about ten days per year at any one location, but southeastern localities may experience more than twice this number. Ranges of daily temperature from maximum to minimum are commonly around 20°F during the summer and are a few 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.

Figure 4.3.4-1 and Figure 4.3.4-2 show annual mean maximum and minimum temperatures throughout Pennsylvania. 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 average minimum temperature throughout Pennsylvania based on temperature data collected between 1981 and 2010.

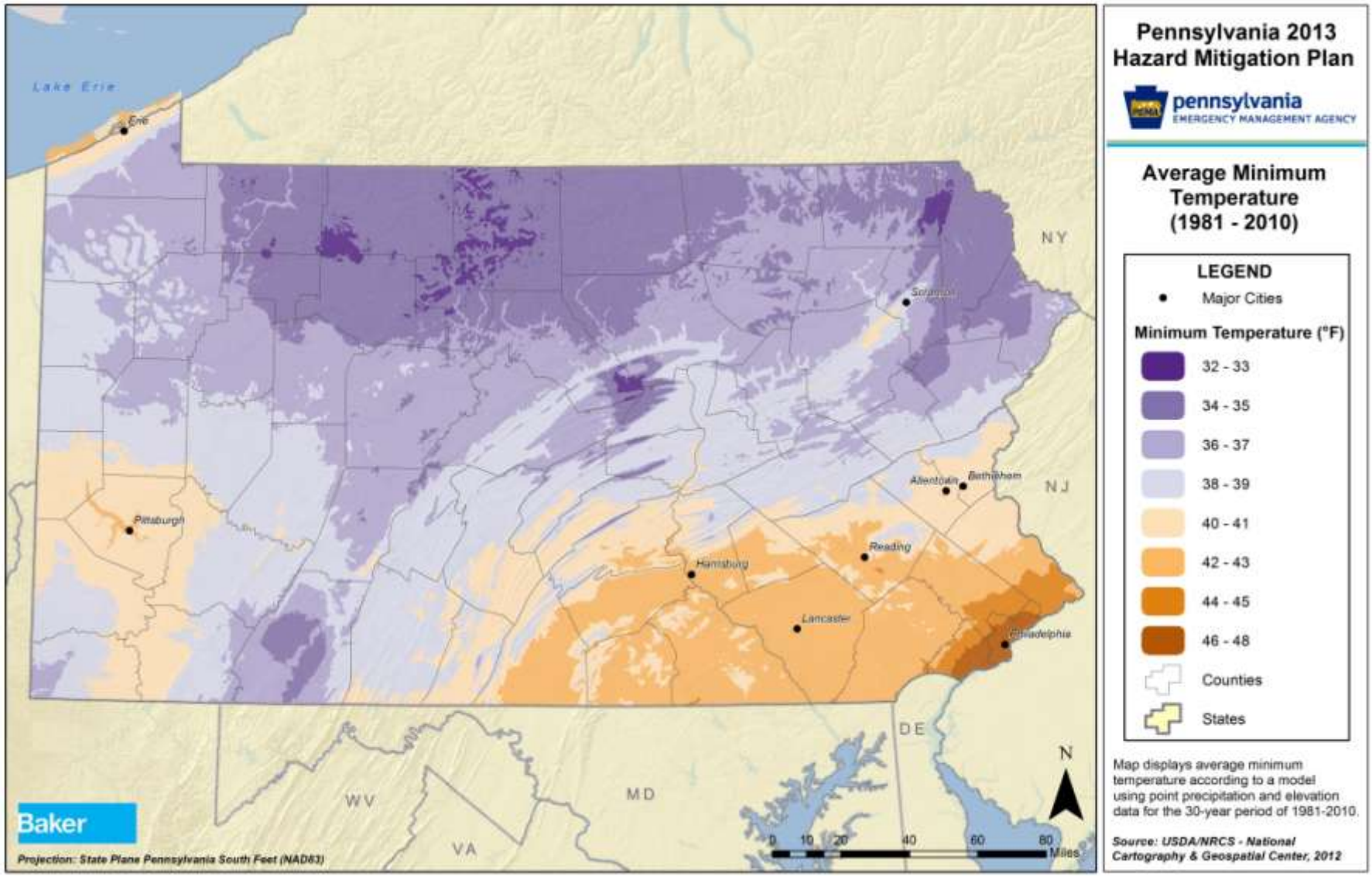
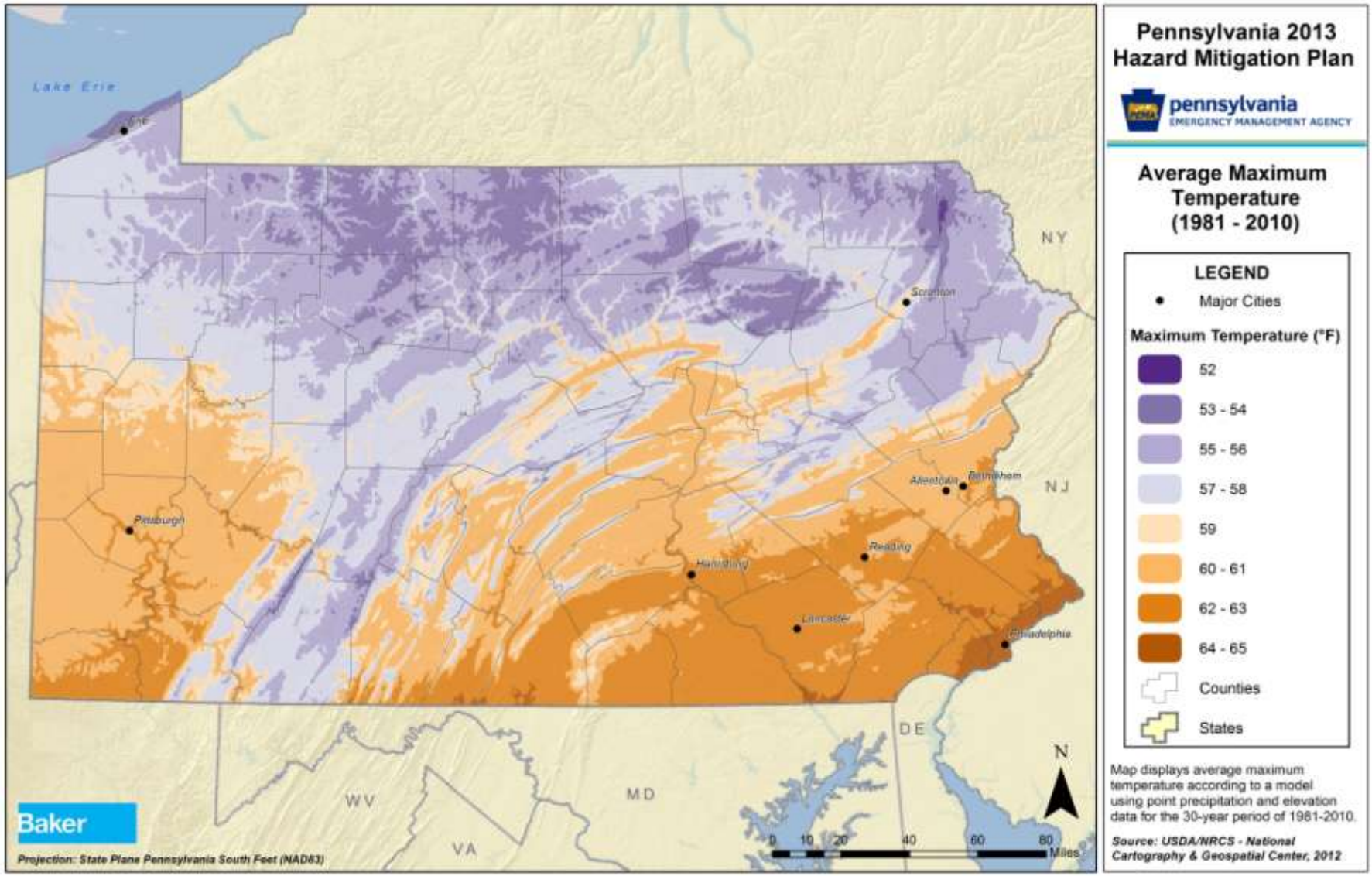


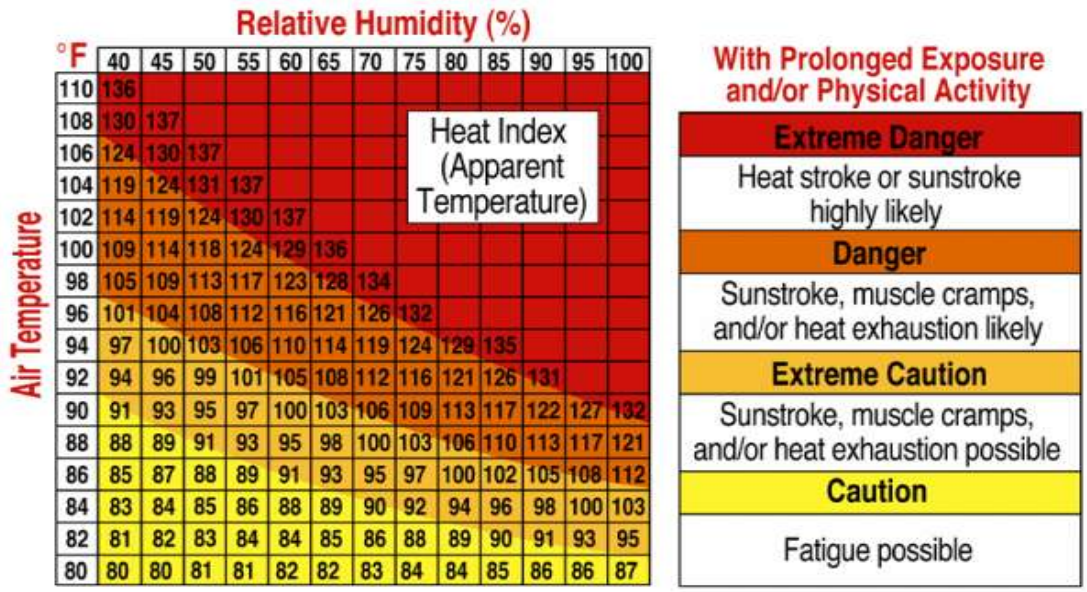
Figure 4.3.4-2 Map showing average maximum temperature throughout Pennsylvania based on temperature data collected between 1981 and 2010.



4.3.4.2. Range of Magnitude

Extreme temperatures can result in elevated utility costs to consumers and also can cause human risks. Extremely high temperatures cause heat stress which can be divided into four categories (see Figure 4.3.4-3). Each category is defined by apparent temperature which is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, heat syncope, heat exhaustion, heatstroke, and death. Note that while the temperatures in Figure 4.3.4-3 serves as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors. The very old and the very young are most vulnerable to health-related impacts of extreme temperatures.

Figure 4.3.4-3 Four categories of heat stress (NOAA, 2010).



°F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	103	106	110	114	119	124	129	135			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

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 Warnings* are issued when heat indices will attain or exceed 105°F, and *Excessive Heat Watches*, are issued when there is a possibility that excessive heat warning criteria may be experienced within twelve to forty-eight hours (NOAA NWS, 2010).

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. 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. Similarly 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. Wind Chill Advisories are issued in the southeast and western sections of Pennsylvania when wind chill values drop to -10°F to -24°F. South-central to northern sections of the Commonwealth when wind chills drop to -15°F to -24°F (NOAA NWS, 2010).

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.

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 (NCDC, 2003). As of the 2013 version of the SSAHMP, these records still hold.

Data from the National Climatic Data Center reports that there have been 315 extreme temperature events in Pennsylvania between 1950 and 2013, resulting in a total of 586 deaths and 531 injuries. Seventy-one of these events have been a result of extreme cold, resulting in 27 deaths and 130 injuries. The database reports an event in January 1994 which resulted in 129 injuries and five million dollars in property damage. There have been 205 extreme heat events, resulting in 560 deaths and 401 injuries. The database reports six events in July 1995 resulting in 134 deaths. Past events typically affected multiple counties or the entire state (NCDC, 2013).

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

The following six maps display the probability of extreme maximum and minimum temperatures for the commonwealth using data from thirty recording stations. Figure 4.3.4-4, Figure 4.3.4-5, and Figure 4.3.4-6 show the number of annual occurrences where temperatures exceed 90°F, 95°F and 100°F, respectively. Figure 4.3.4-7, Figure 4.3.4-8, and Figure 4.3.4-9 show the number of annual occurrences where temperatures fall below 0°F, -10°F and -20°F, respectively.

Data used to construct these maps was collected from the Pennsylvania State Climatologist Office. Every station had at least thirty years of data recorded with the majority having over eighty years. Determining the number of total extreme events over the entire period of record and then dividing that number by the total number of years calculated these values. It is important to note that frequency estimates may not be an accurate representation of future conditions due to the unknown impacts of climate change. Significant, broad evidence supports human influence to a long-term trend of global warming. It has been difficult to predict how much, how fast, or how long the warming will occur, due to the large number of variables

involved. According to the Pennsylvania Climate Impacts Assessment Report (2009), annual and seasonal average temperatures are expected to increase; with one scenario predicting almost a 7 °F increase in annual average temperature by the end of the 21st century. Some areas of the world may experience greater temperature changes than others. Predictions for smaller areas and shorter time periods become more uncertain. However, Pennsylvania is preparing for the worst scenario. Even with such uncertainty, it is *highly likely* that extreme temperatures will occur in the future.

It is important to note that frequency estimates may not be an accurate representation of future conditions due to the unknown impacts of climate change. Significant, broad evidence supports human influence to a long-term trend of global warming. It has been difficult to predict how much, how fast, or how long the warming will occur, due to the large number of variables involved. According to the Pennsylvania Climate Impacts Assessment Report (2009), annual and seasonal average temperatures are expected to increase; with one scenario predicting almost a 7 °F increase in annual average temperature by the end of the 21st century. Some areas of the world may experience greater temperature changes than others. Predictions for smaller areas and shorter time periods become more uncertain. Even with such uncertainty, it is *highly likely* that extreme temperatures will occur in the future.

Figure 4.3.4-4 Map of yearly occurrences of temperature greater than 90°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the frequency of occurrence of extreme values per year as data points.

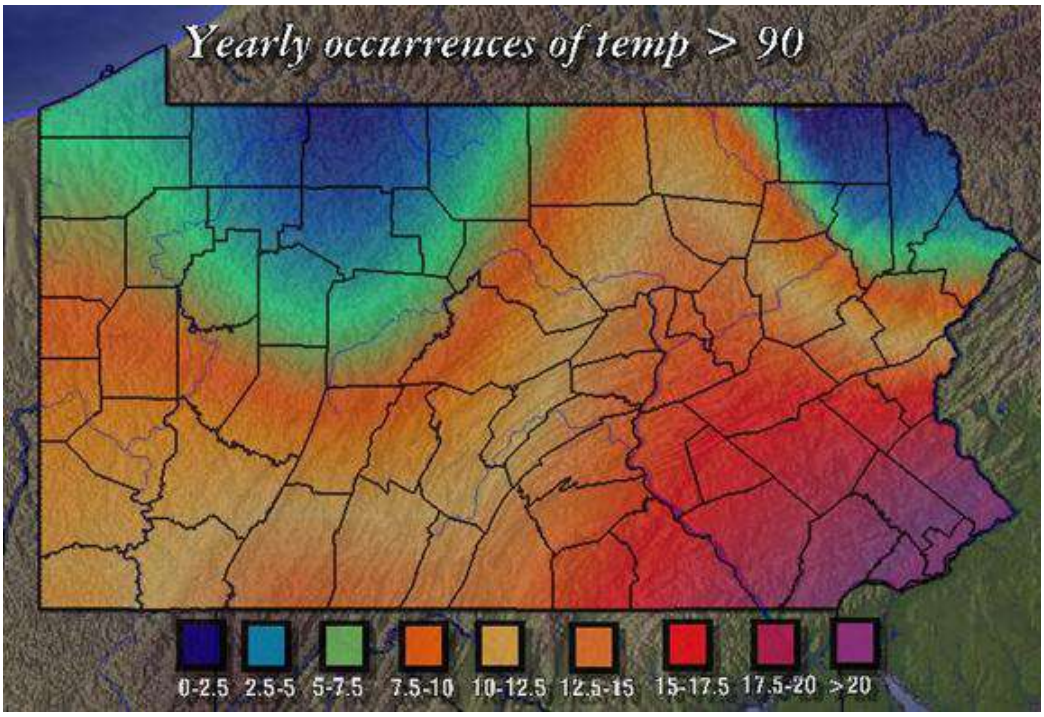


Figure 4.3.4-5 Map of yearly occurrences of temperature greater than 95°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the frequency of occurrence of extreme values per year as data points.

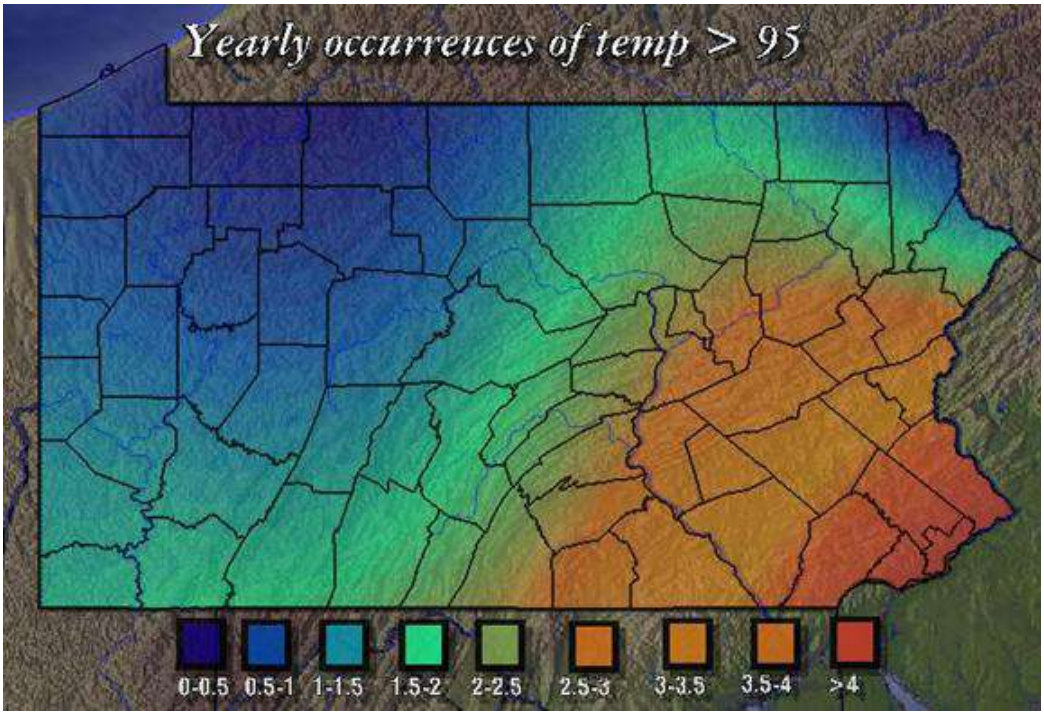


Figure 4.3.4-6 Map of yearly occurrences of temperature greater than 100°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the period of years between each occurrence of the extreme.

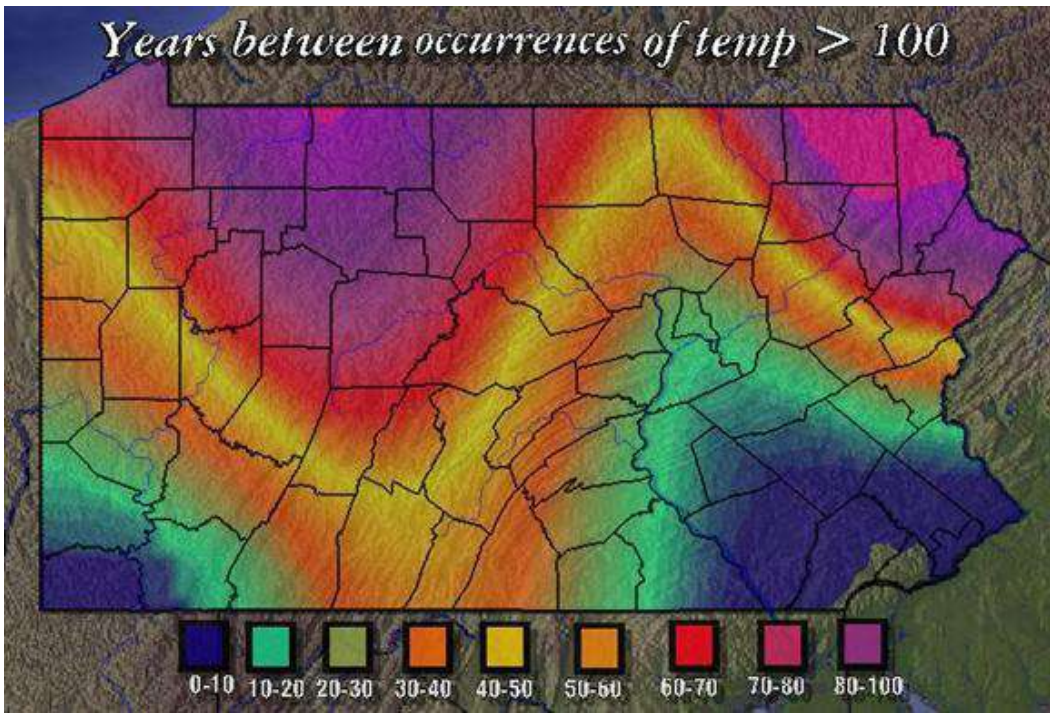


Figure 4.3.4-7 Map of yearly occurrences of temperature below 0°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the frequency of occurrence of extreme values per year as data points.

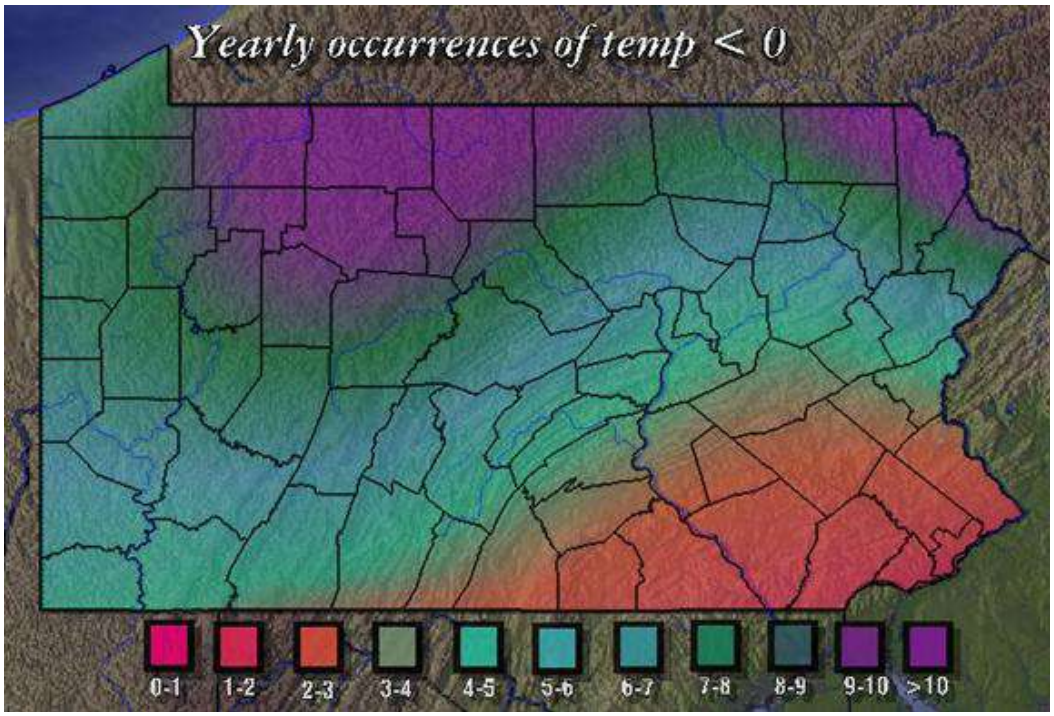


Figure 4.3.4-8 Map of yearly occurrences of temperature below -10°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the period of years between each occurrence of the extreme.

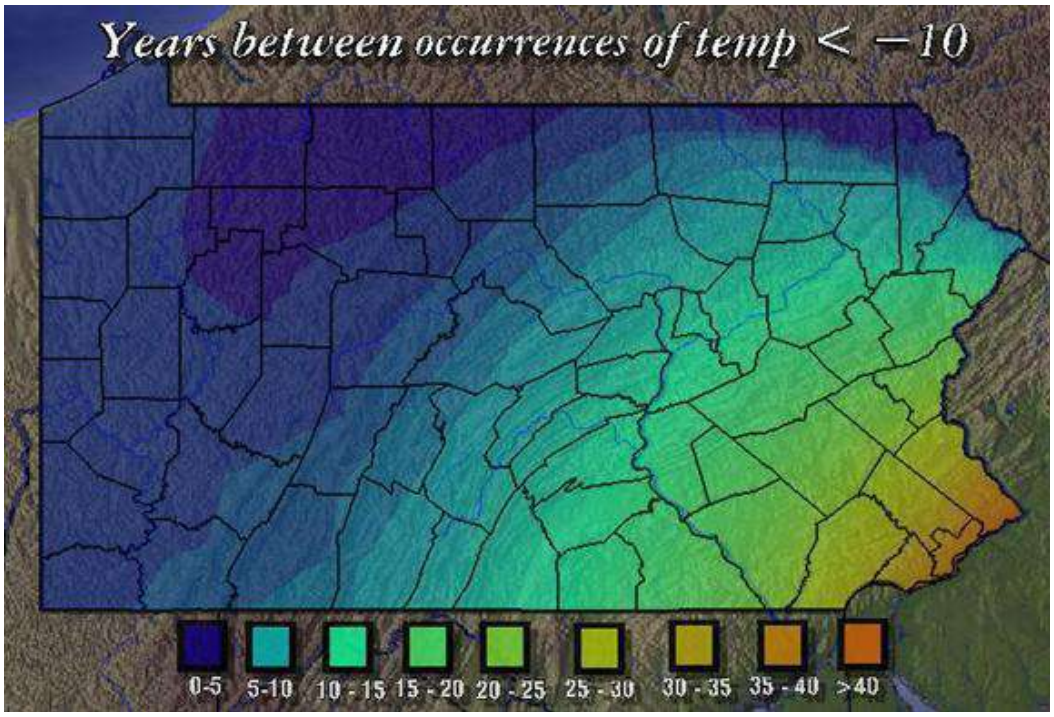
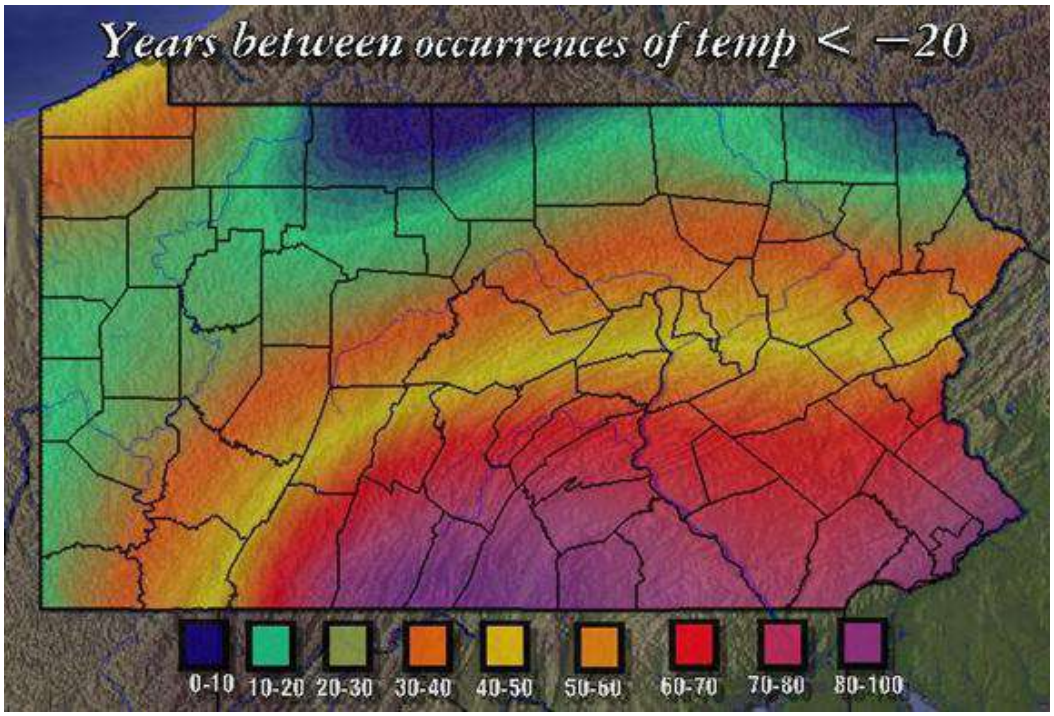


Figure 4.3.4-9 Map of yearly occurrences of temperature below -20°F in Pennsylvania (Pennsylvania State Climatologist). Note that this map was created using the period of years between each occurrence of the extreme.



4.3.4.5. Environmental Impacts

Temporary periods of extreme hot or cold temperatures typically do not have significant environmental impacts but have serious health impacts, especially in urban areas experiencing the heat island effect. However, prolonged periods of hot temperatures may be associated with drought conditions and can damage or destroy vegetation, dry up rivers and streams, and reduce water quality. Prolonged exposure to extremely cold temperatures can kill wildlife and vegetation.

Extreme temperature events are also known to have an impact on utilities. 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.

4.3.4.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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 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. As a whole, 11 of Pennsylvania's 67 counties have identified extreme temperature as a concern in their most recent plan or plan update, as seen in Table 4.3.4-1. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the counties which currently have calculated risk factor values for extreme temperature, the average value is 2.1. The State Risk Factor for extreme temperature is 2.3, while the Pennsylvania THIRA scored extreme temperature as a 6 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.4-1 Counties profiling extreme temperature hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X	Not Ranked	No RF
Allegheny		X	Not Ranked	No RF
Armstrong		X	Not Ranked	No RF
Beaver		X	Not Ranked	No RF
Bedford	X		Medium	2.3
Berks		X	Not Ranked	No RF
Blair		X	Not Ranked	No RF
Bradford		X	Not Ranked	No RF
Bucks	X		Medium	2.2
Butler		X	Not Ranked	No RF
Cambria	X		Medium	2.6
Cameron		X	Not Ranked	No RF
Carbon		X	Not Ranked	No RF
Centre	X		Low	1.4
Chester		X	Not Ranked	No RF
Clarion		X	Not Ranked	No RF
Clearfield		X	Not Ranked	No RF
Clinton		X	Not Ranked	No RF
Columbia		X	Not Ranked	No RF
Crawford		X	Not Ranked	No RF
Cumberland		X	Not Ranked	No RF
Dauphin		X	Not Ranked	No RF
Delaware	X		Medium	2.4
Elk		X	Not Ranked	No RF
Erie		X	Not Ranked	No RF
Fayette	X		Medium	2.4
Forest		X	Not Ranked	No RF
Franklin		X	Not Ranked	No RF
Fulton		X	Not Ranked	No RF
Greene		X	Not Ranked	No RF
Huntingdon		X	Not Ranked	No RF
Indiana		X	Not Ranked	No RF
Jefferson		X	Not Ranked	No RF

Table 4.3.4-1 Counties profiling extreme temperature hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Juniata		X	Not Ranked	No RF
Lackawanna		X	Not Ranked	No RF
Lancaster		X	Not Ranked	No RF
Lawrence	X		Low	1.8
Lebanon*		X	Not Ranked	No RF
Lehigh	X		Medium	2.3
Luzerne		X	Not Ranked	No RF
Lycoming		X	Not Ranked	No RF
McKean		X	Not Ranked	No RF
Mercer		X	Not Ranked	No RF
Mifflin		X	Not Ranked	No RF
Monroe		X	Not Ranked	No RF
Montgomery	X		High	3.0
Montour*		X	Not Ranked	No RF
Northampton	X		Medium	2.3
Northumberland		X	Not Ranked	No RF
Perry*		X	Not Ranked	No RF
Philadelphia**	X		High	A
Pike		X	Not Ranked	No RF
Potter		X	Not Ranked	No RF
Schuylkill		X	Not Ranked	No RF
Snyder		X	Not Ranked	No RF
Somerset		X	Not Ranked	No RF
Sullivan		X	Not Ranked	No RF
Susquehanna		X	Not Ranked	No RF
Tioga		X	Not Ranked	No RF
Union		X	Not Ranked	No RF
Venango		X	Not Ranked	No RF
Warren		X	Not Ranked	No RF
Washington		X	Not Ranked	No RF
Wayne		X	Not Ranked	No RF
Westmoreland		X	Not Ranked	No RF
Wyoming		X	Not Ranked	No RF
York	X		Medium	2.4

Table 4.3.4-1 Counties profiling extreme temperature hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

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 2.3-2. 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 SSAHMPs will work to better define vulnerability and losses for hazards expected to mainly impact health and social welfare.

Extreme Heat

This SSAHMP defines vulnerability for extreme heat as areas having a maximum average temperature over 64 degrees, according to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) study.

Even though brick-and-mortar structures are not usually impacted by extreme temperatures, facilities need to be maintained to ensure that they operate in appropriate conditions for people. The vulnerable counties are home to 979 state critical facilities in total. Bucks, Delaware, and Philadelphia Counties have the most critical facilities located within extreme heat zones. Table 4.3.4-2 lists the number of critical facilities in each county vulnerable to extreme heat.

Table 4.3.4-2 Number of State Critical Facilities impacted by Extreme Heat in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Bucks	47	Lancaster	1
Chester	5	Montgomery	36
Delaware	109	Philadelphia	110
Fulton	2	York	1

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 areas having a minimum average yearly temperature less than 32 degrees, according to the USDA NRCS. 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.

The vulnerable counties are home to 961 state critical facilities in total. McKean and Tioga Counties followed closely by Wayne County have the most critical facilities located within extreme cold zones. Table 4.3.4-3 illustrates the number of critical facilities in each county vulnerable to extreme cold.

Table 4.3.4-3 Number of State Critical Facilities impacted by Extreme Cold in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Bradford	29	Pike	12
Cameron	5	Potter	19
Clearfield	21	Somerset	36
Clinton	4	Sullivan	4
Crawford	4	Susquehanna	25
Elk	21	Tioga	50
Forest	1	Union	1
Jefferson	7	Warren	18
Lackawanna	18	Wayne	42
McKean	50	Wyoming	1

4.3.4.7. State Facility Vulnerability Assessment

Extreme Heat

The vulnerability of state critical facilities was evaluated as facilities that are located within zones that experience an average maximum temperature above 64 degrees. Using this criterion, a total of 311 vulnerable critical facilities have been identified. Due to the large number of schools, fire departments, and police stations in the Commonwealth, it is unsurprising that those categories of facilities have the highest totals. 0 shows the vulnerability of state critical facilities by facility type.

Table 4.3.4-4 State Critical Facilities vulnerable to Extreme Heat by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	5
Banking	10
Chemical	2
Commercial Facilities	15
Defense Industrial Base	7
Education	12
Emergency Services	2
Energy	7
Fire Departments (Non-HSIP)	114
Government Facilities	6
Healthcare & Public Health	12
Hospital (Non-HSIP)	31
National Monuments & Icons	3
Nuclear Reactors, Materials & Waste	1
Police (Non-HSIP)	60
Postal & Shipping	2
School (Non-HSIP)	2
Transportation	13
Water	7
TOTAL VULNERABLE CRITICAL FACILITIES	***311***

Extreme Cold

The vulnerability of state critical facilities was evaluated as facilities that are located within zones that experience a minimum average temperature of 32 degrees or below. Using this criterion, a total of 368 vulnerable critical facilities have been identified. 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. 0 shows the vulnerability of state critical facilities by facility type.

Table 4.3.4-5 State Critical Facilities vulnerable to Extreme Cold by Critical Facility Type	
STATE CRITICAL FACILITY TYPE	**NUMBER OF IMPACTED FACILITIES**
Agriculture	1
Chemical	2
Education	2
Emergency Services	9
Energy	1
Fire Departments (Non-HSIP)	148
Healthcare & Public Health	3
Hospital (Non-HSIP)	11
Police (Non-HSIP)	69
School (Non-HSIP)	121
Water	1
TOTAL VULNERABLE CRITICAL FACILITIES	***368***

4.3.4.8. Jurisdictional Loss Estimation

Extreme Heat

As stated in Section 4.3.4.3, during the years 1950-2013, the NCDC reported 205 extreme heat events in Pennsylvania resulting in 560 deaths and 401 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. Table 4.3.4-6 shows potential jurisdictional losses in extreme heat areas. Jurisdictional loss estimates were identified at the tract level and aggregated at the county level to show the possible losses per county. The County most prone to extreme heat is Philadelphia, with the highest populations, buildings and building costs.

Table 4.3.4-6 Estimated jurisdictional losses in Extreme Heat areas			
COUNTY	**2010 POPULATION**	**NUMBER OF IMPACTED BUILDINGS**	**DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)**
Bucks	625,249	125,454	$38,047,828
Chester	498,886	7,661	$2,319,320
Delaware	558,979	192,058	$53,731,947
Franklin	149,618	3,340	$747,545

Table 4.3.4-6 Estimated jurisdictional losses in Extreme Heat areas

COUNTY	2010 POPULATION	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Lancaster	519,445	9,079	$2,093,378
Montgomery	799,874	79,623	$24,645,189
Philadelphia	1,526,006	660,022	$170,669,801
York	434,972	2,202	$530,450
TOTAL	***5,113,029***	***1,079,439***	***$292,785,458***

Extreme Cold

As stated in Section 4.3.4.3, during the years 1950-2013, the NCDC reported 71 extreme cold events in Pennsylvania resulting in 27 deaths and 130 injuries. It's evident from this that extreme cold is dangerous and can cause death. Therefore it's 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 extreme cold are Wayne and McKean, having high populations, buildings and costs associated to building exposure.

Table 4.3.4-7 Estimated jurisdictional losses in Extreme Cold Temperature areas

COUNTY	2010 POPULATION	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Blair	127,089	1,310	$235,733
Bradford	62,622	22,977	$3,840,010
Cambria	143,679	3,145	$574,514
Cameron	5,085	35,465	$6,320,734
Carbon	65,249	7,426	$1,724,325
Centre	153,990	7,460	$1,358,270
Clarion	39,988	8,996	$1,433,676
Clearfield	81,642	15,890	$2,890,864
Clinton	39,238	35,380	$6,140,434
Crawford	88,765	1,323	$315,038
Elk	31,946	35,039	$6,929,319
Forest	7,716	14,549	$2,572,780
Jefferson	45,200	3,950	$752,487

Table 4.3.4-7 Estimated jurisdictional losses in Extreme Cold Temperature areas

COUNTY	2010 POPULATION	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Juniata	24,636	1,659	$325,872
Lackawanna	214,437	25,781	$5,219,143
Luzerne	320,918	20,215	$4,462,777
Lycoming	116,111	19,227	$3,283,274
McKean	43,450	42,505	$8,092,723
Monroe	169,842	17,742	$4,063,891
Pike	57,369	23,443	$5,073,245
Potter	17,457	44,250	$7,662,393
Snyder	39,702	2,388	$458,096
Somerset	77,742	16,435	$3,439,765
Sullivan	6,428	3,099	$569,719
Susquehanna	43,356	21,996	$4,146,447
Tioga	41,981	36,021	$6,383,217
Union	44,947	9,483	$1,807,132
Warren	41,815	34,588	$6,517,426
Wayne	52,822	75,638	$15,998,764
TOTAL	***2,205,222***	***587,380***	**$112,592,068**

4.3.4.9. State Facility Loss Estimation

The estimated replacement cost of all state critical facilities located in extreme heat hazard zones is approximately $2,267,745,935. The estimated replacement cost of all state critical facilities located in extreme cold hazard zones is approximately $2,267,740,062.

4.3.5. Flood, Flash Flood, Ice Jam

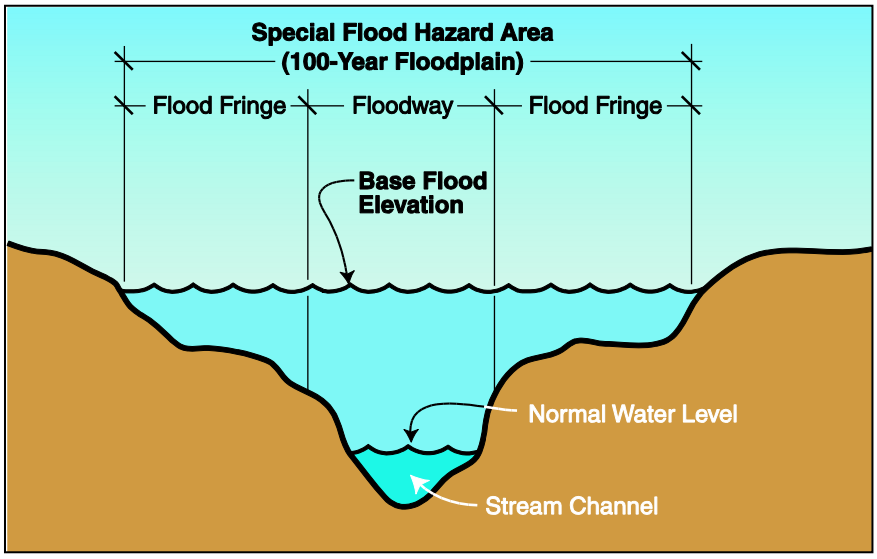
4.3.5.1. Location and Extent

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. Events such as a 1-inch cloudburst lasting thirty minutes may affect only a small watershed and be considered insignificant regionally. Large events, such as a broad-scale tropical storm lasting more than twenty-four 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. However, portions of southeastern Pennsylvania along the Delaware River are subject to tidal or storm surge flooding. This section focuses on riverine and storm-based 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, 4.3.18, and 4.3.20 to get a full picture of flood impacts, because hurricanes, dam failure, and levee failure all impact flooding.

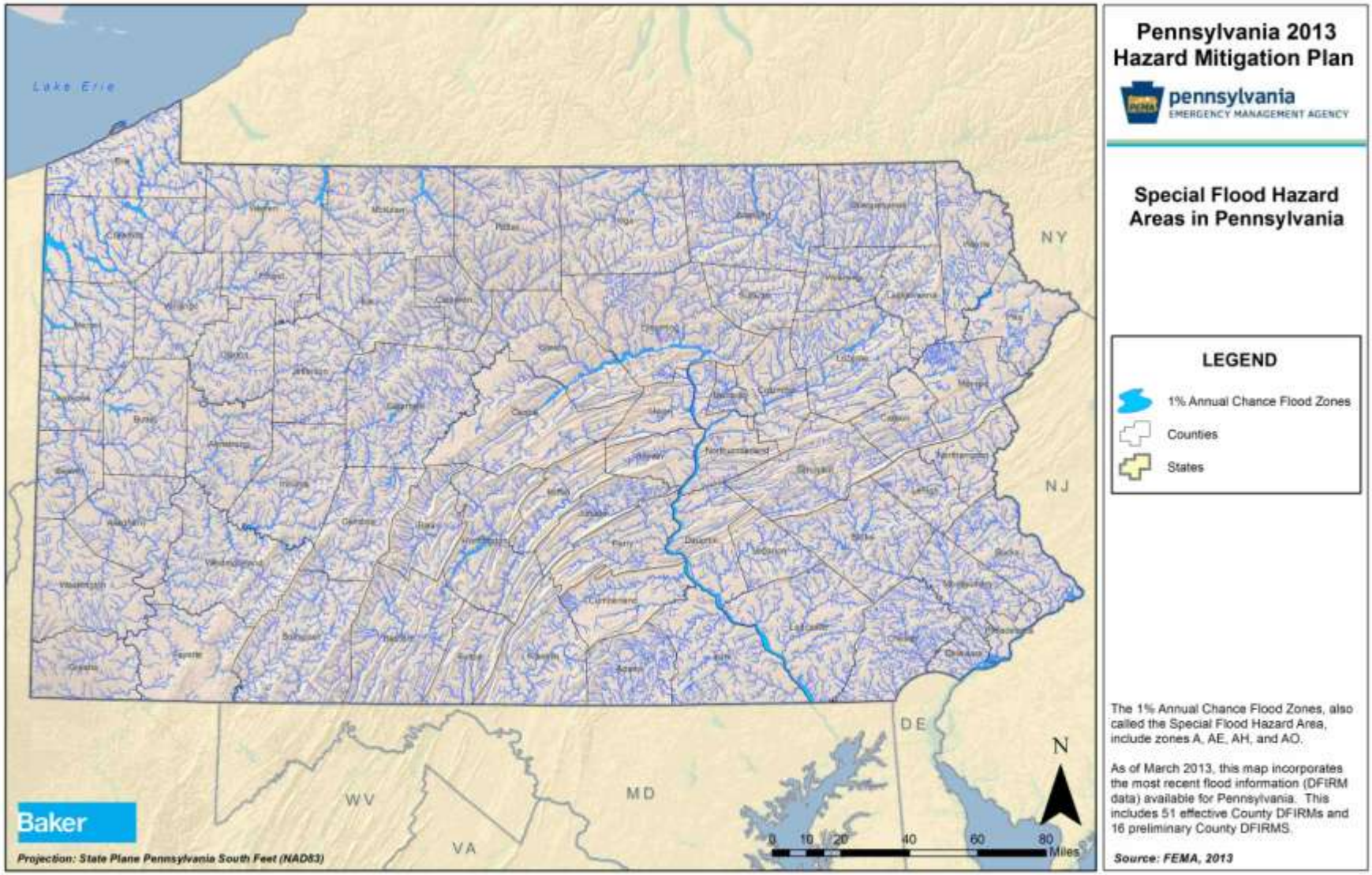
Floodplains found in lowlands, adjacent to rivers, streams, creeks, lakes, or other large water bodies are subject to recurring floods. The size of the floodplain is described by the recurrence interval of a given flood. In assessing the potential spatial extent of flooding it is important to know that a floodplain associated with a flood that has a 10% 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 Digital Flood Insurance Rate Maps (DFIRM) are published identifies the 1%-annual-chance flood which is used to delineate the *Special Flood Hazard Area* and identify *Base Flood Elevations*. Figure 4.3.5-1 illustrates these terms.

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 of Pennsylvania. DFIRMs, paper Flood Insurance Rate Maps (FIRM), 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 Map showing Special Flood Hazard Areas throughout Pennsylvania (FEMA).



4.3.5.2. Range of Magnitude

Both localized and widespread floods are considered hazards when people and property are affected. Injuries and deaths can occur when people are swept away by flood currents or bacteria and disease are spread by moving or stagnant floodwaters. Most property damage results from inundation by sediment-filled water. A large amount of rainfall over a short time span 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.

Several factors determine the severity of floods, including rainfall intensity and duration, topography, ground cover and rate of snowmelt. Water runoff is greater in areas with steep slopes and little or no vegetative ground cover. Many areas of the Commonwealth have relatively steep topography which promotes quick and flashy 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.

Rainfall in Pennsylvania is about average for the eastern United States. When classified according to amount of precipitation, rainfall can be divided into several categories:

- Very light rain – when precipitation rate is <0.01 inches/hour
- Light rain – when precipitation rate is between 0.01 to 0.04 inches/hour
- Moderate rain – when the precipitation rate is between 0.04 to 0.16 inches/hour
- Heavy rain – when the precipitation rate is between 0.16 to 0.63 inches/hour
- Very heavy rain – when the precipitation rate is between 0.63 to 2 inches/hour
- Extreme rain – when the precipitation rate is >2 inches/hour

While significant flood events are typically associated with very heavy and extreme rain, rainfall events of lesser intensity may also cause flooding given sufficient duration.

Flood effects can be volume or force related. Major floods along larger streams having wide floodplains tend to result in large-scale inundations. This causes widespread damage through soaking and silt deposits in homes, businesses, and industrial plants. In hilly regions where runoff paths are steep, flash floods may be prevalent. Flash floods are short in duration and usually occur in a somewhat localized area. In these floods, the velocity rather than the volume of water causes flood damages. Torrents of water can rush down minor hillside gullies at 30-50 miles per hour, carrying trees, debris, and rocks. These floods are often unpredictable and, particularly if they occur at night, can cause major panic and loss of life. Frozen surfaces can more than double normal runoff velocities, particularly in small drainage areas. This causes flash floods which can be compounded by ice and debris jams in channels and culverts. Also obstructions within the floodplain such as bridges and undersized culverts can also increase flooding.

The three worst flooding events experienced in Pennsylvania were the Johnstown Flood of 1889 Tropical Storm Agnes in 1972, and Tropical Storm Lee; 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.

4.3.5.3. Past Occurrence

Pennsylvania has a long and continuous history of floods. Over half 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 nor'easter events were likely issued at least in part to flood impacts as well. Table 4.3.5-1 provides a tabulation of the number of flood events recorded for each county in the Commonwealth between 1950 and 2013. Figure 4.3.5-3 provides this information in map form. Allegheny, Chester, Montgomery, Philadelphia, and Westmoreland Counties have experienced the highest number of events over this 63 year period, but 24 of the counties have had over 63 events, or an average of one flood event per year.

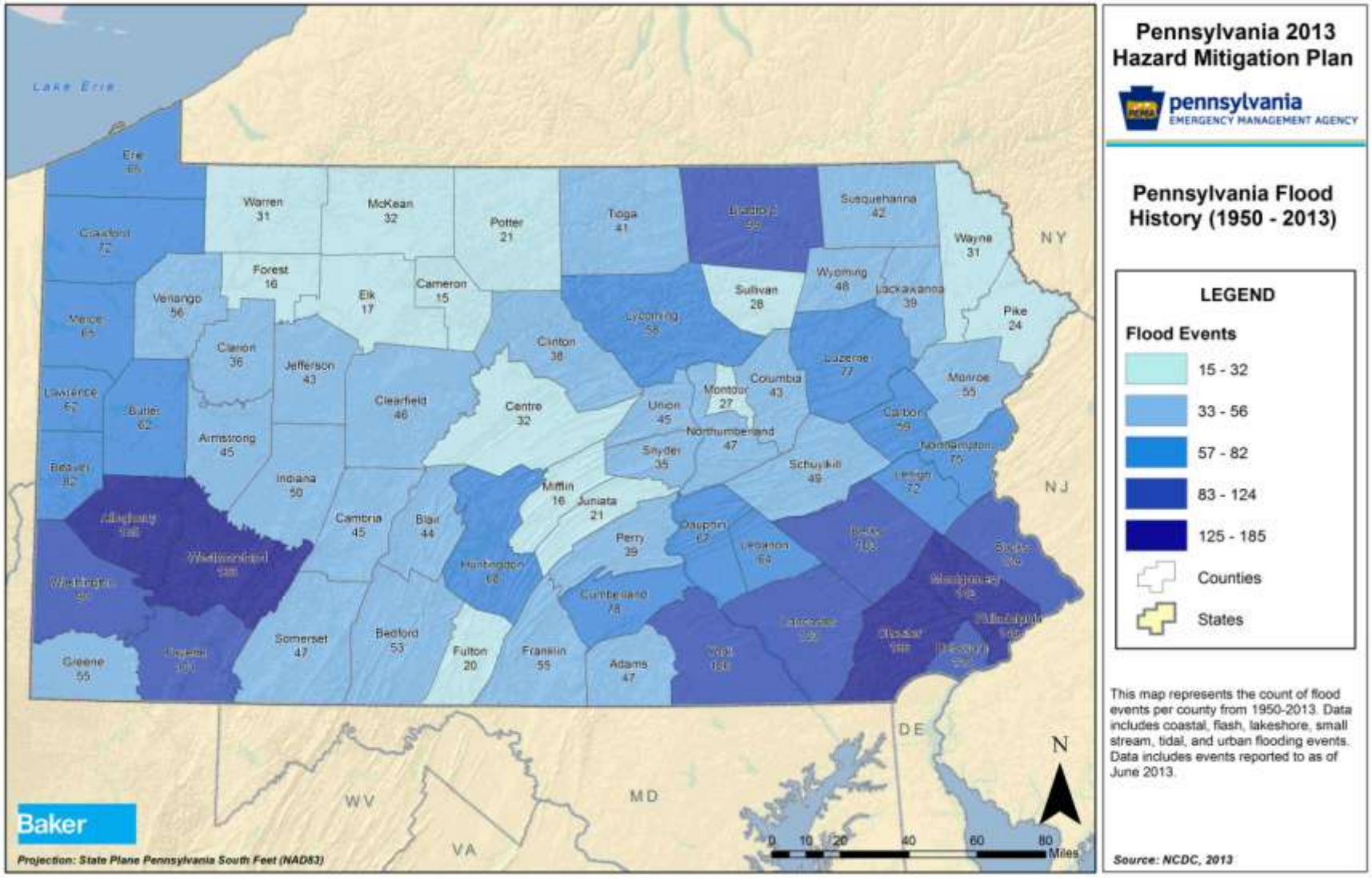
Table 4.3.5-1 Number of flood events by county between 1950 and 2013 (NCDC, 2013).

COUNTY	NUMBER OF EVENTS	COUNTY	NUMBER OF EVENTS
Adams	47	Lackawanna	39
Allegheny	185	Lancaster	103
Armstrong	45	Lawrence	62
Beaver	82	Lebanon	64
Bedford	53	Lehigh	72
Berks	103	Luzerne	77
Blair	44	Lycoming	58
Bradford	99	McKean	32
Bucks	124	Mercer	65
Butler	62	Mifflin	16
Cambria	45	Monroe	55
Cameron	15	Montgomery	142
Carbon	59	Montour	27
Centre	32	Northampton	75
Chester	136	Northumberland	47
Clarion	36	Perry	39
Clearfield	46	Philadelphia	146
Clinton	38	Pike	24
Columbia	43	Potter	21
Crawford	72	Schuylkill	49
Cumberland	78	Snyder	35
Dauphin	67	Somerset	47
Delaware	120	Sullivan	28
Elk	17	Susquehanna	42
Erie	65	Tioga	41
Fayette	101	Union	45
Forest	16	Venango	56
Franklin	55	Warren	31
Fulton	20	Washington	90
Greene	55	Wayne	31

Table 4.3.5-1 Number of flood events by county between 1950 and 2013 (NCDC, 2013).

COUNTY	NUMBER OF EVENTS	COUNTY	NUMBER OF EVENTS
Huntingdon	68	Westmoreland	133
Indiana	50	Wyoming	48
Jefferson	43	York	106
Juniata	21	**TOTAL**	**4,088**

Figure 4.3.5-3 Number of flood events by county between 1950 and 2013 (NCDC, 2013).



Previous versions of the SSAHMP 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 snow pack. This type of flooding occurred in March 1936 and again in January 1996.

Pennsylvania has the most intense recorded rainfall event in the history of the U.S. In August 1942, more than thirty 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 twenty 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.

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 the severe damages suffered in the 1936 flood, major flood-control structures were built throughout much of Pennsylvania. A more recent flood occurred in January 1996. Water levels in many rivers and municipalities exceeded the March 1936 level and in some cases was the second highest flood of record.

In June 1972, Tropical Storm Agnes caused widespread flooding which 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 twenty 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. 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. It is estimated that these structures held back a combined volume of over one million acre-feet. 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. 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 122 deaths, 50 of which were in Pennsylvania. 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. Twomile 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 (see Section 4.3.5.3 for discussion of the Johnstown Flood);
- Johnstown in July 1977 (78 lives lost);
- 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.

More recently, Tropical Storm Lee caused catastrophic flooding in eastern and central Pennsylvania in 2011. Hurricane Irene made landfall in the US on August 27, 2011 and again on August 28, dumping between 2 and 8 inches of rain in eastern Pennsylvania, with its worst rain occurring in the Delaware River basin. One and a half weeks later, beginning on September 5, Tropical Storm Lee and its associated heavy rainfall moved through Pennsylvania and New York. With large portions of the Susquehanna River Basin already saturated by Hurricane 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.

Lee/Irene left significant amounts of water over nearly all of central and eastern Pennsylvania with the worst occurring in Northeastern Pennsylvania communities of Towanda, Wilkes-Barre, Bloomsburg, Danville, and Sunbury. According to the NWS, over 2,000 people were evacuated and 3,000 homes and businesses flooded in Bradford County alone. Bradford County's agricultural community was severely damaged with about $7 million in crop damage. In Luzerne County, 60,000 people were evaluated 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 as being 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 State 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 (NWS, 2012).

Oil City, located in western Pennsylvania, has historically been plagued with ice jams and ice-related flooding more so than most other communities throughout the Commonwealth. Records show 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. A

floating ice control structure on the Allegheny River and a fixed concrete weir on Oil Creek are designed to eliminate flood-causing ice jams on the Allegheny River at the mouth of Oil Creek. The floating structure on the Allegheny River was installed in 1982 and modified in 1983 at a federal cost of $1,110,000. It has effectively reduced ice formation on the river. The ice control structure on Oil Creek cost approximately $2.3 million and was completed in December 1989.

A HMGP award of $450,000 was provided though DR 1898 in 2011 to improve the Oil City Ice Boom. The project went out for bid in January of 2013 for the fabrication of 23 yellow pontoons and one boom. The USACE reviewed the design for the project and it is expected that the new installation will break up the ice on the Allegheny River and Oil Creek, thus protecting nearby properties from ice jam related flooding. (

In the last 20 years, flooding impacted Pennsylvania with state-wide declarations in January 1996, Hurricane Floyd in September 1999, Hurricane Isabel/Henri in September 2003, Lee/Irene in 2011, and Sandy in 2012. 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. In just the last 10 years, there have been a total of 15 flooding related disaster and emergency declarations impacting Pennsylvania in. In addition, since 2000, there have been 27,605 closed flood loss instances totaling over $820 million, as shown in Table 4.3.5-2. The average claims payment over this 13-year period is over $22,000. There are an additional 173 open claims, which may be pending ICC payment to the policy holder.

Table 4.3.5-2 Historic Flood Losses and Payments (PEMA, 2013).

YEAR	LOSS COUNT	BUILDING PAYMENTS	CONTENTS PAYMENTS	ICC PAYMENTS	TOTAL PAYMENTS	AVERAGE PAYMENT
CLOSED CLAIMS						
2001	552	$18,252,071	$7,785,369	$99,650	$26,137,089	$47,349.80
2002	81	$669,940	$235,597	$0	$,537	$11,179.47
2003	775	$7,807,144	$2,610,445	$20,000	$10,437,589	$13,467.86
2004	8944	$164,744,399	$43,573,103	$2,016,735	$210,334,238	$23,516.80
2005	1804	$50,444,034	$8,096,100	$2,123,125	$60,663,259	$33,627.08
2006	3918	$101,996,714	$21,074,105	$3,067,437	$126,138,256	$32,194.55
2007	395	$3,752,164	$743,275	$15,000	$4,510,438	$11,418.83
2008	155	$1,414,932	$270,861	$0	$1,685,793	$10,876.08
2009	564	$10,778,429	$3,659,713	$0	$14,438,142	$25,599.54
2010	1096	$15,749,511	$3,984,221	$66,059	$19,799,790	$18,065.50
2011	9077	$282,398,269	$55,806,724	$3,369,869	$341,574,862	$37,630.81
2012	243	$2,552,146	$1,009,495	$0	$3,561,640	$14,656.96
2013	1	$8,001	$0	$0	$8,001	$8,000.99
OPEN CLAIMS						
2004	12	$281,647	$35,846	$38,183	$355,676	$29,639.70
2005	6	$245,463	$42,250	$74,900	$362,613	$60,435.50
2006	1	$114,210	$782	$15,000	$129,991	$129,991.39

Table 4.3.5-2 Historic Flood Losses and Payments (PEMA, 2013).						
YEAR	LOSS COUNT	BUILDING PAYMENTS	CONTENTS PAYMENTS	ICC PAYMENTS	TOTAL PAYMENTS	AVERAGE PAYMENT
2010	1	$0	$0	$0	$0	$0.00
2011	136	$9,379,678	$1,622,685	$110,050	$11,112,413	$81,708.92
2012	5	$0	$0	$0	$0	$0.00
2013	12	$0	$0	$0	$0	$0.00

4.3.5.4. Future Occurrence

In Pennsylvania, flooding occurs commonly and can take place during any season of the year. Every two to three years, serious flooding occurs along one or more of Pennsylvania's major rivers or streams and 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 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. DFIRMs and 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)

4.3.5.5. Environmental Impacts

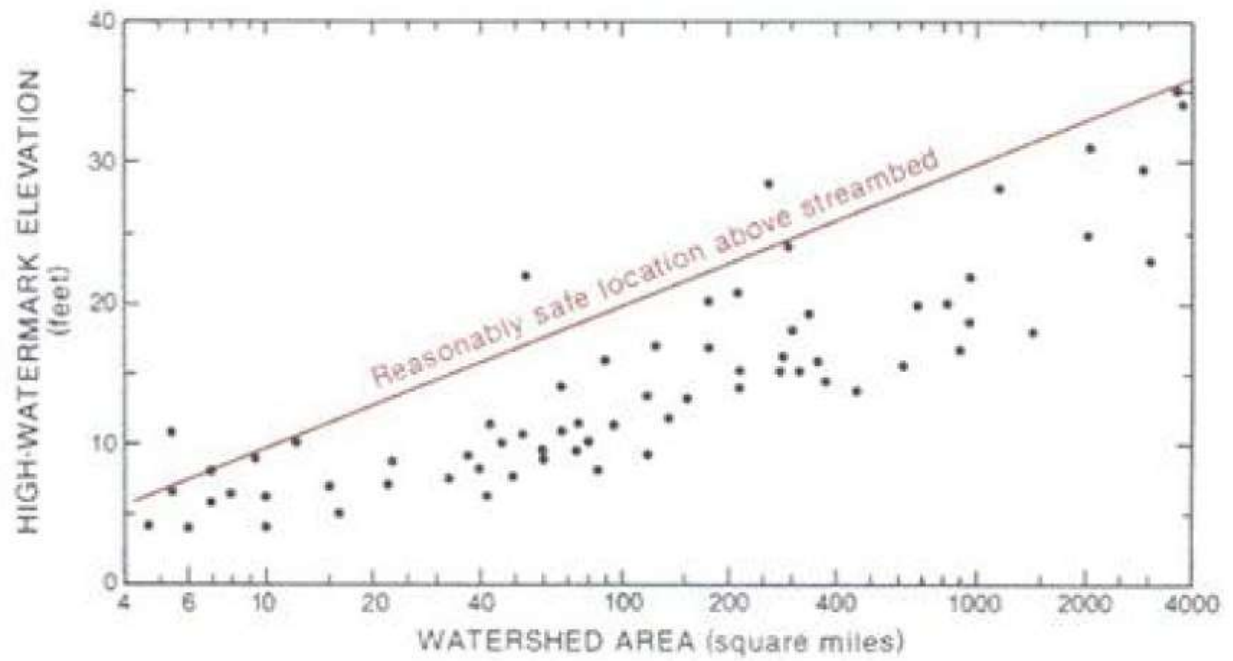
Floods are naturally occurring events that benefit riparian systems which have not been disrupted by human actions. Such benefits include groundwater recharge and the introduction of nutrient rich sediment improving soil fertility. However, the destruction of riparian buffers, changes to land-use and landcover throughout a watershed, and introduction of chemical or biological contaminants which often accompany human presence cause environmental harm when floods occur. Hazardous material facilities are potential sources of contamination during flood events (see Section 4.3.19). 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, increased acid mine drainage, damage or loss of crops and drowning of both humans and animals.

4.3.5.6. Jurisdictional Vulnerability Assessment

A major concern for those involved in almost any activity in the vicinity of a stream is the area's 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 4.3.5-4 shows a plot of historic high watermarks for Pennsylvania floods as a function of watershed area. Using historic high watermark elevations (above streambed), a "reasonably safe" zone can be defined based on the area of a watershed a give property is located in. 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 4.3.5-4 Plot of historic high watermarks in Pennsylvania vs. watershed area.



All counties in Pennsylvania identify flooding as a hazard. Of the 37 counties which currently have calculated risk factor values for flood hazards, the average value is 3.1. This average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for flood, flash flood, and ice jam is 3.4, while the Pennsylvania THIRA scored flood, flash flood, and ice jam as a 9 out of 10 – the number one prioritized threat in Pennsylvania. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

The widespread recognition of flooding as a hazard and high risk factor reveal the sentiment from individual jurisdictions that flood impacts significantly increase community vulnerability

throughout the Commonwealth. The complete list of counties profiling flooding is found in Table 4.3.5-3. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Table 4.3.5-3 Counties profiling flood hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.9
Allegheny	X		High	3.3
Armstrong	X		Not Ranked	No RF
Beaver	X		High	3.1
Bedford	X		High	3.7
Berks	X		Not Ranked	No RF
Blair	X		Not Ranked	No RF
Bradford	X		Not Ranked	No RF
Bucks	X		High	3.2
Butler	X		High	2.8
Cambria	X		High	3.4
Cameron	X		High	3.6
Carbon	X		High	3.0
Centre	X		High	2.7
Chester	X		Not Ranked	No RF
Clarion	X		Not Ranked	No RF
Clearfield	X		High	2.5
Clinton	X		High	3.3
Columbia	X		High	3.2
Crawford	X		High	2.9
Cumberland	X		High	2.7
Dauphin	X		Not Ranked	No RF
Delaware	X		High	3.5
Elk	X		High	2.9
Erie	X		High	3.2
Fayette	X		High	3.0
Forest	X		Not Ranked	No RF
Franklin	X		Not Ranked	No RF
Fulton	X		High	3.9

Table 4.3.5-3 Counties profiling flood hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Greene	X		High	3.1
Huntingdon	X		Not Ranked	No RF
Indiana	X		High	3.3
Jefferson	X		High	2.9
Juniata	X		High	2.7
Lackawanna	X		Not Ranked	No RF
Lancaster	X		High	3.2
Lawrence	X		High	2.8
Lebanon*	X		Not Ranked	12.0
Lehigh	X		High	2.5
Luzerne	X		Not Ranked	No RF
Lycoming	X		High	3.9
McKean	X		High	3.3
Mercer	X		High	2.8
Mifflin	X		Not Ranked	No RF
Monroe	X		High	3.2
Montgomery	X		High	3.0
Montour*	X		Not Ranked	12.0
Northampton	X		High	2.5
Northumberland	X		High	3.2
Perry*	X		Not Ranked	15.0
Philadelphia**	X		High	A
Pike	X		High	3.2
Potter	X		Not Ranked	No RF
Schuylkill	X		Not Ranked	No RF
Snyder	X		High	3.1
Somerset	X		High	3.9
Sullivan	X		Not Ranked	No RF
Susquehanna	X		High	3.2
Tioga	X		High	3.2
Union	X		Not Ranked	No RF
Venango	X		High	2.5
Warren	X		High	2.7

Table 4.3.5-3 Counties profiling flood hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Washington	X		Not Ranked	No RF
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		High	2.5

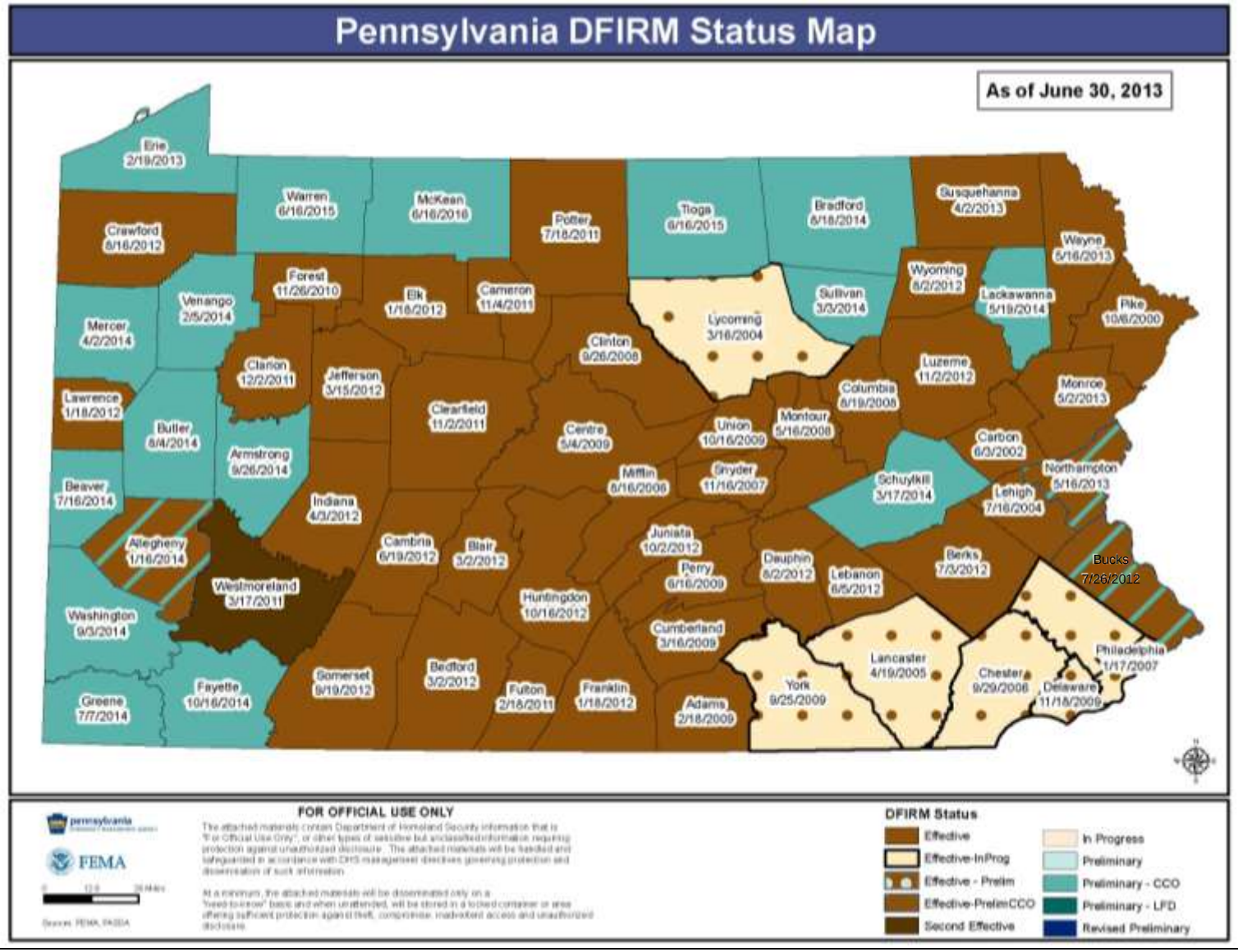
* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As stated in Section 4.2.2, 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 tracts 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 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 used for GIS analysis. County flood hazard areas were collected on a county by county basis. A total of 51 effective DFIRMs were used, as well as 16 Preliminary DFIRMs so that the most recent data for that county was used. With the most current flood data, a reliable list of vulnerable critical facilities can be obtained. A map of counties and their DFIRM status as of June 2013 is presented in Figure 4.3.5-5. While Effective data was obtained from the FEMA via PASDA, Preliminary data was obtained internally through FEMA. No Q3 data was used in the development of the SSAHMP. Having new DFIRM data available nearly statewide adds significant value to communities' ability to discern flood risk. The Effective and Preliminary DFIRM 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 did.

Figure 4.3.5-5 DFIRM Status by county as of June 2013.



A total of 370 critical facilities were found to fall within the 1%-annual-chance flood hazard areas. As seen in Table 4.3.5-4, Allegheny, Cambria, Dauphin, Lackawanna, and Schuylkill Counties have the most critical facilities impacted by flooding. Forest, Fulton, Montour, Pike, Sullivan, and Venango Counties did not have any critical facilities within their special flood hazard areas.

Table 4.3.5-4 Number of Critical Facilities within the 1%-annual-chance flood hazard areas in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	1	Juniata	5
Allegheny	31	Lackawanna	14
Armstrong	8	Lancaster	6
Beaver	3	Lawrence	2
Bedford	1	Lebanon	1
Berks	6	Lehigh	1
Blair	8	Luzerne	7
Bradford	11	Lycoming	13
Bucks	6	McKean	4
Butler	9	Mercer	1
Cambria	15	Mifflin	2
Cameron	1	Monroe	3
Carbon	6	Montgomery	9
Centre	6	Northampton	4
Chester	5	Northumberland	3
Clarion	1	Perry	2
Clearfield	9	Philadelphia	9
Clinton	9	Potter	2
Columbia	8	Schuylkill	18
Crawford	9	Snyder	2
Cumberland	5	Somerset	7
Dauphin	15	Susquehanna	2
Delaware	5	Tioga	4
Elk	1	Union	1
Erie	4	Warren	2
Fayette	11	Washington	12
Franklin	2	Wayne	3
Greene	6	Westmoreland	13
Huntingdon	5	Wyoming	1
Indiana	4	York	4
Jefferson	2	***TOTAL***	***370***

4.3.5.7. State Facility Vulnerability Assessment

Table 4.3.5-5 lists a breakdown of the types of facilities contained within the flood hazard zones. Due to the large number of schools, fire departments, and police stations in the Commonwealth, it is unsurprising that those categories of facilities have the highest number of critical facilities.

Table 4.3.5-5 State Critical Facilities within the 1%-annual-chance flood hazard area by Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	10
Banking	2
Chemical	2
Commercial Facilities	5
Communications	2
Dams	10
Defense Industrial Base	1
Education	1
Emergency Services	2
Energy	3
Fire Departments (Non-HSIP)	188
Healthcare & Public Health	2
Hospital (Non-HSIP)	3
Nuclear Reactors, Materials & Waste	2
Police (Non-HSIP)	72
Postal & Shipping	3
School (Non-HSIP)	45
Transportation	10
Water	7
TOTAL VULNERABLE CRITICAL FACILITIES	***370***

4.3.5.8. Jurisdictional Loss Estimation

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 July 2013 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 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 have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

Table 4.3.5-6 and Table 4.3.5-7 show the number and type of RL and SRL properties for each county in Pennsylvania, respectively. This data was obtained from FEMA in July 2013 and joined with data on mitigated properties from the following sources:

- Commonwealth of Pennsylvania 2010 State Standard All-Hazard Mitigation Plan
- PEMA mitigated properties tracking from July 2013
- ICC data export from July 2013
- FEMA Greatest Savings to the Fund (GSTF) data from August 2013

Information between data sources and within each of the data sources improved between 2010 and 2013. 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 Bureaunet, 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 4.3.5-6 shows the number and type of RL properties for each county in Pennsylvania. As of July 2013, Pennsylvania had 8,180 repetitive loss properties with total losses of $658,455,490.56. Of the 8,180 properties, 1,070 properties have been mitigated, which is 13% of the total repetitive loss properties in the Commonwealth. Additionally, 70 RL properties were removed from the FEMA BureauNet database between 2010 and 2013; this is a reflection of both mitigation to acquire and remove the risk of many RL properties and database improvement projects. Completing FEMA Form AW-501was a task promoted in grant related presentations for recent Disaster Declarations in the Commonwealth.

Based on input from the DCED, an assumption is made that *non-residential* type is anything other than “residential” including, but not necessarily limited to “commercial” building types. Also, *ASSMD Condo* type refers to a situation where an individual owns the structure, or portion of the structure, but not any of the land.

Table 4.3.5-6 Total and mitigated Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013).

COUNTY	SINGLE FMLY		2-4 FAMILY		ASSMD CONDO		OTHER RESID		NON RESIDNT		TOTAL	
	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT
Adams	28	2	2	0	1	0	1	0	1	0	33	2
Allegheny	236	19	25	1	3	1	5	0	82	6	351	27
Armstrong	29	1	0	0	1	0	1	0	4	0	35	1
Beaver	61	17	1	0	0	0	4	0	10	0	76	17
Bedford	120	36	0	0	6	4	3	1	1	0	130	41
Berks	59	17	4	0	2	0	4	0	17	0	86	17
Blair	98	20	0	0	2	0	5	0	7	0	112	20
Bradford	72	13	3	0	2	0	0	0	8	1	85	14
Bucks	670	127	38	2	15	2	19	0	104	7	846	138
Butler	59	8	0	0	1	0	0	0	6	0	66	8
Cambria	9	0	2	0	0	0	0	0	5	0	16	0
Cameron	9	0	0	0	0	0	0	0	1	0	10	0
Carbon	5	2	0	0	0	0	0	0	0	0	5	2
Centre	14	1	2	0	0	0	0	0	4	0	20	1
Chester	123	3	8	0	3	0	6	0	24	1	164	4
Clarion	3	0	1	0	2	0	0	0	5	1	11	1
Clearfield	28	4	2	0	1	0	3	1	8	1	42	6
Clinton	65	2	2	0	1	0	1	0	6	1	75	3
Columbia	310	32	36	1	12	0	4	1	38	1	400	35
Crawford	20	4	1	0	0	0	0	0	4	0	25	4
Cumberland	114	4	16	0	1	0	6	0	20	1	157	5
Dauphin	611	115	36	9	9	2	15	2	84	5	755	133
Delaware	198	28	12	0	5	0	4	0	66	2	285	30
Elk	8	0	0	0	0	0	0	0	3	0	11	0
Erie	33	8	1	1	2	0	0	0	8	1	44	10
Fayette	28	0	3	0	0	0	1	0	21	0	53	0
Forest	1	0	0	0	0	0	0	0	0	0	1	0
Franklin	7	1	0	0	0	0	0	0	0	0	7	1
Fulton	0	0	0	0	0	0	0	0	1	0	1	0
Greene	24	3	1	0	1	0	0	0	8	0	34	3
Huntingdon	49	3	3	0	0	0	0	0	6	0	58	3
Indiana	18	2	2	0	0	0	0	0	0	0	20	2
Jefferson	27	7	0	0	0	0	1	0	10	2	38	9
Juniata	16	0	2	0	0	0	0	0	2	0	20	0
Lackawanna	101	7	26	1	2	0	0	0	18	1	147	9
Lancaster	93	9	5	0	7	0	2	0	42	4	149	13

Table 4.3.5-6 Total and mitigated Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013).

COUNTY	SINGLE FMLY		2-4 FAMILY		ASSMD CONDO		OTHER RESID		NON RESIDNT		TOTAL	
	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT
Lawrence	10	0	1	0	0	0	0	0	2	0	13	0
Lebanon	66	5	3	0	1	0	1	0	5	0	76	5
Lehigh	70	7	0	0	3	0	3	0	35	1	111	8
Luzerne	345	40	72	2	6	0	2	0	66	3	491	45
Lycoming	461	65	39	5	16	1	5	1	28	3	549	75
McKean	7	1	1	0	0	0	0	0	4	1	12	2
Mercer	6	1	0	0	1	0	0	0	3	1	10	2
Mifflin	32	5	0	0	0	0	1	0	12	1	45	6
Monroe	28	6	2	0	1	0	0	0	11	0	42	6
Montgomery	448	49	24	2	14	1	30	0	112	2	628	54
Montour	6	0	0	0	1	1	0	0	3	1	10	2
Northampton	212	59	14	2	4	0	5	0	27	1	262	62
Northumberland	163	38	18	12	10	0	5	3	52	7	248	60
Perry	68	0	11	0	3	0	4	0	14	0	100	0
Philadelphia	79	0	3	0	2	0	5	0	22	0	111	0
Pike	28	1	0	0	0	0	0	0	3	0	31	1
Potter	2	0	0	0	0	0	0	0	1	0	3	0
Schuylkill	55	1	10	0	1	0	0	0	16	0	82	1
Snyder	130	18	13	2	5	1	0	0	9	1	157	22
Somerset	10	0	0	0	0	0	1	0	3	0	14	0
Sullivan	15	1	0	0	2	1	0	0	0	0	17	2
Susquehanna	64	7	2	0	1	0	0	0	6	1	73	8
Tioga	11	1	0	0	0	0	0	0	3	0	14	1
Union	98	27	19	10	2	1	3	2	16	3	138	43
Venango	16	4	1	1	8	7	0	0	27	26	52	38
Warren	8	2	0	0	0	0	0	0	1	0	9	2
Washington	35	0	5	0	1	0	2	0	22	1	65	1
Wayne	28	1	0	0	0	0	0	0	3	0	31	1
Westmoreland	79	5	9	2	6	1	1	0	15	1	110	9
Wyoming	158	32	7	1	8	1	1	1	15	2	189	37
York	97	16	1	0	4	0	2	0	15	2	119	18
TOTAL	**6181**	**887**	**489**	**54**	**179**	**24**	**156**	**12**	**1175**	**93**	**8180**	**1070**

A sub-set of the repetitive loss properties is severe repetitive loss properties; the Commonwealth has 475 severe repetitive loss properties with claims totaling $74,999,965.48.

Table 4.3.5-7 illustrates the number and type of properties by county in Pennsylvania. Of the 475 SRL properties, 46 have been mitigated, or 9.7% of all SRL properties, as documented on the PEMA Mitigated Properties spreadsheet included in *Appendix G – Repetitive Loss and Severe Repetitive Loss Properties Inventory*. Like the RL property data, this data was obtained from FEMA and cross referenced with PEMA, ICC, and GSTF data in July 2013. Additionally, 81 SRL properties were removed from the FEMA Bureaunet database between 2010 and 2013; this is a reflection of both mitigation to acquire and remove the risk of many SRL properties and database improvement projects.

Table 4.3.5-7 Total and mitigated Severe Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013).

COUNTY	SINGLE FMLY		2-4 FAMILY		ASSMD CONDO		OTHER RESID		NON RESIDNT		TOTAL	
	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT
Adams	5	0	0	0	0	0	0	0	0	0	5	0
Allegheny	2	0	0	0	0	0	0	0	0	0	2	0
Armstrong	3	0	0	0	0	0	0	0	0	0	3	0
Beaver	3	3	0	0	0	0	0	0	0	0	3	3
Bedford	10	1	0	0	0	0	1	0	0	0	11	1
Berks	1	0	0	0	0	0	0	0	0	0	1	0
Blair	2	1	0	0	0	0	0	0	0	0	2	1
Bradford	7	2	0	0	0	0	0	0	0	0	7	2
Bucks	91	17	6	0	0	0	1	0	0	0	98	17
Butler	6	1	0	0	0	0	0	0	0	0	6	1
Cambria	0	0	0	0	0	0	0	0	0	0	0	0
Cameron	0	0	0	0	0	0	0	0	0	0	0	0
Carbon	0	0	0	0	0	0	0	0	0	0	0	0
Centre	0	0	0	0	0	0	0	0	0	0	0	0
Chester	9	0	0	0	0	0	0	0	0	0	9	0
Clarion	0	0	0	0	0	0	0	0	0	0	0	0
Clearfield	1	0	0	0	0	0	0	0	0	0	1	0
Clinton	2	0	0	0	0	0	0	0	0	0	2	0
Columbia	15	0	1	0	0	0	0	0	0	0	16	0
Crawford	0	0	0	0	0	0	0	0	0	0	0	0
Cumberland	5	0	1	0	0	0	1	0	0	0	7	0
Dauphin	19	2	1	1	0	0	2	0	0	0	22	3
Delaware	25	1	5	0	0	0	1	0	0	0	31	1
Elk	0	0	0	0	0	0	0	0	0	0	0	0
Erie	1	0	0	0	0	0	0	0	0	0	1	0
Fayette	0	0	0	0	0	0	0	0	0	0	0	0
Forest	0	0	0	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.3.5-7 Total and mitigated Severe Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013).

COUNTY	SINGLE FMLY		2-4 FAMILY		ASSMD CONDO		OTHER RESID		NON RESIDNT		TOTAL	
	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT
Fulton	0	0	0	0	0	0	0	0	0	0	0	0
Greene	0	0	0	0	0	0	0	0	0	0	0	0
Huntingdon	3	0	1	0	0	0	0	0	0	0	4	0
Indiana	0	0	0	0	0	0	0	0	0	0	0	0
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	4	0	3	0	0	0	0	0	0	0	7	0
Lancaster	12	0	1	0	0	0	0	0	0	0	13	0
Lawrence	0	0	0	0	0	0	0	0	0	0	0	0
Lebanon	2	0	0	0	0	0	0	0	0	0	2	0
Lehigh	3	0	0	0	0	0	0	0	0	0	3	0
Luzerne	21	4	6	0	0	0	0	0	0	0	27	4
Lycoming	23	2	4	0	0	0	0	0	0	0	27	2
McKean	0	0	0	0	0	0	0	0	0	0	0	0
Mercer	1	0	0	0	0	0	0	0	0	0	1	0
Mifflin	1	0	0	0	0	0	0	0	0	0	1	0
Monroe	3	0	0	0	0	0	0	0	0	0	3	0
Montgomery	65	1	4	0	0	0	8	0	0	0	77	1
Montour	0	0	0	0	0	0	0	0	0	0	0	0
Northampton	26	6	2	0	0	0	1	0	0	0	29	6
Northumberland	10	1	0	0	0	0	0	0	0	0	10	1
Perry	1	0	0	0	0	0	0	0	0	0	1	0
Philadelphia	10	0	0	0	0	0	0	0	0	0	10	0
Pike	1	0	0	0	0	0	0	0	0	0	1	0
Potter	0	0	0	0	0	0	0	0	0	0	0	0
Schuylkill	2	0	1	0	0	0	0	0	0	0	3	0
Snyder	4	0	1	0	0	0	0	0	0	0	5	0
Somerset	1	0	0	0	0	0	0	0	0	0	1	0
Sullivan	0	0	0	0	0	0	0	0	0	0	0	0
Susquehanna	2	1	0	0	0	0	0	0	0	0	2	1
Tioga	0	0	0	0	0	0	0	0	0	0	0	0
Union	3	0	4	2	0	0	0	0	0	0	7	2
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	0	0	0	0	0	0	0	0	0	0	0	0
Wayne	3	0	0	0	0	0	0	0	0	0	3	0

Table 4.3.5-7 Total and mitigated Severe Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013).

COUNTY	SINGLE FMLY		2-4 FAMILY		ASSMD CONDO		OTHER RESID		NON RESIDNT		TOTAL	
	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT	TOTAL	MIT
Westmoreland	1	0	0	0	0	0	0	0	0	0	1	0
Wyoming	7	0	0	0	0	0	0	0	0	0	7	0
York	3	0	0	0	0	0	0	0	0	0	3	0
TOTAL	**419**	**43**	**41**	**3**	**0**	**0**	**15**	**0**	**0**	**0**	**475**	**46**

Figure 4.3.5-6 displays geocoded mitigated SRL and RL properties from the combined *Repetitive Loss and Severe Repetitive Loss Properties Inventory.* Addresses were mapped using provided spatial coordinates and, where coordinates were missing, GoogleMaps. Due to incomplete or inadequate address information, not all properties are shown on the map; a total of 976 of the 1,116 mitigated RL and SRL properties were able to be mapped. This, however, represents 86.6% of all mitigated properties, a significant improvement over the number of properties able to be mapped in the 2010 SSAHMP. Additionally, a closer look at the spatial data shows that often SRL and RL properties were located adjacent to one another on the ground, making it appear as if there are fewer SRL and RL properties statewide.

As of July 2013, Pennsylvania had 8,180 RL properties with claims totaling $658,455,490.60. At least 1,070 (13%) of these properties have been mitigated. The Commonwealth has 475 SRL properties with claims totaling $74,999,965.48. At least 46 (9.7%) of these properties have been mitigated. A majority (65.5%) of the 475 SRL properties within the Commonwealth are located in Bucks, Montgomery, Delaware Northampton, Luzerne, Lycoming, and Dauphin Counties, while most other counties have less than 20 SRL properties. Twenty four counties have no SRL properties at all. 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 Hurricane Sandy for RL and SRL properties may be estimated at $12,029,031. These avoided losses are based on a brief study based on RL and SRL properties mitigated prior to Hurricane Sandy in Sandy-declared counties, regardless of their location vis-à-vis Sandy-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 4.3.5-8 shows that last payment prior to Hurricane Sandy for RL and SRL structures in the declared counties. A more robust losses avoided 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).

Because of this missing data, Action 4-1d in the Mitigation Strategy is not complete. However, PEMA and FEMA continue to work together to refine a Pennsylvania-specific losses avoided study and better quantify the value of mitigation in Pennsylvania.

Table 4.3.5-8 Losses Avoided in Hurricane Sandy Based on Last Payment to RL and SRL Properties Prior to Hurricane Sandy. Data from PA RL & SRL Inventory (July 2013).

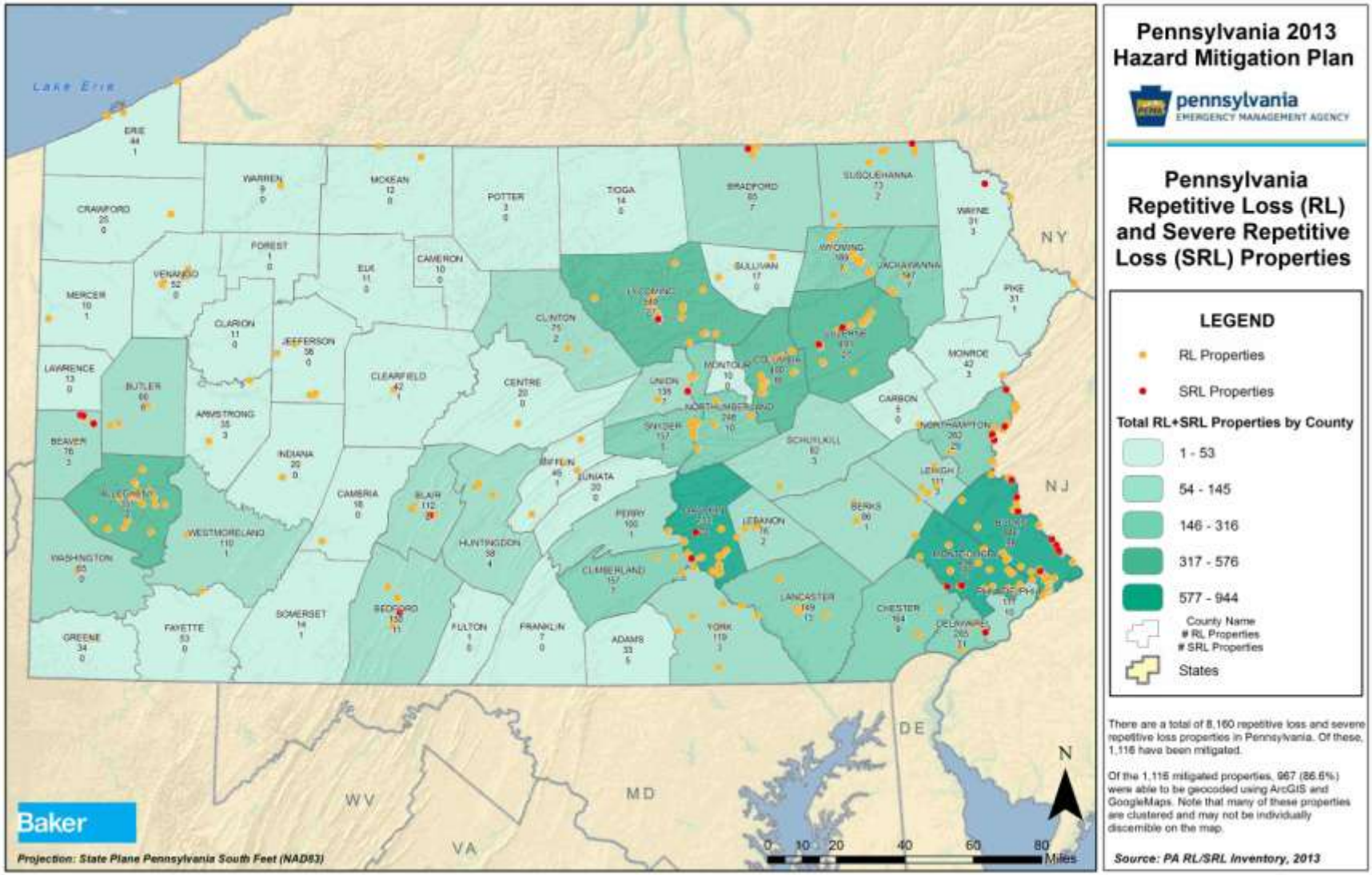
COUNTY	Last Building Payment Prior to Hurricane Sandy	Last Contents Payment Prior to Hurricane Sandy	Last Total Payment Prior to Hurricane Sandy
Bedford	$342,179	$135,279	$477,458
Bucks	$3,729,905	$664,121	$4,394,026
Cameron	$0	$0	$0
Dauphin	$3,439,963	$207,272	$3,647,235
Forest	$0	$0	$0
Franklin	$9,331	$5,000	$14,331
Fulton	$0	$0	$0
Huntingdon	$33,712	$18,363	$52,074
Juniata	$0	$0	$0
Monroe	$202,996	$50,628	$253,624
Northampton	$2,037,044	$175,167	$2,212,211
Philadelphia	$0	$0	$0
Pike	$141,947	$43,000	$184,947
Potter	$0	$0	$0
Somerset	$0	$0	$0
Sullivan	$0	$13,720	$13,720
Wyoming	$637,617	$141,785	$779,402
TOTAL	**$10,574,695**	**$1,454,335**	**$12,029,031**

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. Twenty-three of the 46 SRL mitigated properties are

identified as having been mitigated through PEMA and FEMA. The remaining 23 properties have been mitigated using ICC program funds. Additionally, 900 of the mitigated RL properties have been mitigated using PEMA and FEMA grant program funding. A total of 298 properties used ICC program fund, with 170 of those properties using just ICC program funds.

Figure 4.3.5-6 shows clusters of RL and SRL properties exist in Allegheny County near Pittsburgh, in Lycoming County near Williamsport, in Luzerne and Lackawanna Counties in the Wilkes-Barre-Scranton area, along the Susquehanna in Central Pennsylvania, and in the communities surrounding the Philadelphia Metropolitan area. Additional projects are underway and will be listed once the supporting grant project has been closed and FEMA Form AW-501 is complete.

Figure 4.3.5-6 Map showing the location of mitigated Repetitive Loss and Severe Repetitive Loss properties in Pennsylvania. Data from PA RL & SRL Inventory (July 2013).



According to the National Climatic Data Center, previous flood events occurring between 1950 and 2013 have caused over $1 billion in property damage, over $3 million in crop damage, 86 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 2013 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, or more accurate data. This is a Level 2 study because the model incorporates more up-to-date Census 2010 demographic data in conjunction with previously delineated depth grids. This was done to speed processing and leverage previously completed analysis. For more information on the data and methodology used in this analysis, see Section 4.1.4.

The flood study is an aggregation of flood model results from each county which provide estimates of total economic loss, building damage, content damage, and other economic impacts that can be used in local flood response and mitigation planning activities. "Buildings at least moderately damaged" are defined as the number of buildings at least 11% damaged and up to 100% damaged (FEMA, February 2012). The potential loss estimates due to flooding were calculated using HAZUS-MH 2.1 in 2013 to take advantage of updated Census demographic data in this Level 2 analysis.

Estimated total economic losses for a 1%-annual-chance flood event across the entire Commonwealth sum to $31,316,150,000, of which $31,071,150,000 are building-related losses. The 1%-annual-chance flood simulation estimated the displacement of 138,651 households and a corresponding shelter requirement of 301,556 people. Allegheny and Montgomery Counties are expected to see the highest total economic loss in a 1% annual-chance flood event, while Fulton County is expected to experience the least. This data is also mapped in Figure 4.3.5-6.

Table 4.3.5-9 HAZUS-MH results for a 1%-annual-chance flood event in Pennsylvania.

COUNTY	NO. OF BUILDINGS AT LEAST MODERATELY DAMAGED	NUMBER OF HOUSEHOLDS DISPLACED	SHELTER REQUIREMENT (PEOPLE)	TOTAL ECONOMIC LOSS (BUILDING-RELATED AND BUSINESS INTERRUPTION, MILLIONS $)	TOTAL BUILDING-RELATED LOSSES (BUILDING AND CONTENTS, MILLIONS $)
Adams	50	941	1,891	72.14	71.61
Allegheny	3,885	12,801	31,495	7,990.12	7,920.96
Armstrong	1,940	3,726	8,623	1,002.08	994.07
Beaver	527	2,143	4,601	533.54	530.67
Bedford	261	1,254	1,658	203.74	202.44
Berks	490	2,683	5,269	770.57	767.18
Blair	167	2,093	4,738	159.50	158.35
Bradford	348	1,710	3,034	197.98	196.33
Bucks	2,397	8,964	23,535	1,323.43	1,315.81
Butler	254	2,132	4,507	272.26	270.43

Table 4.3.5-9 HAZUS-MH results for a 1%-annual-chance flood event in Pennsylvania.

COUNTY	NO. OF BUILDINGS AT LEAST MODERATELY DAMAGED	NUMBER OF HOUSEHOLDS DISPLACED	SHELTER REQUIREMENT (PEOPLE)	TOTAL ECONOMIC LOSS (BUILDING-RELATED AND BUSINESS INTERRUPTION, MILLIONS $)	TOTAL BUILDING-RELATED LOSSES (BUILDING AND CONTENTS, MILLIONS $)
Cambria	702	2,019	3,557	939.07	932.74
Cameron	348	347	641	159.42	158.29
Carbon	247	1,095	2,581	113.01	131.75
Centre	132	1,356	2,544	135.22	134.25
Chester	656	3,319	7,366	573.49	570.78
Clarion	80	259	279	71.41	70.62
Clearfield	250	1,360	2,182	309.87	306.63
Clinton	394	2,306	4,606	337.53	333.82
Columbia	1,124	2,380	6,142	664.00	659.16
Crawford	525	2,160	4,095	414.20	411.45
Cumberland	502	2,315	5,029	330.71	328.79
Dauphin	261	1,763	3,362	195.93	194.96
Delaware	1,284	5,374	13,969	809.67	805.98
Elk	182	563	962	139.90	138.73
Erie*	182	1,706	3,084	229.56	228.65
Fayette	349	2,023	3,889	276.68	272.97
Forest	48	51	63	12.94	12.90
Franklin	312	1,912	4,286	190.92	189.85
Fulton**	0	109	15	12.07	12.04
Greene	41	697	964	85.10	84.25
Huntingdon	195	2,086	4,089	128.09	127.05
Indiana	111	1,166	2,149	97.24	96.65
Jefferson	201	1,413	2,809	239.41	237.29
Juniata	50	496	539	58.57	28.06
Lackawanna	1,069	3,287	7,776	631.88	627.80
Lancaster	671	3,766	7,650	655.32	652.03
Lawrence	312	1,263	2,329	425.77	423.71
Lebanon	91	868	1,634	126.98	126.32
Lehigh	278	1,495	3,127	238.17	236.95
Luzerne	1,180	6,899	17,829	1,061.23	1,052.11
Lycoming	898	3,466	8,025	616.48	610.69
McKean	120	1,113	2,334	142.20	140.75
Mercer	127	1,641	3,323	468.12	464.99
Mifflin	273	1,317	2,885	198.51	197.46

Table 4.3.5-9 HAZUS-MH results for a 1%-annual-chance flood event in Pennsylvania.

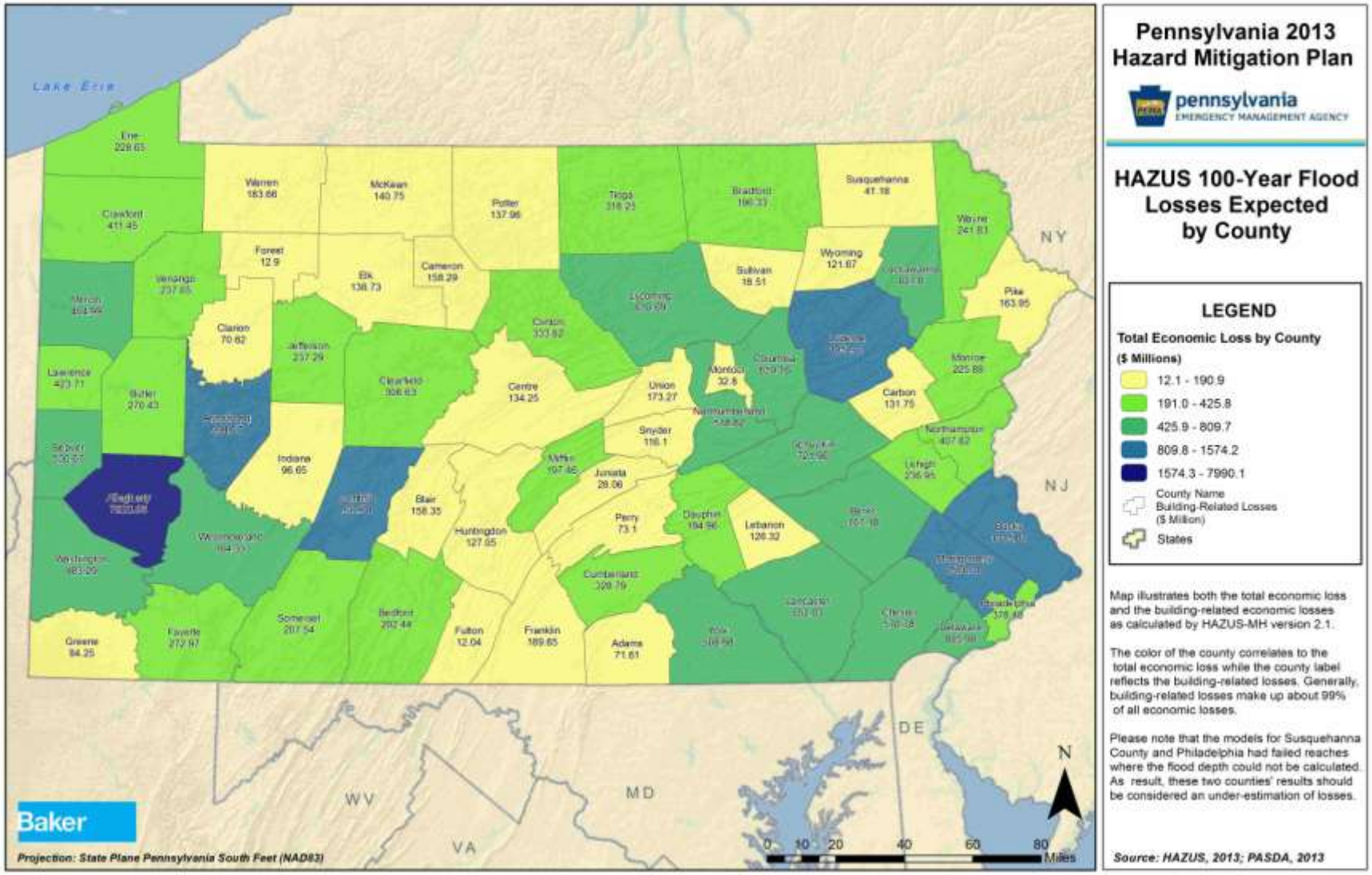
COUNTY	NO. OF BUILDINGS AT LEAST MODERATELY DAMAGED	NUMBER OF HOUSEHOLDS DISPLACED	SHELTER REQUIREMENT (PEOPLE)	TOTAL ECONOMIC LOSS (BUILDING-RELATED AND BUSINESS INTERRUPTION, MILLIONS $)	TOTAL BUILDING-RELATED LOSSES (BUILDING AND CONTENTS, MILLIONS $)
Monroe	209	1,107	1,985	226.89	225.88
Montgomery	1,217	4,181	9,450	1,574.18	1,566.38
Montour	35	229	356	33.37	32.80
Northampton	264	2,356	5,364	410.40	407.82
Northumberland	1,305	3,006	6,683	523.44	518.82
Perry	63	834	1,473	73.82	73.10
Philadelphia***	325	2,036	5,395	381.37	378.48
Pike	264	829	1,369	165.44	163.95
Potter	149	799	1,356	139.81	137.96
Schuylkill	847	3,782	8,349	728.16	721.96
Snyder	50	362	314	116.64	116.10
Somerset	297	1,282	1,841	210.57	207.54
Sullivan	44	97	70	18.83	18.51
Susquehanna***	12	442	486	41.40	41.18
Tioga	692	2,417	5,171	321.58	318.25
Union	296	1,214	2,205	174.63	173.27
Venango	266	815	1,633	238.62	237.05
Warren	344	1,149	2,262	185.17	183.66
Washington	195	1,763	3,083	487.50	483.29
Wayne	193	837	1,896	244.77	241.83
Westmoreland	904	3,980	8,623	771.44	764.35
Wyoming	197	706	1,256	122.56	121.67
York	441	2,591	5,471	511.53	508.98
TOTAL	**32,123**	**138,651**	**301,556**	**31,316.15**	**31,071.15**

*Erie County's results include both riverine and coastal flood losses.

**In Fulton County, no buildings are expected to be at least moderately damaged in the 100-year flood event; this does not preclude buildings that are only very slightly impacted from experiencing building-related losses or causing displacement that would require shelter. This is the calculated result.

***The Susquehanna County and Philadelphia models included failed reaches for which the flood depth and floodplain could not be calculated. As a result, these results are likely an underestimation of potential flood losses.

Figure 4.3.5-7 HAZUS-calculated loss estimates by county.



Between 2003 and 2013, over $1.3 billion in U.S. Small Business Administration (SBA), Individual Assistance, Public Assistance, and Hazard Mitigation Assistance funds have been distributed in response to eight federal disaster declarations. The SBA provides low interest loans to residential home-owners 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, and 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 4.3.5-10. The largest distribution of funds occurred in response to significant flood events in September 2004 and June 2006.

Table 4.3.5-10 Summary of funds distributed in Pennsylvania as a result of disaster declarations related to flooding between 2003 and 2013 (PEMA, 2010, and FEMA, 2013).

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*	10,568,582.47	$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	10/26/2012	DR-4099	18	*none*	*none*	*none*	$10,741,638	$2,623,955	**$13,365,593**
2013 (as of 8/13)	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	***none***
TOTALS			**193**	**120,924**	**$279,206,900**	**$459,363,433**	**$465,324,531**	**$105,269,235**	**$1,309,164,098**

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 U.S. Army Corps of Engineers, 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 are in need of 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. Building new and maintaining existing flood protection projects are both addressed in the beginning of the 2013 mitigation strategy with Actions 1-1a and 1-1b.

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 forty percent for the 50%-annual-chance flood and sixty 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 U.S. Army Corps of Engineers and provide Pennsylvania residents with excellent recreational opportunities as well as save millions of dollars in reduced flood damages. It remains important for coordination between agencies regarding flooding risks as a result of potential flood-control structure failures to continue. This coordination is addressed in actions addressing Objectives 1-5 and 1-7.

4.3.5.9. State Facility Loss Estimation

The state facility loss estimation was calculated by summing the replacement value of all state critical facilities located in the 1%-annual-chance flood hazard area. The estimated replacement value of all State Critical Facilities located in the 1%-annual-chance flood hazard area is $1,853,267,443.

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. Hailstorms occur when ice crystals form within a low pressure front due to the rapid rise of warm air into the upper atmosphere and the subsequent cooling of the air mass. 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.

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.

Table 4.3.6-1 Hailstone size and relationship to updraft speed (NOAA, 2 May 2013).

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

The size of hail is dependent on the strength of the upward air movement along the front of a thunderstorm, called the updraft. Hailstone nuclei are buoyed or lifted by the updraft and grow in size the longer the stone is held aloft. Weaker updrafts create smaller hailstones while strong updrafts provide a longer amount of time for hailstone nuclei to grow in diameter.

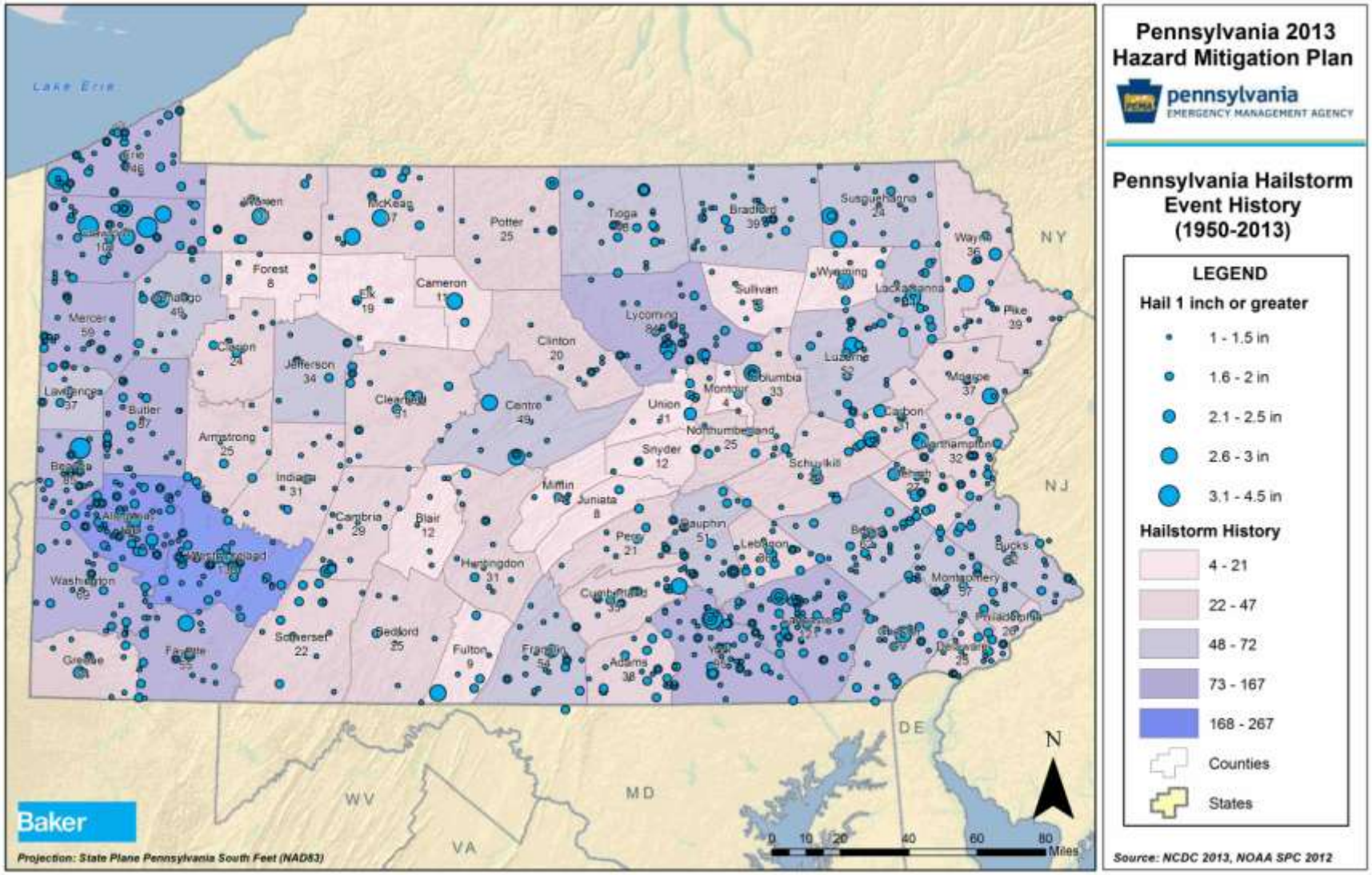
Hailstorms can cause significant damage to crops, livestock and property. Damage is dependent on the size, duration, and intensity of hail precipitation. Those who do not seek shelter could face serious injury. Automobiles and aircraft are particularly susceptible to damage. Since hail precipitation 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 2 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 Franklin. 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 anticipated property damage or injuries.

4.3.6.3. Past Occurrence

Figure 4.3.6.1 shows a map of the number of recorded hailstorm events by county between 1950 and 2013. An *event* is that which produces hail of ¾ inches or greater in diameter. Previous versions of the SSAHMP found that approximately 96% of hailstorm events occurred during the months of April, May, June, July, August, and September. In addition, approximately 87% of historic events occurred during the afternoon (noon to 5pm) or evening (5pm to 9pm) hours. 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.

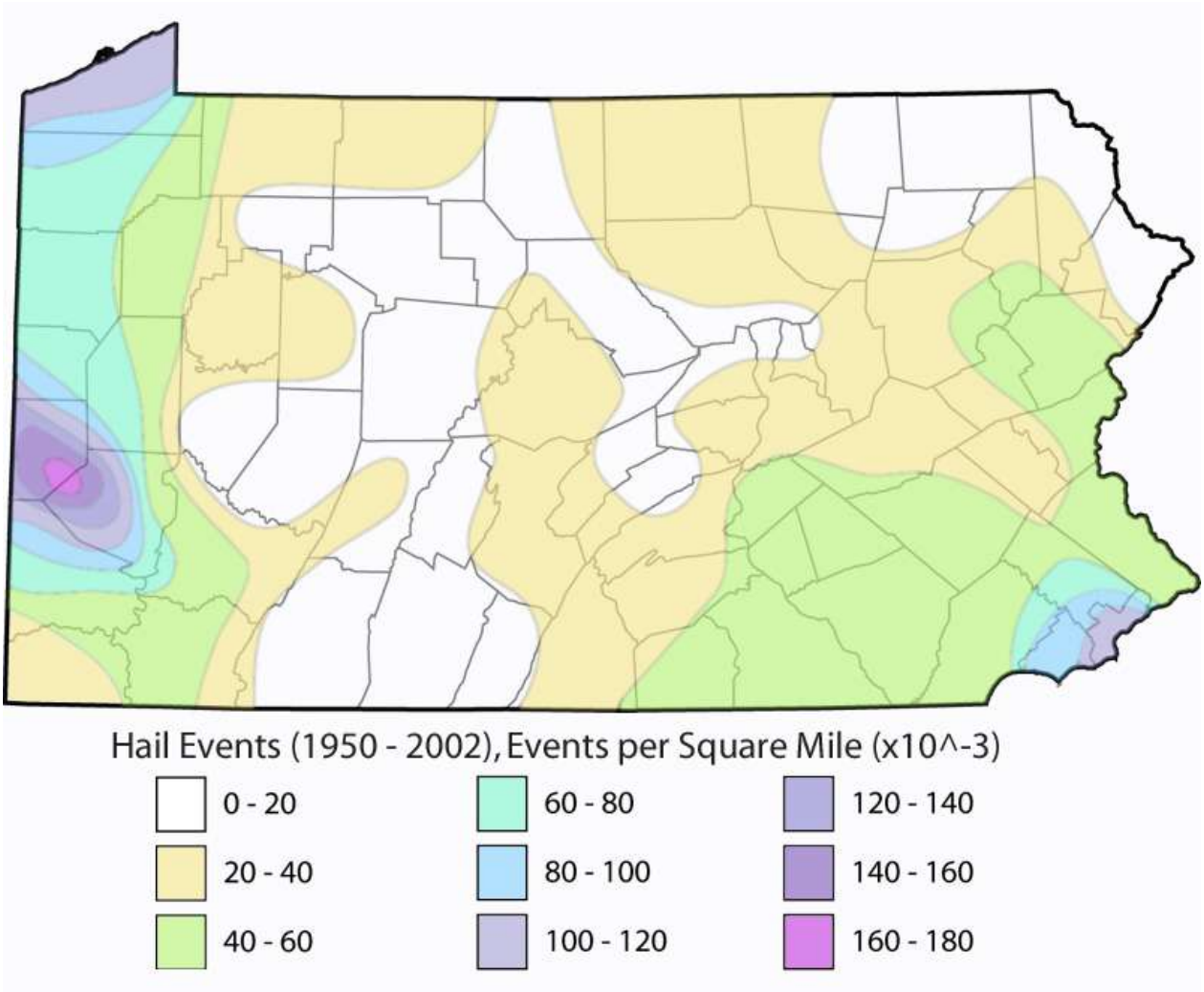
Figure 4.3.6-1 Number of hailstorm events by county between 1950 and 2013 (NCDC, 2013).



4.3.6.4. Future Occurrence

Hailstorm events will occur annually, primarily between April and August, throughout Pennsylvania. Using events collected between 1950 and 2002, Figure 4.3.6-2 shows the number of hail events per square mile across Pennsylvania. It is clear that the southeast and extreme west sections of the Commonwealth can expect to experience a higher number of hailstorm events compared to other areas of Pennsylvania. On the whole, though, 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 square mile in Pennsylvania (Pennsylvania State Climatologist).



4.3.6.5. Environmental Impacts

Damage to trees, shrubbery, and other vegetation may occur during hailstorm events through defoliation. Unless there are compounding stresses, natural vegetation can typically recover over time following the 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.

4.3.6.6. Jurisdictional Vulnerability Assessment

As a hazard, damage to crops and vehicles are typically the most significant impacts of hailstorms. Areas in eastern and central Pennsylvania typically experience less than 2 hailstorms per year while areas in western Pennsylvania experience 2-3 annually. (FEMA, 1997). All jurisdictions are vulnerable to the effects of hailstorms, but jurisdictions with large amounts of farmland and high agricultural yields are more likely to be affected by hailstorm hazards. According to the 2007 US Department of Agriculture Agricultural Census, in Pennsylvania, the top ten jurisdictions for agricultural production are as follows:

1. Lancaster County (18.5% of state total sales)
2. Chester County (9.5% of state total sales)
3. Berks County (6.3% of state total sales)
4. Franklin County (5.2% of state total sales)
5. Lebanon County (4.4% of state total sales)
6. Adams County (3.7% of state total sales)
7. York County (3.7% of state total sales)
8. Cumberland County (2.3% of state total sales)
9. Schuylkill (2.1% of state total sales)
10. Bradford County (2.1% of state total sales)

Beyond these agricultural counties, Table 4.3.6-2 lists which counties profiled hailstorm in their most recent hazard mitigation plan or plan update. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Currently, eight counties have a calculated risk factor value for hailstorms. The State Risk Factor for hailstorms is 1.9, and the THIRA ranking is 6 of 10. For more details on the State Risk Factor and THIRA prioritization, please see Section 4.1.

Table 4.3.6-2 Counties profiling hailstorm hazards with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Adams		X		
Allegheny		X		
Armstrong		X		
Beaver		X		
Bedford	X		Medium	2.4
Berks		X		

Table 4.3.6-2 Counties profiling hailstorm hazards with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Blair		X		
Bradford		X		
Bucks	X		Low	1.6
Butler		X		
Cambria	X		High	2.7
Cameron		X		
Carbon		X		
Centre		X		
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia		X		
Crawford		X		
Cumberland		X		
Dauphin		X		
Delaware		X		
Elk		X		
Erie		X		
Fayette	X		Medium	2.4
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon		X		
Indiana		X		
Jefferson		X		
Juniata		X		
Lackawanna		X		
Lancaster		X		
Lawrence		X		
Lebanon*		X		
Lehigh	X		Medium	2.1

Table 4.3.6-2 Counties profiling hailstorm hazards with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Luzerne		X		
Lycoming	X		High	3.1
McKean		X		
Mercer		X		
Mifflin		X		
Monroe		X		
Montgomery	X		Medium	2.1
Montour*		X		
Northampton	X		Medium	2.1
Northumberland		X		
Perry*		X		
Philadelphia**		X		
Pike		X		
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan		X		
Susquehanna	X		Low	1.8
Tioga		X		
Union		X		
Venango		X		
Warren		X		
Washington		X		
Wayne		X		
Westmoreland		X		
Wyoming		X		
York	X		Medium	2.0

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

4.3.6.7. State Facility Vulnerability Assessment

Hail does not pose a direct threat to state critical facility buildings. Although property damage could result from a hailstorm, the real damage is on agricultural land and its crops. Because hailstorms primarily affect agricultural products, the state facilities that are most vulnerable to hailstorm threats are those that are food and agriculture-related. These agricultural critical facilities are both food producers and food manufacturers, and are located in both urban and rural areas, all of whom could be directly or indirectly impacted by a hailstorm event. Table 4.3.6-3 lists these facilities by county. Lancaster County has the most facilities with 18, followed by Dauphin County with 12 facilities.

Table 4.3.6-3 Number of agriculture State Critical Facilities per county.

COUNTY	NUMBER OF AGRICULTURE CRITICAL FACILITIES	COUNTY	NUMBER OF AGRICULTURE CRITICAL FACILITIES
Adams	5	Lancaster	18
Allegheny	4	Lebanon	3
Berks	8	Lehigh	1
Blair	2	Luzerne	1
Bradford	1	Lycoming	2
Bucks	1	Mercer	1
Cambria	1	Mifflin	1
Chester	3	Montgomery	3
Clearfield	1	Northampton	2
Columbia	2	Northumberland	5
Cumberland	4	Philadelphia	4
Dauphin	12	Schuylkill	4
Delaware	1	Snyder	2
Erie	3	Somerset	1
Fayette	1	Susquehanna	1
Franklin	1	Washington	1
Juniata	1	Westmoreland	1
Lackawanna	1	York	3

4.3.6.8. Jurisdictional Loss Estimation

Across all communities in Pennsylvania, hailstorm events between 1950 and 2013 have caused $5,575,500 in property damage and $3,487,000 in crop damage (NCDC, 2013). As reported by the NCDC, the top hailstorm occurrences involving the largest property damage and crop damage came within Erie County. In Erie County, dime size hail was reported over a large area. Around 3,000 acres of grapes on 24 farms were damaged by the hail. Approximately 25 percent of the grape crop on these 3,000 acres was destroyed. Initial estimates put the financial loss at $2,000,000. A complete list of all damages reported within Pennsylvania is listed in Table 4.3.6-4.

Table 4.3.6-4 Hailstorms per county according to the NCDC between 1950 and 2013 (NCDC, 2013)

COUNTY	HAIL EVENTS	PROP. DAMAGE	CROP DAMAGE	COUNTY	HAIL EVENTS	PROP. DAMAGE	CROP DAMAGE
Adams	42	$10,000	*	Lackawanna	48	$95,000	*
Allegheny	267	$6,000	*	Lancaster	139	$5,000	*
Armstrong	31	*	*	Lawrence	57	$5,000	*
Beaver	108	$1,000	*	Lebanon	41	$5,000	*
Bedford	30	*	*	Lehigh	38	$100,000	$50,000
Berks	68	*	*	Luzerne	63	$113,000	$1,000
Blair	15	*	*	Lycoming	96	$351,000	$500,000
Bradford	58	$79,000	*	McKean	43	$30,000	*
Bucks	67	$10,000	$400,000	Mercer	98	*	*
Butler	117	$51,000	$500,000	Mifflin	14	$30,000	*
Cambria	34	*	*	Monroe	46	*	*
Cameron	11	*	*	Montgomery	67	*	*
Carbon	33	$1,050,000	*	Montour	4	*	*
Centre	53	*	*	Northampton	37	$250,000	*
Chester	72	*	*	Northumberland	27	*	*
Clarion	37	*	*	Perry	29	$15,000	*
Clearfield	33	$2,000	*	Philadelphia	29	*	*
Clinton	28	$7,500	*	Pike	43	$3,000	$1,000
Columbia	36	*	*	Potter	30	*	*
Crawford	146	$1,723,000	$15,000	Schuylkill	37	*	*
Cumberland	40	*	*	Snyder	13	*	$5,000
Dauphin	64	*	*	Somerset	32	*	$5,000
Delaware	36	*	*	Sullivan	14	*	*
Elk	21	*	*	Susquehanna	50	$30,000	*
Erie	167	$1,446,000	$2,010,000	Tioga	50	$10,000	*
Fayette	92	*	*	Union	11	*	*

Table 4.3.6-4 Hailstorms per county according to the NCDC between 1950 and 2013 (NCDC, 2013)

COUNTY	HAIL EVENTS	PROP. DAMAGE	CROP DAMAGE	COUNTY	HAIL EVENTS	PROP. DAMAGE	CROP DAMAGE
Forest	11	$10,000	*	Venango	64	$12,000	*
Franklin	59	*	*	Warren	34	$20,000	*
Fulton	11	$2,000	*	Washington	93	*	*
Greene	25	*	*	Wayne	47	*	*
Huntingdon	33	*	*	Westmoreland	225	*	*
Indiana	38	$100,000	*	Wyoming	19	*	*
Jefferson	53	*	*	York	121	$4,000	*
Juniata	9	*	*	**TOTAL**	**3,704**	**$5,575,500**	**$3,487,000**

** Damage results marked with an asterisk indicate that no reported damage values were provided by the NCDC, not necessarily that the event did not cause any damage.*

Jurisdictional loss estimation stems from lost agricultural revenues statewide. Table 4.3.6-5 enumerates each county's farmland acreage as well as the annual market value of all agricultural products sold, from 2007. As stated in Section 4.3.6.6., Lancaster, Chester, Berks, Franklin, Lebanon, Adams, York, Cumberland, Schuylkill, and Bradford counties are the counties most threatened by hailstorms; if a hailstorm were to eliminate these counties' agricultural yield, total losses could top $3.3 billion.

Table 4.3.6-5 Estimated jurisdictional losses relating to agricultural production (USDA Census of Agriculture 2007)

COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Adams	174,595	$216,994,000
Allegheny	38,023	$9,514,000
Armstrong	122,275	$51,976,000
Beaver	67,075	$15,187,000
Bedford	210,990	$90,858,000
Berks	222,119	$367,840,000
Blair	87,434	$85,199,000
Bradford	266,635	$121,311,000
Bucks	75,883	$70,573,000
Butler	129,850	$38,664,000
Cambria	87,924	$23,168,000
Cameron	5,092	$828,000
Carbon	20,035	$8,944,000
Centre	148,464	$69,661,000
Chester	166,891	$553,290,000
Clarion	132,140	$21,958,000
Clearfield	62,721	$11,102,000
Clinton	56,626	$43,661,000
Columbia	122,621	$45,874,000
Crawford	232,093	$101,036,000
Cumberland	157,388	$132,803,000
Dauphin	89,533	$82,887,000
Delaware	4,361	$9,455,000
Elk	33,258	$3,717,000
Erie	173,125	$71,284,000
Fayette	140,688	$25,974,000
Forest	10,728	$3,106,000
Franklin	242,634	$304,450,000
Fulton	103,516	$38,038,000
Greene	150,203	$9,316,000
Huntingdon	148,289	$62,320,000
Indiana	187,711	$76,428,000

Table 4.3.6-5 Estimated jurisdictional losses relating to agricultural production (USDA Census of Agriculture 2007)

COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Jefferson	87,043	$25,317,000
Juniata	97,681	$91,658,000
Lackawanna	39,756	$16,216,000
Lancaster	425,336	$1,072,151,000
Lawrence	92,391	$35,639,000
Lebanon	113,486	$257,097,000
Lehigh	84,643	$72,059,000
Luzerne	66,577	$18,151,000
Lycoming	160,456	$53,381,000
McKean	41,466	$5,185,000
Mercer	171,860	$60,655,000
Mifflin	94,133	$86,818,000
Monroe	29,165	$7,819,000
Montgomery	41,908	$30,028,000
Montour	50,252	$36,193,000
Northampton	68,252	$31,762,000
Northumberland	147,660	$110,978,000
Perry	144,375	$105,052,000
Philadelphia	262	$487,000
Pike	27,569	$2,524,000
Potter	88,457	$31,377,000
Schuylkill	118,501	$124,752,000
Snyder	100,179	$109,041,000
Somerset	206,651	$83,152,000
Sullivan	27,821	$7,240,000
Susquehanna	158,218	$49,287,000
Tioga	184,108	$53,828,000
Union	63,795	$90,497,000
Venango	64,796	$11,796,000
Warren	99,582	$18,603,000
Washington	211,053	$28,649,000
Wayne	92,939	$29,428,000
Westmoreland	167,489	$58,437,000
Wyoming	77,957	$13,496,000
York	292,507	$212,634,000
TOTAL	***7,809,244***	***$5,808,803,000***

4.3.6.9. State Facility Loss Estimation

The vulnerable state critical facilities identified in Section 4.3.6.7 are agriculture-related facilities, all but three of which are privately held entities for which replacement values are unavailable. The three publicly held agriculture facilities are offices and laboratory space of the Department of Agriculture which are unlikely to face serious impacts from hailstorms.

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. Nor'easters are extra-tropical storms which typically develop from low-pressure centers off the Atlantic Coast north of North Carolina during the winter months. Extra-tropical is a term used to describe a hurricane or tropical storm that's cyclone has lost its 'tropical' characteristics. While an extra-tropical storm donates a change in weather pattern and how the storm is gathering energy, it may still have winds that are tropical storm or hurricane force.

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. In general, coastal storm systems affect communities in the eastern portion of Pennsylvania more often than western communities. However, 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. 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 these storms may also come in the form of heavy snow or ice (see Section 4.3.16).

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. 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. Historically, tropical cyclone events have brought intense rainfall to Pennsylvania, sometimes leading to damaging floods, northeast winds, which, combined with waterlogged soils, caused trees and utility poles to fall.

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-

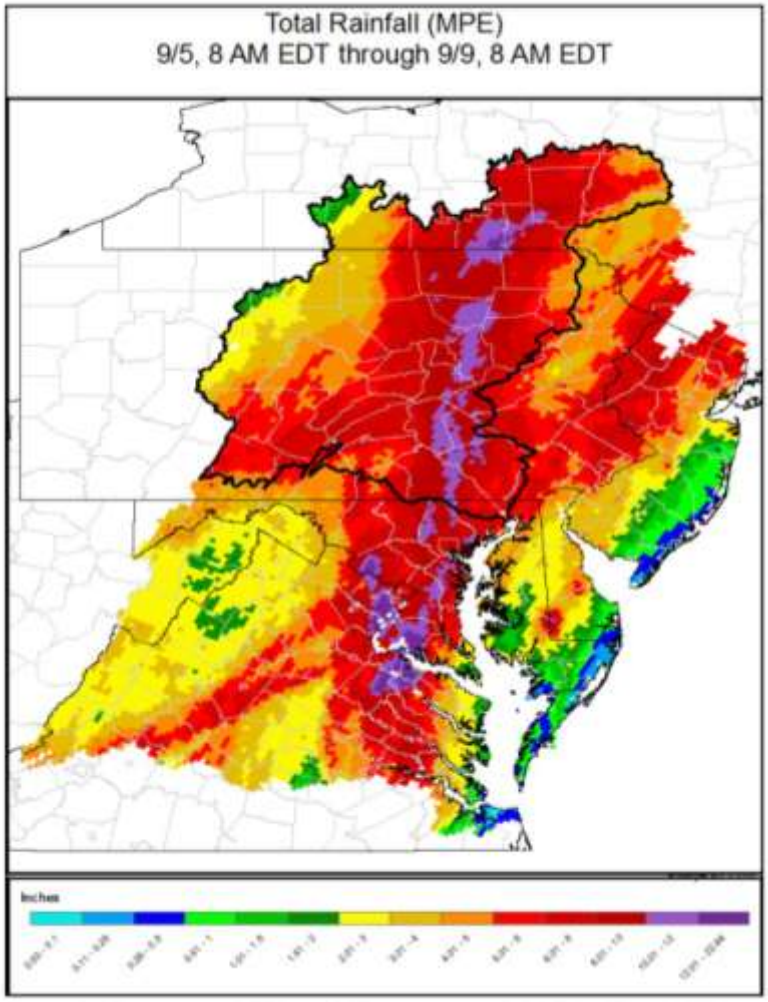
Simpson Scale. The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure and storm surge potential (a threat only to the tidal portions of the Delaware River), which are combined to estimate potential damage. Table 4.3.7-1 lists Saffir-Simpson 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. While major hurricanes comprise only 20% of all tropical cyclones making landfall, they account for over 70% of the damage in the United States.

Table 4.3.7-1 Saffir-Simpson Scale categories with associated wind speeds and damages (NHC, 2009).

STORM CATEGORY	WIND SPEED (mph)	DESCRIPTION OF DAMAGES
1	74-95	*MINIMAL*: Damage is limited primarily to shrubbery and trees, unanchored mobile homes and signs. No significant structural damage.
2	96-110	*MODERATE*: Some trees are toppled, some roof coverings are damaged and major damage occurs to mobile homes. Some roofing material, door and window damage.
3	111-130	*EXTENSIVE*: Some structural damage to small residences and utility buildings, with a minor amount of curtain wall failures. Mobile homes are destroyed. Large trees are toppled. Terrain may be flooded well inland.
4	131-155	*EXTREME*: Extensive damage to roofs, windows and doors; roof systems on small buildings completely fail. More extensive curtain wall failures. Terrain may be flooded well inland.
5	>155	*CATASTROPHIC*: Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Massive evacuation of residential areas may be required.

Section 4.3.7.3 lists, maps, and describes the past hurricane, tropical storm, and nor'easter events occurring in Pennsylvania. However, it is important to indicate the worst-case scenario or event for a tropical storm in Pennsylvania, which was Tropical Storm Lee/Hurricane Irene in 2011. Hurricane Irene made landfall in the US on August 27, 2011 and again on August 28, dumping between 2 and 8 inches of rain in eastern Pennsylvania, with its worst rain occurring in the Delaware River basin. One and a half weeks later, beginning on September 5, Tropical Storm Lee and its associated heavy rainfall moved through Pennsylvania and New York. With large portions of the Susquehanna River Basin already saturated by Hurricane 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. Rainfall totals recorded by the National Weather Service are shown in Figure 4.3.7-1 below.

Figure 4.3.7-1 Total Rainfall from the remnants of Tropical Storm Lee (NWS, 2012).



Lee/Irene left significant amounts of water over nearly all of central and eastern Pennsylvania with the worst occurring in Northeastern Pennsylvania communities of Towanda, Wilkes-Barre, Bloomsburg, Danville, and Sunbury. According to the NWS, over 2,000 people were evacuated and 3,000 homes and businesses flooded in Bradford County alone. Bradford County's agricultural community was severely damaged with about $7 million in crop damage. In Luzerne County, 60,000 people were evaluated 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 as being 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 State 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 (NWS, 2012).

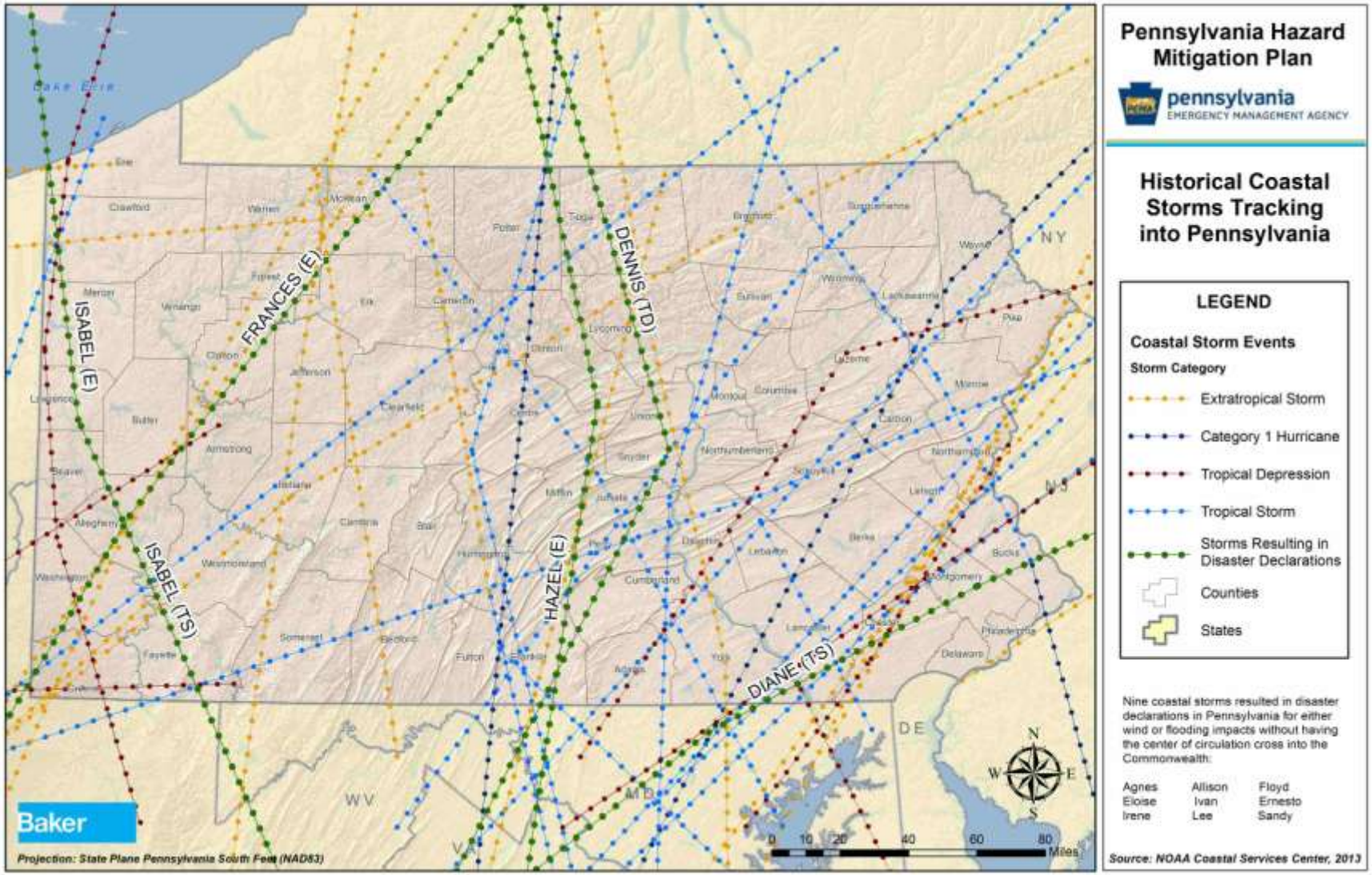
4.3.7.3. Past Occurrence

As shown in Section 4.2.1, 13 Presidential Disaster 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, nineteen named tropical cyclones have tracked through Pennsylvania; a summary of these storms is provided in Table 4.3.7-2 with storm category as recorded over Pennsylvania. A map of all events since 1876 is provided in Figure 4.3.7-2.

Table 4.3.7-2 Tropical cyclone events which tracked through Pennsylvania between 1952 and present (NOAA CSC, 2010). Note that events with circulation centers that did not move through Pennsylvania are not included in this table, but are identified in text. Storm categories: E = Extra-tropical storm, TD = Tropical depression, TS = Tropical storm

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)

Figure 4.3.7-2 Map showing historical coastal storm events which tracked through Pennsylvania.



It is important to note that Table 4.3.7-2 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. However, storms of this type have had serious impacts on Pennsylvania. Perhaps the best example of this is Hurricane Agnes (1972). While it was the most significant tropical storm event to impact the Commonwealth, 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. After making first landfall as a minimal hurricane near Panama City, FL, Agnes weakened and exited back into the Atlantic off the North Carolina coast. However, the storm skirted along the coast, made a second landfall near New York City as a tropical storm and merged with an extra-tropical low pressure system over northern Pennsylvania. This brought extremely heavy rains to Pennsylvania, with particular concentrations of rain in the Susquehanna River Basin. Maximum rainfall from the storm, falling in the period of June 20-25, 1972, was about 18 inches the middle of the Susquehanna drainage area; however this is an unofficial measurement. The maximum official depth of 15.2 inches was recorded in Harrisburg, PA. Estimated losses in Pennsylvania alone were near $3 billion; total damages for the storm nationwide were estimated at $4 billion. Although storm damages were serious over the entire Commonwealth, both the eastern and western portions escaped the extreme rainfall and losses suffered in central areas. Other tropical cyclones which did not track through Pennsylvania, but caused significant damage to communities in the Commonwealth include Sandy (2012), Lee/Irene (2011), Ivan (2004), Allison (2001), Floyd (1999) and Eloise (1975).

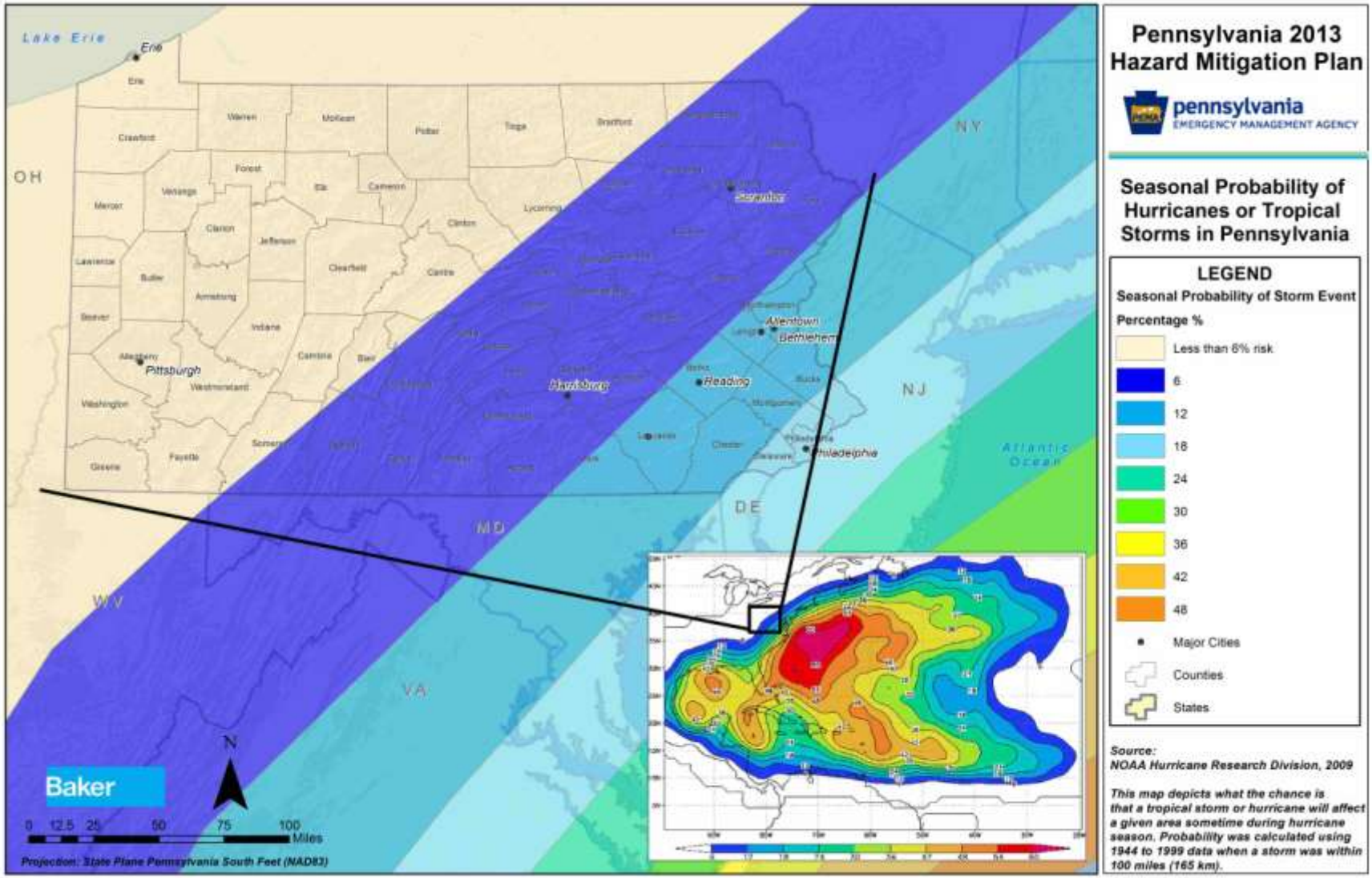
4.3.7.4. Future Occurrence

The National Oceanic and Atmospheric Administration Hurricane Research Division published the map included as Figure 4.3.7-3 showing the chance that a tropical storm or hurricane will affect a given area during the entire Atlantic hurricane season spanning from June to November. Note that this figure does not provide information on the probability of various storm intensities. However, based on historical data between 1944 and 1999, this map shows that areas of Pennsylvania a wide range of probabilities of experiencing a tropical storm or hurricane event between June and November of any given year (NOAA HRD, 2009).

Note that these probabilities are the result of only a single study and may differ from other seasonal probability estimates not identified in this report. Outlier storms may also have a large impact on Pennsylvania even though their probability is low. For instance, western and northwestern Pennsylvania's calculated risk is less than 6% annually. This is not to say that west and northwest Pennsylvania will not experience coastal storms, but indicates this area of Pennsylvania has comparatively the lowest probability of future events in the Commonwealth. This area is still subject to being impacted by a hurricane or tropical storm in a given year as shown in the storm tracks mapped in Figure 4.3.7-2. Southeastern Pennsylvania, on the other hand, has the highest calculated probability of future events with a calculated probability of 12-18% annually. It is important to balance various forms of research in prioritizing preparedness and mitigation solutions to all hazards.

Studies investigating the probability of future occurrence of nor'easters have not been identified. However, there is some evidence that as the earth continues to warm with climate change, there will be an increase in the overall intensity of coastal storms. Past storms have a strong correlation between sea surface temperatures and Atlantic Basin hurricanes; if surface temperatures continue to rise, there is a possible for more, larger storm events. NOAA states with the Intergovernmental Panel on Climate Change A1B scenario, there may be an increase in the number of intense storms, and models indicate that hurricanes by the end of the 21st century will likely see rainfall rates increase 20% within 100 km of storm centers (Knutson, 2013). This information, historical events, and input from the SPT indicate the annual occurrence of coastal storm events is considered *highly likely* as defined by the Risk Factor methodology.

Figure 4.3.7-3 Seasonal probability of Atlantic Basin hurricanes or tropical storms across Pennsylvania.



4.3.7.5. Environmental Impacts

The environmental impacts associated with coastal storms in Pennsylvania are consistent with those described for flood hazards in Section 4.3.5.5 and wind hazards in Section 4.3.14.5.

Beyond the environmental impacts of hurricanes, tropical storms, and nor'easters, Super Storm 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.

4.3.7.6. Jurisdictional Vulnerability Assessment

Table 4.3.7-3 lists which counties did and did not profile coastal storms in their most recent HMP, along with any ranking provided in those county plans. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 18 counties which currently have calculated risk factor values for hurricane, tropical storm, and nor'easter, the average value is 2.2; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for hurricane, tropical storm, and nor'easter is 2.6, while the Pennsylvania THIRA scored hurricane, tropical storm, and nor'easter as an 8 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.7-3 Counties profiling hurricane, tropical storm, and nor'easters with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Adams		X		
Allegheny	X		Low	1.9
Armstrong	X		Not Ranked	No RF
Beaver		X		
Bedford		X		
Berks	X		Not Ranked	No RF
Blair		X		
Bradford	X		Not Ranked	No RF

Table 4.3.7-3 Counties profiling hurricane, tropical storm, and nor'easters with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Bucks	X		High	2.7
Butler		X		
Cambria		X		
Cameron	X		Medium	2.2
Carbon	X		Medium	2.2
Centre	X			
Chester		X		
Clarion		X		
Clearfield	X		Low	1.8
Clinton	X		Low	1.9
Columbia	X		Low	1.9
Crawford		X		
Cumberland	X		Medium	2.2
Dauphin	X		Not Ranked	No RF
Delaware	X		Medium	2.2
Elk		X		
Erie		X		
Fayette	X		Medium	2.3
Forest		X		
Franklin	X		Not Ranked	No RF
Fulton		X		
Greene		X		
Huntingdon		X		
Indiana		X		
Jefferson	X		Medium	2.1
Juniata		X		
Lackawanna	X		Not Ranked	No RF
Lancaster		X		
Lawrence		X		
Lebanon*		X		
Lehigh		X		
Luzerne	X		Not Ranked	No RF
Lycoming		X		

Table 4.3.7-3 Counties profiling hurricane, tropical storm, and nor'easters with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
McKean		X		
Mercer	X		Medium	2.3
Mifflin		X		
Monroe	X		Low	1.9
Montgomery	X		High	3
Montour*	X		Not Ranked	9.6
Northampton		X		
Northumberland		X		
Perry*		X		
Philadelphia**	X		Medium	B
Pike	X		Medium	2.2
Potter		X		
Schuylkill	X		Not Ranked	No RF
Snyder		X		
Somerset		X		
Sullivan	X		Not Ranked	No RF
Susquehanna		X		
Tioga		X		
Union	X		Not Ranked	No RF
Venango		X		
Warren	X		Medium	2.2
Washington		X		
Wayne		X		
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Medium	2.2

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As stated in Section 4.2.2, 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 tracts 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 vulnerability of state critical facilities was evaluated as identifying facilities that are located in the hurricane probability zones of 12 and 18 percent. Four zones fall within Pennsylvania and the top two zones were chosen for analysis due to the higher percentage of chance of occurrence than the lowest percentage zone of 6 percent. Because a hurricane, tropical storm, or nor'easter event may happen anywhere in the Commonwealth, all jurisdictions and critical facilities face a small risk, but these events are most likely in the 12 and 18% zones, and thus the critical facilities and jurisdictions located in those zones are the most vulnerable to this hazard. See Figure 4.3.7-3 for an overview of the extent, which is focused on the southeastern portion of the Commonwealth.

Table 4.3.7-4 shows the number of critical facilities per county within the most vulnerable storm event probability zones of 12 and 18 percent. The top three counties having the most exposed critical facilities fall within the highest probability zone (18%) are Montgomery, Delaware, and Lancaster Counties.

Table 4.3.7-4 Number of State Critical Facilities within storm event probability zones of 12 and 18 percent.

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Berks	124	Lehigh	66
Bucks	124	Monroe	13
Chester	123	Montgomery	201
Columbia	1	Northampton	79
Dauphin	1	Philadelphia	117
Delaware	140	Pike	1
Franklin	1	York	42
Lancaster	128		

4.3.7.7. State Facility Vulnerability Assessment

It was determined that 19% of all State critical facilities fall within the most vulnerable hurricane probability zones, with a total of 1,161. Table 4.3.7-6 lists a breakdown of the types of facilities contained within the zones. Due to the large number of fire departments, police stations, and hospitals in the Commonwealth, it is unsurprising that those categories of facility have the highest number of critical facilities.

Table 4.3.7-5 State Critical Facilities within 12 and 18 percent storm event probability zones by facility type.

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	37
Banking	16
Chemical	5
Commercial Facilities	27
Communications	1
Dams	3
Defense Industrial Base	10
Education	59
Emergency Services	18
Energy	18
Fire Departments (Non-HSIP)	508
Government Facilities	12
Healthcare & Public Health	26
Hospital (Non-HSIP)	83
Information Technology	1
National Monuments & Icons	4
Nuclear Reactors, Materials & Waste	1
Police (Non-HSIP)	297
Postal & Shipping	3
Transportation	20
Water	12
TOTAL VULNERABLE CRITICAL FACILITIES	***1,161***

4.3.7.8. Jurisdictional Loss Estimation

Similar to the vulnerability analysis, jurisdictional loss estimates were based on the total exposed buildings and associated dollar value of exposure in Census tracts located within the 12 and 18% calculated probability zones for hurricane (See Figure 4.3.7-3). Jurisdictional loss estimates are provided in 0.

Table 4.3.7-6 Estimated jurisdictional losses in 12 and 18 percent storm event probability zones.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	4,323	$1,070,018
Berks	184,069	$48,751,140
Bucks	321,764	$108,123,710
Carbon	1,590	$403,034
Chester	261,350	$89,860,597
Delaware	281,319	$86,856,472
Lancaster	229,390	$59,359,549
Lebanon	8,391	$2,282,914
Lehigh	197,004	$54,944,212
Monroe	44,251	$11,974,631
Montgomery	484,549	$160,866,480
Northampton	166,353	$46,823,603
Philadelphia	778,715	$201,276,171
York	83,493	$20,176,478
TOTAL	***3,046,561***	**$892,769,009**

FEMA's HAZUS-MH version 2.1 loss estimation model was used to explore the potential damage of hurricane wind hazards in the Commonwealth using a Level 2 analysis that incorporates more recent, more accurate 2010 Census Tract demographic data. While more refined than an out-of-the-box Level 1 analysis, this analysis is still an estimate of damage to buildings, essential facilities, transportation systems, utility systems, and high potential loss facilities based on national data and historical damage curves and storm tracks included in the HAZUS software. For more information on the data and methodology used in this analysis, see Section 4.1.4.

Probabilistic hurricane models for three historical storms were used to illustrate potential losses from a similar event. The historical storms selected are Hurricanes Floyd, Hazel, and Frances – each of which caused enough damage to warrant a disaster declaration in Pennsylvania. 0 displays a summary of hurricane losses predicted by HAZUS for these events and Figure 4.7.3-4 shows the HAZUS hurricane total economic loss estimates for the 100-year probabilistic hurricane scenario. Total economic loss estimates are the sum of building-related damages and business interruption losses, which are the losses associated with the inability to operate a business because of damage sustained in the scenario. As seen in Figure 4.3.7-4, HAZUS shows that the impact of the probabilistic 100-year hurricane event could be highest in south central Pennsylvania.

Table 4.3.7-7 Summary of hurricane losses predicted by HAZUS.

EVENT NAME	BUILDINGS AT LEAST MODERATELY DAMAGED	BUILDINGS DAMAGED BEYOND REPAIR	TOTAL ECONOMIC LOSS (MILLIONS)	BUILDING-RELATED ECONOMIC LOSS (THOUSANDS)	SHELTER REQUIREMENT	DEBRIS (MILLIONS OF TONS)
Hurricane Hazel	8,884	270	$2,354.36	$2,239.88	70	3.99
Hurricane Floyd	1,277	6	$904.14	$879.39	0	0.63
Hurricane Frances	0	0	$0.034	$0.033	0	0

Figure 4.3.7-4 HAZUS 100-year probabilistic hurricane event estimated total economic losses by Census tract. Note that only tracts experiencing at least $1000 in losses are displayed on the map. Total economic losses include both direct building losses (shown in Table 4.3.7-9) and business interruption losses.

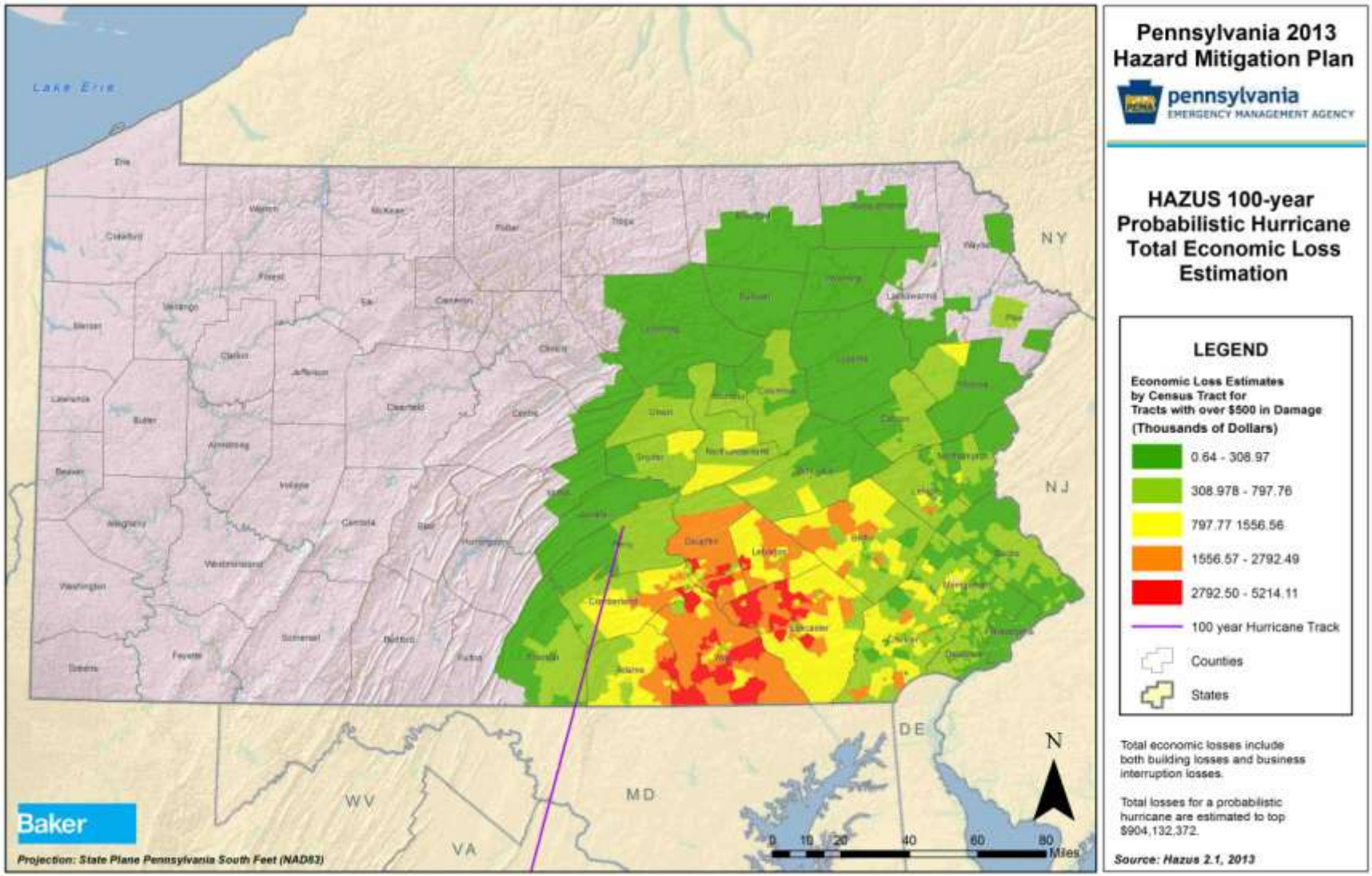


Table 4.3.7-8 shows the total building related losses by county for the 100-year probabilitstic hurricane model. *Appendix H* contains the full report on the HAZUS hurricane results. It is important to note that the building-related losses reported in this table are the estimated costs to repair or replace the damage caused to a building and its contents only. All counties with building-related losses of any magnitude are reported in this table.

Table 4.3.7-8 Total building-related losses from the HAZUS Probabilistic 100-year Hurricane Event.

COUNTY	TOTAL BUILDING-RELATED LOSSES (Thousands of $)	COUNTY	TOTAL BUILDING-RELATED LOSSES (Thousands of $)
Adams	$10,419,997	Huntingdon	$4,400,695
Allegheny	$160,352,004	Jefferson	$8,819,229
Armstrong	$6,962,784	Juniata	$4,652,843
Beaver	$19,658,974	Lancaster	$2,105,556
Bedford	$4,611,099	Lawrence	$24,616,085
Berks	$45,608,475	Lebanon	$55,845,528
Blair	$13,030,784	Lehigh	$9,300,394
Bradford	$5,622,523	Luzerne	$14,179,980
Bucks	$89,765,891	Lycoming	$40,540,454
Butler	$21,004,608	McKean	$35,569,644
Cambria	$15,834,947	Mercer	$11,967,239
Cameron	$905,333	Mifflin	$4,622,357
Carbon	$8,046,680	Montgomery	$12,896,775
Centre	$16,160,405	Montour	$4,439,219
Chester	$70,830,117	Northampton	$20,798,174
Clarion	$4,463,519	Northumberland	$118,942,877
Clearfield	$7,945,319	Perry	$2,083,139
Clinton	$3,972,137	Philadelphia	$36,378,693
Columbia	$6,954,372	Potter	$9,598,061
Crawford	$9,612,365	Schuylkill	$4,322,658
Cumberland	$26,979,564	Snyder	$178,499,440
Dauphin	$32,210,473	Somerset	$9,681,749
Delaware	$72,877,456	Sullivan	$2,448,085
Elk	$3,985,364	Tioga	$16,213,443
Erie	$30,307,615	Union	$3,980,579
Fayette	$12,795,592	Venango	$8,041,941
Forest	$1,433,676	Warren	$1,121,926
Franklin	$13,961,905	Washington	$4,385,455
Fulton	$1,378,326	Westmoreland	$4,040,863
Greene	$3,472,808	York	$4,018,048

4.3.7.9. State Facility Loss Estimation

The estimated replacement cost of all state critical facilities located in hurricane hazard zones is $6,867,999,216.

4.3.8. Invasive Species

4.3.8.1. Location and Extent

An invasive species is a species that is not indigenous to a given ecosystem and that, when introduced to a non-native environment, is likely to cause economic or environmental harm, or pose a hazard to human health. The Commonwealth of Pennsylvania plays host to a number of invasive pathogens, insects, plants, invertebrates, fish, and higher mammals. These species have largely been introduced by the actions of humans. Common pathways for invasive species threats include unintentional release of species, the movement of goods and equipment that may unknowingly harbor species, smuggling, ship ballast, hull fouling, and escape from cultivation (PISC, 2010). Invasive species threats are generally divided into two main subsets:

- ***Aquatic Invasive Species*** are nonnative viruses, invertebrates, fish, and aquatic plants that 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 arthropods, vascular plants, higher vertebrates, or pathogens 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.

The Governor's Invasive Species Council of Pennsylvania (PISC), the lead organization for invasive species threats, identifies a number of species threats that are or could potentially become significant in Pennsylvania but does not prioritize or rank them. These species are listed in Table 4.3.8-1.

Table 4.3.8-1 Invasive species of concern to the Commonwealth (PISC 2010).

INVASIVE SPECIES OF CONCERN IN PENNSYLVANIA*		
Aquatic Invasive Species		
Amphibians and Reptiles		
Red-Eared Slider	Yellow-bellied Slider	
Fishes, Diseases, Invertebrates		
Northern Snakehead	Round Goby	
European Rudd	Sea Lamprey	Zebra Mussel
Tubenose Goby	West Nile Virus	Asian Clam
Asian Carp	Viral Hemorrhagic Septicemia	Rusty Crayfish
Eurasian Ruffe	Spring Viremia of Carp	Spiny Waterflea
Flathead Catfish	Quagga Mussel	Fishhook Waterflea
Mammals and Birds		
Nutria	Mute Swans	Canada Goose
Submerged Aquatic Plants		
Wild Taro	Water Chestnut	Limnophila Sessiliflora

Table 4.3.8-1 Invasive species of concern to the Commonwealth (PISC 2010).

INVASIVE SPECIES OF CONCERN IN PENNSYLVANIA*		
Aquatic Invasive Species		
Hydrilla	Eurasian Watermilfoil	Carolina fanwort
Curly Leaf Pondweed	Giant Salvinia	Parrot feather
Alligator Weed	East Indian Hygrophila	Brazilian waterweed
Water Spinach	Didymo	
Terrestrial Aquatic Plants		
Narrow Leaved Cattail	Japanese Knotweed	Giant Knotweed
Japanese Hops	Common Reed	Hybrid Cattail
Giant Hogweed	Purple Loosestrife	
Terrestrial Invasive Species		
Human and Animal Pathogens		
Avian Influenza	Plague	Q Fever
Smallpox	Salmonellosis	Chronic Wasting Disease
West Nile Virus	Brucellosis	Bovine Spongiform Encephalopathy
Foot and Mouth Disease	Anthrax	
Botulism	Glanders	
Plant Pathogens		
Chrysanthemum White Rust	Potato Wart	Plum Pox Virus
Dutch Elm Disease	White Pine Blister	Ralstonia Blight
Sudden Oak Death	European Stone Fruit Yellows	Ring Rot
Birds		
European Starling	Pigeons	House Sparrows
Monk Parakeet		
Insects and Other Invertebrates		
Japanese Beetle	Gypsy Moth	Tracheal Mite
Pine Shoot Beetle	Brown Marmorated Stink Bug	Non-Native Earthworms
Emerald Ash Borer	Ahemlock Wooly Adelgid	Potato Cyst Nematode
Exotic Bark Beetle	Elongate Hemlock Scale	Golden Nematode
Asian Longhorned Beetle	Beech Bark Scale	Soybean Cyst Nematode
Siren Wood Wasp	Varroa Mite	Giant African Snail
Higher Mammals		
Norway Rat	13-Lined Ground Squirrel	Feral Swine
House Mouse		
Vascular Plants		
Tropical Soda Apple	Goatsrue	Asiatic Bittersweet
Beach Vitex	Multiflora Rose	Japanese Knotweed
Benghal Dayflower	Johnsongrass	Tree of Heaven
Rosary Pea	Garlic Mustard	Purple Loosestrife
Cagon Grass	Mile-A-Minute	Japanese Hops
Kudzu	Canada Thistle	Common Reed

*Species listed above have been mentioned in documents of the Governor's Council on Invasive Species and do not represent a comprehensive list of invasive species threats.

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. For example, kudzu vine is an aggressive vascular plant; by virtue of its wide ecological parameters and its ease of spread, the vine is a more widespread invasive species threat. Other species' spread has been limited by state agency activity. For example, the Emerald Ash Borer's spread is slower than it would be naturally because of an aggressive quarantine and testing program. However, the Ash Borer is in 25 more counties than it was at the time of the 2010 Hazard Mitigation Plan. Overall, though, by nature of being invasive, these threats can infiltrate most areas of the Commonwealth.

Most new introductions of invasive species occur because of human activity. There are a few key pathways to introduction into Pennsylvania:

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

4.3.8.2. Range of Magnitude

The magnitude of invasive species threats ranges from nuisance to widespread killer. Some invasive species like the Brown Marmorated Stink Bugs are not considered an agricultural pest and do not harm humans. Other invasive species can cause significant changes in the composition of Pennsylvania ecosystems. For example, the Emerald Ash Borer has a 99% mortality rate for any ash tree it infects. Didymo, an aggressive form of algae, can clog waterways and smother native aquatic plants and animals. Still more invasive species can cause widespread illness or death in humans; one species of particular concern with this magnitude is anthrax, considered by the Centers for Disease Control and Prevention (CDC) to be a Category A agent that may pose a significant, widespread threat to public health.

The magnitude of an invasive species threat is generally amplified when the ecosystem or host species is already stressed, such as in times of drought. The already weakened state of the native ecosystem causes it to more easily succumb to an infestation. An example of a possible worst-case scenario for invasive species is if the Emerald Ash Borer spreads to t the Commonwealth's 323 million ash trees. With the high mortality rate associated with the ash borer, Pennsylvania's hardwood forests would be devastated. This would have a serious impact on Pennsylvania's logging activities and its many state parks and game lands. The economic impact could be serious, stretching from logging to tourism to other production activities

dependent on Pennsylvania lumber. A 2010 Department of Agriculture report estimated that more than 80,000 Pennsylvanians have been employed in forest product industries, and Pennsylvania is the nation's leading producer of hardwood lumber. The economic impact of this industry is estimated at $26 billion, a significant potential loss should a hardwood-living invasice species take root in Pennsylvania (Department of Agriculture, 2010).

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 4.3.8-2, the volume of acts and quarantines has increased since 2000 (PISC, 2013).

Table 4.3.8-2 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		

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 2009 alone, Pennsylvania imported over $115 billion in goods from abroad, including agricultural, forestry, and fisheries goods that commonly carry unknown pests (U.S. Census, 2009). Furthermore, climate change is contributing to the introduction of new invasive species. As maximum and minimum seasonal temperatures change, pests are able to establish themselves in previously inhospitable climates. This also gives introduced species an earlier start and increases the magnitude of their growth. This may shift the dominance of ecosystems in the favor of nonnative species. For more information on recent changes in extreme temperatures, see Section 4.3.4.

In order to combat the increase in future occurrences, the PISC, which is a collaboration of state agencies, public organizations, and federal agencies, released the Invasive Species Management Plan in April 2010. This plan outlines the Commonwealth's goals for the management of the spread of nonnative invasive species as well as 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 www.invasivespeciescouncil.com. 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.

4.3.8.5. Environmental Impacts

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. This can affect the health of individual host organisms as well as the overall well-being of the affected ecosystem. Beyond causing human, animal, and plant harm, there are secondary impacts of invasive species that go beyond harm to host species and ecosystems, particular in the case of invasive species that attack forests. Pennsylvania's forests prevent soil degradation and erosion, protect watersheds, stabilize slopes, and absorb carbon dioxide emissions. 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 population, invasive species remain a hazard for the economic livelihood of the state.

4.3.8.6. Jurisdictional Vulnerability Assessment

Invasive species threats do not generally impact buildings; instead, they impact landscapes, crops, and people, in the case of human-borne pathogens. Because of this wide array of invasive species present in Pennsylvania, most jurisdictions are vulnerable to some kind of invasive species threat.

However, the invasive species on the Pennsylvania Department of Agriculture's list of most significant threats attack crops and trees. As a result, the most vulnerable jurisdictions are those with the Commonwealth's highest concentration of agricultural production, as well as the highest concentration of the timber and logging industry. According to the 2011 County Business Patterns data collected for Pennsylvania, the agriculture, forestry, fishing, and hunting industry boasts an annual payroll of nearly $86 million across the nearly 500 establishments in Pennsylvania. The counties with the highest concentration of logging establishments are Elk (20 establishments), Bradford (14 establishments), McKean (16 establishments), Crawford (13 establishments), and Jefferson Counties (11 establishments); the counties with the highest agricultural production are:

1. Lancaster County (18.5% of state total sales)
2. Chester County (9.5% of state total sales)
3. Berks County (6.3% of state total sales)
4. Franklin County (5.2% of state total sales)
5. Lebanon County (4.4% of state total sales)
6. Adams County (3.7% of state total sales)
7. York County (3.7% of state total sales)
8. Cumberland County (2.3% of state total sales)
9. Schuylkill (2.1% of state total sales)
10. Bradford County (2.1% of state total sales)

In addition, a number of counties have identified invasive species, forest diseases, and infestations as significant concerns, as shown in Table 4.3.8-3. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 40 counties which currently have calculated risk factor values for invasive species, the average value is 2.3; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for invasive species is 2, while the Pennsylvania THIRA scored invasive species as a 7 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.8-3 Counties profiling invasive species hazards with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Adams		X	High	3.4
Allegheny		X		
Armstrong		X		
Beaver		X		
Bedford	X		Medium	2.3
Berks		X		
Blair		X		
Bradford		X		
Bucks		X		
Butler		X		
Cambria		X		
Cameron		X		
Carbon		X		
Centre		X		
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia		X		
Crawford		X		
Cumberland		X		
Dauphin		X		
Delaware		X		
Elk		X		
Erie	X		Low	1.6
Fayette		X		
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon		X		
Indiana	X		Medium	2.0
Jefferson		X		

Table 4.3.8-3 Counties profiling invasive species hazards with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Juniata		X		
Lackawanna		X		
Lancaster		X		
Lawrence		X		
Lebanon*		X		
Lehigh		X		
Luzerne		X		
Lycoming		X		
McKean	X		Medium	2.3
Mercer		X		
Mifflin	x		Not Ranked	5.55
Monroe		X		
Montgomery		X		
Montour*		X		
Northampton		X		
Northumberland		X		
Perry*	x		Not Ranked	5.55
Philadelphia**		X		
Pike		X		
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan		X		
Susquehanna		X		
Tioga		X		
Union		X		
Venango		X		
Warren		X		
Washington		X		
Wayne		X		
Westmoreland		X		
Wyoming		X		
York	X		Low	1.8

Table 4.3.8-3 Counties profiling invasive species hazards with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

4.3.8.7. State Facility Vulnerability Assessment

Invasive species do not pose a direct threat to state critical facility buildings. However, the Commonwealth identifies 106 food and agriculture-related critical facilities, including seed producers, dairies, and other farm producers; 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 6,569 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. 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.

4.3.8.8. Jurisdictional 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 depend 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: lost revenue from diseased, damaged, or deceased crops, livestock, lumber, etc; economic losses from the cost of eradication programs; and losses in the form of illness or death of humans.

Jurisdictional loss estimates stems from lost agricultural and wood product revenues statewide. Table 4.3.8-4 examines the potential losses to vulnerable jurisdictions in the form of agricultural land and market value of agricultural products. If an invasive species threat were to eliminate these counties' agricultural yield, total losses could reach $2.5 billion. County-by-county loss estimates for timber, lumber and wood products are unavailable, but DCNR estimates that the total value of all Pennsylvania wood products is $5.5 billion (PADCNR, 2004).

Table 4.3.8-4 Estimated agricultural jurisdictional losses due to Invasive Species.

COUNTY	TOTAL ACRES IN FARMS	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS ($)
Berks	222,119	$367,840,000
Chester	166,891	$553,290,000
Franklin	242,634	$304,450,000
Lancaster	425336	$1,072,151,000
Lebanon	113,486	$257,097,000
TOTAL	***1,170,466***	***$2,554,828,000***

4.3.8.9. State Facility Loss Estimation

The state critical facilities most vulnerable to invasive species threats are privately held organizations; as a result, replacement value estimates are not available. Looking more broadly, 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, 2010). 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.

Aside from losses to state facilities, combatting invasive species is an expensive task. DCNR states in its Invasive Species Management Plan that in 2011, they spent $220,000 on suppressing the Hemlock Woolly Adelgid alone; other forest pest surveys cost $500,000 per year, and the gypsy moth suppression program ranges from $500,000 to $10 million annually. These programs could cause an undue burden on budgets should invasive species grow.

4.3.9. Landslide

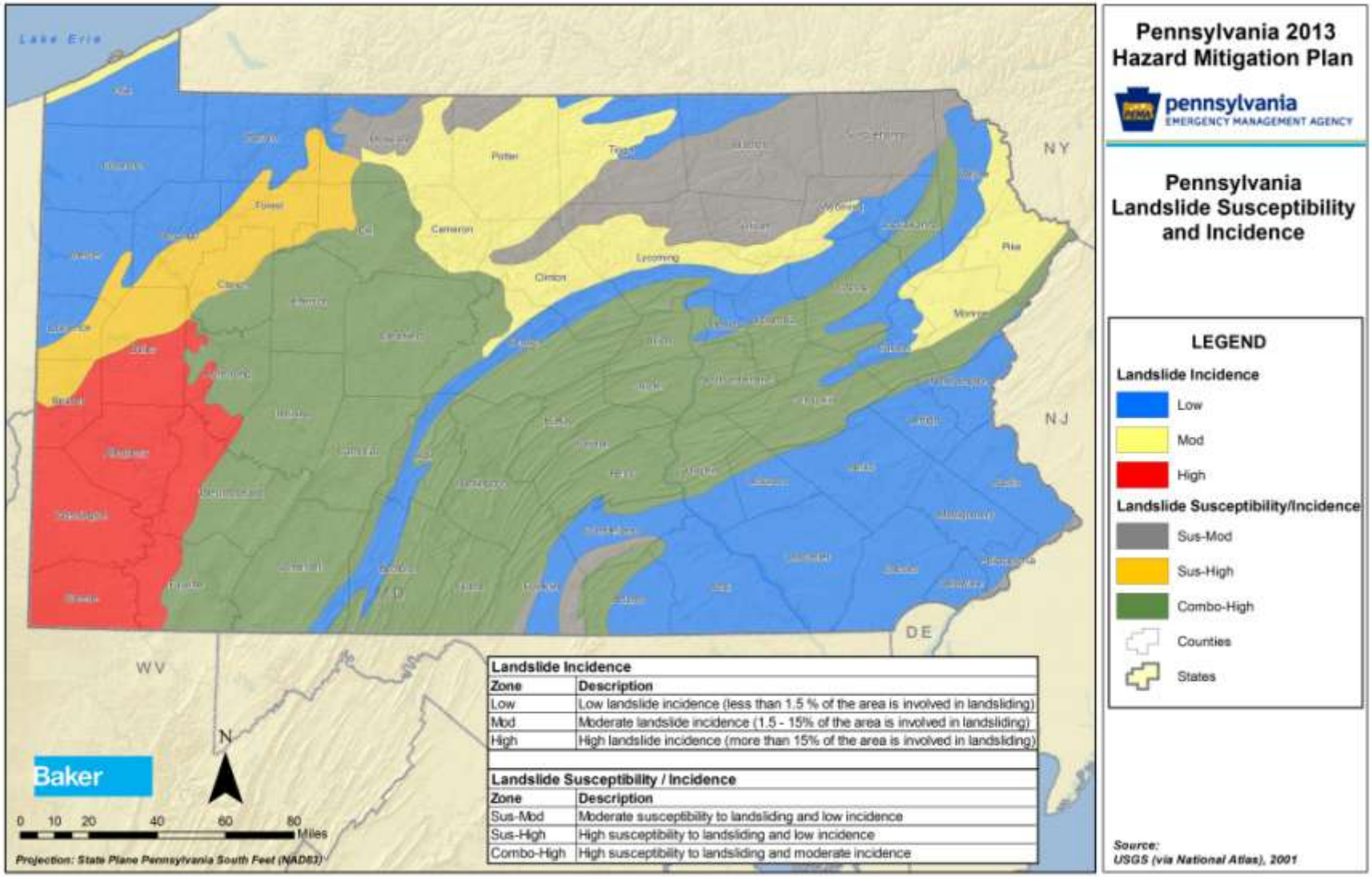
4.3.9.1. Location and Extent

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, specific rainstorms, or snowmelt events. Areas experiencing erosion, decline in vegetation cover and earthquakes are also susceptible to landslides. Landslides can also occur on manmade slopes such as along highways or through development that contributes to slope failure by altering the natural slope gradient, increasing soil water content or removing vegetation cover. Figure 4.3.9-1 shows the range of landslide susceptibility and incidence for Pennsylvania indicating which areas are most likely to experience 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 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). The Monongahela Valley and Pittsburgh in southwestern Pennsylvania is the most slide-prone portion of the Commonwealth.

Figure 4.3.9-1 Map showing landslide susceptibility and incidence areas across Pennsylvania.



4.3.9.2. Range of Magnitude

Landslides cause damage to transportation routes, utilities and buildings (Figure 4.3.9-2). 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. 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 Photos showing damage to a private home (left) and PA Route 51 (right) due to landslide incidents.

(Photograph by *V.W.H. Campbell, Jr., Pittsburgh Post-Gazette. February 1983*)

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 Pennsylvania Department Transportation 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. Undeterminable 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 (PADCNR, 2009).

4.3.9.3. Past Occurrence

Pennsylvania has a long history of significant landslide activity. This has resulted from a combination of humid temperature climate, locally steep and rugged topography, and great diversity in the erosion and weathering characteristics of relatively 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.

A comprehensive inventory of landslide events across the entire Commonwealth is not available, and the USGS does not maintain a formal inventory of landslides. Instead, the USGS Lanslide Hazards Program collects data as events are reported to the agency. However, landslide inventory maps were created in the late 1970s and early 1980s by the U.S. Geological Survey for areas of central and western Pennsylvania as part of an Appalachians-wide study of landslides. These maps show landslides that were identified mainly from aerial photographs for most areas of the Pennsylvania were landslides commonly occur. An example of one of these maps is shown in Figure 4.3.9-3. Additional maps are available at: http://www.dcnr.state.pa.us/topogeo/hazards/landslides/slidepubs.aspx (PADCNR, 2009).

Figure 4.3.9-3 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 (PADCNR, 2009).

The NCDC has also begun capturing landslides as they occur in conjunction with severe storms. This inventory is quite new; as a result, there are only two landslides recorded in the events database. 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.

Even prior to 2011, Allegheny County has had a long history of landslide hazards. However, a few catastrophic landslide events have occurred in Pittsburgh in the past, include a rockslide in 1942 that buried a bus near Aliquippa, killing 22 people on board. In 1951, excavators for a new office building made an 8-foot deep cut at the base of a hill along Island Avenue in Stowe, triggering a 500-foot wide landslide that destroyed 6 houses and disrupted a streetcar line and utilities. In 1983, a rockslide killed 2 people who were sitting in their cars at a traffic light on Saw Mill Run Boulevard.

Historically, there were two significant landslide events which resulted in fatalities. In December 1942, a 150-cubic-yard rock fall from a highway cut along the Oho River opposite Ambridge, Beaver County, crushing a bus. Twenty-two people were killed and four were injured (Ackenheil, 1954; Gray and others, 1979). In February 1983, a 300-cubic yard rock fall occurred in Pittsburgh in during remedial excavation of a highway slope having a long history of rock falls. This rock fall crushed three vehicles. Two persons were killed and one was injured. These events can be considered the worst-case event for Pennsylvania. However, typically, every year one or more construction workers are killed or injured in cave-ins of trenches and other excavations in Pennsylvania.

4.3.9.4. Future Occurrence

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 be widely varied.

4.3.9.5. Environmental Impacts

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…
- Increased sediment runoff both during and after event

Beyond the environmental impacts, landslides can have serious impacts on transportation routes, utilities, and buildings depending on their location.

4.3.9.6. Jurisdictional Vulnerability Assessment

Much of Pennsylvania has landslide susceptible areas in the form of loose soil and both natural and human-made steep slopes. Most highways have sections cut in rock or soil that can fail. Vulnerable areas are primarily located in the Ridge and Valley Physiographic Province spanning central Pennsylvania and encroaching into the northeastern section of the state and in far southwestern Pennsylvania (Butler, Beaver, Allegheny, and Greene Counties). These landslide susceptibility areas, characterized as High (more than 15% of the land involved in landsliding) and Combo-High landslide hazard zone (high susceptibility and moderate instance of landslides) by the USGS, were used to identify vulnerable jurisdictions and critical facilities. The exact vulnerability of a jurisdiction will depend on the geology and topography. GIS analysis shows that 48 of the 67 counties are vulnerable to landslide events.

Additionally, 50 counties profiled landslide hazards in their most recent hazard mitigation plan or plan update. The complete list of counties profiling landslides is found in Table 4.3.9-1. As

stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 33 counties which currently have calculated risk factor values for landslide, the average value is 1.6; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for landslide is 2.2, while the Pennsylvania THIRA scored landslide as a 4 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.9-1 Counties profiling landslides with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Adams		X		
Allegheny	X		Medium	2.0
Armstrong	X		Not Ranked	No RF
Beaver	X		Low	1.6
Bedford	X		Low	1.3
Berks	X		Not Ranked	No RF
Blair	X		Not Ranked	No RF
Bradford	X		Not Ranked	No RF
Bucks	X		Low	1.3
Butler	X		Low	1.3
Cambria	X		Medium	2.2
Cameron	X		Low	1.3
Carbon	X		Low	1.9
Centre	X		Low	1.6
Chester		X		
Clarion	X		Not Ranked	No RF
Clearfield	X		Low	1.6
Clinton	X		Medium	2.3
Columbia	X		Low	1.9
Crawford	X		Low	1.1
Cumberland	X		Low	1.3
Dauphin	X		Not Ranked	No RF
Delaware	X		Low	1.3
Elk	X		Low	1.6

Table 4.3.9-1 Counties profiling landslides with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Erie	X		Low	1.3
Fayette	X		High	2.5
Forest	X		Not Ranked	No RF
Franklin		X		
Fulton		X		
Greene	X		High	2.6
Huntingdon		X		
Indiana	X		Low	1.6
Jefferson	X		Low	1.8
Juniata		X		
Lackawanna	X		Not Ranked	No RF
Lancaster		X		
Lawrence	X		Low	1.3
Lebanon*		X		
Lehigh	X		Low	1.3
Luzerne	X		Not Ranked	No RF
Lycoming		X		
McKean	X		Low	1.7
Mercer	X		Medium	2.2
Mifflin		X		
Monroe		X		
Montgomery	X		Low	1.6
Montour*	X		Not Ranked	2.0
Northampton	X		Low	1.3
Northumberland	X		Low	1.6
Perry*	X		Not Ranked	2.0
Philadelphia**		X		
Pike		X		
Potter	X		Not Ranked	No RF
Schuylkill		X		
Snyder	X		Low	1.5
Somerset		X		
Sullivan		X		

Table 4.3.9-1 Counties profiling landslides with hazard ranking and risk factor (if available).

COUNTY	Profiled Hazard	Did Not Profile Hazard	Ranking (if available)	Risk Factor (If available)
Susquehanna	X		Low	1.8
Tioga	X		Medium	2.1
Union	X		Not Ranked	No RF
Venango	X		Low	1.3
Warren	X		Low	1.3
Washington	X		Not Ranked	No RF
Wayne		X		
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Low	1.5

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

The vulnerable counties are home to 3,211 state critical facilities. Allegheny, Cambria, Luzerne, Washington, and Westmoreland Counties have the most critical facilities located within landslide hazard zones. Table 4.3.9-2 illustrates the number of critical facilities in each county vulnerable to landslide hazards.

Table 4.3.9-2 Number of State Critical Facilities impacted by landslides in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	16	Juniata	15
Allegheny	705	Lackawanna	119
Armstrong	93	Lawrence	1
Beaver	108	Lebanon	7
Bedford	31	Lehigh	1
Blair	36	Luzerne	195
Butler	81	Lycoming	14
Cambria	144	Mifflin	28
Carbon	48	Monroe	15
Centre	65	Montour	13
Clarion	16	Northampton	1
Clearfield	88	Northumberland	91

Table 4.3.9-2 Number of State Critical Facilities impacted by landslides in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Clinton	4	Perry	22
Columbia	65	Pike	10
Cumberland	6	Schuylkill	204
Dauphin	44	Snyder	23
Elk	20	Somerset	85
Fayette	121	Susquehanna	5
Franklin	8	Union	16
Fulton	14	Washington	148
Greene	38	Wayne	11
Huntingdon	47	Westmoreland	273
Indiana	68	York	2
Jefferson	46		

Some municipalities in Pennsylvania have grading codes and ordinances intended to ensure appropriate geological and engineering investigation, design, and construction of excavated slopes and fill slopes. In many cases, the objectives of these codes are not met because of limited or non-existent capability for knowledgeable review and follow-up inspection and enforcement of their provisions.

4.3.9.7. State Facility Vulnerability Assessment

The vulnerability of state critical facilities was evaluated as facilities that are located in the landslide susceptibility areas rated High or Combo-High. Using this criterion, a total of 3,211 vulnerable critical facilities have been identified. 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. The vulnerability of each individual critical facility will differ based on the topographic position of the facility as well as underlying geology. Table 4.3.9-3 shows the vulnerability of state critical facilities by facility type.

Table 4.3.9-3 State Critical Facilities vulnerable to landslides by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	33
Banking	6
Chemical	1
Commercial Facilities	24
Communications	1
Critical Manufacturing	2
Dams	20
Defense Industrial Base	7

Table 4.3.9-3 State Critical Facilities vulnerable to landslides by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Education	46
Emergency Services	40
Energy	14
Fire Departments (Non-HSIP)	1,233
Government Facilities	11
Healthcare & Public Health	7
Hospital (Non-HSIP)	93
National Monuments & Icons	1
Nuclear Reactors, Materials & Waste	4
Police (Non-HSIP)	588
Postal & Shipping	4
School (Non-HSIP)	1,032
Transportation	30
Water	14
Agriculture	33
Banking	6
TOTAL VULNERABLE CRITICAL FACILITIES	***3,211***

4.3.9.8. Jurisdictional Loss Estimation

As stated in Section 4.3.9.6, loss estimates were prepared based on the sum of the number and value of buildings in Census tracts located in landslide combo-high areas, aggregated to the county level. The Commonwealth has a total of 3,291,555 potentially impacted buildings with over $746 billion in exposure in 50 counties. Allegheny County is the most threatened jurisdiction with 706,960 vulnerable buildings and over $180 billion in possible losses stemming from landslide events. Luzerne, Washington, and Westmoreland Counties are also highly threatened by landslide hazards with over $31 billion each in possible building and contents losses. Table 4.3.9-4 illustrates the number of impacted buildings and their associated dollar value of exposure by county.

Table 4.3.9-4 Estimated jurisdictional losses due to landslides.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	28,542	$6,512,907
Allegheny	706,960	$180,606,811
Armstrong	70,067	$14,115,273
Beaver	86,154	$22,023,606
Bedford	34,395	$6,276,009

Table 4.3.9-4 Estimated jurisdictional losses due to landslides.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Berks	12,240	$2,643,201
Blair	50,987	$10,666,665
Butler	95,301	$25,002,688
Cambria	102,381	$21,746,588
Cameron	5,214	$1,048,498
Carbon	40,581	$9,301,732
Centre	88,141	$20,029,636
Clarion	21,913	$4,155,500
Clearfield	76,155	$14,298,037
Clinton	14,661	$2,871,184
Columbia	46,682	$10,293,284
Cumberland	32,316	$7,615,040
Dauphin	53,901	$13,315,786
Elk	32,620	$6,564,209
Fayette	108,993	$21,491,644
Forest	2,499	$425,414
Franklin	34,151	$6,609,908
Fulton	25,440	$4,642,568
Greene	32,453	$6,253,362
Huntingdon	59,376	$11,664,374
Indiana	80,594	$16,313,646
Jefferson	57,165	$11,041,035
Juniata	41,698	$7,704,686
Lackawanna	89,223	$20,107,209
Lebanon	11,804	$2,612,339
Lehigh	5,965	$1,230,258
Luzerne	145,086	$31,746,439
Lycoming	16,378	$3,218,802
McKean	1,205	$221,841
Mifflin	44,344	$8,490,432
Monroe	53,403	$14,321,925
Montour	15,459	$3,743,907
Northampton	11,165	$2,670,134
Northumberland	68,366	$14,689,258
Perry	66,093	$14,659,509
Pike	10,715	$2,714,783
Schuylkill	110,405	$24,135,616
Snyder	37,714	$8,069,002

Table 4.3.9-4 Estimated jurisdictional losses due to landslides.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Somerset	76,466	$15,327,784
Susquehanna	2,188	$432,042
Union	52,167	$11,273,059
Washington	143,661	$34,783,249
Wayne	16,325	$3,447,079
Westmoreland	265,845	$61,884,497
York	5,998	$1,344,791
TOTAL	***3,291,555***	**$746,357,246**

4.3.9.9. State Facility Loss Estimation

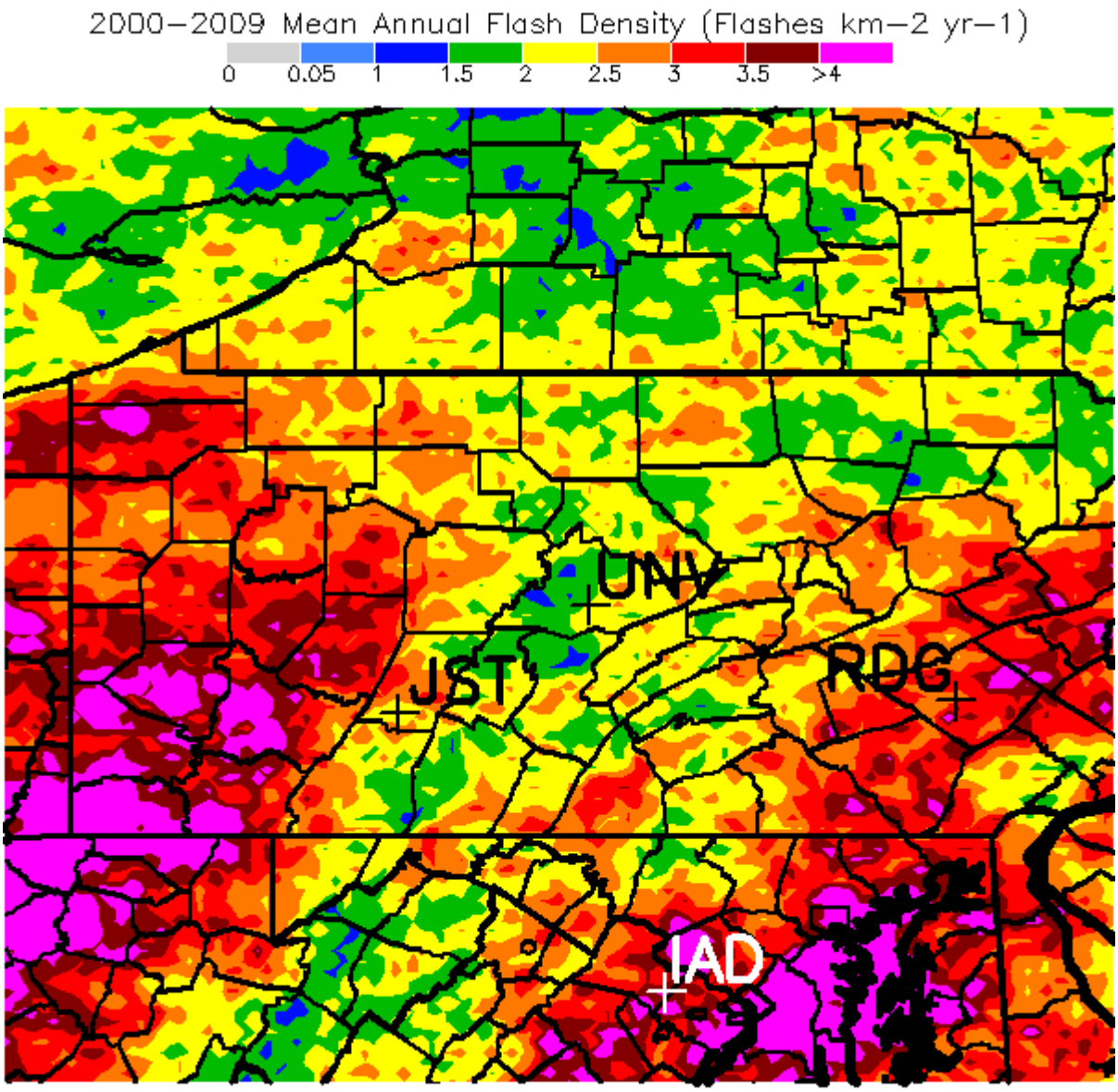
The specific state facility losses will depend on the slope and soil type a given facility is constructed on. For example, facilities located on steep slopes or built on loose soils are more likely to experience landslides of the land beneath them. Additionally, facilities located in valleys are more likely to be buried as a result of debris flow from higher slopes. In total, though, the estimated replacement cost of all State Critical Facilities located in landslide combo-high hazard zones with available replacement values is $24,789,223,523.

4.3.10. Lightning Strike

4.3.10.1. Location and Extent

Lightning events occur across the entire Commonwealth. Different areas experience varying event frequencies, but in all cases lightning strikes occur primarily during the summer months. Figure 4.3.10-1 below shows the average annual lightning flash density for 2000-2009 from the Cooperative for Applied Meteorological Studies (2013). This image indicates that relatively more lightning flashes occur in southwestern Pennsylvania and in the Lehigh Valley. While the impact of flash events is highly localized, strong storms can result in numerous widespread events over a broad area. 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. While the most lightning flashes occur in southwestern Pennsylvania, eastern and southeastern Pennsylvania is 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 Mean annual flash density, 2000-2009 (Cooperative for Applied Meteorological Studies, 2013)



4.3.10.2. Range of Magnitude

Each year, lightning is responsible for the deaths of a hundred or so people, injuries to several hundred more, and millions of dollars in property damage, in the United States. Many case histories show heart damage. Inflated lungs and brain damage have also been observed from lightning fatalities. Loss of consciousness, amnesia, paralysis and burns are reported by many who have survived. Deaths and injuries to livestock and other 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.

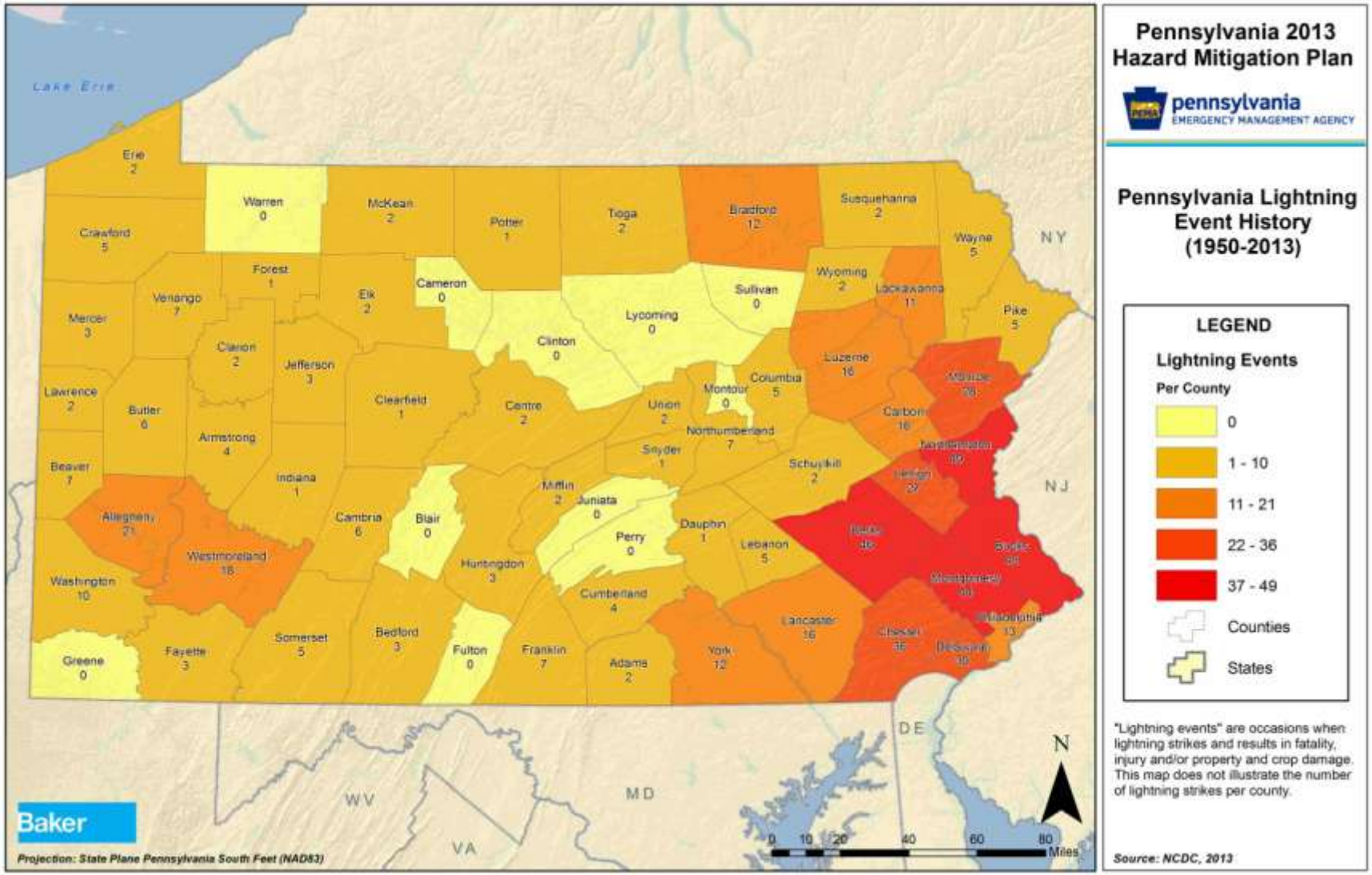
Between 1959 and 1994, Pennsylvania ranked third among all states in the U.S. with 644 casualties (i.e. combination of deaths and injuries). This represents approximately 5% of casualties which occurred throughout the U.S over that 35-year period. Pennsylvania ranked first among all states in the U.S. with 1,441 damage reports. However, it is unclear what the total dollar value is for these damages (NOAA NWS, 1997).

The worst-case event lightning event would be a strike 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.

4.3.10.3. Past Occurrence

Records from the National Climatic Data Center show that there were 579 lightning *events* in the 67 counties across Pennsylvania between 1950 and 2013. A lightning "event" is defined as a lightning strike which results in fatality, injury, and/or property or crop damage (NCDC, 2010). Forty-three of sixty-seven counties in Pennsylvania have reported five or fewer events, fifteen counties reported six to 20 events, and nine counties have reported more than twenty events over this 63 year period. Northampton and Burks County have both reported the most events with 49 each in the reporting period (see Figure 4.3.10-2). Additionally, according to the National Weather Service Lightning Safety Program, Pennsylvania has averaged one lightning fatality per year from 2006-2012. Evaluation of previous versions of the SSAHMP 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 recordation of lightning events is highly subjective and therefore lightning vulnerability is clearly epistemic.

Figure 4.3.10-2 Map showing the number of lightning events in each county across Pennsylvania between 1950 and 2013 (NCDC, 2010).



4.3.10.4. Future Occurrence

Figure 4.3.10-1 showed the frequency of lightning flashes in Pennsylvania between 2000 and 2009. While the map should not be used to predict future lightning activity, it provides a basic estimate of the number of lightning flashes that can be expected per square kilometer per year. In Pennsylvania, these values range from 1.5 to greater than 4 flashes per km^2 peryear.

It is worth noting that while lightning flashes appear to be more frequent in western Pennsylvania, lightning strike *events* as shown in Figure 4.3.10-2 appear to be more common in southeast Pennsylvania and Allegheny and Westmoreland Counties. This is due to denser populations with an increased number of associated properties or structures in these areas.

4.3.10.5. Environmental Impacts

The environmental impacts most often associated with lightning strikes include damage or death to trees and ignition of wildfires.

4.3.10.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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.

In the case of lightning strikes, population and building density has a correlation with hazard vulnerability and loss. In particular, the urban and suburban areas around Philadelphia have higher population and structure density as well as taller buildings that can act as lightning rods; therefore, they naturally have experienced greater vulnerability and loss during past lightning events. Additionally, those counties experiencing more than 20 lightning events over the NCDC reporting period are considered vulnerable to lightning events: Allegheny, Berks, Bucks, Chester, Delaware, Lehigh, Monroe, Montgomery, and Northampton Counties. These counties also have some large tracts of forested land that would be prone to a lightning-ignited wildfire event.

Twelve of the 67 counties identify lightning strikes as a hazard, as seen Table 4.3.10-1. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

All counties currently profiling lightning strike have a calculated risk factor values. The average RF is 1.8; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for Lightning Strikes is 2.2, while

the Pennsylvania THIRA scored lightning a 6 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.10-1 Counties profiling lightning strike hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny		X		
Armstrong		X		
Beaver		X		
Bedford	X		Low	1.5
Berks		X		
Blair		X		
Bradford		X		
Bucks	X		Medium	2.0
Butler		X		
Cambria	X		Low	1.5
Cameron		X		
Carbon		X		
Centre	X		Low	1.3
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia		X		
Crawford	X		Medium	2.4
Cumberland		X		
Dauphin		X		
Delaware		X		
Elk		X		
Erie		X		
Fayette	X		Low	1.8
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon		X		

Table 4.3.10-1 Counties profiling lightning strike hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Indiana		X		
Jefferson		X		
Juniata		X		
Lackawanna		X		
Lancaster		X		
Lawrence	X		Low	1.9
Lebanon*		X		
Lehigh	X		Medium	2.0
Luzerne		X		
Lycoming		X		
McKean		X		
Mercer		X		
Mifflin		X		
Monroe		X		
Montgomery	X		Medium	2.1
Montour*		X		
Northampton	X		Medium	2.0
Northumberland		X		
Perry*		X		
Philadelphia**		X		
Pike		X		
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan		X		
Susquehanna	X		Low	1.4
Tioga		X		
Union		X		
Venango		X		
Warren	X		Low	1.6
Washington		X		
Wayne		X		

Table 4.3.10-1 Counties profiling lightning strike hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Westmoreland		X		
Wyoming		X		
York	X		Medium	2.4

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

The fourteen counties vulnerable to lightning strike hazards host 1,631 state critical facilities, as seen in Table 4.3.10-2. Of the vulnerable counties, Allegheny has the most critical facilities, followed by Montgomery County.

Table 4.3.10-2 State critical facilities vulnerable to lightning strikes by county.

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Allegheny	703	Fayette	1
Beaver	1	Lehigh	77
Berks	147	Monroe	32
Bucks	124	Montgomery	199
Butler	1	Northampton	82
Chester	122	Philadelphia	1
Delaware	139	Westmoreland	2

4.3.10.7. State Facility Vulnerability Assessment

State critical facilities that are vulnerable to lightning strikes have historically been isolated to southeastern Pennsylvania, but for this analysis the vulnerability measure is any state critical facility located in the nine aforementioned most vulnerable counties. The precise vulnerability of lightning strikes will depend on a facility's height vis-à-vis surrounding buildings as well as the absence or presence of a lightning rod or other lightning channeling technology in the structure. As expected, the categories of facility most vulnerable to lightning strikes include fire departments, schools, and police departments (Table 4.3.10-3). Any of the 22 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. It is important to note that most of the food and agriculture-related critical facilities are privately owned farms that may own sizeable herds of livestock, but the Commonwealth critical facilities list does not indicate which of the twenty two do own herds.

Finally, if the entertainment and recreation facilities are outdoor recreation spaces with wide open spaces, there may be added lightning strike vulnerability.

Table 4.3.10-3 State Critical Facilities vulnerable to lightning by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	22
Banking	10
Chemical	3
Commercial Facilities	28
Communications	1
Dams	5
Defense Industrial Base	8
Education	53
Emergency Services	15
Energy	14
Fire Departments (Non-HSIP)	643
Government Facilities	9
Healthcare & Public Health	19
Hospital (Non-HSIP)	79
Nuclear Reactors, Materials & Waste	1
Police (Non-HSIP)	389
Postal & Shipping	5
School (Non-HSIP)	294
Transportation	21
Water	12
TOTAL VULNERABLE CRITICAL FACILITIES	***1,631***

4.3.10.8. Jurisdictional Loss Estimation

During the years of 1950-2013, the NCDC reports that in Pennsylvania, lightning has caused 28 deaths, 2250 injuries. The highest reported loss in property damage 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.

Using GIS, jurisdictional losses were estimated to total $827 billion, as shown in Table 4.3.10-4. The total number of buildings that may be impacted by lightning strikes in the twenty-one vulnerable counties is $2,793,805. The jurisdiction most threatened by lightning strikes in terms of dollar amount of loss is Allegheny County, with $170 billion in exposed buildings and contents.

Table 4.3.10-4 Estimated jurisdictional losses due to lightning strikes.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Allegheny	666,754	$170,090,579
Beaver	14,265	$4,735,685
Berks	214,878	$56,231,792
Bucks	319,283	$107,502,439
Butler	10,453	$3,740,680
Carbon	6,450	$1,640,614
Chester	256,870	$88,796,727
Delaware	268,456	$84,115,326
Lackawanna	3,379	$700,643
Lancaster	18,105	$4,944,082
Lebanon	5,582	$1,592,987
Lehigh	215,706	$59,301,465
Monroe	113,484	$28,932,611
Montgomery	439,397	$149,314,686
Northampton	178,622	$49,582,595
Philadelphia	18,123	$5,453,004
Pike	12,180	$2,775,393
Schuylkill	7,666	$1,820,286
Washington	1,556	$302,176
Wayne	3,379	$700,643
Westmoreland	19,217	$4,948,641
TOTAL	***2,793,805***	***$827,223,054***

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.

4.3.10.9. State Facility Loss Estimation

The total replacement cost of all state critical facilities located in areas vulnerable to lightning strike is $10,692,310,083. 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.

4.3.11. Pandemic and Infectious Disease

4.3.11.1. Location and Extent

Pandemic is defined as a disease affecting or attacking the population of 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. Infectious diseases are also highly virulent, but are not spread person-to-person.

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.

Historically, the Commonwealth is primarily concerned with two diseases with pandemic and infectious potential: West Nile Virus and influenza. West Nile Virus is a vector-borne disease that can cause headache, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and, in its most serious form, death. The virus spreads via mosquito bite and is aided by warm temperatures and wet climates conducive to mosquito breeding. 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 (PADEP-WNCP, 2009).

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. H5N1 did not reach pandemic proportions in the United States, but the Commonwealth began actively planning for an occurrence of an influenza pandemic. As stated in the Pennsylvania Department of Health (DOH) Influenza Pandemic Response Plan, “an influenza pandemic is inevitable and will probably give little warning” (PA DOH, 2005). 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. The estimated morbidity and mortality during and influenza pandemic within 12-16 weeks nationwide and in Pennsylvania are shown Table 4.3.11-1.

Table 4.3.11-1 Estimated morbidity and mortality during an influenza pandemic within 12-16 weeks

	UNITED STATES	PENNSYLVANIA
Require Outpatient Care	50 Million	1.6 Million
Hospitalizations	2 Million	37,800
Deaths	500,000	9,100

The 2009 H1N1 virus, colloquially known as *swine flu*, was a primary concern during the development of the 2010 SSAHMP. However, the threat of that flu strain has passed since it is no longer novel. This virus was first detected in people in the United States in April 2009. On June 11, 2009, the world health organization signaled that a pandemic of 2009 H1N1 flu was underway (CDC, 2009).

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% of cases are clinically asymptomatic. Approximately 20% 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.

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. In terms of lives lost, the impact various pandemic influenza outbreaks have had globally over the last century has declined. The severity of illness from the 2009 H1N1 influenza flu virus varied as expected with any influenza pandemic. The gravest cases occurring mainly among those considered at high risk: children, the elderly, pregnant women, and chronic disease patients with reduced immune system capacity. Most people infected with H1N1 in 2009 recovered without needing medical treatment, and this flu strain is now included in flu shots. However, the virus also resulted in many deaths, including 78 in Pennsylvania by the time the pandemic ended. According to the CDC, about 70% of those who hospitalized with the 2009 H1N1 flu virus in the United States belonged to a high risk group (CDC, 2009).

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.

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 (US DHHS, 2010). As the densest city in the Commonwealth, Philadelphia was particularly hurt from this event.

4.3.11.3. Past Occurrence

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. Table 4.3.11-2 illustrates the virus's overall geography, human infection, and mortality for the past ten years.

Table 4.3.11-2 Previous West Nile Virus occurrences in Pennsylvania 2000-2012 (PA DEP).

YEAR	NUMBER OF COUNTIES WITH VIRUS DETECTED	POSITIVE HUMAN CASES	HUMAN DEATHS
2000	19	0	0
2001	16	3	0
2002	63	62	9
2003	67	237	9
2004	46	15	2
2005	33	25	2
2006	48	9	2
2007	25	9	0
2008	35	14	1
2009	33	0	0
2010	37	8	0
2011	59	6	0
2012	2	0	0

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 4.3.11-3.

Table 4.3.11-3 List of previous significant outbreaks of influenza over the past century (Global Security, 2009; WHO, 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 were 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% 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, 10,940 cases of 2009 H1N1 were confirmed in Pennsylvania resulting in 78 deaths.

4.3.11.4. Future Occurrence

Future occurrences of West Nile Virus are unclear. Instances of the virus have been generally decreasing due to aggressive planning and eradication efforts, but some scientists suggest that as global temperatures rise and extreme weather conditions due to climate change, the range of the virus in the United States will grow (Epstein, 2001).

As with West Nile Virus, the precise timing of pandemic influenza is uncertain, but occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or “novel” virus to which the population has no immunity. This emergence of a novel virus is the first step toward a pandemic.

Future pandemics may also emerge from other diseases, especially invasive pathogens that Pennsylvanians do not have natural immunity to. Overall, though, the probability of future pandemic events can be considered *possible* according to the Risk Factor Methodology (see Section 4.1).

4.3.11.5. Environmental Impacts

There are no true environmental impacts of pandemics and infectious disease threats, but there will be significant economic and social costs beyond the possibility of disease-related deaths. Widespread illness may increase the likelihood of shortages of personnel to perform essential community services. In addition, high rates of illness and worker absenteeism occur within the business community, and these contribute to social and economic disruption. On a national scale, the Congressional Budget Office Estimates that a severe pandemic could cost the US economy more than $600 million, or 5% of the Gross Domestic Product (US DHHS 2005). Social and economic disruptions could be temporary but may be amplified in today’s closely interrelated and interdependent systems of trade and commerce. Social disruption may be

greatest when rates of absenteeism impair essential services, such as power, transportation, and communications.

4.3.11.6. Jurisdictional Vulnerability Assessment

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. Table 4.3.11-4illustrates the 27 counties that identified pandemic disease or public health emergency as a significant hazard in the most recent hazard mitigation plan. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 19 counties that calculated risk factors for pandemic hazards, the average risk factor was 2.2. This average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for pandemic is 2.0, while the Pennsylvania THIRA scored pandemic as a 7 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.11-4 Counties profiling pandemic hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny	X		Medium	2.2
Armstrong		X		
Beaver	X		Medium	2.4
Bedford	X		Low	1.5
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks		X		
Butler		X		
Cambria	X		Low	1.5
Cameron	X		Low	1.9
Carbon		X		
Centre	X		Medium	2.1
Chester		X		
Clarion		X		
Clearfield	X		Low	1.1
Clinton		X		

Table 4.3.11-4 Counties profiling pandemic hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Columbia	X		Low	1.8
Crawford	X		Medium	2.2
Cumberland	X		High	2.6
Dauphin		X		
Delaware	X		Medium	2.3
Elk		X		
Erie		X		
Fayette	X		Medium	2.3
Forest	X		Not Ranked	No RF
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon	X		Not Ranked	No RF
Indiana	X		Medium	2.3
Jefferson		X		
Juniata	X		Medium	2.2
Lackawanna		X		
Lancaster		X		
Lawrence	X		Medium	2.2
Lebanon*	X		Not Ranked	6.9
Lehigh		X		
Luzerne		X		
Lycoming		X		
McKean		X		
Mercer	X		Medium	2.2
Mifflin	X		Not Ranked	No RF
Monroe	X		Low	1.8
Montgomery		X		
Montour*	X		Not Ranked	5.3
Northampton		X	Medium	2.2
Northumberland		X	High	2.5
Perry*	X		Not Ranked	8.4
Philadelphia**		X		

Table 4.3.11-4 Counties profiling pandemic hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Pike	X		Medium	2.0
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan		X		
Susquehanna		X		
Tioga		X		
Union		X		
Venango	X		Low	1.4
Warren	X		Medium	2.3
Washington		X		
Wayne		X		
Westmoreland		X		
Wyoming		X		
York	X		Medium	2.4

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

4.3.11.7. State Facility Vulnerability Assessment

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 Virus.

4.3.11.8. Jurisdictional Loss Estimation

Jurisdictional losses in a pandemic or infectious disease outbreak 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. For historical context, though, the Asian and Hong Kong Flu pandemics killed over 1.5 million people worldwide and caused an estimated $32 billion loss due to lost productivity and medical

expenses (Smith, 2004). With Pennsylvania's economy so integral to the national economy, economic losses from a pandemic or infectious disease threat could be significant.

4.3.11.9. State Facility Loss Estimation

The physical plant and facilities of the Commonwealth are not likely to be damaged by a pandemic disease outbreak. 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.

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. 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, formed in the radioactive decay series of 238U and 232Th, respectively. 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.

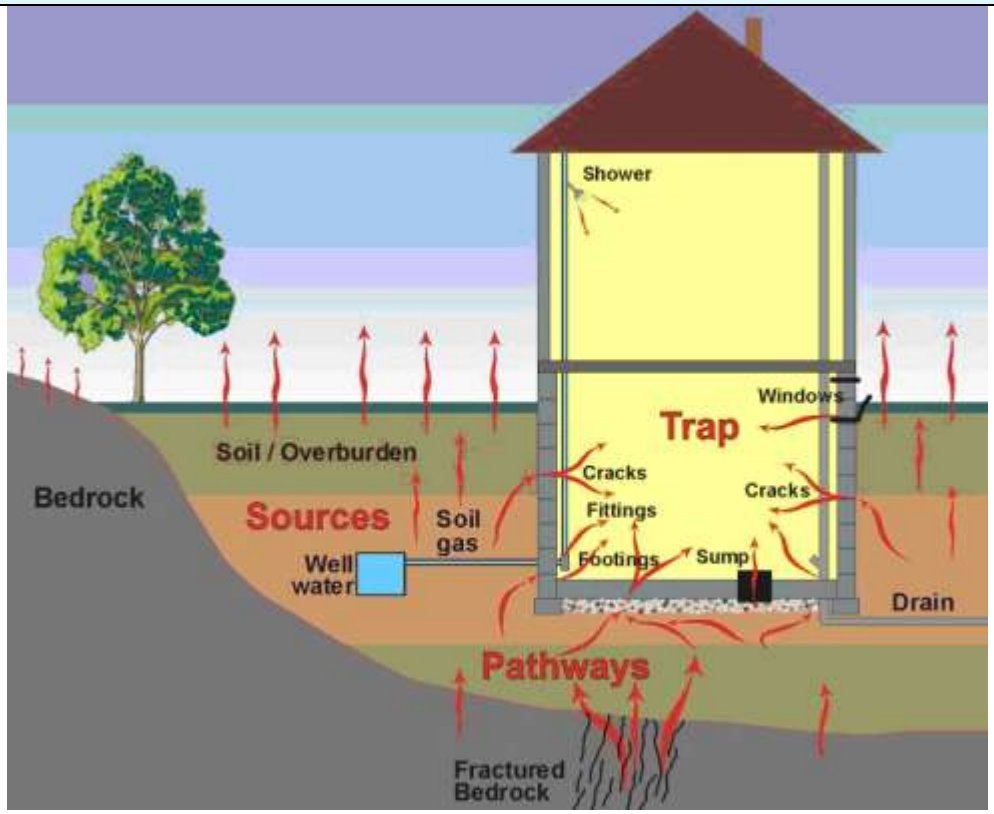
The distribution of radon is correlated with the distribution of radium (i.e. 226Ra), its immediate radioactive parent, and with uranium, its original ancestor. Due to the short half-life of radon, the distance that radon atoms can travel from their parent before decay is generally limited to distances of feet or tens of feet.

Three sources of radon in houses are now recognized:

- 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.

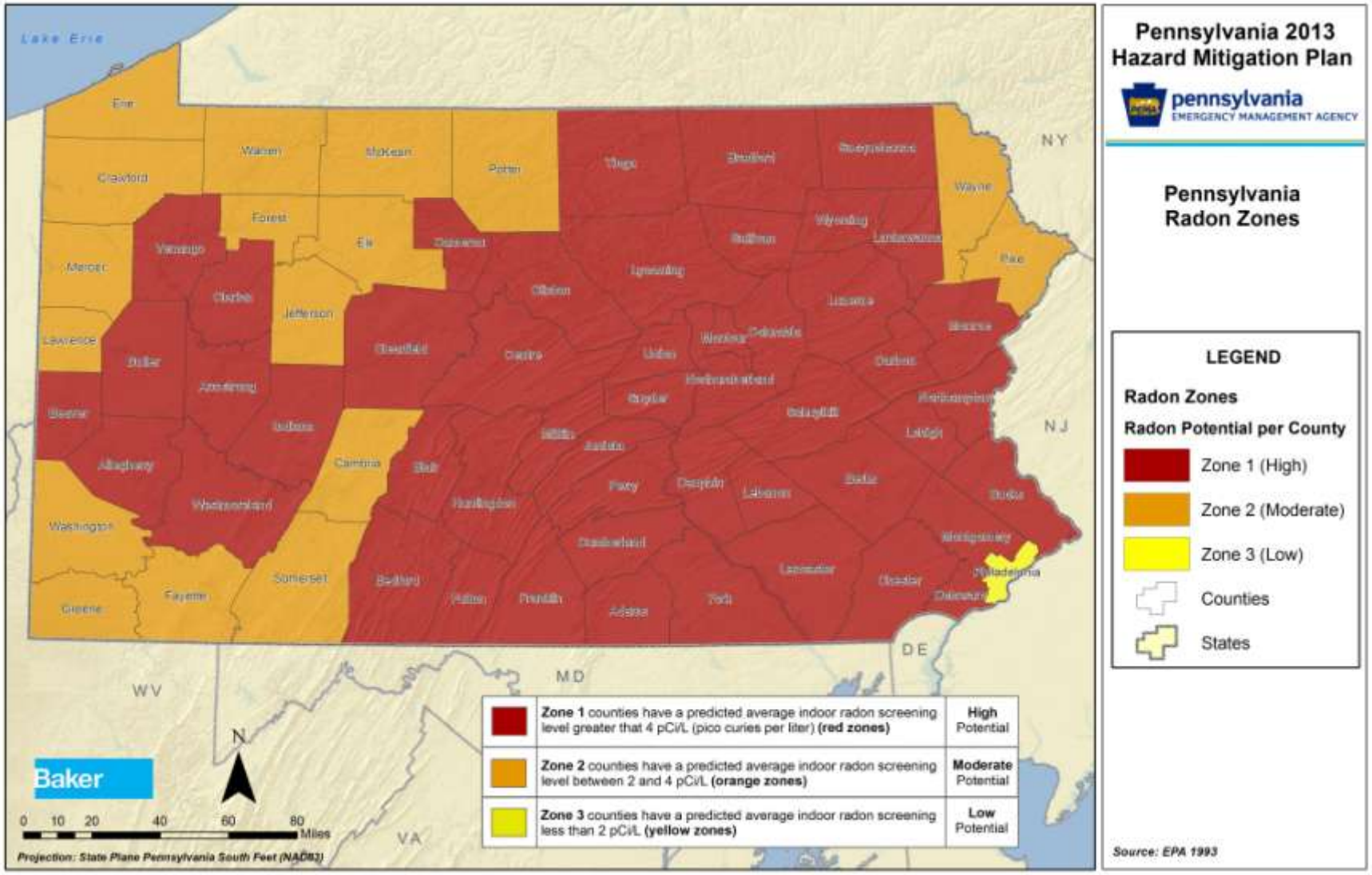
Figure 4.3.12-1 illustrates radon entry points into a home.

Figure 4.3.12-1 Sketch of radon entry points into a house (Arizona Geological Survey, 2006).



Each county in Pennsylvania is classified as having a *low*, *moderate*, or *high* radon hazard potential (see Figure 4.3.12-2). While this analysis has not been repeated since 1993, 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. The average indoor radon screening level for these counties is greater than 4 pCi/L. The City of Philadelphia is the only jurisdiction designated with a *low* radon hazard potential.

Figure 4.3.12-2 Radon hazard zones in Pennsylvania (USEPA, 1993).



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. 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. The radon content of soil gas clearly tends to be higher in soils containing higher levels of radium and uranium, especially if the radium occupies a site on or near the surface of a grain from which the radon can easily escape. The amount of pore space in the soil and its permeability for air flow, including cracks and channels, are important factors determining radon concentration in soil gas and its rate of flow into a house. Soil depth and moisture content, mineral host and form for radium, and other soil properties may also be important. For houses built on bedrock, fractured zones may supply air having radon concentrations similar to those in deep soil.

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 having 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 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 (USEPA, 2010). The main hazard is actually from the radon daughter products (218Po, 214Pb, 214Bi), which may become attached to lung tissue and induce lung cancer by their radioactive decay.

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. As is shown in Table 4.3.12-1, a smoker exposed to radon has a much higher risk of lung cancer.

Table 4.3.12-1 Radon risk for smokers and non-smokers (USEPA, 2010).

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
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.

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.

4.3.12.3. Past Occurrence

Current data on abundance and distribution of radon in Pennsylvania houses is considered incomplete and potentially biased, but PA DEP's Bureau of Radiation Protection Radon division provided available radon test results by zip code for Pennsylvania. Test results are available for

first floor and basements. Radon testing is typically done under one of two different scenarios, one for real estate and one for non-real estate transactions. In the real estate situation PA DEP collects the basement or lowest livable level to be tested, at a minimum. In non-real estate situations, the protocol says to test the lowest living level. This usually implies the first floor. Figures 4.3.12-3 and 4.3.12-4 illustrate these radon test results. Please note that zip codes with no data do not indicate the absence of results; instead, those zip codes had insufficient results or the existing results were missing some key information, causing the results to be suppressed.

Figure 4.3.12-3 Pennsylvania Average Basement Radon Test Results from 1990-2010 (PA DEP, 2013)

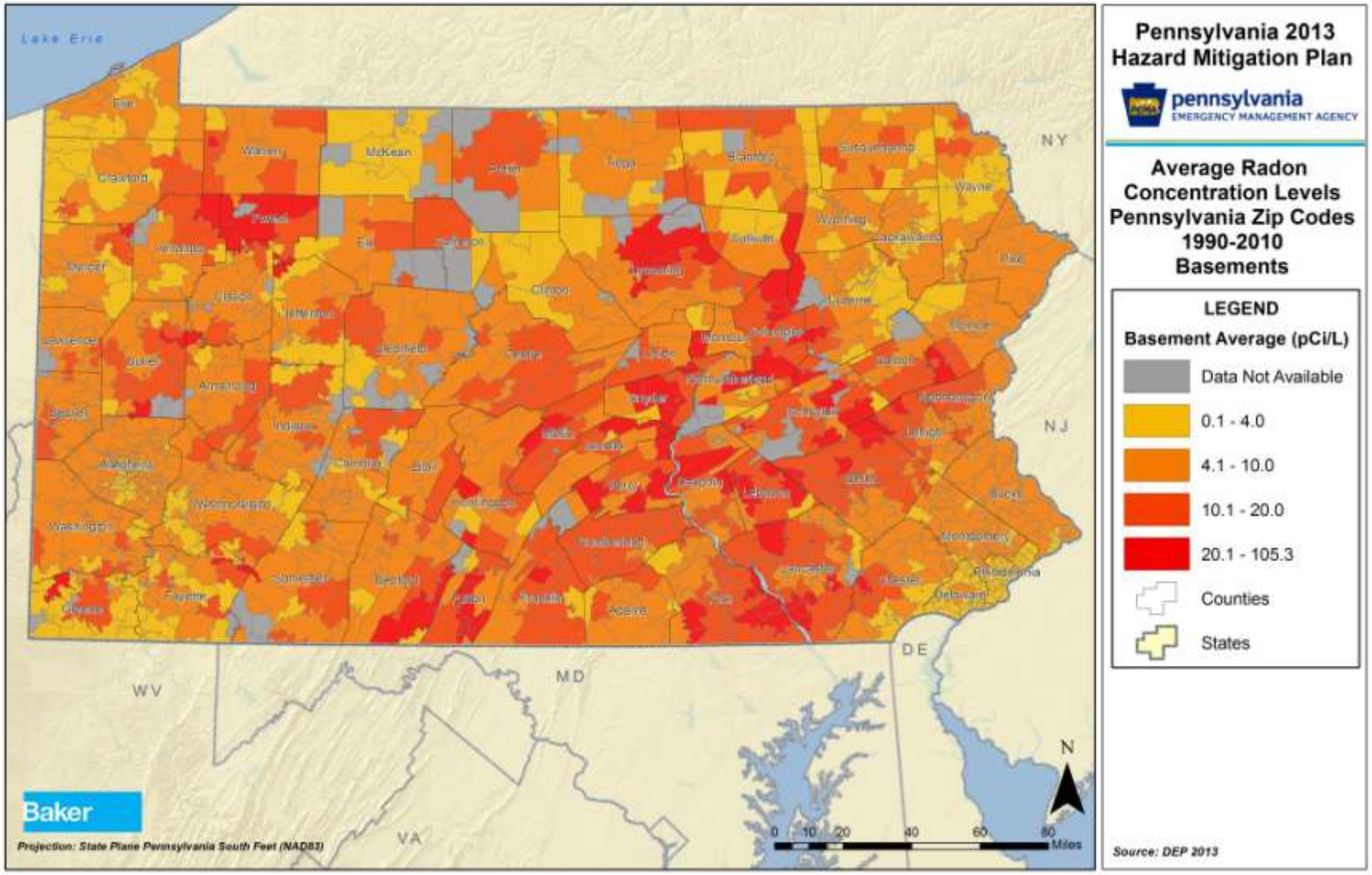
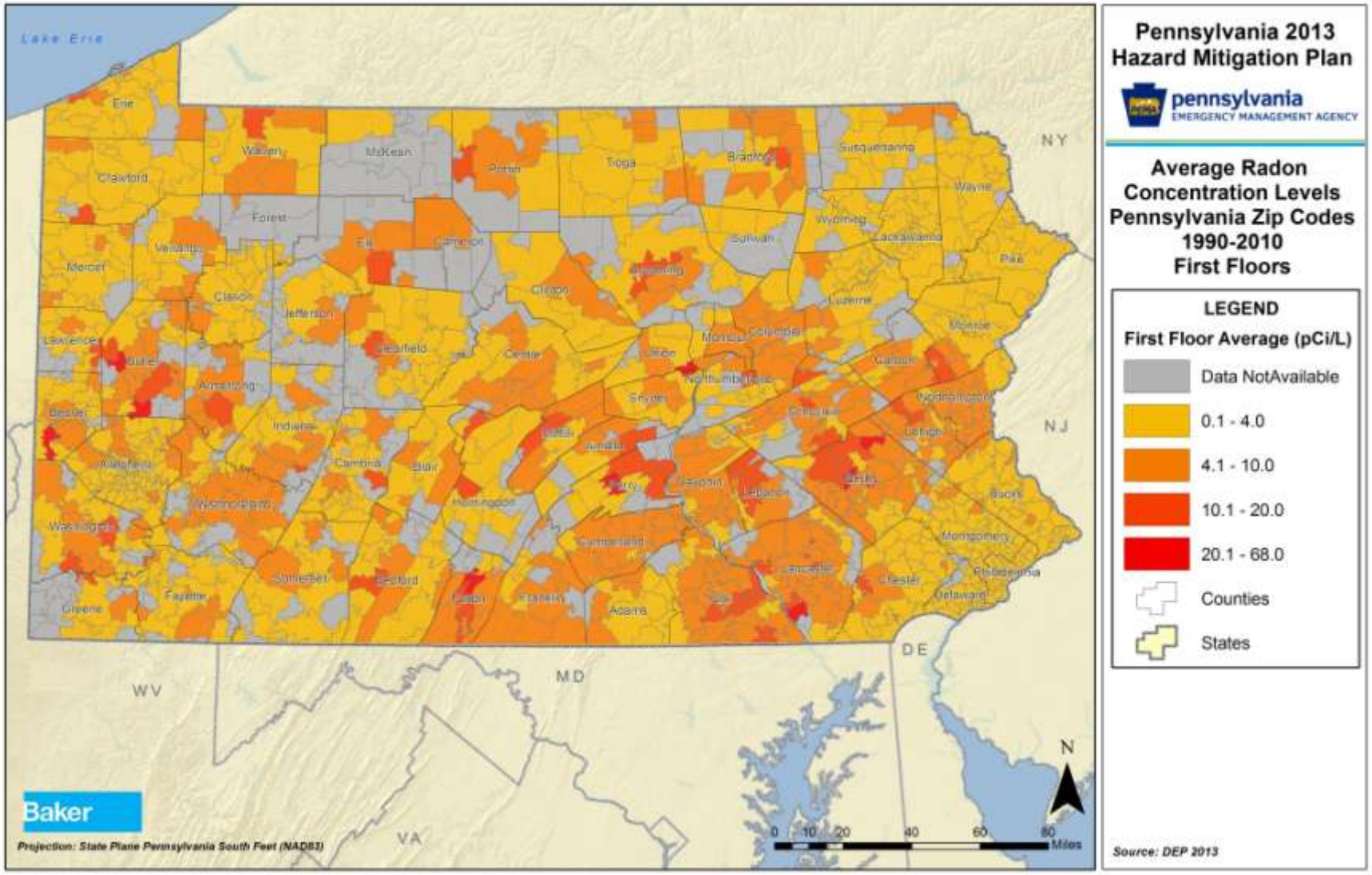


Figure 4.3.12-4 Pennsylvania Average First Floor Radon Test Results from 1990-2010 (PA DEP, 2013)



Values exceeding the EPA guideline of 4 pCi/L occur in all regions of the Commonwealth. Glaciated areas in northern Pennsylvania tend to have relatively low frequencies of elevated radon, perhaps because of thin soils and incomplete weathering. The Appalachian Plateaus province in western Pennsylvania also appears to have lower than average radon, as does the Atlantic Coastal Plain near Philadelphia and other areas having a shallow water table. The highest proportion of elevated values is in a zone extending from central Pennsylvania to southeastern Pennsylvania, and in the Reading Prong. High values in the latter area are attributed to known uranium-rich granitic gneisses (Smith, 1976; Gunderson et al., 1988), accentuated by local factors such as shear zones, and include a surprising number of extremely high radon values (>200 pCi/L). Elevated radon values in the larger, northwest-southeast-trending zone (Centre through York Counties) are not understood, but may represent some combination of black shale (Martinsburg Formation), limestone soil, and deep weathering. Some houses (0.6-percent in Cumberland and Dauphin Counties) exceed an extremely hazardous 200 pCi/L.

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. 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. Environmental Impacts

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.

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 4 pCi/L, the threshold for action, as described in Section 4.3.12.3.

As a whole, 19 of Pennsylvania's 67 counties have identified radon exposure as a concern in their most recent plan or plan update, as seen in Table 4.3.12-2, along with any ranking provided. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 12 counties which currently have calculated risk factor values for radon exposure, the average value is 2.1; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for radon exposure is 2.1, while the Pennsylvania THIRA scored radon exposure as a 4 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.12-2 Counties profiling radon exposure with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny		X		
Armstrong		X		
Beaver		X		
Bedford	X		Medium	2.0
Berks	X		Not Ranked	No RF
Blair		X		
Bradford		X		
Bucks		X		
Butler		X		
Cambria		X		
Cameron		X		
Carbon		X		
Centre		X		
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia	X		Low	1.9
Crawford		X		
Cumberland		X		
Dauphin		X		
Delaware	X		Low	1.8
Elk		X		
Erie		X		
Fayette	X		Medium	2.3
Forest		X		
Franklin		X		
Fulton		X		
Greene	X		Low	1.9
Huntingdon		X		
Indiana		X		
Jefferson		X		
Juniata	X		Medium	2.4
Lackawanna		X		

Table 4.3.12-2 Counties profiling radon exposure with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Lancaster	X		High	2.6
Lawrence		X		
Lebanon*	X		Not Ranked	6.9
Lehigh	X		Medium	2.4
Luzerne		X		
Lycoming		X		
McKean		X		
Mercer		X		
Mifflin		X		
Monroe		X		
Montgomery	X		High	2.6
Montour*	X		Not Ranked	5.3
Northampton	X		Medium	2.4
Northumberland	X		Medium	2.2
Perry*	X		Not Ranked	8.4
Philadelphia**		X		
Pike		X		
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan	X		Not Ranked	No RF
Susquehanna	X		Low	1.8
Tioga		X		
Union		X		
Venango		X		
Warren		X		
Washington		X		
Wayne		X		
Westmoreland		X		
Wyoming	X		Not Ranked	No RF
York	X		Medium	2.2

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating. **Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As stated in Section 4.2.2, 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 tracts 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 vulnerability of state critical facilities was evaluated as identifying facilities that are located in zip codes with average basement and/or first floor radon readings of over 4 pCi/L., the EPA's recommended threshold for action. The geographic area is large, with all 67 counties having at least one vulnerable zip code. Using this criterion, a total of 5,674 vulnerable critical facilities have been identified.

Table 4.3.12-3 Number of State Critical Facilities falling within zip codes with high average radon test results.

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	49	Lackawanna	161
Allegheny	702	Lancaster	140
Armstrong	94	Lawrence	67
Beaver	158	Lebanon	106
Bedford	38	Lehigh	77
Berks	148	Luzerne	234
Blair	84	Lycoming	87
Bradford	74	McKean	18
Bucks	124	Mercer	73
Butler	90	Mifflin	27
Cambria	128	Monroe	31
Cameron	6	Montgomery	198
Carbon	62	Montour	16
Centre	70	Northampton	84
Chester	118	Northumberland	83
Clarion	28	Perry	22
Clearfield	76	Philadelphia	103
Clinton	39	Pike	26
Columbia	73	Potter	13
Crawford	82	Schuylkill	185
Cumberland	69	Snyder	23
Dauphin	180	Somerset	82
Delaware	137	Sullivan	13
Elk	19	Susquehanna	43

Table 4.3.12-3 Number of State Critical Facilities falling within zip codes with high average radon test results.

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Erie	67	Tioga	45
Fayette	108	Union	15
Forest	5	Venango	44
Franklin	39	Warren	45
Fulton	14	Washington	137
Greene	33	Wayne	42
Huntingdon	45	Westmoreland	253
Indiana	58	Wyoming	22
Jefferson	29	York	98
Juniata	15	**Grand Total**	**5,674**

It was stated in Section 4.3.12.3 that one of the highest proportions of elevated radon values fall within the Reading Prong Section of the New England Physiographic Province, located in parts of Lebanon, Berks, Lehigh, and Northampton Counties (See Figure 2.1-2 for location of New England Physiographic Province). It was found that 415 critical facilities were located in this known elevated radon zone.

4.3.12.7. State Facility Vulnerability Assessment

0lists a breakdown of the types of state critical facilities contained within the zip codes with elevated radon test results. 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.

Table 4.3.12-4 State Critical Facilities vulnerable to High Potential (Level 1) EPA Radon Zones by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	103
Banking	24
Chemical	11
Commercial Facilities	57
Communications	4
Critical Manufacturing	3
Dams	30
Defense Industrial Base	19
Education	131
Emergency Services	88
Energy	33
Fire Departments (Non-HSIP)	2,222
Government Facilities	41
Healthcare & Public Health	39
Hospital (Non-HSIP)	232
Information Technology	3
Manufacturing	1
National Monuments & Icons	5
Nuclear Reactors, Materials & Waste	7
Police (Non-HSIP)	1,128
Postal & Shipping	6
School (Non-HSIP)	1,407
Transportation	49
Water	31
Grand Total	***5,674***

4.3.12.8. Jurisdictional Loss Estimation

The EPA determines that an average radon mitigation system costs $1,200. The EPA also states that current state surveys show that 1 home in 5 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 0.

Table 4.3.12-5 Estimated jurisdictional losses in areas with high radon test results

COUNTY	TOTAL NUMBER OF BUILDINGS	NUMBER OF IMPACTED BUILDINGS (20% OF TOTAL)	RADON MITIGATION COSTS (SYSTEM COST x IMPACTED BUILDINGS, THOUSANDS $)
Adams	82,567	16,513	$19,816,080.00
Allegheny	704,188	140,838	$169,005,120.00
Armstrong	71,063	14,213	$17,055,120.00
Beaver	121,767	24,353	$29,224,080.00
Bedford	46,880	9,376	$11,251,200.00
Berks	221,199	44,240	$53,087,760.00
Blair	81,662	16,332	$19,598,880.00
Bradford	40,561	8,112	$9,734,640.00
Bucks	320,122	64,024	$76,829,280.00
Butler	111,671	22,334	$26,801,040.00
Cambria	92,292	18,458	$22,150,080.00
Cameron	17,846	3,569	$4,283,040.00
Carbon	56,555	11,311	$13,573,200.00
Centre	97,410	19,482	$23,378,400.00
Chester	246,212	49,242	$59,090,880.00
Clarion	51,547	10,309	$12,371,280.00
Clearfield	56,636	11,327	$13,592,640.00
Clinton	52,074	10,415	$12,497,760.00
Columbia	63,122	12,624	$15,149,280.00
Crawford	64,840	12,968	$15,561,600.00
Cumberland	136,500	27,300	$32,760,000.00
Dauphin	138,389	27,678	$33,213,360.00
Delaware	264,907	52,981	$63,577,680.00
Elk	31,182	6,236	$7,483,680.00
Erie	138,536	27,707	$33,248,640.00
Fayette	86,910	17,382	$20,858,400.00
Forest	32,605	6,521	$7,825,200.00
Franklin	93,939	18,788	$22,545,360.00
Fulton	25,440	5,088	$6,105,600.00
Greene	26,382	5,276	$6,331,680.00
Huntingdon	52,708	10,542	$12,649,920.00
Indiana	65,380	13,076	$15,691,200.00
Jefferson	48,028	9,606	$11,526,720.00
Juniata	38,398	7,680	$9,215,520.00
Lackawanna	145,424	29,085	$34,901,760.00
Lancaster	255,460	51,092	$61,310,400.00
Lawrence	58,568	11,714	$14,056,320.00

Table 4.3.12-5 Estimated jurisdictional losses in areas with high radon test results

COUNTY	TOTAL NUMBER OF BUILDINGS	NUMBER OF IMPACTED BUILDINGS (20% OF TOTAL)	RADON MITIGATION COSTS (SYSTEM COST x IMPACTED BUILDINGS, THOUSANDS $)
Lebanon	93,575	18,715	$22,458,000.00
Lehigh	207,520	41,504	$49,804,800.00
Luzerne	192,245	38,449	$46,138,800.00
Lycoming	79,873	15,975	$19,169,520.00
Mckean	25,537	5,107	$6,128,880.00
Mercer	68,643	13,729	$16,474,320.00
Mifflin	44,344	8,869	$10,642,560.00
Monroe	134,818	26,964	$32,356,320.00
Montgomery	447,177	89,435	$107,322,480.00
Montour	28,852	5,770	$6,924,480.00
Northampton	181,973	36,395	$43,673,520.00
Northumberland	54,634	10,927	$13,112,160.00
Perry	50,540	10,108	$12,129,600.00
Philadelphia	743,761	148,752	$178,502,640.00
Pike	70,552	14,110	$16,932,480.00
Potter	25,685	5,137	$6,164,400.00
Schuylkill	97,044	19,409	$23,290,560.00
Snyder	35,994	7,199	$8,638,560.00
Somerset	74,988	14,998	$17,997,120.00
Sullivan	24,267	4,853	$5,824,080.00
Susquehanna	32,952	6,590	$7,908,480.00
Tioga	30,452	6,090	$7,308,480.00
Union	45,226	9,045	$10,854,240.00
Venango	59,232	11,846	$14,215,680.00
Warren	48,364	9,673	$11,607,360.00
Washington	142,399	28,480	$34,175,760.00
Wayne	75,404	15,081	$18,096,960.00
Westmoreland	242,653	48,531	$58,236,720.00
Wyoming	35,596	7,119	$8,543,040.00
York	206,911	41,382	$49,658,640.00
Grand Total	***7,840,181***	***1,568,036***	***$1,881,643,440.00***

4.3.12.9. State Facility Loss Estimation

The estimated cost for mitigation of all State Critical Facilities located in zip codes with elevated radon test results is estimated to be $6.8, when using the average radon mitigation system value of $1,200 on its 5,674 facilities.

4.3.13. Subsidence, Sinkhole

4.3.13.1. Location and Extent

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.

Figure 4.3.13-1shows the distribution of limestone bedrock across Pennsylvania along with locations of known subsidence and sinkhole events as inventoried by DCNR. Thick sequences of structurally deformed carbonates comprise the surface bedrock of a sizable area in central, south-central and southeastern Pennsylvania. The carbonate rock formations, which are Cambrian through Devonian in age, have developed karst landforms, resulting in significant land-subsidence problems. 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.

DCNR created a series of maps showing the density of identified karst features across south-central and eastern Pennsylvania (see Figure 4.3.13-2 for example). Karst features are defined as pockets of limestone or dolomite bedrock located within more stable geological formations that could cause subsidence or sinkholes. 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 (PADCNR, 2003).

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. Poorly managed stormwater has particularly 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.

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. 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.

Sinkholes generally develop where the cover above a mine is thin. Piggott and Eynon (1978) indicated that sinkhole development normally occurs where the interval to the ground surface is less than three to five times the thickness of the extracted seam and the maximum interval is up to ten times the thickness of the extracted seam. 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 the majority of sinkholes, which constituted about 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 4.3.19.

Figure 4.3.13-1 Map showing areas of Pennsylvania subject to natural subsidence due to the presence of limestone bedrock. Inventoried surface depression and sinkhole locations are also shown.

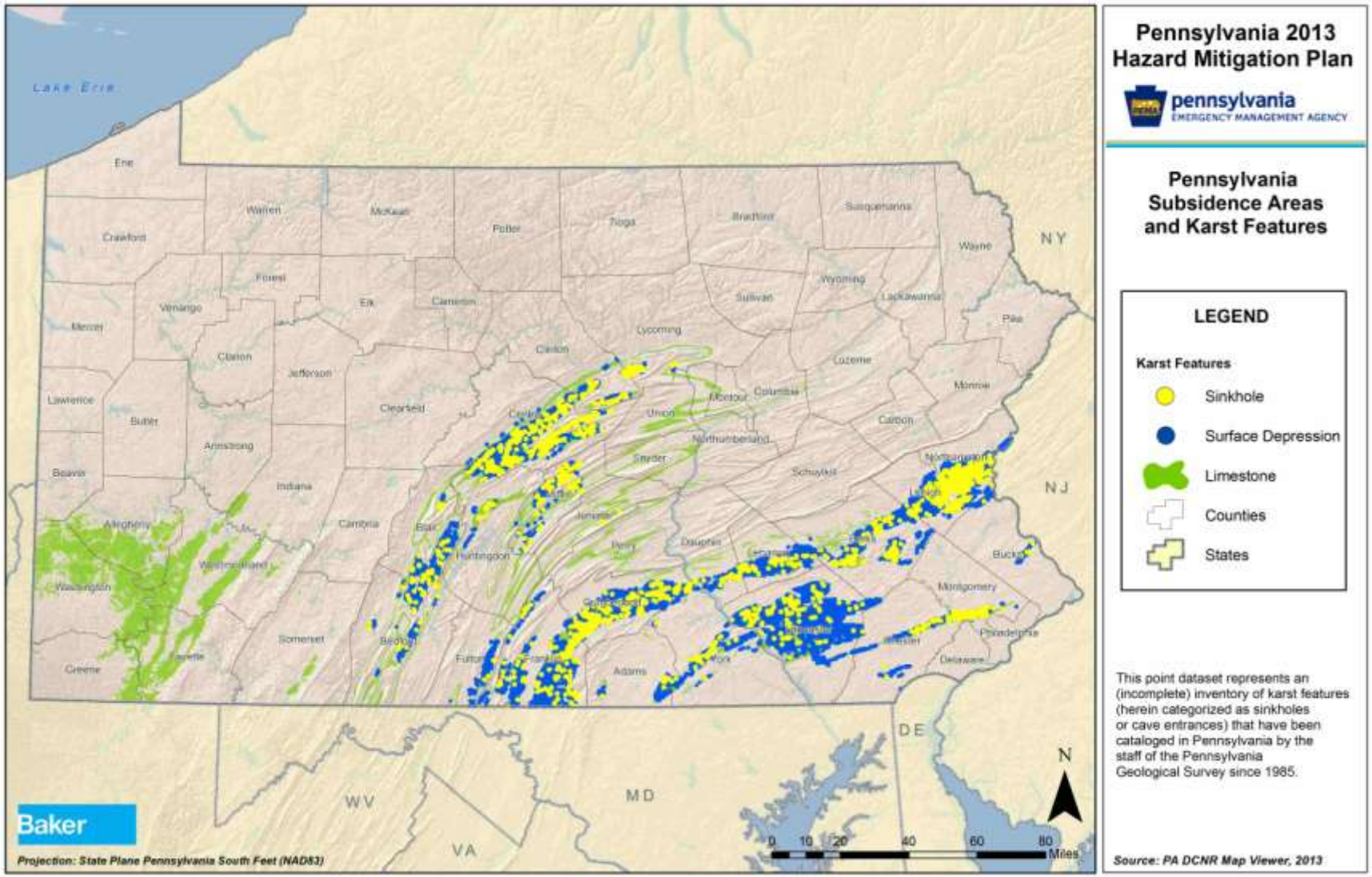
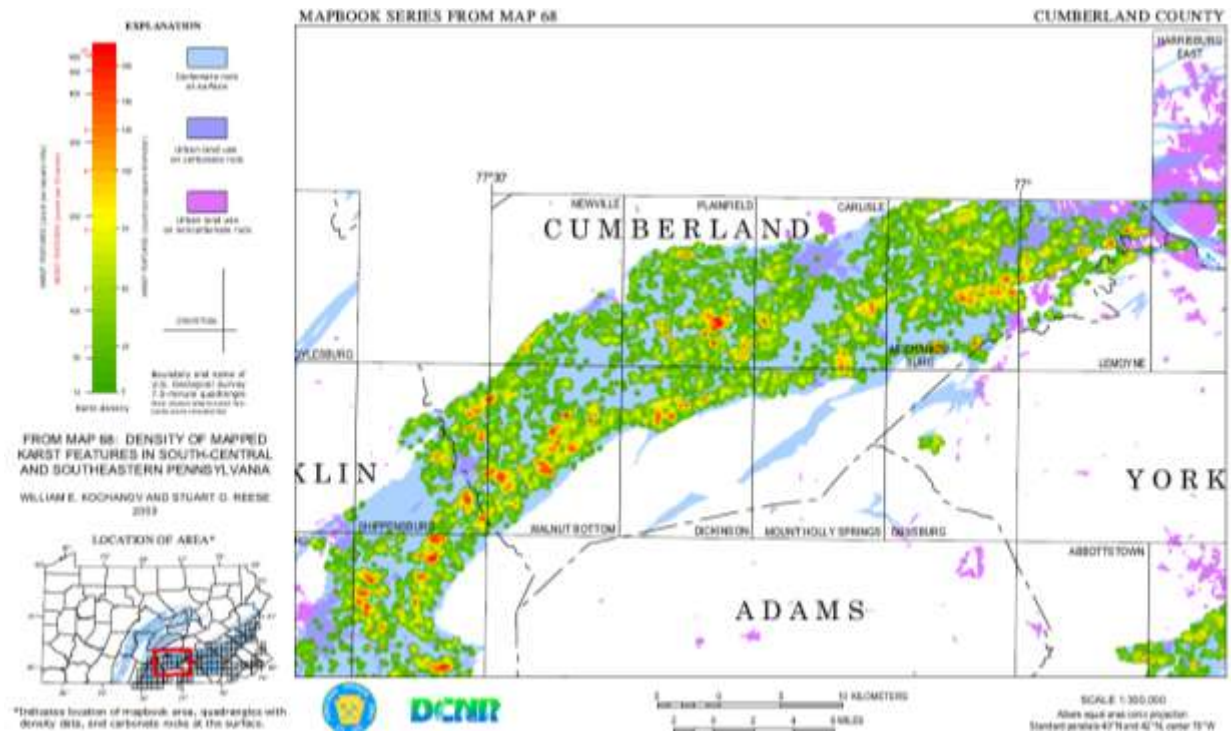


Figure 4.3.13-2 Example of map showing density of karst features in Cumberland County. An index map showing the coverage of the inventory is also provided.



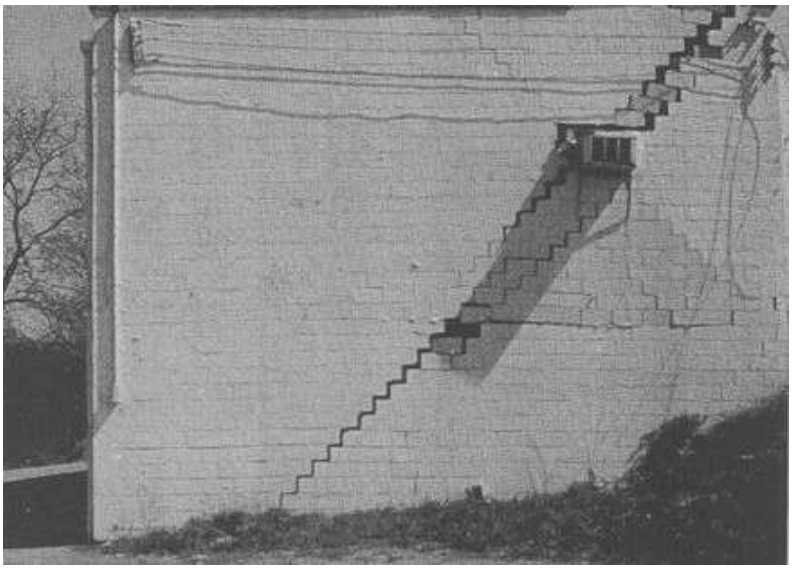
4.3.13.2. Range of Magnitude

No two subsidence areas or sinkholes are exactly alike. Variations in size and shape, time period under which they occur (i.e. gradually or abruptly), and their proximity to development ultimately determines the magnitude of damage incurred. 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 damages to private and public property including buildings, roads, and underground infrastructure. Figure 4.3.12-3 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. If mitigation measures are not taken, the cost to fill in and stabilize sinkholes can be significant although sinkholes are limited in extent. The 1994 event in Allentown (see top-left image in Figure 4.3.13-3) is one of the worst-case known events in Pennsylvania. Damage to the Corporate Plaza Building was significant, but dollar information is unknown.

Figure 4.3.13-3 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*. PADCNR, 2009).

Sinkhole in Dauphin County has exposed a utility pipeline (Kochanov, 1999).



Building damage as a result of subsidence in western Pennsylvania. An abandoned mine is located approximately 175 feet below the ground surface. The source of this photograph is unknown.

4.3.13.3. Past Occurrence

DCNR provides an online inventory of sinkholes which lists 3,619 sinkholes which have been identified across Pennsylvania – a 26% increase in sinkholes from what was reported in the 2010 SSAHMP. The distribution of these sinkholes by county is provided in Table 4.3.13-1. 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 4.3.13-1 Summary of sinkholes identified in the Pennsylvania (PA DCNR, 2013)

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
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***

4.3.13.4. Future Occurrence

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).

4.3.13.5. Environmental Impacts

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. Vegetation is usually damaged during abrupt subsidence events. However, re-growth takes place over time.

4.3.13.6. Jurisdictional Vulnerability Assessment

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.

As stated in Section 4.2.2, 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 tracts 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.

Since natural subsidence and sinkhole events occur when the predominant bedrock type is limestone, the 37 Pennsylvania counties that that are located on top of these limestone areas are vulnerable to subsidence and sinkhole occurrences. Risk to mining-related subsidence are discussed in Section 4.3.19: Environmental Hazards. Additionally, subsidence and sinkholes are an identified hazard in 38 county hazard mitigation plans, shown in Table 4.3.13-2. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 19 counties which currently have calculated risk factor values for Subsidence/Sinkholes, the average value is 1.7; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for Subsidence/Sinkhole is 1.7, and the Pennsylvania THIRA does not evaluate this hazard. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.13-2 Counties profiling subsidence/sinkhole hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny	X		Medium	2.1
Armstrong	X		Not Ranked	No RF
Beaver		X		
Bedford	X		Low	1.3
Berks	X		Not Ranked	No RF
Blair		X		
Bradford		X		
Bucks	X		Low	1.3
Butler	X		Low	1.3
Cambria	X		Low	1.3
Cameron	X		Medium	2.2
Carbon		X		
Centre	X		Low	1.8
Chester		X		
Clarion	X		Not Ranked	No RF
Clearfield		X		
Clinton		X		
Columbia		X		
Crawford		X		

Table 4.3.13-2 Counties profiling subsidence/sinkhole hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Cumberland	X		High	2.6
Dauphin	X		Not Ranked	No RF
Delaware	X		Low	1.6
Elk		X		
Erie		X		
Fayette	X		High	2.5
Forest		X		
Franklin	X		Not Ranked	No RF
Fulton		X		
Greene	X		Low	1.3
Huntingdon		X		
Indiana		X		
Jefferson	X		Low	1.8
Juniata		X		
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Low	1.8
Lawrence	X		Low	1.3
Lebanon*	X		Not Ranked	2.8
Lehigh	X		Low	1.4
Luzerne	X		Not Ranked	No RF
Lycoming		X		
McKean	X		Low	1.8
Mercer	X		Low	1.3
Mifflin		X		
Monroe		X		
Montgomery	X		Medium	2.0
Montour*	X		Not Ranked	8.8
Northampton	X		Low	1.4
Northumberland	X		Low	1.6
Perry*	X		Not Ranked	8.4
Philadelphia**		X		
Pike		X		
Potter	X		Not Ranked	No RF

Table 4.3.13-2 Counties profiling subsidence/sinkhole hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Schuylkill	X		Not Ranked	No RF
Snyder	X		Low	1.3
Somerset		X		
Sullivan	X		Not Ranked	No RF
Susquehanna		X		
Tioga	X		Medium	2.1
Union		X		
Venango		X		
Warren		X		
Washington	X		Not Ranked	No RF
Wayne		X		
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Low	1.8

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As seen in Table 4.3.13-3, Allegheny, Lancaster, and Westmoreland Counties have the most critical facilities potentially impacted by subsidence and sinkhole events. Of the vulnerable counties, Somerset, Montour, and Indiana Counties have the fewest vulnerable critical facilities. These counties have localized limestone and thus are not likely to experience widespread subsidence and sinkhole incidents.

Table 4.3.13-3 Number of State Critical Facilities impacted by subsidence and sinkholes in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	5	Lancaster	65
Allegheny	166	Lebanon	41
Bedford	10	Lehigh	19
Berks	24	Luzerne	3
Blair	8	Lycoming	6
Centre	24	Mifflin	11
Chester	13	Montgomery	9

Table 4.3.13-3 Number of State Critical Facilities impacted by subsidence and sinkholes in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Clinton	12	Montour	2
Columbia	3	Northampton	3
Cumberland	31	Northumberland	4
Dauphin	33	Perry	3
Fayette	46	Snyder	9
Franklin	23	Somerset	2
Greene	8	Union	11
Huntingdon	7	Washington	57
Indiana	2	Westmoreland	106
Juniata	14	York	23

4.3.13.7. State Facility Vulnerability Assessment

As is the case with jurisdictional vulnerability, the state critical facilities that are vulnerable to subsidence and sinkholes are those that are located on top of limestone features. A total of 803 state critical facilities are vulnerable to subsidence and sinkhole events. Table 4.3.13-5 shows number of impacted state critical facilities by facility type.

Table 4.3.13-4 State Critical Facilities vulnerable to subsidence and sinkholes by critical facility type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	25
Banking	5
Chemical	1
Commercial Facilities	5
Defense Industrial Base	3
Education	13
Emergency Services	14
Energy	4
Fire Departments (Non-HSIP)	315
Government Facilities	3
Healthcare & Public Health	7
Hospital (Non-HSIP)	31
Nuclear Reactors, Materials & Waste	2
Police (Non-HSIP)	141
Postal & Shipping	1
School (Non-HSIP)	224
Transportation	7
Water	2
Grand Total	**803**

4.3.13.8. Jurisdictional Loss Estimation

As stated in Section 4.3.9.6, loss estimates were prepared based on the sum of the number and value of buildings in Census tracts located over limestone bedrock features, aggregated to the county level. Subsidence and sinkholes have the potential to affect 811,610 structures in the Commonwealth with over $195 billion in exposed buildings and contents (Table 4.3.13-5). Of course, not every one of the buildings in a given Census tract or jurisdiction is situated above limestone feature, but those that are could face serious damage. Of the jurisdictions vulnerable to subsidence and sinkholes, Allegheny is the most threatened with over $45 billion in building and contents in vulnerable areas.

Table 4.3.13-5 Estimated jurisdictional losses due to subsidence and sinkholes.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	11,030	$2,796,552.00
Allegheny	199,520	$45,739,650.00
Armstrong	2,988	$544,578.00
Beaver	3,541	$1,006,299.00
Bedford	4,143	$753,288.00
Berks	20,698	$5,130,937.00
Blair	8,666	$1,776,558.00
Bucks	4,240	$1,723,745.00
Centre	22,407	$4,377,024.00
Chester	3,762	$839,760.00
Clinton	5,664	$1,149,047.00
Cumberland	52,800	$13,972,904.00
Dauphin	13,181	$3,030,111.00
Fayette	23,705	$4,629,062.00
Franklin	39,166	$8,776,732.00
Greene	8,163	$1,470,011.00
Huntingdon	5,044	$1,199,487.00
Indiana	2,542	$440,090.00
Lancaster	98,965	$24,671,808.00
Lebanon	20,091	$4,561,648.00
Lehigh	15,786	$4,704,857.00
Luzerne	2,936	$625,198.00
Lycoming	3,774	$826,940.00
Mifflin	9,285	$1,811,008.00
Montgomery	15,776	$5,160,135.00
Northampton	26,513	$8,959,584.00
Northumberland	5,409	$1,210,663.00
Perry	1,954	$325,491.00
Snyder	5,053	$1,273,737.00
Union	11,639	$2,749,797.00
Washington	59,930	$14,110,389.00
Westmoreland	67,947	$16,314,747.00
York	35,292	$8,531,820.00

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.

4.3.13.9. State Facility Loss Estimation

Of the 1,263 vulnerable critical facilities, 83 do not have replacement values; these facilities are largely private entities. The estimated replacement cost of all state critical facilities with replacement values located in areas susceptible to natural subsidence and sinkhole hazard zones is $6,262,828,204. Actual losses may be lower because special regulations have been established at the state level for the construction of certain facilities (e.g. sanitary landfills).

4.3.14. Tornado, Windstorm

4.3.14.1. Location and Extent

Both tornado and windstorm events can occur throughout Pennsylvania. Tornado events are usually localized. However, severe thunderstorms may result in conditions favorable to the formation of numerous or long-lived tornadoes. Tornadoes can occur at any time during the day or night, but are most frequent during late afternoon into early evening, the warmest hours of the day, and most likely to occur during the spring and early summer months of March through June. 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 wind speeds of 110 mph (175 km/h) or less, are approximately 250 feet (75 m) across, and travel a few miles (several kilometers) before dissipating. 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). Some tornadoes never touch the ground and are short-lived, while others may touch the ground several times.

Straight-line winds and windstorms are experienced on a region-wide scale. While such winds usually accompany tornadoes, straight-lined winds are caused by the movement of air from areas of higher pressure to areas of lower pressure. Stronger winds are the result of greater differences in pressure. 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. Wind events can vary in spatial size from small microscale events which take place over only a few hundred meters to large-scale synoptic wind events often associated with warm or cold fronts.

4.3.14.2. Range of Magnitude

Each year, tornadoes account for $1.1 billion in damages and cause over 80 deaths nationally (NCAR, 2001). While the extent of tornado damage is usually localized, the vortex of extreme wind associated with a tornado can result in some of the most destructive forces on Earth. Rotational wind speeds can range from 100 mph to more than 250 mph. In addition, the speed of forward motion can range from 0 to 50 mph. Therefore, some estimates place the maximum velocity (combination of ground speed, wind speed and upper winds) of tornadoes at about 300 mph. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning normally harmless objects into deadly missiles.

Damages and deaths can be especially significant when 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.

Table 4.3.14-1 Enhanced Fujita Scale (EF-Scale) categories with associated wind speeds and description of damages.

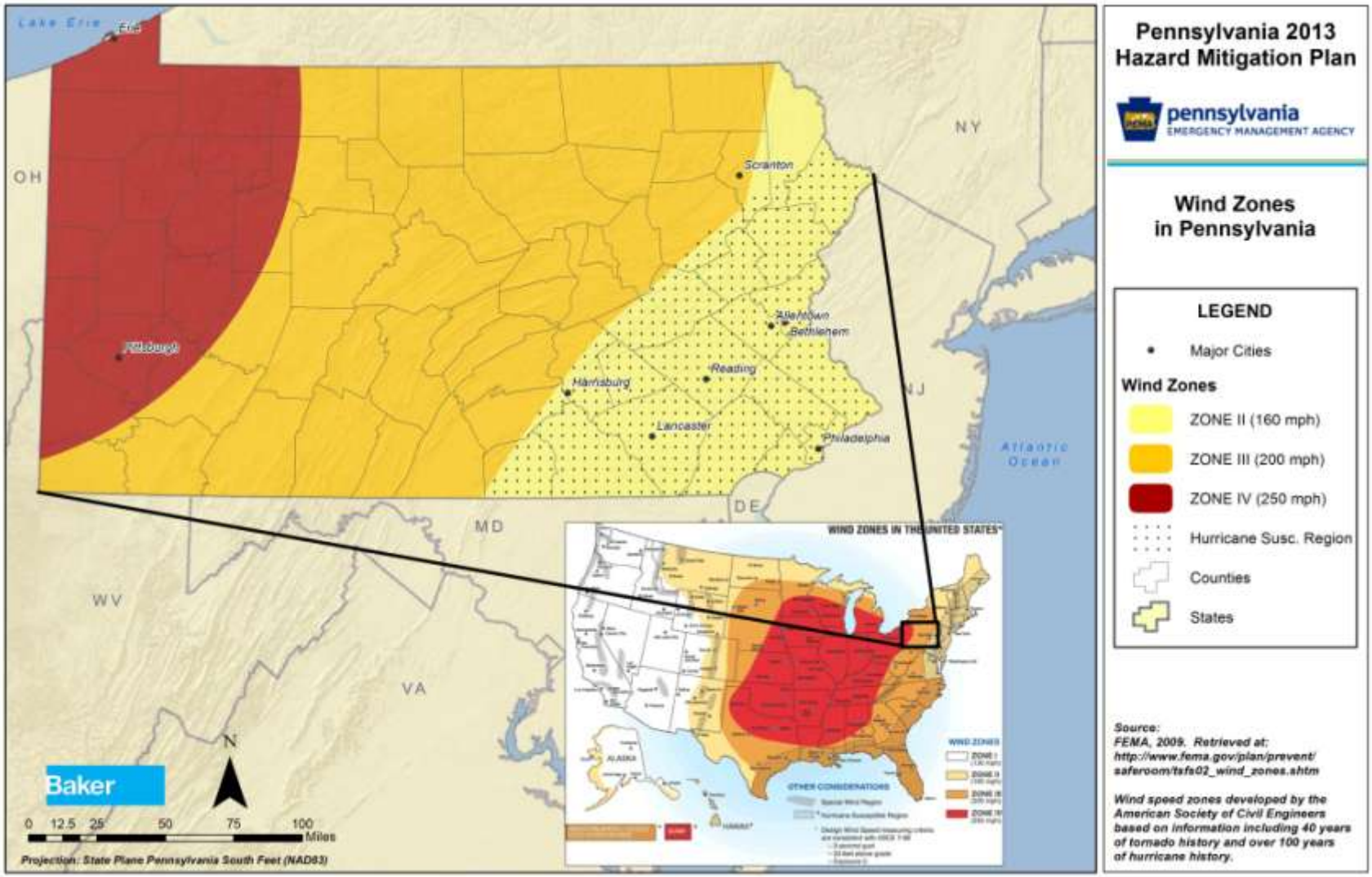
EF-SCALE NUMBER	WIND SPEED (mph)	F-SCALE NUMBER	TYPE OF DAMAGE POSSIBLE
EF0	65–85	F0-F1	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86-110	F1	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111–135	F1-F2	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136–165	F2-F3	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166–200	F3	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	F3-F6	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (300 ft); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.

The impact of tornado hazards is ultimately dependent on the amount of population or 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.

Figure 4.3.14-1 shows wind speed zones developed by the American Society of Civil Engineers based on information including 40 years of tornado history and over 100 years of hurricane history. 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. Extreme 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.

Figure 4.3.14-1 Design wind speeds for community shelters across the United States (FEMA 2009).



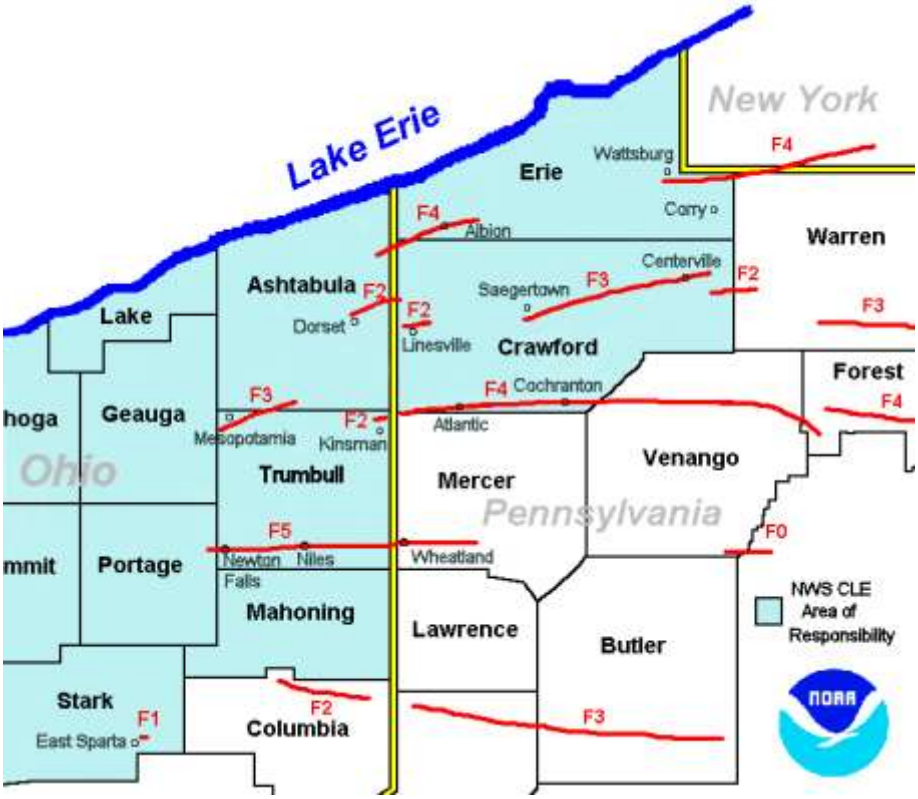
The wind zones identified in Figure 4.3.14-1 represent the strongest wind speeds anticipated throughout Pennsylvania, not the normal or routine wind speeds expected statewide. The May 31, 1985 tornado swarm event discussed in Section 4.3.14.3 marks the worst documented tornado outbreak in Pennsylvania.

The worst-case tornado event on record occurred on July 15, 2004 in Campbelltown, Lebanon County. This F3 tornado, which had estimated wind speeds of 175-200 miles per hour, leveled 32 houses, severely damaged 37 homes, and an additional 50 homes suffered more minor damage. Two people were hospitalized from the tornado, one critically injured. While only on the ground for 10-15 minutes, the NCDC estimates that the tornado caused $18 million in property damage.

4.3.14.3. Past Occurrence

Tornadoes have occurred throughout Pennsylvania. Western and southeastern sections of the Commonwealth have been struck more frequently. On May 31, 1985 a very rare outbreak of 21 tornadoes tracked across northeast Ohio and northwest Pennsylvania, including Erie, Warren, Crawford, Forest, Mercer, Venango, Mercer, and Butler counties, killing 76 people (Figure 4.3.14-2). One of these tornadoes was rated an F6 while six were rated F4s on the old Fujita Scale. The deadliest tornado touched down near Jamestown, PA as an F4 on the old Fujita Scale, killing 23 people and destroying 371 homes. It stayed on the ground for over an hour and produced a 56-mile long damage path.

Figure 4.3.14-2 Map showing tornado tracks during the May 31, 1985 tornado outbreak (NOAA NWS, 2005).



Another storm in May 1985 killed six people, injured sixty, and destroyed campers, manufactured homes, homes and businesses across Lycoming, Union and Northumberland Counties. Figure 4.3.14-3 shows the number of tornado events for each county of the Commonwealth between 1950 and 2013; Figure 4.3.14-4provides a map of tornado touchdowns and tracks across Pennsylvania. Crawford, Erie, Lancaster, Westmoreland, and York Counties have recorded the highest number of tornadoes over this time period. Evaluation of previous versions of the SSAHMP 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.

Figure 4.3.14-3 Graph showing the number of tornado events across Pennsylvania by county between 1950 and June 2013 (NCDC, 2013).

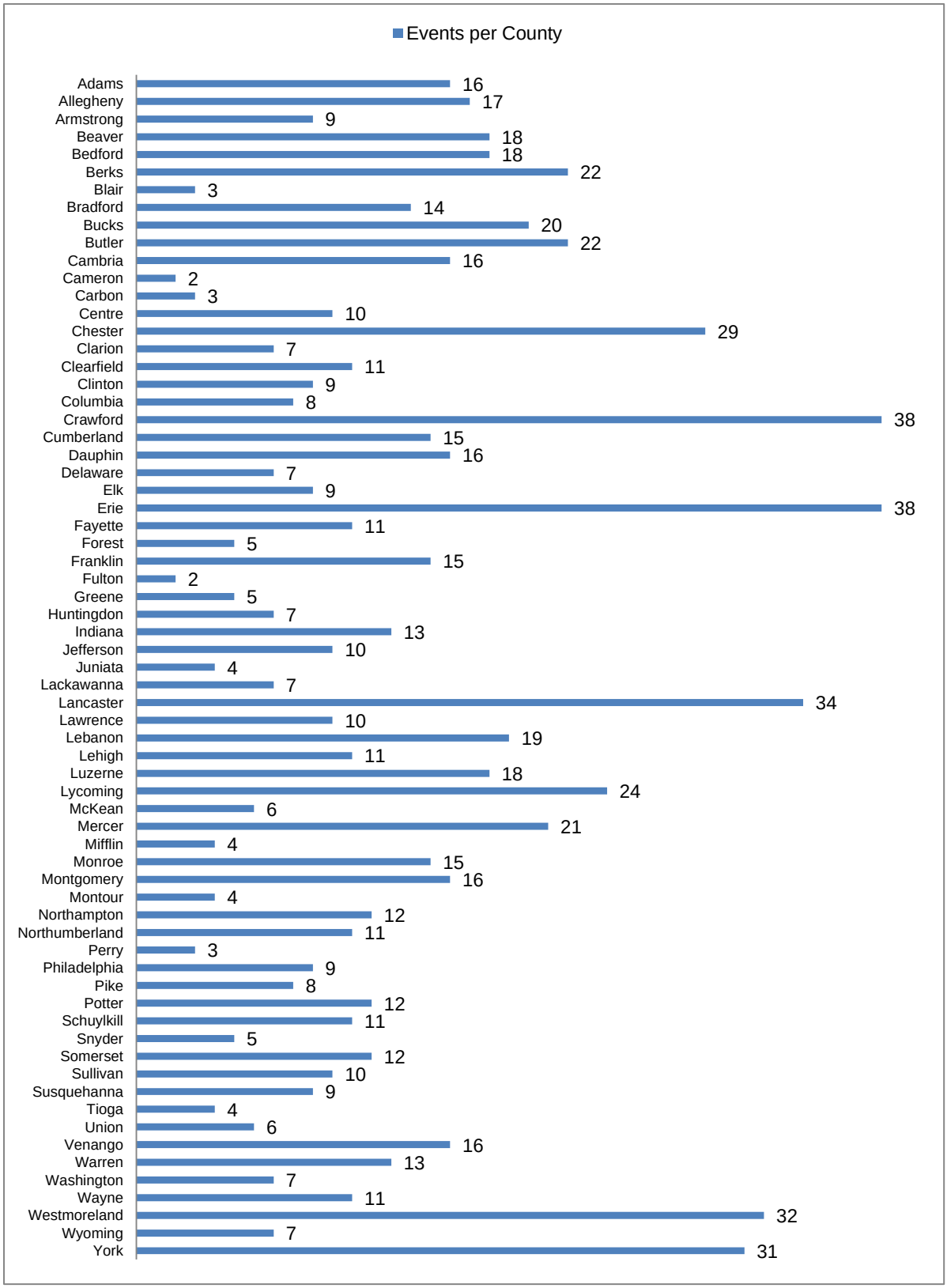
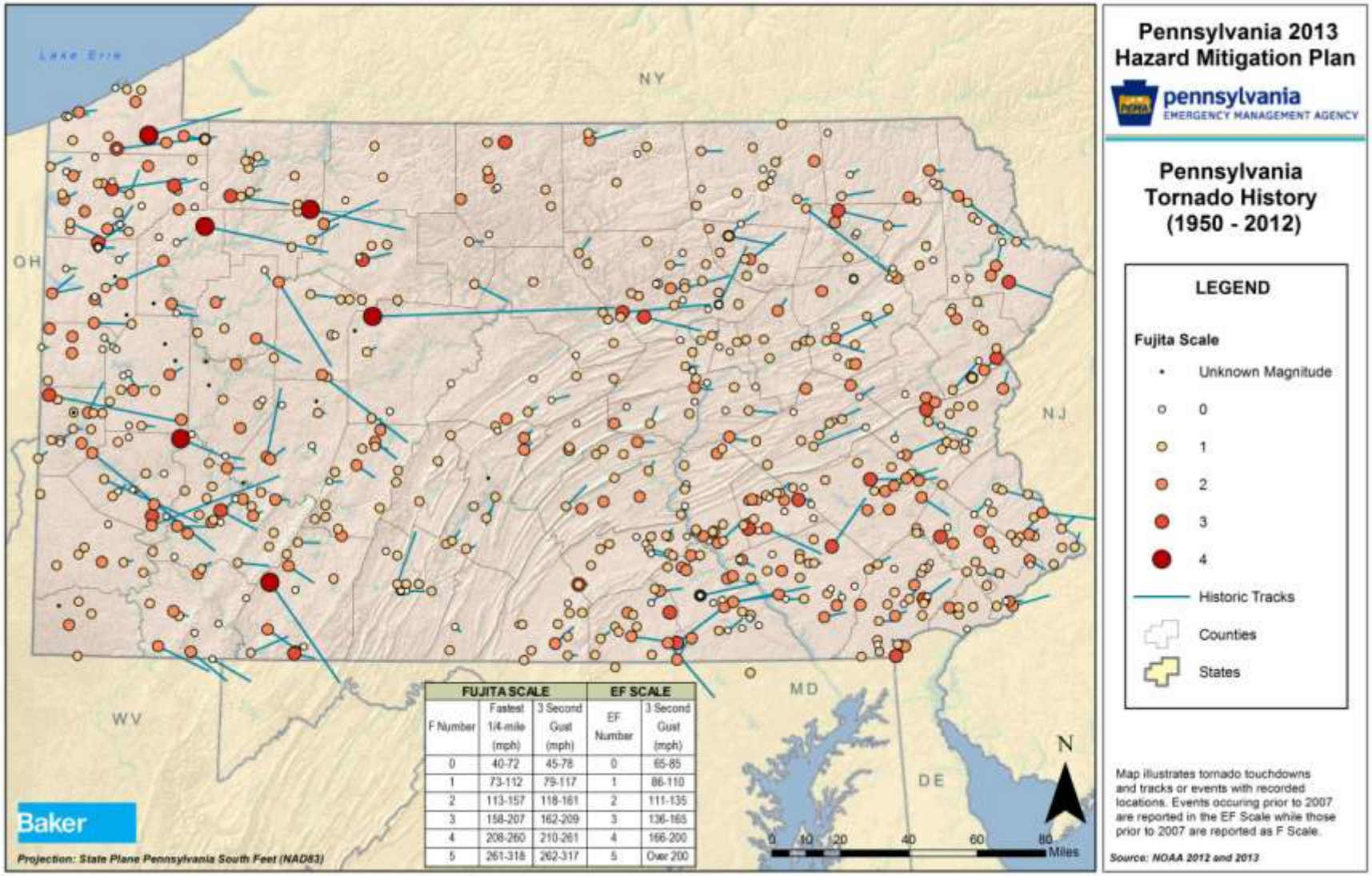


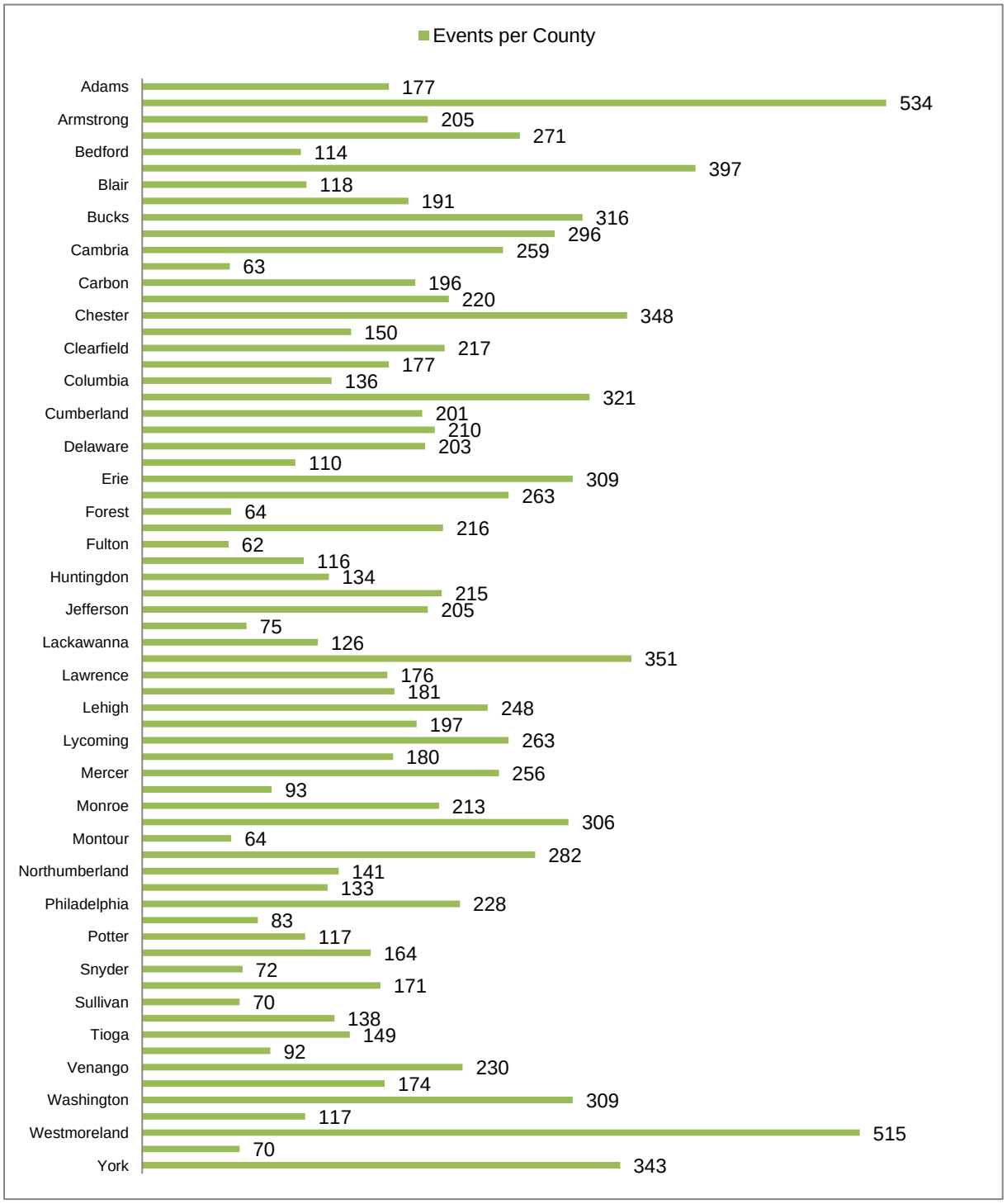
Figure 4.3.14-4 Map showing the number of tornadoes in each county across Pennsylvania between 1950 and 2012 (NOAA SPC, 2013). Note that the F5 tornado which tracked through Ohio and Pennsylvania on May 31, 1985 is not identified in this dataset.



FUJITA SCALE			EF SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85
1	73-112	79-117	1	86-110
2	113-157	118-161	2	111-135
3	158-207	162-209	3	136-165
4	208-260	210-261	4	166-200
5	261-318	262-317	5	Over 200

Total windstorm events reported for each county in Pennsylvania between 1950 and 2013 are provided in Figure 4.3.14-5. Events may be the result of thunderstorms, hurricanes, tropical storms, winter storms, or nor'easters.

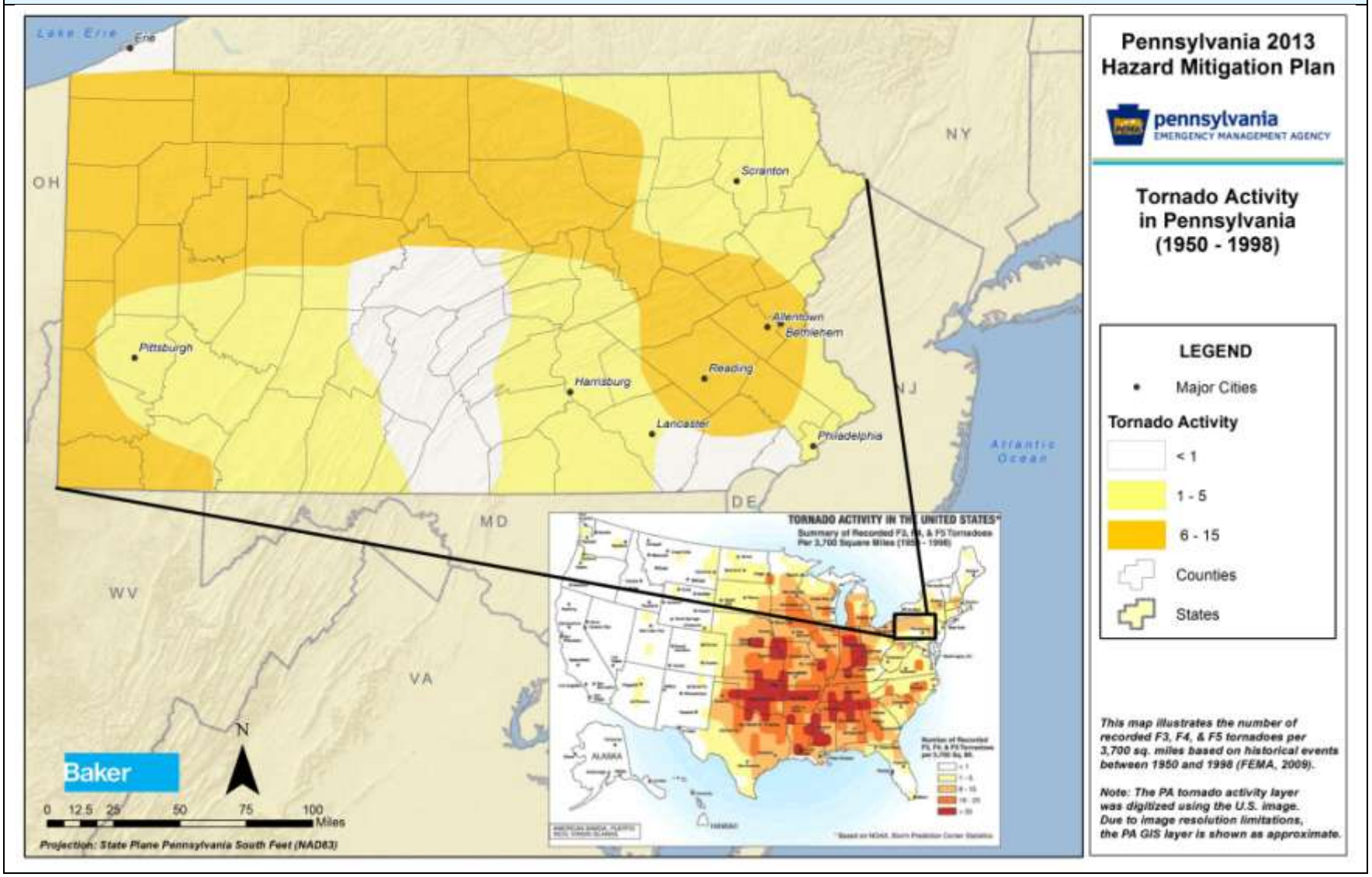
Figure 4.3.14-5 Graph showing the number of windstorm events across Pennsylvania by county between 1950 and June 2013 (NCDC, 2013).



4.3.14.4. Future Occurrence

According to the National Weather Service, the Commonwealth of Pennsylvania has an annual average of ten tornadoes with two related deaths. Based on historical events between 1950 and 1998, there are three zones in Pennsylvania which experience <1, 1 to 5, and 6 to 15 F3, F4, and F5 tornadoes per 3,700 square miles (Figure 4.3.14-7).

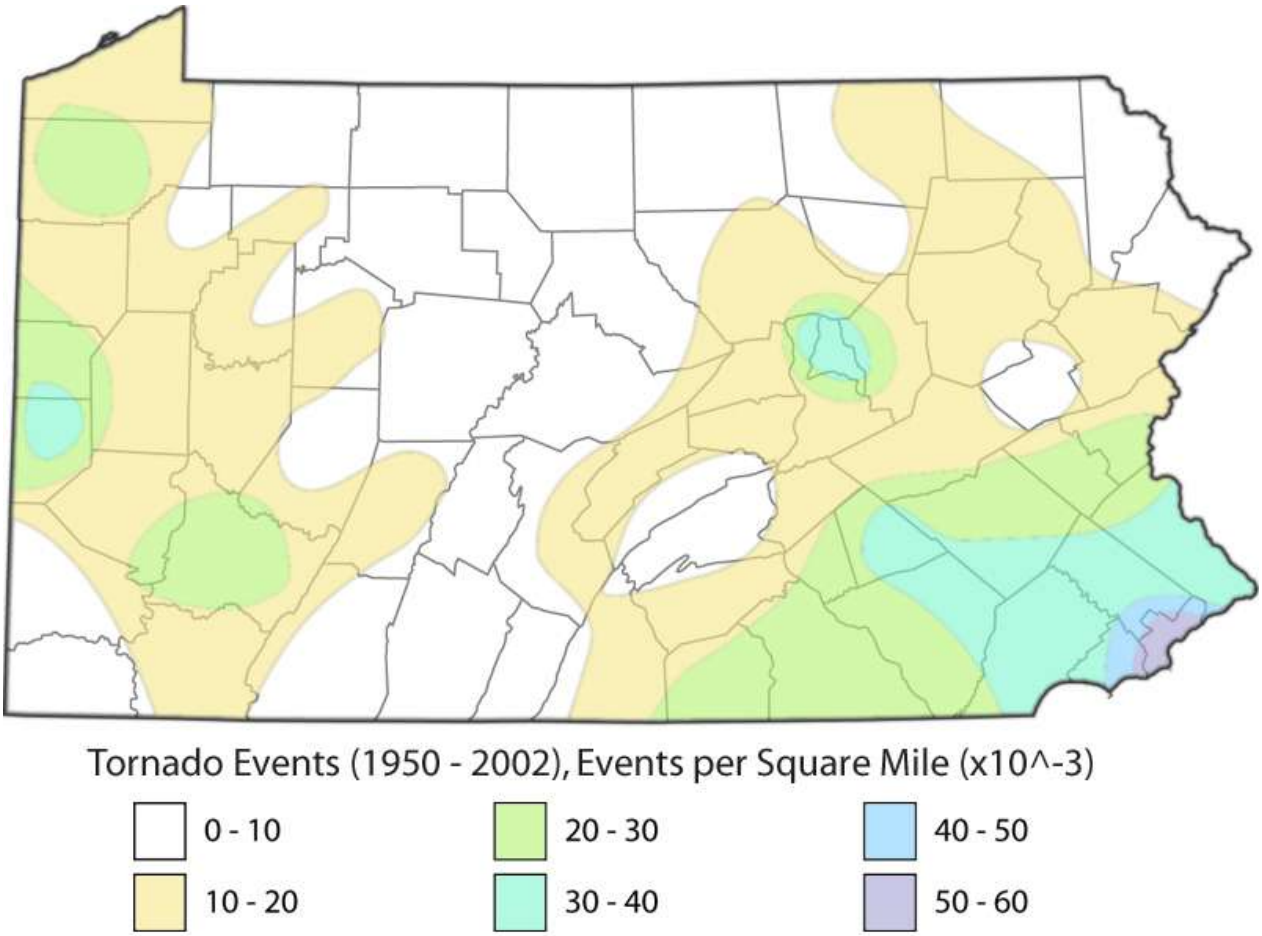
Figure 4.3.14-6 Map showing historical tornado activity in Pennsylvania from 1950-1998.



The 2007 SSAHMP performed an investigation of the time of year and time of day when tornadoes most often occur. Analysis of events between 1950 and 2000 showed that approximately 72% of tornadoes in Pennsylvania occurred between the months of May and August. Approximately 79% of historical tornadoes occurred between noon and 9 p.m. (PEMA, 2007).

Using events collected between 1950 and 2000, Figure 4.3.14-7shows the number of total tornado events per square mile across Pennsylvania from the State Climatologist. It is clear that the southeast and western sections of the Commonwealth experience a higher frequency of events compared to other areas of Pennsylvania. This analysis represents the best available information on tornado density in the Commonwealth.

Figure 4.3.14-7 Total tornado events per square mile in Pennsylvania (Pennsylvania State Climatologist).

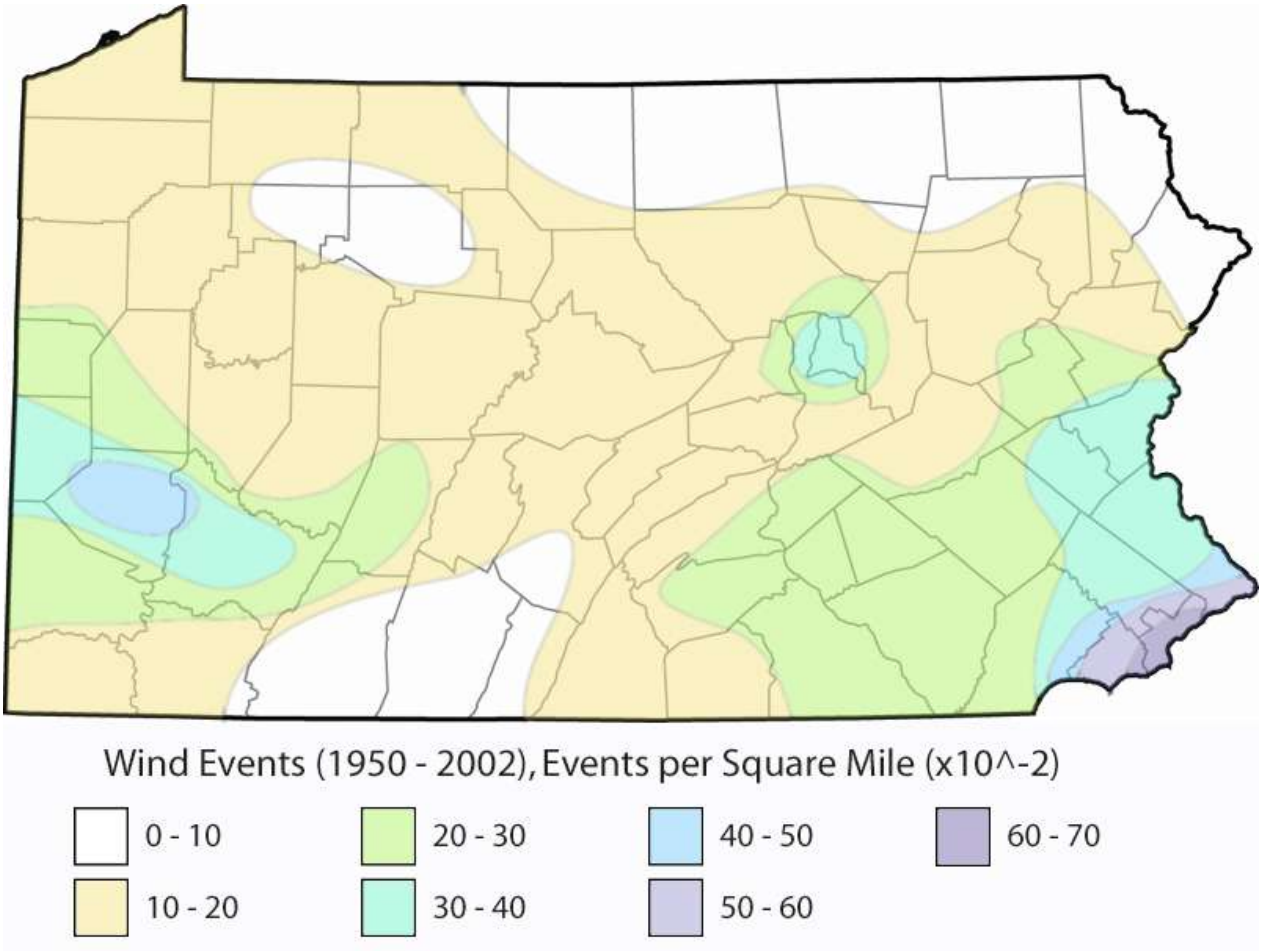


Similarly to tornadoes, an investigation of the time of year and time of day when windstorm events most often occur was performed in the 2007 SSAHMP. Using historical events between 1950 and 2000, the analysis showed that approximately 73% of windstorms in Pennsylvania occurred between the months of May and August. Approximately 74% of windstorms occurred

between 2 p.m. and 9 p.m. (PEMA, 2007). These results are expected, since severe wind events are most often associated with thunderstorm events which are usually experienced during the late afternoon or evening in the late spring and summer months.

Using events collected between 1950 and 2002, Figure 4.3.14-8 shows the number of wind events per square mile across Pennsylvania. It is clear that the southeast and extreme western sections of the Commonwealth experience a higher frequency of events compared to other areas of Pennsylvania.

Figure 4.3.14-8 Wind events per square mile in Pennsylvania (Pennsylvania State Climatologist).



4.3.14.5. Environmental Impacts

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 4.3.14-1 in order to prevent release of hazardous materials into the environment.

4.3.14.6. Jurisdictional Vulnerability Assessment

According to the NCDC, a total of 867 tornados have occurred in Pennsylvania during the years 1950-2013. All 67 Pennsylvania counties have experienced at least one tornado. All counties except Carbon and Philadelphia have identified tornado or windstorm as a hazard of significant concern to their communities, as listed in Table 4.3.14-2. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 39 counties with calculated risk factors for tornado and windstorm hazards, the average risk factor is 2.4. The State calculated risk factor is 2.2, and the Pennsylvania THIRA prioritizes Tornado/Windstorm hazards as a 7of 10. For more details, please see Section 4.1.

Table 4.3.14-2 Counties profiling tornado and windstorm hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.7
Allegheny	X		High	2.9
Armstrong	X		Not Ranked	No RF
Beaver	X		High	2.5
Bedford	X		High	2.8
Berks	X		Not Ranked	No RF
Blair	X		Not Ranked	No RF
Bradford	X		Not Ranked	No RF
Bucks	X		Medium	2.1
Butler	X		Medium	2.3
Cambria	X		Medium	2.2
Cameron	X		Low	1.3
Carbon		X		
Centre	X		Medium	2.4
Chester	X		Not Ranked	No RF
Clarion	X		Not Ranked	No RF
Clearfield	X		Low	1.8
Clinton	X		High	2.9
Columbia	X		High	2.7
Crawford	X		Medium	2.2

Table 4.3.14-2 Counties profiling tornado and windstorm hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Cumberland	X		High	2.7
Dauphin	X		Not Ranked	No RF
Delaware	X		Medium	2.1
Elk	X		Medium	2.4
Erie	X		Medium	2.2
Fayette	X		Medium	2.4
Forest	X		Not Ranked	No RF
Franklin	X		Not Ranked	No RF
Fulton	X		High	3.0
Greene	X		Low	1.8
Huntingdon	X		Not Ranked	No RF
Indiana	X		Medium	2.4
Jefferson	X		High	2.5
Juniata	X		Medium	2.3
Lackawanna	X		Not Ranked	No RF
Lancaster	X		High	2.5
Lawrence	X		Medium	2.4
Lebanon*	X		Not Ranked	11.6
Lehigh	X		Medium	2.1
Luzerne	X		Not Ranked	No RF
Lycoming	X		High	3.7
McKean	X		Medium	2.2
Mercer	X		Medium	2.3
Mifflin	X		Not Ranked	No RF
Monroe	X		Medium	2.2
Montgomery	X		High	2.7
Montour*	X		Not Ranked	5.0
Northampton	X		Medium	2.1
Northumberland	X		Medium	2.2
Perry*	X		Not Ranked	3.3
Philadelphia**		X		
Pike	X		Medium	2.1
Potter	X		Not Ranked	No RF

Table 4.3.14-2 Counties profiling tornado and windstorm hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Schuylkill	X		Not Ranked	No RF
Snyder	X		Medium	2.4
Somerset	X		High	2.6
Sullivan	X		Not Ranked	No RF
Susquehanna	X		Medium	2.1
Tioga	X		Medium	2.4
Union	X		Not Ranked	No RF
Venango	X		High	2.7
Warren	X		Medium	2.1
Washington	X		Not Ranked	No RF
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Medium	2.3

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As stated in Section 4.2.2, 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 tracts 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.

Vulnerability for tornados was classified as generating a 5-mile buffer around all historic locations where tornados touched down. To refine the analysis, only tornados with a Fujita Scale of F1 or greater was chosen for analysis. Approximately 78% of all Pennsylvania tornados had a scale of F1 or above. Five miles was chosen as a buffer size based on the available historic tornado path averages in Pennsylvania, as seen on Figure 4.3.14-4. The buffer accounts for the varying changes in direction a tornado may travel. In total, 531 tornados individually received a 5 mile buffer to determine how many critical facilities fell within the

vulnerable zone. Using this criterion, a total of 4,320 vulnerable critical facilities have been identified, as illustrated in Table 4.3.14-3.

Table 4.3.14-3 Number of State Critical Facilities impacted by tornados in each county using a 5 mile buffer of historical tornados (F1 or greater)

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	47	Lackawanna	110
Allegheny	513	Lancaster	132
Armstrong	68	Lawrence	46
Beaver	148	Lebanon	97
Bedford	27	Lehigh	65
Berks	109	Luzerne	157
Blair	42	Lycoming	80
Bradford	38	McKean	14
Bucks	106	Mercer	62
Butler	80	Mifflin	20
Cambria	124	Monroe	27
Cameron	2	Montgomery	189
Carbon	17	Montour	2
Centre	36	Northampton	67
Chester	106	Northumberland	71
Clarion	16	Perry	16
Clearfield	9	Philadelphia	105
Clinton	19	Pike	11
Columbia	63	Potter	10
Crawford	66	Schuylkill	145
Cumberland	61	Snyder	17
Dauphin	175	Somerset	51
Delaware	124	Sullivan	10
Elk	16	Susquehanna	8
Erie	57	Tioga	22
Fayette	83	Union	10
Forest	1	Venango	20
Franklin	33	Warren	24
Fulton	2	Washington	88
Greene	17	Wayne	20
Huntingdon	19	Westmoreland	222
Indiana	33	Wyoming	13
Jefferson	27	York	90
Juniata	15	***Grand Total***	***4320***

The top ten counties containing critical facilities were (in order of total number) Allegheny, Westmoreland, Montgomery, Dauphin, Luzerne, Beaver, Schuylkill, Lancaster, Cambria, and Delaware.

4.3.14.7. State Facility Vulnerability Assessment

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. Table 4.3.14-4 lists a breakdown of the types of facilities contained within the tornado zones.

Table 4.3.14-4 State Critical Facilities vulnerable to tornados by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	89
Banking	19
Chemical	4
Commercial Facilities	49
Communications	2
Critical Manufacturing	3
Dams	20
Defense Industrial Base	15
Education	118
Emergency Services	65
Energy	21
Fire Departments (Non-HSIP)	1,687
Government Facilities	34
Healthcare & Public Health	34
Hospital (Non-HSIP)	180
Information Technology	3
Manufacturing	1
National Monuments & Icons	4
Nuclear Reactors, Materials & Waste	6
Police (Non-HSIP)	893
Postal & Shipping	7
School (Non-HSIP)	1,002
Transportation	41
Water	23
Grand Total	***4,320***

4.3.14.8. Jurisdictional Loss Estimation

As stated in Section 4.3.9.6, loss estimates were prepared based on the sum of the number and value of buildings in Census tracts located within five miles of historic F1 or stronger tornado events, aggregated to the county level. The Commonwealth has a total of 6,127,881 potentially

impacted buildings with over $1.5 billion in exposure in all 67 counties. Philadelphia County is the most threatened jurisdiction with 675,707 vulnerable buildings and over $176 billion in possible losses stemming from tornado events.

Although tornados are typically thought of as occurring in rural areas, total buildings impacted were found to occur in more densely populated counties, with Philadelphia having the highest occurrence of impacted buildings, followed by Allegheny, Montgomery, Bucks and Delaware counties. High building numbers correlates to high dollar values of building and content exposure. Table 4.3.14-5 illustrates the number of potentially impacted buildings and their associated dollar value of exposure by county.

Table 4.3.14-5 Potential jurisdictional losses due to tornados.

COUNTY	TOTAL NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	74,459	$17,543,280.00
Allegheny	510,986	$128,832,247.00
Armstrong	53,396	$10,791,837.00
Beaver	109,012	$27,694,713.00
Bedford	16,591	$3,065,491.00
Berks	179,059	$46,491,124.00
Blair	39,409	$7,848,158.00
Bradford	25,817	$4,582,888.00
Bucks	267,285	$90,881,375.00
Butler	88,604	$23,568,630.00
Cambria	84,029	$18,256,351.00
Cameron	6,650	$1,133,012.00
Carbon	26,059	$6,082,874.00
Centre	43,953	$11,729,936.00
Chester	221,399	$76,014,508.00
Clarion	26,926	$5,005,882.00
Clearfield	15,952	$2,986,002.00
Clinton	18,589	$3,379,897.00
Columbia	41,754	$8,971,733.00
Crawford	70,364	$14,090,376.00
Cumberland	135,468	$34,986,303.00
Dauphin	146,980	$35,877,702.00
Delaware	268,476	$83,504,854.00
Elk	20,512	$4,290,248.00
Erie	121,237	$27,388,540.00
Fayette	70,276	$14,302,595.00
Forest	15,328	$2,691,824.00
Franklin	69,319	$15,384,721.00

Table 4.3.14-5 Potential jurisdictional losses due to tornados.

COUNTY	TOTAL NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Fulton	2,296	$390,355.00
Greene	9,361	$1,956,631.00
Huntingdon	20,204	$3,994,349.00
Indiana	44,198	$9,521,816.00
Jefferson	34,940	$6,761,437.00
Juniata	23,325	$4,515,367.00
Lackawanna	83,720	$19,365,384.00
Lancaster	215,321	$55,371,453.00
Lawrence	41,992	$9,429,062.00
Lebanon	71,232	$16,772,592.00
Lehigh	181,344	$48,802,779.00
Luzerne	121,089	$27,486,487.00
Lycoming	73,220	$14,754,682.00
McKean	19,898	$3,947,364.00
Mercer	70,521	$15,051,880.00
Mifflin	22,286	$4,481,044.00
Monroe	77,546	$19,889,679.00
Montgomery	455,042	$151,908,102.00
Montour	13,664	$2,807,833.00
Northampton	162,594	$44,989,493.00
Northumberland	49,766	$10,337,826.00
Perry	50,717	$11,577,861.00
Philadelphia	675,707	$176,337,295.00
Pike	31,375	$7,050,372.00
Potter	17,165	$3,118,001.00
Schuylkill	63,866	$14,179,941.00
Snyder	29,141	$6,495,496.00
Somerset	45,568	$9,308,342.00
Sullivan	14,199	$2,494,683.00
Susquehanna	15,445	$2,847,329.00
Tioga	3,931	$795,829.00
Union	28,011	$6,454,644.00
Venango	26,812	$5,215,311.00
Warren	15,350	$2,947,043.00
Washington	72,283	$16,000,935.00
Wayne	29,552	$6,220,852.00
Westmoreland	211,720	$50,145,162.00
Wyoming	26,495	$5,721,765.00

Table 4.3.14-5 Potential jurisdictional losses due to tornados.

COUNTY	TOTAL NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
York	209,096	$52,263,528.00
Grand Total	***6,127,881***	***$1,579,087,105.00***

4.3.14.9. State Facility Loss Estimation

State facility loss estimates were calculated by summing the replacement cost of all state critical facilities located within the tornado hazard area defined in section 4.3.14.6. The estimated replacement cost of all state critical facilities located in tornado zones is approximately $32,255,517,320.

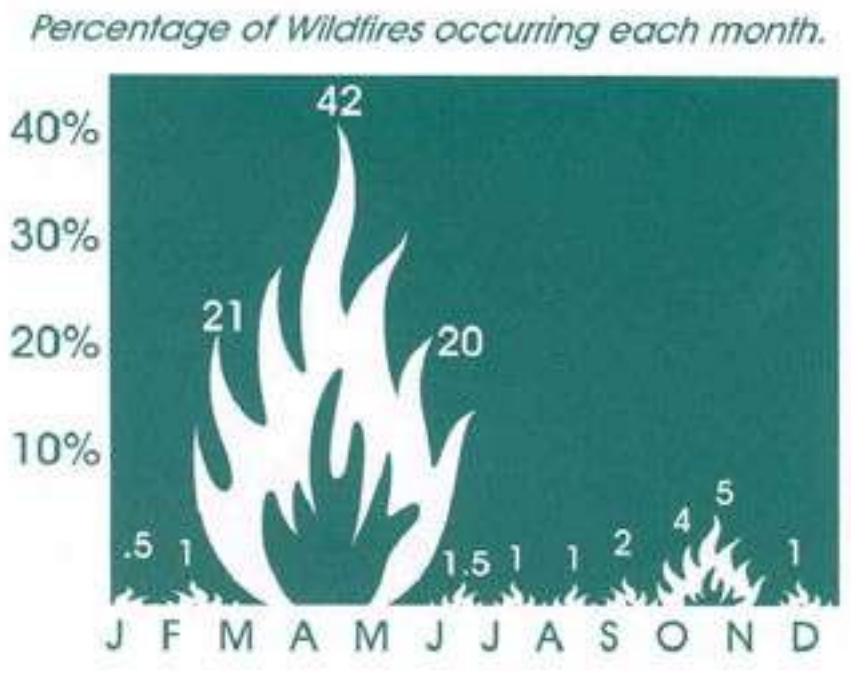
4.3.15. Wildfire

4.3.15.1. Location and Extent

Wildfires occur throughout wooded and open vegetation areas of Pennsylvania. They can occur any time of the year, but mostly occur during long, dry hot spells. 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 strikes and in rare instances, spontaneous combustion.

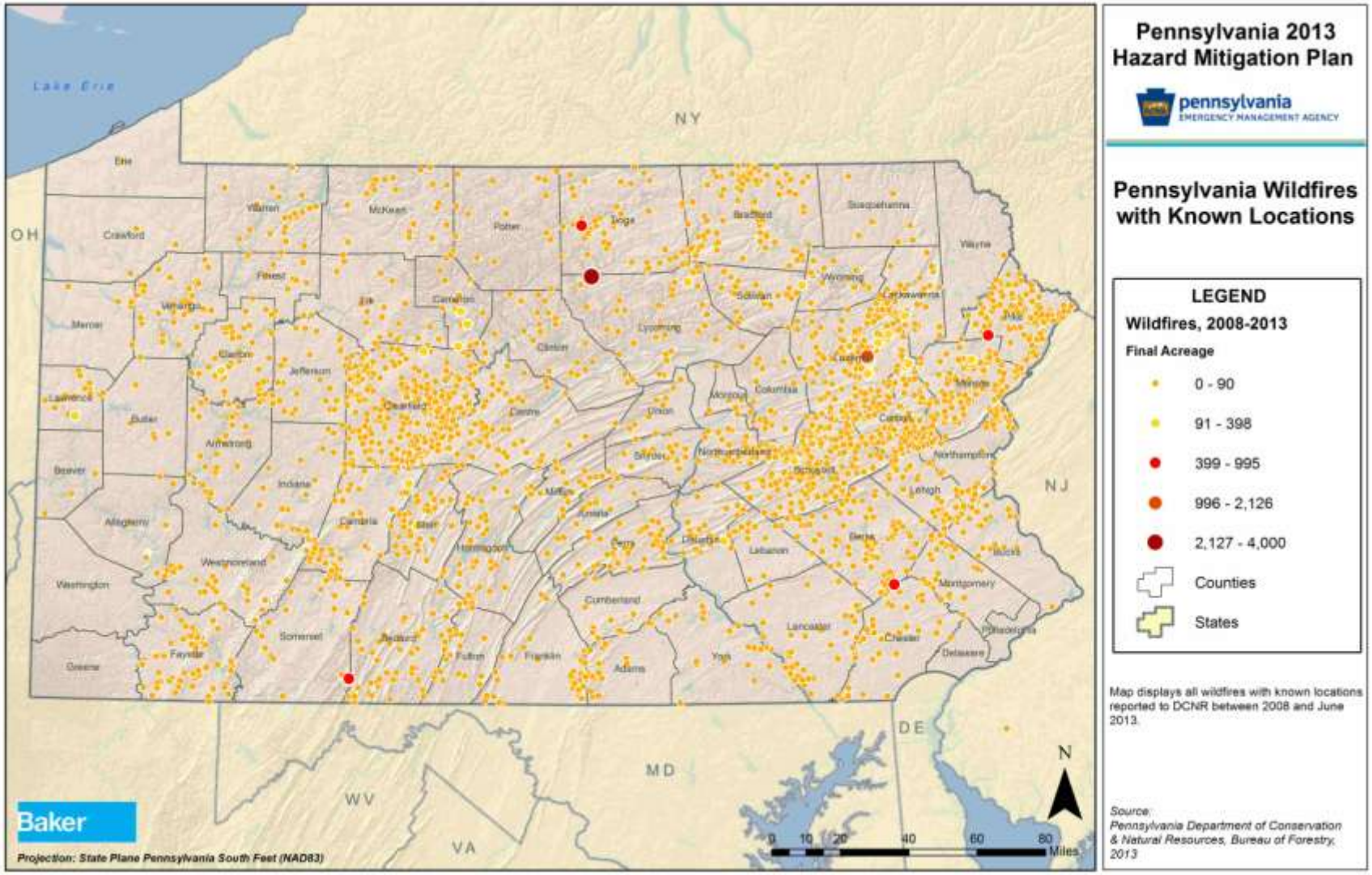
Open fields, grass, dense brush and forest-covered areas are typical sites for wildfire events. Under dry conditions or droughts, wildfires have the potential to burn forests as well as croplands. The greatest potential for wildfires is in the spring months of March, April and May, and, to a lesser extent, 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. 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 (PA DCNR, 2013).



Most wildfires in Pennsylvania are caused by people, often by debris burns (PADCNR-BOF, 2010). 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. Figure 4.3.15-2 shows the locations wildfires that the Bureau of Forestry (BOF) *responded to* since 2002. This data from 2002-June 2013, and all the wildfire data in this section, represents the best available data for wildfires. Wildfires are known to be an under reported. Many wildfires occur every year and are suppressed by volunteer fire departments without any response or assistance from the BOF. To date, information on the number and size of these fires is not located in any central point. It is estimated that there are approximately 5,000 to 10,000 wildfires occurring annually in Pennsylvania. By far the most wildfires have occurred in Clearfield, Schuylkill, and Luzerne Counties.

Figure 4.3.15-2 Map showing location of wildfire events with known locations reported to DCNR across Pennsylvania (PADCNR-BOF, 2013).



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 could burn in areas of Monroe or Pike Counties. In Monroe County in particular, concerns about ignition of fallen limbs after strong wind storms and winter storms continue.

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 and action plan in coordination with local emergency managers. Communities at risks 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 addition to the risk wildfires pose to the general public and property owners, the safety of firefighters is also a concern. Although loss of life among firefighters does not occur often in Pennsylvania, it is always a risk. More common firefighting injuries includes 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.

The largest wildfire in Pennsylvania in recent years burned 10,000 acres in the north-central area of the Commonwealth. This fire was controlled within a week. It destroyed five cabins, but there was no loss of life. Several other fires have burned over 2,000 acres each and again have been controlled within a week of the reported start. 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.

4.3.15.3. Past Occurrence

The Pennsylvania Department of Conservation of Natural Resources, Bureau of Forestry (BOF), maintains an inventory of wildfire events dating back to 1913. This information indicates that while wildfires have occurred and will likely continue to occur annually, the total number of fires

has fallen in recent years. Table 4.3.15-1 shows this nearly 100 years of wildfire history in Pennsylvania. The most expensive year for fighting wildfires was 2006, when the estimated cost of extinction for all fires neared $1 million.

Table 4.3.15-1 Pennsylvania wildfire history (DCNR, 2013).

YEAR	NUMBER OF FIRES	ACRES BURNED	AVERAGE SIZE	COST OF EXTINCTION ($)
1913	937	386,267	412.2	$ 29,593.56
1914	1,182	360,236	304.8	$ 32,535.83
1915	1,080	340,634	315.4	$ 27,154.94
1916	1,012	143,295	141.6	$ 13,760.86
1917	1,902	286,184	150.5	$ 27,831.28
1918	1,625	227,485	140.0	$ 30,166.12
1919	950	126,626	133.3	$ 15,839.21
1920	1,597	256,158	160.4	$ 55,538.10
1921	2,409	188,536	78.3	$ 60,941.12
1922	3,628	331,566	91.4	$ 185,201.55
1923	3,538	375,737	106.2	$ 158,825.45
1924	1,997	95,792	48.0	$ 85,777.64
1925	2,562	125,150	48.8	$ 63,793.35
1926	2,917	224,256	76.9	$ 177,353.41
1927	1,246	37,680	30.2	$ 28,856.14
1928	2,534	111,631	44.1	$ 99,380.14
1929	2,467	41,929	17.0	$ 59,367.33
1930	6,790	312,300	46.0	$ 675,943.52
1931	4,020	150,140	37.3	$ 200,143.09
1932	4,898	95,141	19.4	$ 171,429.95
1933	2,028	28,598	14.1	$ 43,760.63
1934	4,188	179,727	42.9	$ 146,624.42
1935	3,507	72,551	20.7	$ 92,119.85
1936	2,926	35,328	12.1	$ 76,062.77
1937	2,470	35,364	14.3	$ 54,137.62
1938	3,467	57,590	16.6	$ 104,336.84
1939	4,790	72,287	15.1	$ 195,912.67
1940	2,411	33,972	14.1	$ 71,881.86
1941	4,084	109,116	26.7	$ 204,385.27
1942	2,010	71,386	35.5	$ 101,133.20
1943	2,117	67,826	32.0	$ 118,771.21
1944	1,723	68,001	39.5	$ 84,943.42
1945	865	26,366	30.5	$ 40,960.39
1946	2,171	47,931	22.1	$ 89,413.56
1947	1,495	52,494	35.1	$ 124,148.65
1948	871	13,016	14.9	$ 32,401.30
1949	1,540	32,723	21.2	$ 88,151.34
1951	858	33,959	39.6	$ 65,942.14
1952	1,653	68,823	41.6	$ 228,056.49
1653	1,414	33,148	23.4	$ 274,457.69
1954	947	21,275	22.5	$ 96,405.78

Table 4.3.15-1 Pennsylvania wildfire history (DCNR, 2013).

YEAR	NUMBER OF FIRES	ACRES BURNED	AVERAGE SIZE	COST OF EXTINCTION ($)
1955	1,258	33,783	26.9	$ 167,187.49
1956	559	6,940	12.4	$ 29,754.95
1957	1,250	37,077	29.7	$ 144,824.45
1958	912	15,537	17.0	$ 64,470.12
1959	984	25,812	26.2	$ 90,650.83
1960	1,257	33,324	26.5	$ 179,476.52
1961	537	3,104	5.8	$ 44,871.66
1962	1,773	44,315	25.0	$ 323,696.69
1963	2,641	44,583	16.9	$ 659,436.01
1964	1,909	27,098	14.2	$ 436,923.45
1965	1,207	12,835	10.6	$ 199,268.69
1966	1,353	13,276	9.8	$ 317,896.12
1967	918	5,264	5.7	$ 178,169.18
1968	1,454	13,039	9.0	$ 197,748.90
1969	1,735	16,507	9.5	$ 194,011.00
1970	907	4,508	5.0	$ 104,303.00
1971	1,607	14,901	9.3	$ 248,867.00
1972	1,000	3,881	3.9	$ 94,655.00
1973	1,000	3,930	3.9	$ 111,662.00
1974	1,446	8,231	5.7	$ 226,315.00
1975	1,323	5,755	4.3	$ 183,637.00
1976	1,781	14,852	8.3	$ 431,470.00
1977	1,630	10,402	6.4	$ 296,390.00
1978	1,149	5,091	4.4	$ 201,401.00
1979	1,544	8,514	5.5	$ 256,363.00
1980	1,864	8,606	4.6	$ 440,971.00
1981	1,827	13,440	7.4	$ 391,466.00
1982	1,536	9,396	6.1	$ 404,841.00
1983	948	4,038	4.3	$ 260,117.00
1984	800	3,886	4.9	$ 175,808.00
1985	1,284	6,537	5.1	$ 329,613.00
1986	1,640	16,192	9.9	$ 471,247.00
1987	1,331	5,290	3.9	$ 253,278.00
1988	1,761	6,803	3.9	$ 657,523.00
1989	1,327	9,527	7.2	$ 371,381.00
1990	829	15,541	18.59	$ 370,287.00
1991	1,330	3,820	2.87	$ 474,286.00
1992	876	1,926	2.20	$ 170,817.00
1993	653	3,318	5.08	$ 244,323.00
1994	903	4,537	5.24	$ 423,484.00
1995	1,034	3,459	3.35	$ 419,194.00
1996	397	1,712	4.30	$ 229,585.00
1997	967	4,023	4.16	$ 589,152.00
1998	910	6,013	6.61	$ 736,103.00
2000	744	4,702	6.32	$ 598,394.00

Table 4.3.15-1 Pennsylvania wildfire history (DCNR, 2013).

YEAR	NUMBER OF FIRES	ACRES BURNED	AVERAGE SIZE	COST OF EXTINCTION ($)
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	13.7	$ 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	11.1	$ 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
TOTAL	***160,201***	***5,973,267***	***35***	***$24,409,571.17***

4.3.15.4. Future Occurrence

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. Weather conditions, particularly drought events, increase the likelihood of wildfires occurring. Additionally, invasive forest insects can increase the likelihood of wildfires occurring; insects that attack and kill trees increase the total wildfire fuel available in wooded areas. Climate change is also likely to increase the probability of future wildfires. Prolonged periods of drought caused by climate change can potentially increase the length of the wildfire season and provide a more favorable climate for ignition.

It is important to note that 98% of wildfires in Pennsylvania are human-caused (PADCNR-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.

4.3.15.5. Environmental Impacts

Vegetation loss is often a concern, but it typically is not a serious impact since natural re-growth occurs with time. The most significant environmental impact is the potential for severe erosion, silting of stream beds and reservoirs, and flooding due to ground-cover loss following a fire event.

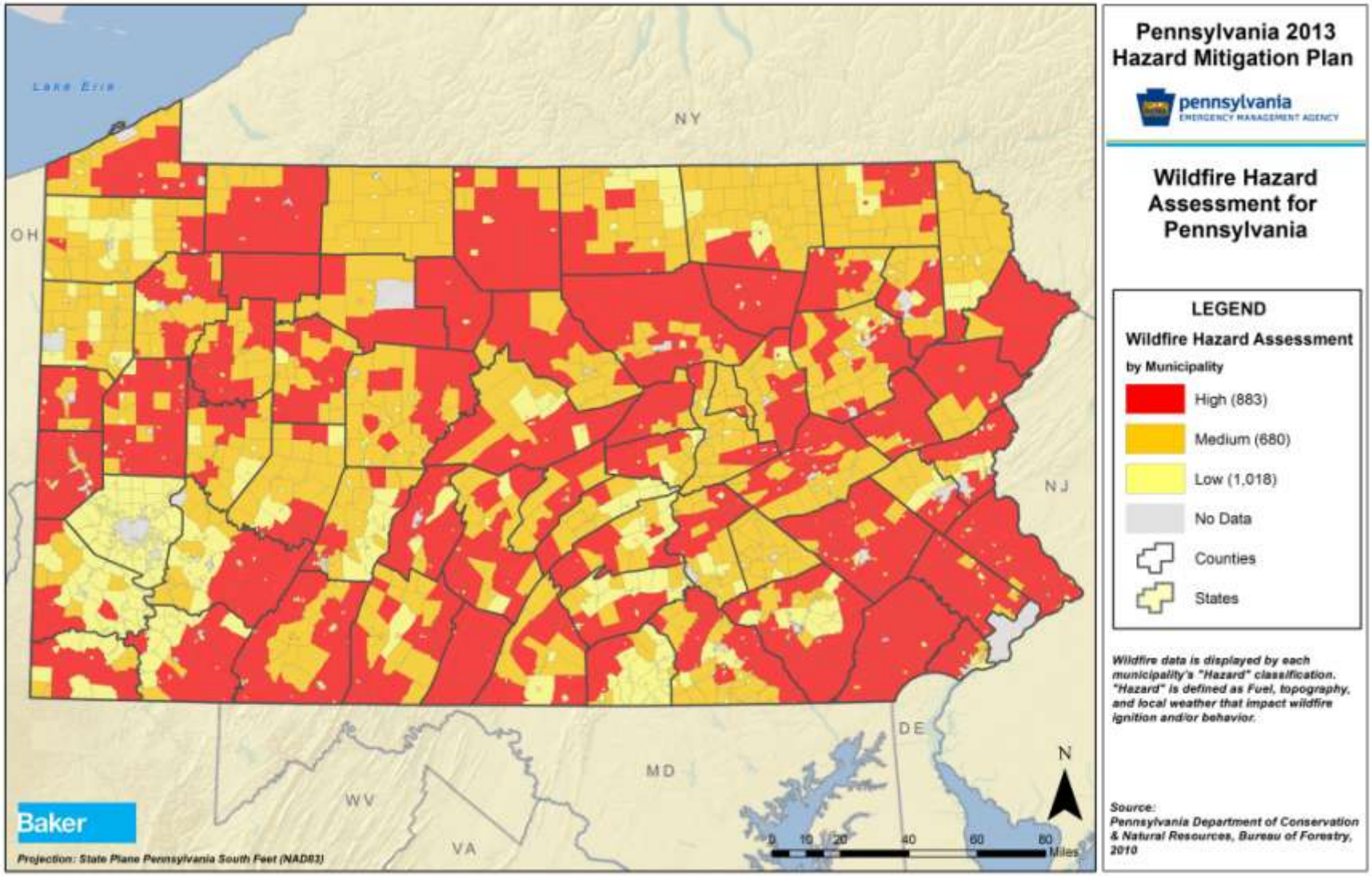
Wildfires also have a positive environmental impact in that they burn dead trees, leaves, and grasses to allow more open spaces for new and different types of vegetation to grow and receive sunlight. Another positive effect of a wildfire is that it stimulates the growth of new shoots on trees and shrubs and its heat can open pine cones and other seed pods.

4.3.15.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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 Pennsylvania Department of Conservation of Natural Resources, BOF conducts jurisdictional assessments of wildfire hazard throughout the Commonwealth. This analysis was completed in 2009 and represents the best available information on areas of wildfire hazards. *Hazard* is defined by fuel, topography, and local weather that impact wildfire ignition and/or behavior. In other words, the wildfire *hazard* expresses which jurisdictions are most vulnerable to wildfires, shown in Figure 4.3.15-3.

Figure 4.3.15-3 Map showing wildfire *hazard* by jurisdiction across Pennsylvania.



Another component of jurisdictional vulnerability involves examining the number of past wildfire occurrences and their respective acres burned. Table 4.3.15-2displays number of reported wildfires and acres burned per county. In terms of number of past wildfires, Clearfield County is the most vulnerable with 358 wildfire events. Lycoming County is most vulnerable to large-scale wildfires; from 2002-2008 this county only had 36 events but they burned an average of 123.7 acres.

Table 4.3.15-2 Number of reported wildfires and acres burned per county from 2002-2013 (PADCNR, 2013)

COUNTY	WILDFIRES	ACRES BURNED	COUNTY	WILDFIRES	ACRES BURNED
Adams	19	12.86	Lackawanna	59	731.1
Allegheny	24	6.6	Lancaster	51	58.924
Armstrong	38	101.91	Lawrence	22	155.9
Beaver	4	14.5	Lebanon	16	26.55
Bedford	58	306.62	Lehigh	64	56.99
Berks	162	852.99	Luzerne	252	4237.56
Blair	37	448.5	Lycoming	36	4453.27
Bradford	135	208.13	McKean	26	201.07
Bucks	13	10.62	Mercer	6	8.5
Butler	5	7.15	Mifflin	16	60.89
Cambria	47	309.537	Monroe	117	317.06
Cameron	22	867.518	Montgomery	19	15.1
Carbon	189	239.32212	Montour	7	13.1
Centre	87	299.1841	Northampton	62	95.47
Chester	41	170.8	Northumberland	103	115.13
Clarion	37	358.4	Perry	55	92.28
Clearfield	358	832.34829	Pike	146	1161.52
Clinton	28	345.251	Potter	14	156.86
Columbia	22	65.55	Schuylkill	261	798.87
Crawford	4	5.33	Snyder	18	89.6
Cumberland	10	18.76	Somerset	21	608.52
Dauphin	35	304.05	Sullivan	26	215.61
Elk	23	233.6316	Susquehanna	9	19
Erie	1	2.6	Tioga	50	1008.2
Fayette	87	203.55	Union	10	18.11
Forest	4	112.7	Venango	44	91.07
Franklin	48	154.69	Warren	33	286.155
Fulton	18	10.16	Wayne	2	7
Huntingdon	49	210.64	Westmoreland	37	135.6
Indiana	23	101.35	Wyoming	10	39.25
Jefferson	31	107.96	York	25	36.4
Juniata	14	66.19	***Total***	***3,290***	***22,300.06***

The final component of wildfire vulnerability is the how much forested land and agricultural land in each county. All agricultural land is somewhat vulnerable to wildfire, as its open nature and frequent proximity to forested lands can fuel wild land fires. While all agricultural land is somewhat vulnerable to wildfire for these reasons, woodlands and idle croplands are a particularly vulnerable sub-type of agricultural land vulnerable to wildfires. Table 4.3.15-3 shows the total acres land in farms as well as the total acreage of woodlands and idle cropland per county as reported to the 2007 Census of Agriculture. Please note that this does not indicate all wooded or idle lands per county, just those woodlands and idle cropland in farms.

Table 4.3.15-3 Farmland, woodland, and idle cropland by county (USDA, Census of Agriculture, 2007).

COUNTY	TOTAL ACRES OF LAND IN FARMS	TOTAL ACRES OF WOODLAND	TOTAL ACRES OF IDLE CROPLAND
Adams	174,595	25,393	6,768
Allegheny	38,023	10,560	5,444
Armstrong	122,275	30,196	8,355
Beaver	67,075	18,232	5,210
Bedford	210,990	58,145	7,989
Berks	222,119	21,778	7,816
Blair	87,434	15,783	3,637
Bradford	266,635	70,680	18,488
Bucks	75,883	7,366	2,153
Butler	129,850	27,792	6,273
Cambria	87,924	22,532	7,120
Cameron	5,092	2,087	(D)
Carbon	20,035	5,978	1,801
Centre	148,464	42,008	5,660
Chester	166,891	18,095	2,758
Clarion	132,140	42,875	11,037
Clearfield	62,721	20,373	3,702
Clinton	56,626	14,644	3,611
Columbia	122,621	22,905	15,774
Crawford	232,093	55,047	9,550
Cumberland	157,388	16,120	9,364
Dauphin	89,533	11,277	5,179
Delaware	4,361	1,811	(D)
Elk	33,258	14,650	2,344
Erie	173,125	41,485	13,449
Fayette	140,688	40,109	8,702
Forest	10,728	5,374	(D)
Franklin	242,634	26,451	6,589
Fulton	103,516	36,245	6,637
Greene	150,203	45,325	8,490
Huntingdon	148,289	52,593	7,449
Indiana	187,711	46,117	19,415

Table 4.3.15-3 Farmland, woodland, and idle cropland by county (USDA, Census of Agriculture, 2007).

COUNTY	TOTAL ACRES OF LAND IN FARMS	TOTAL ACRES OF WOODLAND	TOTAL ACRES OF IDLE CROPLAND
Jefferson	87,043	22,534	6,643
Juniata	97,681	27,006	5,427
Lackawanna	39,756	10,868	4,699
Lancaster	425,336	30,545	4,884
Lawrence	92,391	12,809	3,640
Lebanon	113,486	7,679	2,216
Lehigh	84,643	5,880	2,412
Luzerne	66,577	19,562	6,859
Lycoming	160,456	52,399	13,757
McKean	41,466	16,333	1,411
Mercer	171,860	32,028	7,404
Mifflin	94,133	21,893	4,175
Monroe	29,165	10,970	1,798
Montgomery	41,908	5,580	2,861
Montour	50,252	9,482	9,108
Northampton	68,252	4,210	2,220
Northumberland	147,660	22,448	11,724
Perry	144,375	35,390	9,941
Philadelphia	262	67	592
Pike	27,569	22,688	5,302
Potter	88,457	32,421	10,033
Schuylkill	118,501	24,550	5,511
Snyder	100,179	21,228	15,130
Somerset	206,651	52,057	1,012
Sullivan	27,821	8,462	9,610
Susquehanna	158,218	51,510	11,906
Tioga	184,108	49,615	3,864
Union	63,795	5,818	2,616
Venango	64,796	24,431	7,741
Warren	99,582	39,865	12,595
Washington	211,053	50,663	1,984
Wayne	92,939	29,530	12,513
Westmoreland	167,489	29,575	9,766
Wyoming	77,957	24,253	11,023
York	292,507	33,416	6,768
TOTAL	***7,809,244***	***1,717,791***	***433,785***

NOTE: Data marked with a (D) has been withheld by the Census to avoid disclosing data for individual operations.

In addition to the jurisdictions with a high wildfire hazard value, Table 4.3.15-4 shows which counties did and did not profile wildfires in their most recent hazard mitigation plan, along with any risk factor/ranking information. 50 of 67 counties profiled this hazard. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 32 counties which currently have calculated risk factor values for wildfire, the average value is 2.4; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for wildfire is 2.4, while the Pennsylvania THIRA scored wildfire as a 5 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.15-4 Counties profiling wildfire hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.4
Allegheny	X		High	2.7
Armstrong	X		Not Ranked	No RF
Beaver		X		
Bedford	X		Medium	2.2
Berks	X		Not Ranked	No RF
Blair	X		Not Ranked	No RF
Bradford		X		
Bucks	X		Medium	2.2
Butler	X		Low	1.8
Cambria	X		High	2.5
Cameron	X		High	2.8
Carbon	X		High	2.8
Centre	X		Low	1.7
Chester		X		
Clarion		X		
Clearfield	X		Low	1.8
Clinton	X		High	2.7
Columbia	X		Low	1.7
Crawford		X		
Cumberland	X		Medium	2.4
Dauphin	X		Not Ranked	No RF

Table 4.3.15-4 Counties profiling wildfire hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Delaware	X		Medium	2.1
Elk	X		High	2.6
Erie		X		
Fayette	X		High	3.0
Forest		X		
Franklin	X		Not Ranked	No RF
Fulton		X		
Greene		X		
Huntingdon	X		Not Ranked	No RF
Indiana		X		
Jefferson	X		Medium	2.3
Juniata	X		Low	1.3
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Low	1.8
Lawrence	X		High	3.4
Lebanon*	X		Not Ranked	1.0
Lehigh	X		Medium	2.2
Luzerne	X		Not Ranked	No RF
Lycoming		X		
McKean	X		High	2.7
Mercer	X		Low	1.9
Mifflin	X		Not Ranked	No RF
Monroe	X		High	2.8
Montgomery	X		Medium	2.0
Montour*		X		
Northampton	X		Medium	2.2
Northumberland	X		Low	1.5
Perry*	X		Not Ranked	1.0
Philadelphia**		X		
Pike	X		High	3.1
Potter		X		
Schuylkill	X		Not Ranked	No RF
Snyder	X		Medium	2.4

Table 4.3.15-4 Counties profiling wildfire hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Somerset	X		High	3.4
Sullivan	X		Not Ranked	No RF
Susquehanna	X		Medium	2.0
Tioga	X		High	2.6
Union	X		Not Ranked	No RF
Venango	X		Medium	2.4
Warren	X		Medium	2.4
Washington		X		
Wayne		X		
Westmoreland		X		
Wyoming	X		Not Ranked	No RF
York	X		Low	1.9

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

The jurisdictions vulnerable to wildfire hazards are home to 1,538 state critical facilities, shown inTable 4.3.15-5. The average vulnerable county hosts about 25 vulnerable critical facilities. Geographically, over one-third of the vulnerable critical facilities are located in the southeastern Pennsylvania counties of Montgomery, Bucks, and Chester.

Table 4.3.15-5 Number of state critical facilities impacted by wildfire located in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	7	Jefferson	21
Armstrong	28	Lackawanna	57
Beaver	83	Lancaster	52
Bedford	14	Lawrence	20
Berks	74	Lehigh	17
Blair	30	Luzerne	48
Bradford	6	Lycoming	30
Bucks	85	Mifflin	12
Butler	44	Monroe	20
Cambria	17	Montgomery	157

Table 4.3.15-5 Number of state critical facilities impacted by wildfire located in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Cameron	3	Montour	7
Carbon	38	Northampton	22
Centre	31	Northumberland	22
Chester	102	Perry	3
Clarion	9	Pike	17
Clearfield	12	Potter	7
Clinton	1	Schuylkill	74
Columbia	19	Snyder	7
Crawford	1	Somerset	22
Cumberland	6	Sullivan	6
Dauphin	13	Susquehanna	9
Delaware	62	Tioga	3
Elk	6	Union	4
Erie	11	Venango	13
Fayette	37	Warren	20
Forest	5	Washington	6
Franklin	9	Wayne	2
Fulton	6	Westmoreland	42
Greene	12	Wyoming	5
Huntingdon	11	York	18
Indiana	13	**Grand Total**	**1,538**

In Pennsylvania, 36 communities have taken steps to reduce their wildfire vulnerability by joining the Firewise. Firewise participation is outlined in more detail in 0

Summary & Evaluation of Local Mitigation Capability.

4.3.15.7. State Facility Vulnerability Assessment

State facility vulnerability to wildfires was evaluated as facilities that are located within a high-hazard municipality. Using this criterion, it was determined that over 25% of all critical facilities fall into these highest hazard wildfire areas, seen in 0 There are five government facilities potentially impacted by wildfires. It is important to note that while they are not considered critical facilities, Pennsylvania's many state parks, state game lands, and state forests are also highly susceptible to wildfire events by nature.

Table 4.3.15-6 State Critical Facilities vulnerable to wildfire by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	21
Banking	7
Chemical	4
Commercial Facilities	15
Communications	1
Dams	16
Defense Industrial Base	6
Education	34
Emergency Services	20
Energy	16
Fire Departments (Non-HSIP)	691
Government Facilities	5
Healthcare & Public Health	14
Hospital (Non-HSIP)	66
National Monuments & Icons	1
Nuclear Reactors, Materials & Waste	1
Police (Non-HSIP)	311
Postal & Shipping	1
School (Non-HSIP)	294
Transportation	10
Water	4
Grand Total	***1,538***

4.3.15.8. Jurisdictional Loss Estimation

According to the National Climatic Data Center, there were 54 wildfire events from 1950-2013 with reported property damage of $1,405,000. This is considered a broad estimate of jurisdictional losses. As stated in Section 4.3.9.6, loss estimates were prepared based on the sum of the number and value of buildings located within wildfire high-hazard jurisdictions, aggregated to the county level. Using this technique, Montgomery County was identified as the jurisdiction most threatened by wildfire hazards with $127 billion in exposed building and contents value (0). Bucks, Berks, Chester, Delaware, and Lancaster counties are also highly threatened by wildfire events. Each of these counties has over 100,000 exposed buildings worth $30-95 billion.

Table 4.3.15-7 Estimated jurisdictional losses in wildfire High Hazard areas

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS ($)
Adams	22,674	$5,142,810
Allegheny	1,652	$368,265
Armstrong	20,817	$4,264,530
Beaver	80,852	$20,992,541
Bedford	28,139	$4,903,310
Berks	140,619	$37,688,000
Blair	42,693	$8,731,004
Bradford	5,552	$907,751
Bucks	278,182	$95,375,042
Butler	76,927	$18,429,749
Cambria	24,095	$4,869,669
Cameron	39,323	$6,905,571
Carbon	63,207	$14,565,129
Centre	56,951	$11,838,361
Chester	243,231	$85,689,971
Clarion	33,351	$5,982,911
Clearfield	22,597	$3,815,979
Clinton	31,296	$5,478,425
Columbia	29,470	$5,599,327
Crawford	8,445	$1,773,876
Cumberland	32,568	$7,933,629
Dauphin	25,379	$5,827,216
Delaware	153,931	$54,635,123
Elk	19,910	$3,679,290
Erie	33,325	$7,325,002
Fayette	37,606	$7,147,592
Forest	30,106	$5,119,416
Franklin	34,715	$7,566,621
Fulton	14,699	$2,657,617
Greene	12,315	$2,352,567
Huntingdon	31,874	$6,061,297
Indiana	24,340	$4,841,493
Jefferson	24,073	$4,404,597
Juniata	15,877	$2,859,639
Lackawanna	57,729	$12,812,741
Lancaster	122,814	$30,296,942
Lawrence	28,264	$6,046,921
Lehigh	55,959	$17,377,468
Luzerne	75,836	$17,488,995

Table 4.3.15-7 Estimated jurisdictional losses in wildfire High Hazard areas

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS ($)
Lycoming	55,457	$10,416,509
Mckean	3,504	$640,829
Mifflin	22,555	$4,453,176
Monroe	92,982	$22,120,898
Montgomery	366,737	$127,701,377
Montour	1,955	$822,789
Northampton	71,559	$20,456,956
Northumberland	17,858	$3,716,933
Perry	31,551	$7,440,292
Philadelphia	17,542	$5,721,785
Pike	48,641	$11,878,628
Potter	38,280	$6,625,976
Schuylkill	56,149	$11,654,800
Snyder	15,205	$3,114,066
Somerset	48,522	$9,407,900
Sullivan	24,267	$4,320,707
Susquehanna	13,504	$2,608,801
Tioga	12,880	$2,199,234
Union	30,651	$6,067,339
Venango	20,926	$3,663,769
Warren	31,166	$5,799,808
Washington	11,493	$2,323,382
Wayne	23,196	$5,079,273
Westmoreland	50,905	$11,214,851
Wyoming	19,631	$3,666,036
York	96,189	$23,154,898
Grand Total	***3,304,698***	***$866,027,399***

4.3.15.9. State Facility Loss Estimation

The estimated replacement cost of all State Critical Facilities located in High Hazard jurisdictions is $9,464,720,342. The exact losses will depend on the construction material of each facility, its location in relation to wooded areas, and the size and intensity of the wildfire event itself.

4.3.16. Winter Storm

4.3.16.1. Location and Extent

Winter storms are regional events. An event most often impacts a large swath or all of Pennsylvania. In many cases, surrounding states and even the larger northeastern U.S. region are affected.

4.3.16.2. Range of Magnitude

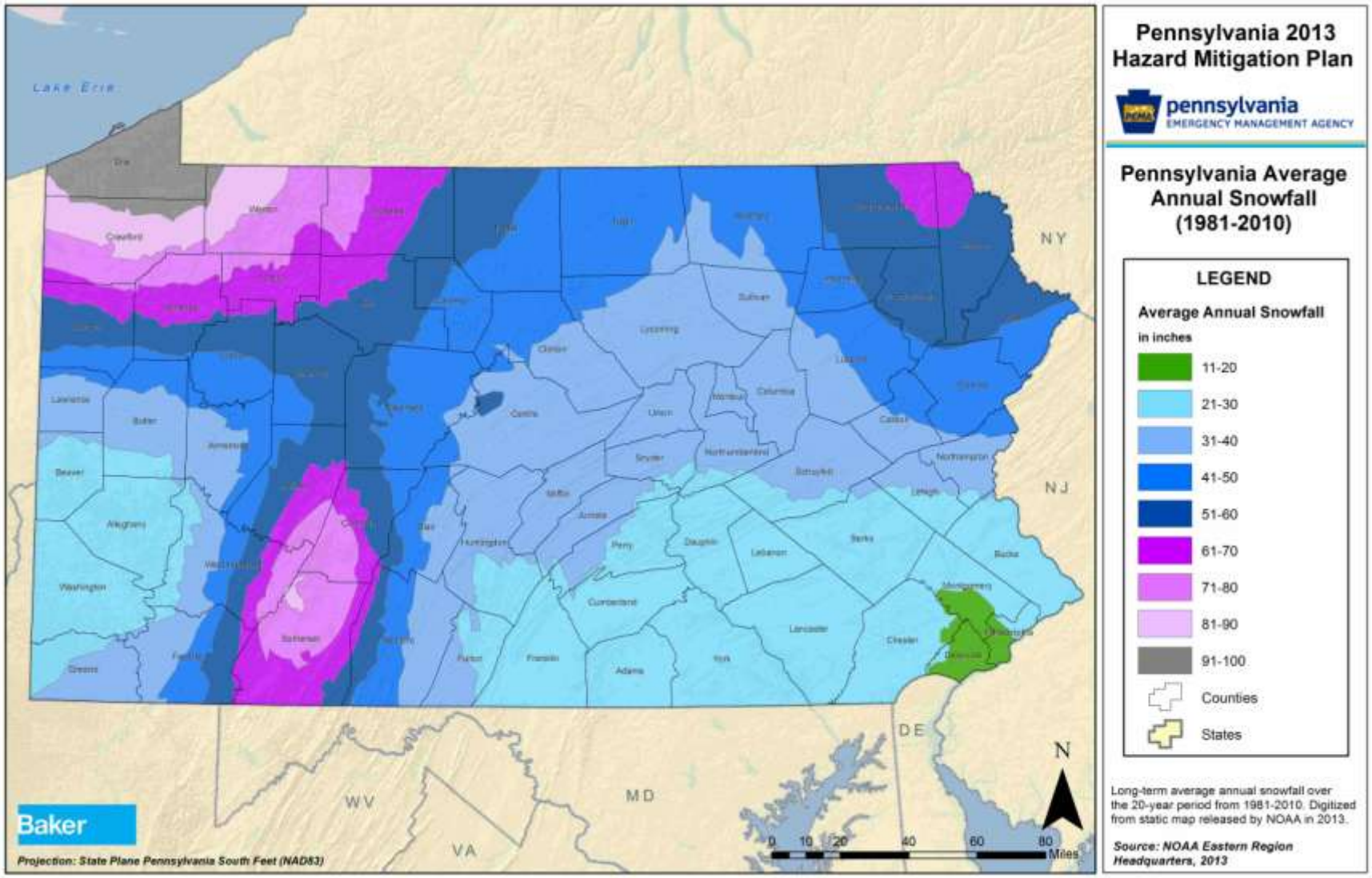
Winter storms consist of cold temperatures, heavy snow or ice and sometimes strong winds. They begin as low-pressure systems that move through Pennsylvania usually following the jet stream. Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific 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. These storms typically fall into one of the following categories:

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

Average annual snowfall across Pennsylvania ranges from 11 inches in the southeast to over 100inches inches in the northwest (see Table 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. Orographic lift enhances snowfall over higher elevations (note particularly higher average snowfall in Somerset County in the Allegheny Mountains). The snowfall season is November through April, and amounts are generally below one inch during October and May. The greatest monthly snowfalls occur in March as moisture supply begins to increase with rising temperatures.

Figure 4.3.16-1 Pennsylvania mean annual snowfall (NOAA NWS, 2012).



A summary of the most extreme snowfall events as well as the greatest snowfall depth recorded in Pennsylvania is provided in Table 4.3.16-1.

Table 4.3.16-1 Summary of Pennsylvania snowfall and snow depth extremes (NCDC, 2010)

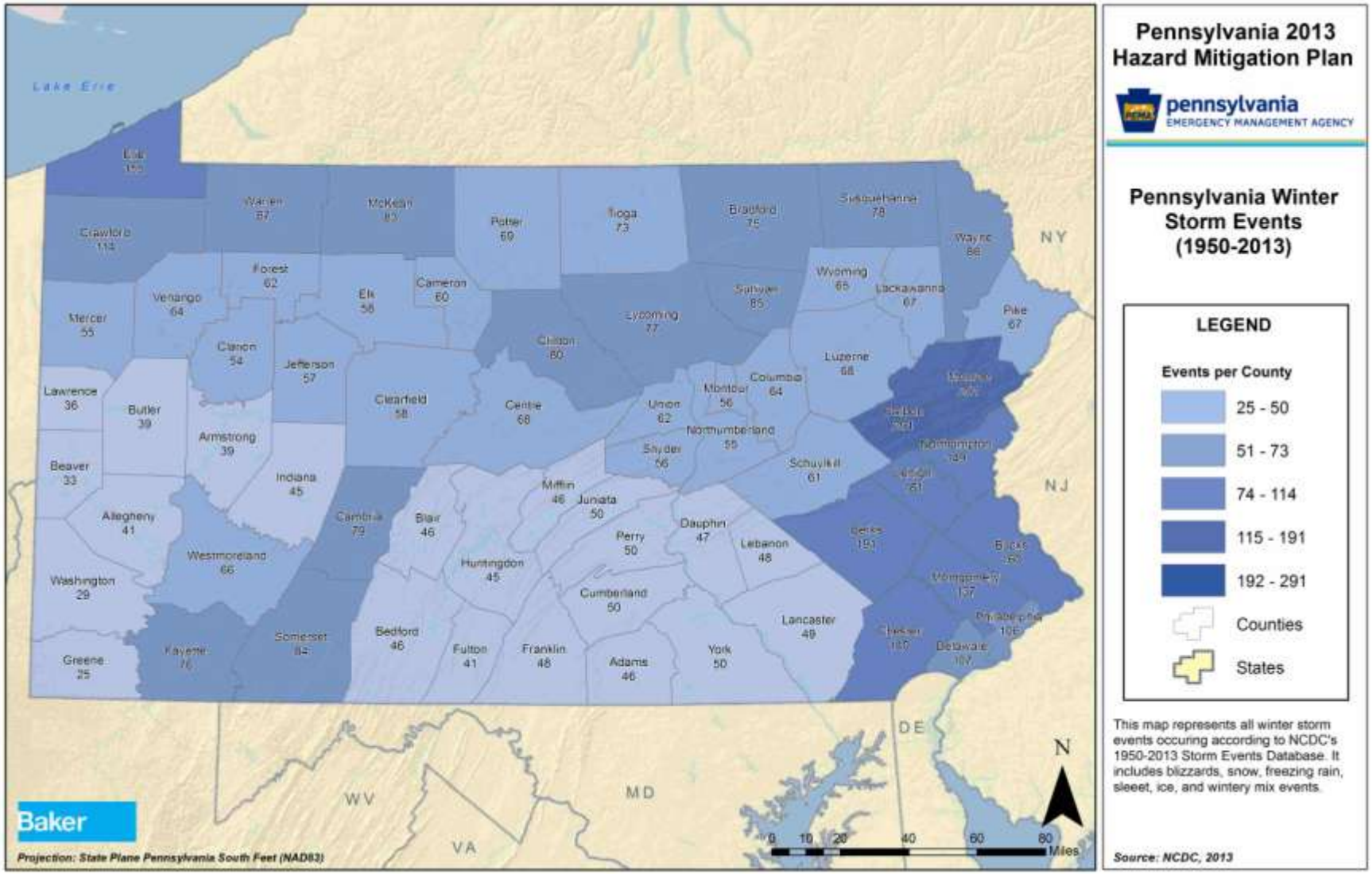
CATEGORY	SNOW AMOUNT (INCHES)	STATION LOCATION	ENDING DATE
Greatest daily snowfall	38	Morgantown	3/20/1958
Greatest 2-day snowfall (snowed both days)	45.3	Coatesville 1 SW	2/14/1899
Greatest 3-day snowfall (snowed all 3 days)	52.4	Coatesville 1 SW	2/14/1899
Greatest 4-day snowfall (snowed all 4 days)	53	Coatesville 1 SW	2/14/899
Greatest 5-day snowfall (snowed all 5 days)	43	Emporium 1 E	12/29/1944
Greatest 6-day snowfall (snowed all 6 days)	50	Emporium 1 E	12/29/1944
Greatest 7-day snowfall (snowed all 7 days)	57	Emporium 1 E	12/29/1944
Greatest monthly snowfall total	84.4	Ebensburg Sewage Plant	January 1978
Greatest Aug-July snowfall total	186.1	Ebensburg Sewage Plant	1978
Greatest daily snow depth	55	Beavertown 1 NE	1/13/1996

The worst winter storm on record occurred on March 12-13, 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; snowfall totals ranged from twelve inches in Philadelphia to 20 inches in Harrisburg and Scranton to 24 inches in the Pittsburgh area. This event garnered a Presidential Emergency Declaration; the overall damage estimate for all states in this event was $6.6 billion.

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 storm events by county across Pennsylvania between 1950 and 2013. While this map implies that certain areas have experienced significantly more events than others, the true distribution of past events throughout the Commonwealth is likely more uniform.

Figure 4.3.16-2 Map showing the number of winter storm events by county across Pennsylvania (NCDC, 2013).



In the winter of 1993-1994, 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 in excess of 33 inches across southwest and south-central portions of the Commonwealth, strong winds and sleet/freezing rains. Numerous storm-related power outages were reported and as many as 600,000 residents were without electricity, in some cases for several days at a time. A ravaging ice storm followed, affecting the southeastern portion of the Commonwealth, which closed major arterial roads and downed trees and power lines. 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.

Serious power supply shortages continued through mid-January because of record cold temperatures at many places, causing sporadic power generation outages across the Commonwealth. The entire Pennsylvania-New Jersey-Maryland grid and its partners in the District of Columbia, New York and Virginia experienced 15-30 minute rolling blackouts, threatening the lives of people and the safety of the facilities in which they resided. Power and fuel shortages affecting Pennsylvania and the East Coast power grid system required the Governor to recommend power conservation measures be taken by all commercial, residential and industrial power consumers.

The record cold conditions 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. As a result, trucks were dispatched to haul salt from New York to expedite deliveries to Pennsylvania Department of Transportation storage sites.

During January and February 1994, Pennsylvania experienced at least seventeen regional or statewide winter storms. 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 (Weather Underground, 2010). These storms crippled many areas of Pennsylvania. Additional notable storms from this record-setting winter occurred on February 9-10, 2010 and February 25-26, 2010.

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: http://vlb.ncdc.noaa.gov/ussc/USSCAppController?action=options&state=36.

4.3.16.5. Environmental Impacts

Environmental impacts often include damage 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 surface and ground waters. This is particularly a concern in highly urban areas such as Philadelphia, Pittsburgh, and Harrisburg. Another important secondary impact for winter storms is building or structure collapses; if there is a heavy snowfall or a significant accumulation over time, the weight of the snow may cause building damage or even collapse.

Winter storms have a positive environmental impact as well; gradual melting of snow and ice provides excellent groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

4.3.16.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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.

As stated in Section 4.3.16.1, much of the Commonwealth experiences winter storm events. Even areas that do not experience significant yearly snowfall are still vulnerable to the effects of localized snow and ice storms. However, the counties that are most vulnerable to winter storm hazards are those that experience significant snowfalls. For this analysis, jurisdictions experiencing over 70 inches of snow were considered most vulnerable to sustained winter storm hazards; the area of Pennsylvania falling under this category has shrunk from 2010-2013 to only 11 counties. However, 65 counties in Pennsylvania currently identify winter storms as a hazard, displayed in Table 4.3.16-2. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile

Of the 40 counties which currently have calculated risk factor values for winter storm hazards, the average value is 3.0. The calculated state risk factor for winter storms is 3.1, and the

Pennsylvania THIRA ranks winter storms as an 8 of 10. For more details, please see Section 4.1.

Table 4.3.16-2 Counties profiling winter storm hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.7
Allegheny	X		High	2.7
Armstrong	X		Not Ranked	No RF
Beaver	X		High	3.0
Bedford	X		High	3.3
Berks	X		Not Ranked	No RF
Blair	X		Not Ranked	No RF
Bradford		X		
Bucks	X		High	3.0
Butler	X		High	3.0
Cambria	X		High	3.3
Cameron	X		High	3.2
Carbon	X		High	3.0
Centre	X		High	3.0
Chester	X		Not Ranked	No RF
Clarion	X		Not Ranked	No RF
Clearfield		X	Medium	2.4
Clinton	X		High	3.0
Columbia	X		High	2.9
Crawford	X		High	3.0
Cumberland	X		High	2.7
Dauphin	X		Not Ranked	No RF
Delaware	X		High	3.0
Elk	X		High	3.0
Erie	X		High	3.5
Fayette	X		High	3.0
Forest	X		Not Ranked	No RF
Franklin	X		Not Ranked	No RF
Fulton	X		High	2.5
Greene	X		High	3.0
Huntingdon	X		Not Ranked	No RF

Table 4.3.16-2 Counties profiling winter storm hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Indiana	X		High	3.0
Jefferson	X		High	3.0
Juniata	X		High	3.1
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Medium	2.1
Lawrence	X		High	3.3
Lebanon*	X		Not Ranked	9.5
Lehigh	X		High	2.7
Luzerne	X		Not Ranked	No RF
Lycoming	X		High	3.7
McKean	X		High	3.0
Mercer	X		High	3.0
Mifflin	X		Not Ranked	No RF
Monroe	X		High	3.0
Montgomery	X		High	2.9
Montour*	X		Not Ranked	No RF
Northampton	X		High	2.7
Northumberland	X		High	2.9
Perry*	X		Not Ranked	9.5
Philadelphia**	X		High	A
Pike	X		High	3.1
Potter	X		Not Ranked	No RF
Schuylkill	X		Not Ranked	No RF
Snyder	X		High	3.0
Somerset	X		High	3.7
Sullivan	X		Not Ranked	No RF
Susquehanna	X		High	3.0
Tioga	X		High	3.0
Union	X		Not Ranked	No RF
Venango	X		High	2.7
Warren	X		High	2.7
Washington	X		Not Ranked	No RF
Wayne	X		Not Ranked	No RF

Table 4.3.16-2 Counties profiling winter storm hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		High	2.7

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

The ten counties most affected by winter storms host a total of 345 state critical facilities (Table 4.3.16-3). Of these counties, Crawford has the most vulnerable critical facilities with a total of 81 vulnerable facilities. Forest County has the fewest with only one state critical facility impacted by winter storms.

Table 4.3.16-3 Number of State Critical Facilities impacted by winter storms in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Cambria	74	McKean	8
Crawford	81	Somerset	52
Erie	66	Venango	7
Forest	1	Warren	42
Indiana	8	Westmoreland	6

4.3.16.7. State Facility Vulnerability Assessment

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. They could potentially affect all critical facilities, but those located in areas experiencing 70 or more inches of snowfall or more experience the most risk. These facilities are largely concentrated in northwestern Pennsylvania. The critical facilities considered most vulnerable are listed by type in Table 4.3.16-4.

Table 4.3.16-4 State Critical Facilities vulnerable to winter storms by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	4
Banking	1
Commercial Facilities	1
Critical Manufacturing	1
Dams	4
Education	9
Emergency Services	6
Energy	2
Fire Departments (Non-HSIP)	140
Government Facilities	4
Hospital (Non-HSIP)	18
National Monuments & Icons	1
Police (Non-HSIP)	60
School (Non-HSIP)	87
Transportation	1
Water	6
Grand Total	***345***

4.3.16.8. Jurisdictional Loss Estimation

In the jurisdictions affected by 70 or more inches of snowfall per year, 424,799 buildings may be impacted by winter storms. These buildings have a combined loss estimate of $90.1 billion (Table 4.3.16-5). Of the vulnerable jurisdictions, Erie County is the most threatened with 140,915 impacted buildings worth over $32 billion.

Table 4.3.16-5 Estimated jurisdictional losses due to winter storms.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS ($)
Cambria	57,174	$12,866,002.00
Crawford	69,380	$13,690,978.00
Erie	140,915	$32,417,238.00
Forest	6,717	$1,106,896.00
Indiana	12,952	$2,375,474.00
McKean	8,129	$1,667,663.00
Mercer	5,760	$1,156,082.00
Somerset	44,577	$9,573,203.00
Venango	11,309	$1,969,411.00
Warren	47,584	$9,113,823.00
Westmoreland	20,302	$4,208,113.00
Grand Total	**424,799**	**$90,144,883.00**

4.3.16.9. State Facility Loss Estimation

Winter storm hazards can cause a range of damage to state critical facilities that will depend on the magnitude and duration of storm events. Losses may be as small as lost productivity and wages when workers are unable to travel or as large as sustained roof damage or building collapse. Roof pitch and building age are typical determinants in the vulnerability of an individual structure to snow load or icing during a winter storm. However, if all the critical facilities located in winter storm hazard zones were to be destroyed in a winter storm event, the estimated replacement cost of all State Critical Facilities is $2,675,883,338.

HUMAN-MADE HAZARDS

4.3.17. Civil Disturbance

4.3.17.1. 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. Civil disturbance is typically a symptom of, and a form of protest against, major socio-political problems. 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. Additionally, Pennsylvania has 26 state correctional facilities, one motivational boot camp, 14 community corrections centers, 40 contract facilities and a training academy. In addition, Pennsylvania is home to eight federal prison facilities as well as local and private facilities that may be targets for civil unrest.

4.3.17.2. 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 (Blumer, 1946):

- **Casual Crowd:** A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
- **Cohesive Crowd:** A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.
- **Expressive Crowd:** An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are

assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.

- **Aggressive Crowd:** An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional, and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators and strikers, though not all demonstrators and strikers are aggressive.

A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent and lawless. Similar to crowds, mobs have different levels of commitment and can be classified into four categories (Alvarez and Bachman, 2007):

- **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 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 blacks, 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 23 people were dead, 725 were injured, and nearly 1,500 were arrested. A similar event could occur in one of Pennsylvania's major cities and have a comparable impact.

4.3.17.3. Past Occurrence

Over the past 265 years Pennsylvania has had a dozen civil disorders take place which were notable enough to be recorded in the state's history (Klein, 1973):

- 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 (1969)
- 1998 – State College (1998)
- 2011 – State College Paterno Riots
- 2011 – Occupy Philadelphia protests

While there have been some civil disturbances in the Commonwealth, they have largely 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. These kinds of events have been housed in two different PEMA databases in recent years: PEIRS and WebEOC. Between January 2001 and June 2009, there was an average of 19 civil disturbance events reported to PEIRS, as shown in Table 4.3.17-1 below.

Table 4.3.17-1 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*

WebEOC captured emergency and incidents reported in 2010, 2011, and 2012. Events are not available for 2013. WebEOC categorized events differently than PEIRS did, but in general, events with the type “law enforcement” can be considered various kinds of civil disturbance events, shown in Table 4.3.17-2.

Table 4.3.17-2 Civil disturbance events reported to WebEOC, 2010-2012 (PEMA, 2013)

EVENT TYPE	2010	2011	2012
Law Enforcement	764	841	1,048
Civil Disorder - total	***2,653***		

4.3.17.4. Future Occurrence

Civil disturbance is always a possibility as long as there is discrimination or other perceived social or economic injustices. However, it may be possible to recognize the potential for an event to occur in the near-term. For example, an upcoming significant sporting event at one of the colleges or universities in the Commonwealth may result in gathering of large crowds. Local law enforcement should anticipate these types of events and be prepared to handle a crowd so that peaceful gatherings are prevented from turning into unruly public disturbances. Overall, the probability of future civil disturbance events can be considered *likely* as defined by the Risk Factor Methodology (See Section 4.1).

4.3.17.5. Environmental Impacts

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, and infrastructure. 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.

4.3.17.6. 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, Harrisburg, Dauphin County, Pittsburgh, Allegheny County, and individual county seats may have higher vulnerabilities due to higher concentrations of local, state, and federal facilities. Sites identified in Section 4.3.17.1 are locations where such events are more likely to occur and therefore should be considered more vulnerable.

Table 4.3.17-3 illustrates which counties did and did not profile civil disturbance, along with any ranking provided. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 9 counties which currently have calculated risk factor values for civil disturbance, the average value is 1.6; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for civil disturbance is 2, while the Pennsylvania THIRA scored civil disturbance as a 6 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.17-3 Counties profiling civil disturbance hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny	X		Medium	2.2
Armstrong		X		
Beaver		X		
Bedford		X		
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks		X		
Butler	X		Low	1.6
Cambria		X		
Cameron	X		Low	1.2
Carbon		X		
Centre	X		Low	1.6
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia		X		
Crawford		X		
Cumberland	X		Low	1.2
Dauphin		X		
Delaware		X		
Elk		X		
Erie		X		
Fayette	X		Low	1.3
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon	X		Not Ranked	No RF
Indiana		X		
Jefferson		X		

Table 4.3.17-3 Counties profiling civil disturbance hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Juniata	X		Low	1.3
Lackawanna		X		
Lancaster		X		
Lawrence		X		
Lebanon*		X		
Lehigh	X		Medium	2.0
Luzerne		X		
Lycoming		X		
McKean		X		
Mercer	X		Low	1.9
Mifflin	X		Not Ranked	No RF
Monroe		X		
Montgomery	X		Medium	2.2
Montour*	X		Not Ranked	2.0
Northampton	X		Medium	2.0
Northumberland		X		
Perry*	X		Not Ranked	1.0
Philadelphia**		X		
Pike		X		
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset	X		Not Ranked	No RF
Sullivan		X		
Susquehanna		X		
Tioga		X		
Union		X		
Venango		X		
Warren		X		
Washington		X		
Wayne		X		
Westmoreland		X		
Wyoming		X		
York	X		Low	1.6

Table 4.3.17-3 Counties profiling civil disturbance hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

4.3.17.7. State Facility Vulnerability Assessment

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 4.3.17-4 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.

Table 4.3.17-4 State Critical Facilities vulnerable to Civil Disturbance incidents by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Government Facilities	41
National Monuments & Icons	6
Grand Total	**47**

4.3.17.8. Jurisdictional Loss Estimation

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 County, and Dauphin County, the most vulnerable jurisdictions, have total estimated losses of approximately $429.6 billion (Table 4.3.17-5).

Table 4.3.17-5 Estimated jurisdictional losses due to civil disturbances.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Allegheny	706,960	$180,606,811.00
Dauphin	163,526	$39,786,066.00
Philadelphia	778,715	$201,276,171.00
TOTAL	***1,649,201***	***$421,669,048.00***

4.3.17.9. State Facility Loss Estimation

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. The critical facilities listed in Section 4.3.17.7 have a total replacement value of $1,753,675,818. Please note, though, that national monuments and icons do not have a replacement value, so potential losses should be considered an underestimation. 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 my occur. Failure to pursue a program of civil disturbance awareness may result in increased loss of lives and property.

4.3.18. Dam Failure

The Dam Failure profile can be found in *Appendix H*.

4.3.19. Environmental Hazards

Environmental hazards in Pennsylvania focus mainly on hazardous material release, coal mining, and oil and gas well drilling (both conventional and unconventional). These hazards result from human activities and industries and can result in injury and death to humans and damage to property.

Additional environmental hazards include superfund facilities, manure spills, and product defect or contamination. These are included in the definition of environmental hazards, but were not profiled in the SSAHMP update. Superfund sites are hazards originating from abandoned hazardous waste sites listed on the National Priorities List. The EPA maintains superfund site information which includes hazardous waste sites, potentially hazardous waste sites and remedial activities across the nation, including sites that are on the National Priorities List (NPL) or being considered for the NPL. There are 290 superfund sites in Pennsylvania. Manure spills involve the release of stored or transported agricultural waste. Product defect or contamination includes highly flammable or otherwise unsafe consumer products and dangerous foods.

No information on deaths, serious injury, or property damage could be found for superfund sites, manure spills, or product defect or contamination; therefore these types of environmental hazards were not profiled in this plan.

4.3.19.1. Location and Extent

Hazardous Materials Release

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 (PL 1990-165, §207(e)). 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 hazard material release incidents. There are over 120,000 miles of highway in the state and many of those are used to transport hazardous materials (PennDOT, 2012). These roads also cross rivers and streams at many points and have the potential to pollute watersheds that serve as domestic water supplies for parts of the state.

Potential also exists for hazardous material releases to occur along rail lines as collisions and derailments of train cars can result in large spills. A number of severe rail events have occurred in Pennsylvania.

Pipelines can also transport hazardous liquids and flammable substances such as natural gas. Incidents can occur when pipes corrode, when they are damaged during excavation, incorrectly operated, or damaged by other forces. Pipelines exist in all but three counties in Pennsylvania. Pipelines transporting natural gas compose the most miles of the total miles of pipeline in the Commonwealth (10,185 of 13,086 miles). Pipelines carrying highly volatile liquids make up the third highest amount of total pipeline miles (731 miles). 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 risk 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 legislations require that all owners or operators of facilities that manufacture, produce, use, import, export, store, supply, or distribute any extremely hazardous substance, as defined by the EPA, at or above the threshold planning quantity, as established by EPA, shall report to the county where the facility is located and Commonwealth that the facility is subject to the requirement to assist the Local Emergency Planning Committee (LEPC) in the development of an Off-site Emergency Response Plan. The community right-to-know reporting requirements keep communities abreast of the presence and release of chemicals at individual facilities. As of 2010, there were 3,355 SARA Title III facilities in Pennsylvania. The breakdown of these facilities by county is located in Table 4.3.19-1.

Table 4.3.19-1 Number of SARA Title III facilities in Pennsylvania Counties (PEMA, 2010).

COUNTY	NUMBER OF SARA TITLE III FACILITIES	COUNTY	NUMBER OF SARA TITLE III FACILITIES
Adams	100	Lackawanna	35
Allegheny	244	Lancaster	191
Armstrong	34	Lawrence	28
Beaver	70	Lebanon	50
Bedford	18	Lehigh	93
Berks	159	Luzerne	40

Table 4.3.19-1 Number of SARA Title III facilities in Pennsylvania Counties (PEMA, 2010).

COUNTY	NUMBER OF SARA TITLE III FACILITIES	COUNTY	NUMBER OF SARA TITLE III FACILITIES
Blair	43	Lycoming	86
Bradford	15	McKean	28
Bucks	143	Mercer	38
Butler	45	Mifflin	12
Cambria	50	Monroe	25
Cameron	2	Montgomery	298
Carbon	17	Montour	9
Centre	42	Northampton	40
Chester	76	Northumberland	38
Clarion	13	Perry	12
Clearfield	31	Philadelphia	155
Clinton	22	Pike	2
Columbia	29	Potter	14
Crawford	36	Schuylkill	57
Cumberland	94	Snyder	20
Dauphin	122	Somerset	31
Delaware	77	Sullivan	4
Elk	17	Susquehanna	16
Erie	64	Tioga	21
Fayette	31	Union	13
Forest	4	Venango	16
Franklin	61	Warren	16
Fulton	3	Washington	54
Greene	10	Wayne	14
Huntingdon	10	Westmoreland	81
Indiana	14	Wyoming	5
Jefferson	20	York	85
Juniata	12	**TOTAL**	**3,355**

The list of SARA Title III facilities is not an exhaustive, fully-comprehensive inventory of all hazardous material locations within the State. The EPA tracks key information about the chemicals handled by manufacturing or processing facilities through its Toxic 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 313-listed toxic chemical in the course of a calendar year are required to report TRI information to the EPA, the federal enforcement agency for SARA Title III, and PEMA. 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 4.3.22.

Coal Mining

Mining, including surface, underground, and open-pit operations, was conducted in Pennsylvania before the 1860s and was instrumental in the development of the Commonwealth. Coal mining, bituminous in the west and anthracite in the northeast, was probably the most important of Pennsylvania's mining activities and continues to be a major industry.

While mining has been used in Pennsylvania to extract substances other than coal such as metal ores (copper, iron, and zinc), clay and shale, and limestone, most of these deposits are of limited extent so only small areas have been undermined. However, coal 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, and Schuylkill Counties.

Figure 4.3.19-2 shows the location of active 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 4.3.19-1, however there are mines located outside the field areas. The vulnerability analysis and loss estimations following in Sections 4.3.19.6, 4.3.19.7, 4.3.19.8, and 4.3.19.9 uses the data in Figure 4.3.19-2. Table 4.3.19-2 lists the number of active and abandoned coal mines in each county. Statewide, 48 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, Jefferson County and Somerset County, contain the highest number of coal mines in the state with 1,323 and 1,384 mines respectively.

Figure 4.3.19-1 Distribution of Pennsylvania Coals (PADCNR-BTGS, 2008).

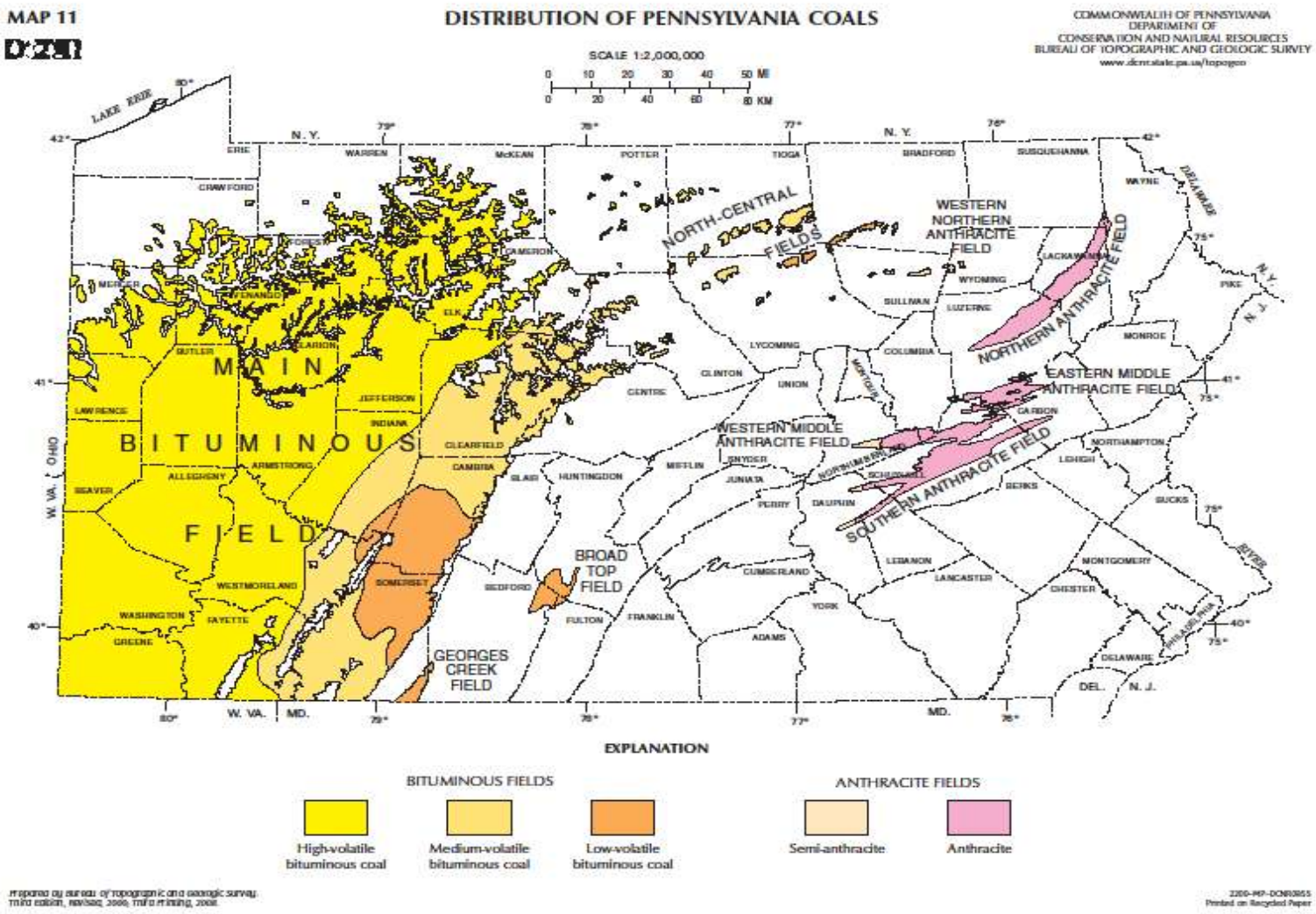


Figure 4.3.19-2 Coal Mining Operations in Pennsylvania (PADEP 2013).

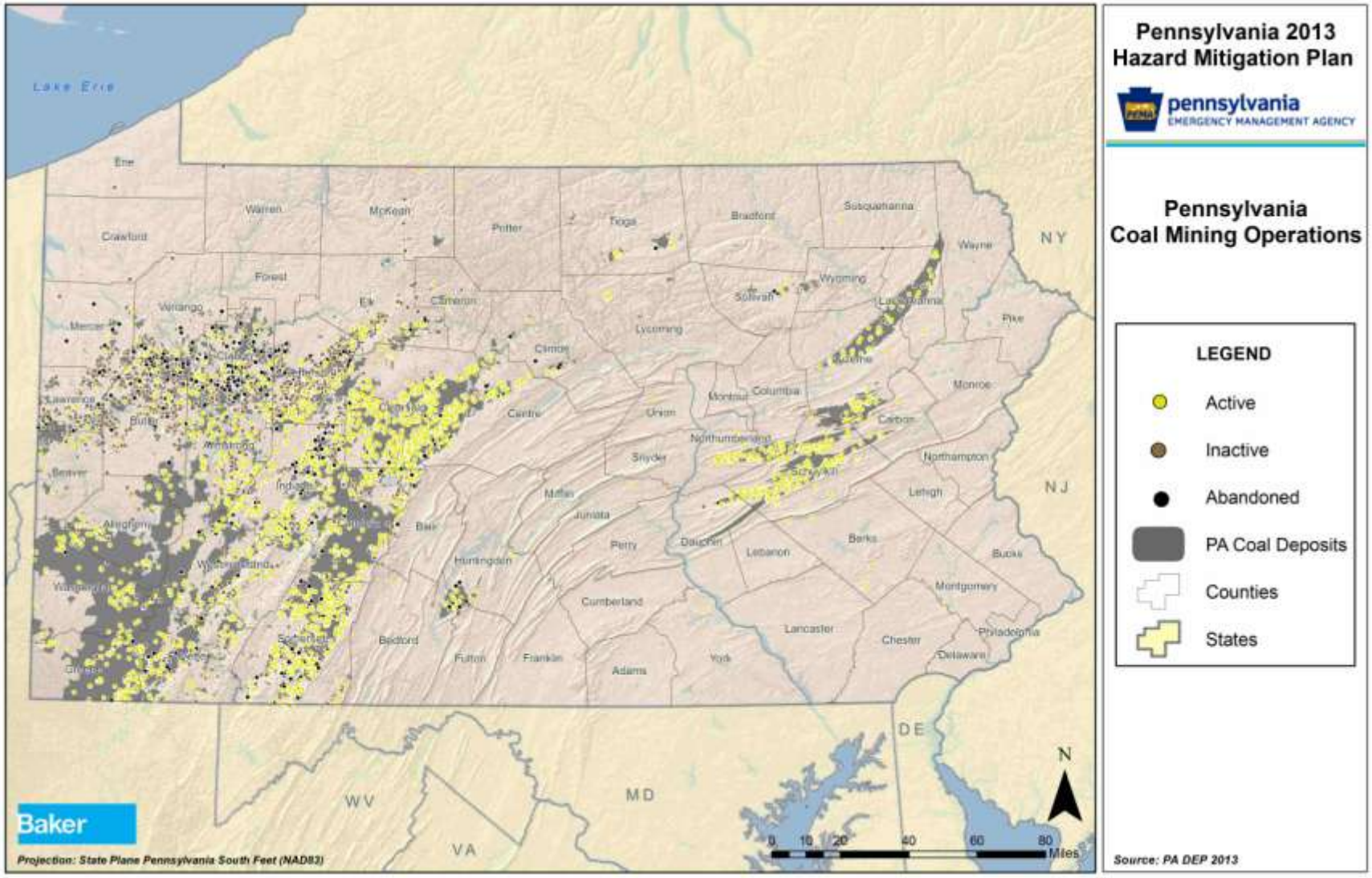


Table 4.3.19-2 Number of Active and Abandoned Coal Mines in Pennsylvania Counties (PADEP, 2013)

COUNTY	NUMBER OF MINES	COUNTY	NUMBER OF MINES
Adams	0	Lackawanna	34
Allegheny	176	Lancaster	0
Armstrong	530	Lawrence	241
Beaver	57	Lebanon	0
Bedford	37	Lehigh	0
Berks	6	Luzerne	189
Blair	26	Lycoming	10
Bradford	1	McKean	7
Bucks	0	Mercer	77
Butler	745	Mifflin	0
Cambria	636	Monroe	0
Cameron	15	Montgomery	1
Carbon	14	Montour	0
Centre	100	Northampton	0
Chester	0	Northumberland	115
Clarion	1,056	Perry	0
Clearfield	1,130	Philadelphia	0
Clinton	29	Pike	0
Columbia	33	Potter	1
Crawford	2	Schuylkill	500
Cumberland	0	Snyder	0
Dauphin	16	Somerset	1,384
Delaware	0	Sullivan	14
Elk	318	Susquehanna	2
Erie	2	Tioga	18
Fayette	445	Union	1
Forest	0	Venango	211
Franklin	0	Warren	2
Fulton	5	Washington	240
Greene	224	Wayne	0
Huntingdon	17	Westmoreland	431
Indiana	1,071	Wyoming	1
Jefferson	1,323	York	1
Juniata	2	**TOTAL**	**11,496**

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 EPA estimates that over 3,000 miles of streams in Pennsylvania have been contaminated by acid mine drainage which occurs when metal sulfides in rock oxidize and generate acidity in water that comes in contact with them.

Table 4.3.19-3 shows coal slurry ponds in the Commonwealth including impoundment name, Mine Safety and Health Administration (MSHA) ID number and the county it is located in. A slurry pond is an impoundment used to store waste created during coal preparation also known as washing. The waste contained in the impoundment consists of silt, dust, water, coal fines and washing/treatment chemicals. 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. 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 Coal Impoundment Location & Information System, there are 41 coal slurry impoundments in Pennsylvania with Washington County having the most at 17 impoundments.

Table 4.3.19-3 Summary of Coal Slurry Impoundments in the Commonwealth. (Coal Impoundment LIS 2012).

Impoundment Name	MSHA ID No.	County
Harmar Refuse Bank Slurry Pond Tailings	1211-PA02-00375-01	Allegheny
Harmar Storage Pond #4 Slurry Impoundement	1211-PA02-00375-04	Allegheny
Slurry-Bald Knob Prep Plant	1211-PA02-00194-03	Allegheny
Treatment Pond 14-North Impoundment	1211-PA02-00049-05	Allegheny
Treatment Pond Cleaning Plant	1211-PA02-00047-03	Armstrong
Cambria Slurry Pond #4	1211-PA02-00254-03	Cambria
Isabella Fresh Water Pond	1211-PA02-00001-03	Fayette
Isabella Slurry Pond	1211-PA02-00001-06	Fayette
LaBelle Slurry Pond #3 Tailings	1211-PA02-00003-04	Fayette
SLURRY POND	1211-PA02-00363-02	Fayette
Slurry Pond #2 La Belle Site	1211-PA02-00003-03	Fayette
Bailey Mine Complex Fresh Water Impoundment	1211-PA02-00107-01	Greene
Bailey Mine Slurry Impoundment Dam	1211-PA02-00107-02	Greene
Bailey Sedimentation Pond No 1	1211-PA02-00107-04	Greene
Bailey Sedimentation Pond No 2	1211-PA02-00107-05	Greene
Cumberland Mine No 1 Refuse-Slurry Pond	1211-PA02-00057-02	Greene
Emerald-Sedimentation Pond 11	1211-PA02-00012-04	Greene
Emerald-Slurry Pond #1	1211-PA02-00012-02	Greene
Robena #4 Slurry	1211-PA02-00063-04	Greene
Robena #6 Refuse	1211-PA02-00063-11	Greene
Robena Sedimentation Pond	1211-PA02-00063-01	Greene
Robena-Colvin Shaft Sedimentation Pond	1211-PA02-00063-12	Greene
Weisner Hollow Sediment Pond	1211-PA02-00190-03	Jefferson

Table 4.3.19-3 Summary of Coal Slurry Impoundments in the Commonwealth. (Coal Impoundment LIS 2012).

Impoundment Name	MSHA ID No.	County
Weisner Hollow Slurry Impoundment	1211-PA02-00190-02	Jefferson
Champion Impoundment	1211-PA02-00193-05	Washington
Champion Slurry	1211-PA02-00193-04	Washington
Champion Slurry Duck Pond	1211-PA02-00193-03	Washington
Eighty Four Pond 5 Abandoned Slurry Tailings	1211-PA02-00055-03	Washington
Eighty Four Pond 7 Debris Control	1211-PA02-00055-06	Washington
Eighty Four Steel Pond at the Prep Plant	1211-PA02-00055-04	Washington
Maple Creek Mine Water Treatment Pond	1211-PA02-00058-02	Washington
Maple Creek Silt Pond A	1211-PA02-00058-07	Washington
Maple Creek Slurry Pond #2	1211-PA02-00058-05	Washington
Maple Creek Slurry Pond#1-Old	1211-PA02-00058-01	Washington
Maple Creek Slurry Pond#3	1211-PA02-00058-06	Washington
Marianna Sediment Pond Marianna Mine #58	1211-PA02-00018-05	Washington
Marianna Slurry Home No. 5	1211-PA02-00018-02	Washington
Mathies Mine Main Slurry Pond Refuse Area Pond #2	1211-PA02-00059-02	Washington
Mathies Refuse Area Sediment Pond #2 Slurry	1211-PA02-00059-05	Washington
Mine No. 84-Slurry Pond #6 Tailings	1211-PA02-00055-05	Washington
Silt Pond B Sediment Basin	1211-PA02-00058-08	Washington

Conventional Oil and Gas Well Incidents

More than 350,000 oil and gas wells have been drilled in Pennsylvania since the first commercial oil well was developed in 1859 (PADEP-BOGM 2013). PA DEP differentiates between conventional and unconventional oil and gas wells. Conventional wells are traditional vertical wells, while unconventional wells are typically horizontally drilled wells commonly associated with the Marcellus Shale. As a result, this SSAHMP will follow this convention. Active and abandoned oil and gas wells exist in 51 of Pennsylvania's 67 counties with the majority of activity occurring western portion of the Commonwealth as shown in Figure 4.3.19-3 and Figure 4.3.19-4.

Data on conventional oil and gas wells obtained from PA DEP, provided in Table 4.3.19-4 below, shows that over 40 percent of existing oil and gas wells are located in just four counties; Armstrong, Indiana, McKean and Warren. These four counties have more than 9,000 wells each within their political boundaries totaling 40,714 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. To view the number of domestic water wells per county, see Table 4.3.2-5.

Figure 4.3.19-3 Conventional Oil and Gas Well Locations and the location in Pennsylvania (PADEP, 2013).

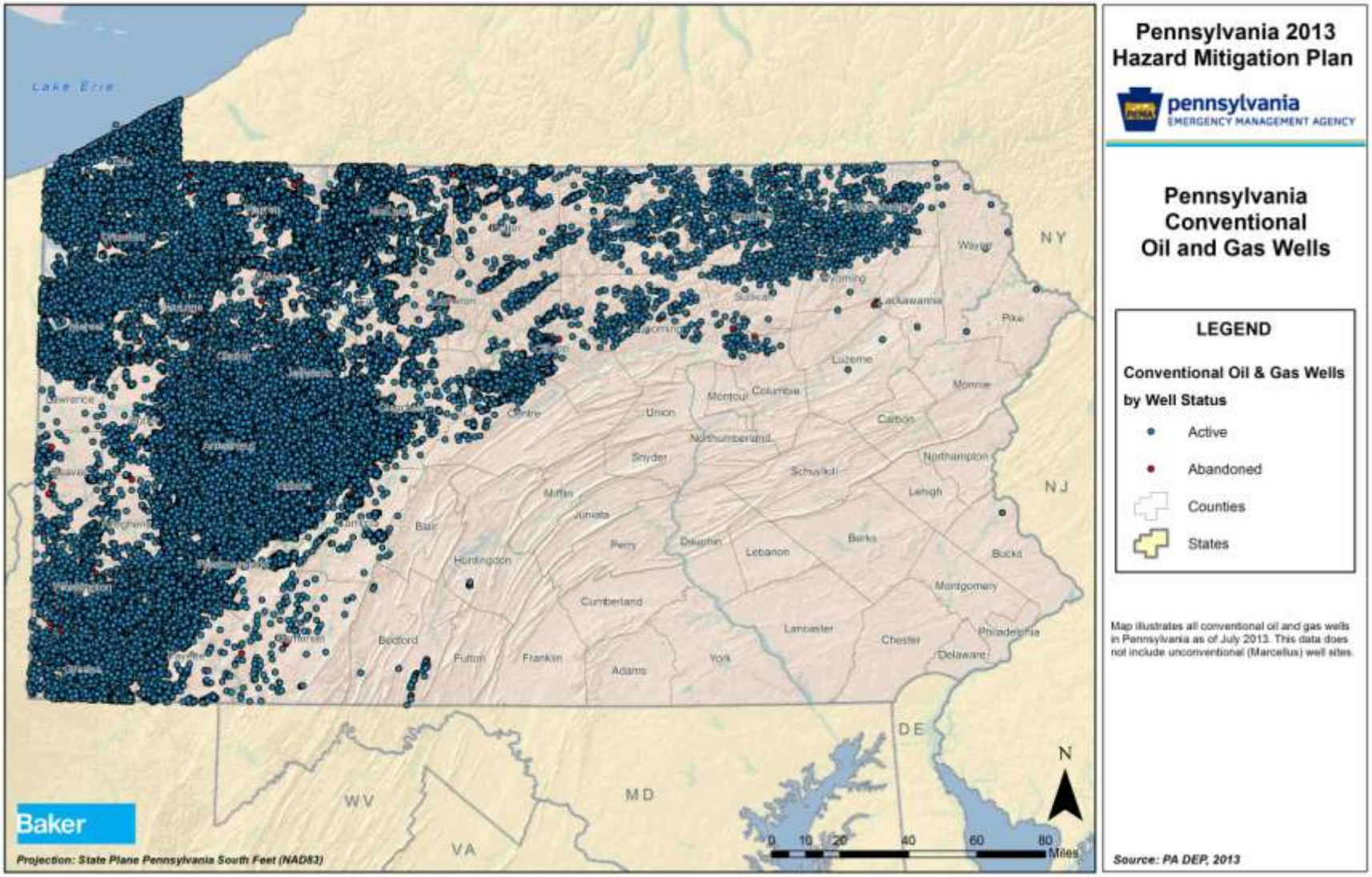


Table 4.3.19-4 Number of conventional oil and gas wells by county throughout Pennsylvania.

COUNTY	ACTIVE OIL AND GAS WELLS	ABANDONED OIL AND GAS WELLS	PLUGGED OIL AND GAS WELLS	INACTIVE OIL AND GAS WELLS	TOTAL OIL AND GAS WELLS
Adams	0	0	0	0	0
Allegheny	1,183	61	556	2	1,802
Armstrong	8,839	121	700	24	9,684
Beaver	158	11	86	1	256
Bedford	42	0	42	0	84
Berks	0	0	0	0	0
Blair	0	0	9	0	9
Bradford	35	6	23	7	71
Bucks	1	0	1	0	2
Butler	986	78	448	0	1,512
Cambria	681	6	111	19	817
Cameron	60	8	63	2	133
Carbon	0	0	2	0	2
Centre	952	0	103	19	1,074
Chester	0	0	0	0	0
Clarion	3,581	68	541	23	4,213
Clearfield	4,212	13	237	15	4,477
Clinton	477	41	171	3	692
Columbia	0	0	0	0	0
Crawford	3,202	51	592	0	3,845
Cumberland	0	0	0	0	0
Dauphin	0	0	0	0	0
Delaware	0	0	0	0	0
Elk	2,183	45	954	19	3,201
Erie	2,768	288	660	3	3,719
Fayette	3,208	5	212	23	3,448
Forest	3,695	186	407	11	4,299
Franklin	0	0	0	0	0
Fulton	0	0	3	0	3
Greene	1,992	256	1,241	20	3,509
Huntingdon	4	0	1	0	5
Indiana	11,613	88	786	38	12,525
Jefferson	4,150	72	570	5	4,797
Juniata	0	0	1	0	1
Lackawanna	2	2	7	0	11
Lancaster	0	0	0	0	0
Lawrence	187	5	43	0	235
Lebanon	0	0	0	0	0
Lehigh	0	0	0	0	0
Luzerne	1	1	7	0	9
Lycoming	34	5	27	0	66

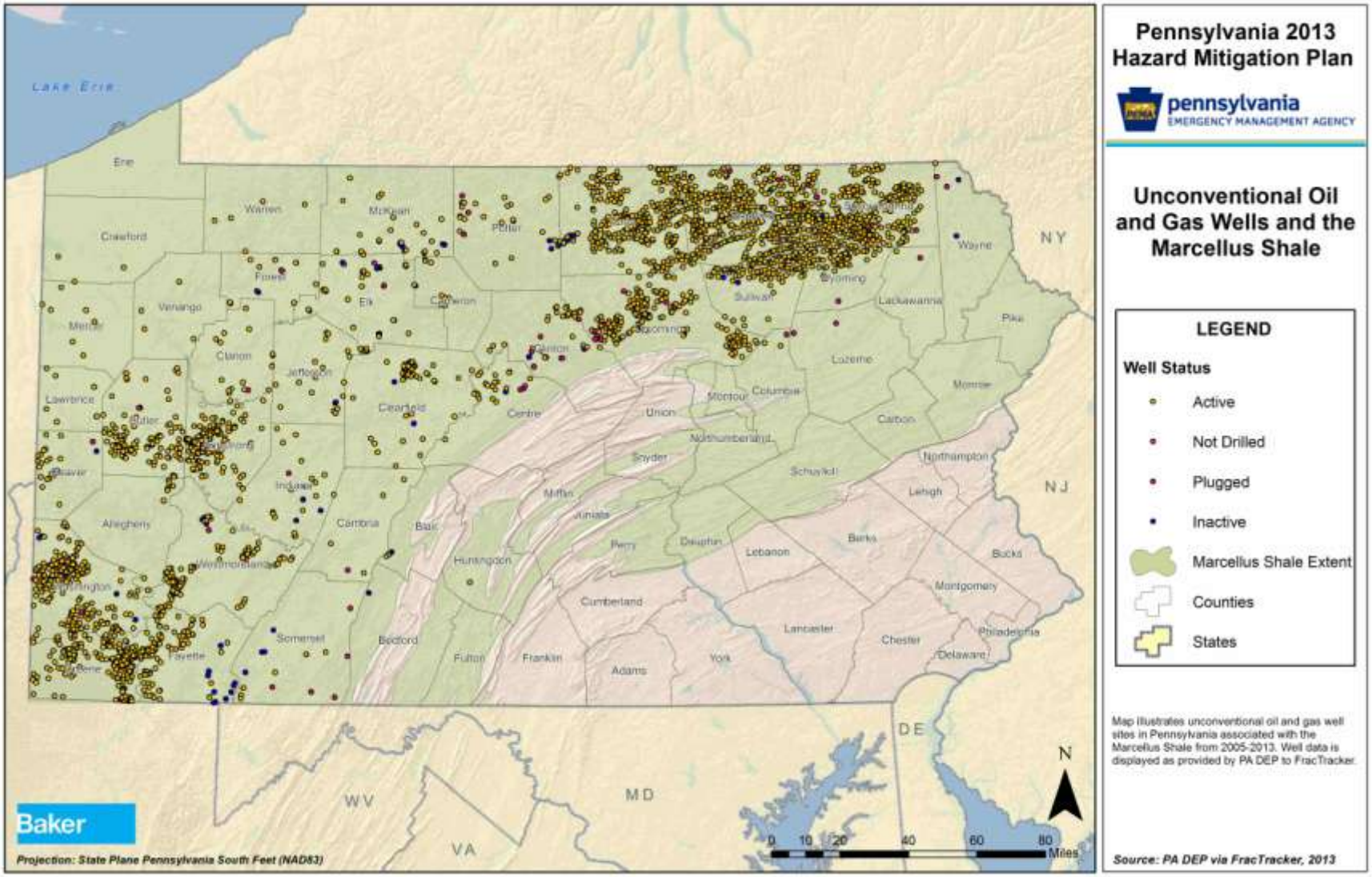
Table 4.3.19-4 Number of conventional oil and gas wells by county throughout Pennsylvania.

COUNTY	ACTIVE OIL AND GAS WELLS	ABANDONED OIL AND GAS WELLS	PLUGGED OIL AND GAS WELLS	INACTIVE OIL AND GAS WELLS	TOTAL OIL AND GAS WELLS
McKean	9,724	470	4,456	33	14,683
Mercer	3,339	26	197	1	3,563
Mifflin	0	0	2	0	2
Monroe	0	0	1	0	1
Montgomery	0	0	1	0	1
Montour	0	0	0	0	0
Northampton	0	0	0	0	0
Northumberland	0	0	1	0	1
Perry	0	0	0	0	0
Philadelphia	0	0	0	0	0
Pike	2	0	1	0	3
Potter	1,014	94	270	6	1,384
Schuylkill	0	0	0	0	0
Snyder	0	0	0	0	0
Somerset	85	4	104	5	198
Sullivan	0	0	3	0	3
Susquehanna	7	0	4	0	11
Tioga	124	19	119	3	265
Union	0	0	0	0	0
Venango	3,775	959	2,175	20	6,929
Warren	9,752	386	1,394	15	11,547
Washington	1,893	128	950	11	2,982
Wayne	4	0	6	0	10
Westmoreland	5,802	28	595	32	6,457
Wyoming	2	3	6	0	11
York	0	0	0	0	0
Grand Total	***89,769***	***3,534***	***18,889***	***360***	***112,552***

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

In recent years, the advancement in drilling technology and capability has allowed for natural gas extraction from the unconventional oil and gas wells – namely the Marcellus Shale and Utica Shale formations. The Marcellus Shale exists at a depth of 5,000 to 8,000 feet (PADEP-BOGM, 2010a). This type of extraction represents the unconventional oil and gas well, and it presents new and unique challenges and hazards in the Commonwealth. Approximately 14,000 permits have been issued for unconventional oil and gas well drilling to date in Pennsylvania. Unconventional wells have been around since 1979, but the volume of unconventional oil and gas well activity skyrocketed from 2009-2013. Figure 4.3.19-4 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 4.3.19-4.

Figure 4.3.19-4 Unconventional Oil and Gas Well Locations and the location in Pennsylvania (PADEP, 2013).



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 4.3.19-5 Number of unconventional well permits issued and unconventional wells drilled to date (7/2013) in Pennsylvania Counties (PA DEP, 2013).

COUNTY	MARCELLUS SHALE FORMATION PRESENT	NO. OF UNCONVENTIONAL PERMITS ISSUED	NO. OF ACTIVE UNCONVENTIONAL DRILLED WELLS
Adams	No	0	0
Allegheny	Yes	55	41
Armstrong	Yes	277	204
Beaver	Yes	100	80
Bedford	Yes	2	1
Berks	Yes	0	0
Blair	Yes	9	5
Bradford	Yes	2,790	2,032
Bucks	No	0	0
Butler	Yes	495	301
Cambria	Yes	24	10
Cameron	Yes	43	0
Carbon	Yes	0	0
Centre	Yes	185	51
Chester	No	0	0
Clarion	Yes	95	55
Clearfield	Yes	412	216
Clinton	Yes	171	87
Columbia	Yes	18	9
Crawford	Yes	5	5
Cumberland	Yes	0	0
Dauphin	Yes	0	0
Delaware	No	0	0
Elk	Yes	205	104
Erie	Yes	1	1
Fayette	Yes	374	300
Forest	Yes	39	34
Franklin	Yes	0	0
Fulton	Yes	0	0
Greene	Yes	940	722
Huntingdon	Yes	2	1

Table 4.3.19-5 Number of unconventional well permits issued and unconventional wells drilled to date (7/2013) in Pennsylvania Counties (PA DEP, 2013).

COUNTY	MARCELLUS SHALE FORMATION PRESENT	NO. OF UNCONVENTIONAL PERMITS ISSUED	NO. OF ACTIVE UNCONVENTIONAL DRILLED WELLS
Indiana	Yes	97	69
Jefferson	Yes	121	69
Juniata	Yes	0	0
Lackawanna	Yes	29	1
Lancaster	No	0	0
Lawrence	Yes	57	50
Lebanon	Yes	0	0
Lehigh	No	0	0
Luzerne	Yes	15	1
Lycoming	Yes	1,308	883
McKean	Yes	172	114
Mercer	Yes	24	26
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	236	105
Schuylkill	Yes	0	0
Snyder	Yes	0	0
Somerset	Yes	57	21
Sullivan	Yes	225	178
Susquehanna	Yes	1,400	1,169
Tioga	Yes	1,641	958
Union	Yes	0	0
Venango	Yes	12	10
Warren	Yes	16	10
Washington	Yes	1,440	1,024
Wayne	Yes	21	6
Westmoreland	Yes	462	341
Wyoming	Yes	317	245
York	No	0	0
TOTAL	***58***	***13,893***	***9,564***

4.3.19.2. Range of Magnitude

Hazardous Materials Release

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. Hazardous 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 exacerbating or mitigating 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 with the type of material released and the distance and related response time for emergency response teams. 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.

A worst case scenario event of a hazardous material release would be one equivalent to the Lac-Megantic train derailment in July 2012. An unmanned train broke loose and sped downhill before jumping the tracks near the Montreal-Maine border. Each of the train's 73 cars except one was carrying oil, and five of them exploded. 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 stood at 15 on July 13, 2013, and an estimated 36 people are still missing. At this point, the overall environmental impact of this event is unknown. The worst recorded hazardous materials incident 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.

Coal Mining

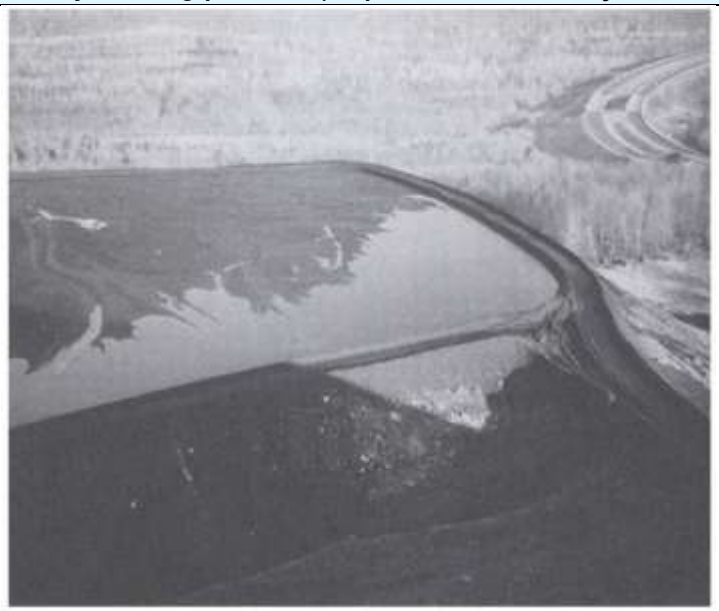
Major impacts from mining include surface-elevation changes and subsidence, modification of vegetation, the chemical degradation and flow redistribution of surface water and groundwater, the creation of mine voids and entry openings, adverse aesthetic impacts, and changes in land use.

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. Injuries and death, such as All-Terrain Vehicle (ATV) accidents and drowning, can also occur in abandoned mines.

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

Also as potentially dangerous are slurry ponds or tailings dams (Table 4.3.19-5). Mineral byproducts from coal mining are pumped to slurry or tailings dams for removal by sedimentation. If the dams or structures supporting the slurry ponds fail, they pose hazards similar to dam failure (see Appendix I – Dam Failure Profile).

Figure 4.3.19-5 Typical slurry or tailing (coal-fines) impoundment in Pennsylvania's Anthracite region.



Reject wastes from coal mining that contain sulfide minerals can also degrade groundwater and surface water that comes into contact with them. Coal refuse piles have historically been prolific sources of acid mine drainage which has impaired many streams in Pennsylvania.

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. The federal government offered buyouts of homes of residents so they could relocate from the Centralia, resulting in a cost of over $40 million to carry this out and demolish homes. In 1992, Pennsylvania claimed eminent domain on all properties in the town and condemned all the buildings. In 1981 the town had over 1,000 residents, but today only a few remain.

In Somerset County, the Quecreek Mine accident nearly became Pennsylvania's worst case scenario when 7 million tons of water flooded into the mine. 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 has a positive outcome in all miners being safely rescued (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.

Conventional Oil and Gas Well Incidents

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. 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. This can spoil public drinking water supplies and be particularly detrimental to vegetation and aquatic animals. Additional information on incidents involving oil and gas transmission and distribution by pipeline is available in Section 4.3.26, Utility Interruption.

Methane can leak into domestic drinking wells and pose fire and explosion hazards (Figure 4.3.19-6). 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.

Figure 4.3.19-6 Natural Gas fire in Hopewell Township, Washington County, Pennsylvania. ***Photo from Pittsburgh Post Gazette, June 17, 2010.***

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

Marcellus Shale play 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 Marcellus Shale formation exists at a depth normally between 5,000 and 8,000 feet and holds trillions of cubic feet of natural gas. Extraction from this depth was previously not feasible but as drilling technology has improved over the years, recovering natural gas from Marcellus Shale is now possible (PADEP-BOGM, 2010a).

This extraction process is different from traditional natural gas extraction in that it often requires horizontal drilling. Horizontal drilling is accomplished by hydraulic fracturing which involves pumping one to eight million gallons of water, mixed with sand and other additives including hydrochloric or muriatic acid, into the shale formation. The fluid or “frac fluid” that is recovered from this process must be properly treated as the water quality is very poor.

Frac fluid is extremely saline and can be three to six times as salty as sea water. Other contaminants can include barium, bromine, lithium strontium, sulfate, ammonium and very high concentrations of total dissolved solids (TDS). There is also some concern about normally occurring radioactive materials (NORMS) present in shale and potentially present in recovered drilling fluid but there is very little data available on the radioactivity of frac fluid in Pennsylvania (Kirby, 2010).

Currently there is no known technology to treat water with this level of salinity (Vidic, 2010). High levels of TDSs, though not harmful to humans, can be extremely harmful to aquatic life and can damage industrial equipment. Often recovered frac fluid is stored in earthen impoundments and after treatment is taken to a sewage treatment facility. There is concern surrounding the toxic solid waste that remains after frac fluid is treated.

In addition to the traditional hazards associated with oil and gas well drilling, potential impacts from Marcellus Shale gas well drilling include:

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

In 2010, the worst environmental disaster in United States history was and can be attributed to oil well drilling and extraction. British Petroleum's (BP) Deepwater Horizon oil rig, located in the Gulf of Mexico off the coast of Louisiana, began leaking millions of gallons of oil into the ocean after an explosion occurred at the site on April 20, 2010 killing 11 workers. The resulting environmental and economic impacts have been devastating to the region.

4.3.19.3. Past Occurrence

Hazardous Materials Release

Since the passage of SARA Title III facilities which 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 plant. 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 4.3.19-6 shows the number of hazardous material release incidents by county for the years 2006-2011 as reported in PEMA Pennsylvania Hazardous Material Emergency Planning and Response Act Annual Reports. According to the reports, the number of hazardous material release incidents in Pennsylvania has increased from 665 incidents in 2006 to 2,026 incidents in 2011. The data contained in the reports in non-specific to incidents. Data prior to 2006 is not available.

Table 4.3.19-6 Number of Hazardous Material Release Incidents in Pennsylvania Counties 2006 -2011 (PEMA Pennsylvania Hazardous Material Emergency Planning and Response Act Annual Reports)

COUNTY	NO. OF INCIDENTS IN 2006	NO. OF INCIDENTS IN 2007	NO. OF INCIDENTS IN 2008	NO. OF INCIDENTS IN 2009	NO. OF INCIDENTS IN 2010	NO. OF INCIDENTS IN 2011
Adams	7	13	11	10	13	7
Allegheny	39	55	146	95	147	155
Armstrong	6	8	5	1	13	5
Beaver	10	19	19	21	43	43
Bedford	1	1	5	9	17	26
Berks	29	31	37	26	46	79
Blair	1	7	8	12	11	16
Bradford	10	4	12	11	19	30
Bucks	14	7	8	17	31	49

Table 4.3.19-6 Number of Hazardous Material Release Incidents in Pennsylvania Counties 2006 -2011 (PEMA Pennsylvania Hazardous Material Emergency Planning and Response Act Annual Reports)

COUNTY	NO. OF INCIDENTS IN 2006	NO. OF INCIDENTS IN 2007	NO. OF INCIDENTS IN 2008	NO. OF INCIDENTS IN 2009	NO. OF INCIDENTS IN 2010	NO. OF INCIDENTS IN 2011
Butler	2	7	6	8	9	12
Cambria	7	13	12	11	18	23
Cameron	1	2	2	2	0	3
Carbon	4	8	6	10	14	10
Centre	10	7	9	5	4	10
Chester	13	17	19	17	41	50
Clarion	6	17	32	25	29	49
Clearfield	7	8	17	15	21	37
Clinton	5	4	5	3	8	17
Columbia	6	5	0	7	5	8
Crawford	13	10	2	3	15	7
Cumberland	18	12	16	16	27	41
Dauphin	18	26	13	34	55	57
Delaware	38	27	25	37	39	47
Elk	2	5	9	0	3	7
Erie	9	15	29	20	27	28
Fayette	7	5	9	11	15	35
Forest	0	0	3	2	4	2
Franklin	6	11	4	13	16	15
Fulton	2	2	0	2	2	2
Greene	3	3	2	6	5	6
Huntingdon	4	6	7	12	7	5
Indiana	4	7	7	8	15	7
Jefferson	18	31	37	23	45	60
Juniata	0	0	0	1	3	4
Lackawanna	6	7	4	7	12	12
Lancaster	29	42	22	24	45	50
Lawrence	14	18	10	9	15	15
Lebanon	15	26	15	21	21	30
Lehigh	42	49	38	26	57	51
Luzerne	10	14	8	26	39	62
Lycoming	5	2	3	9	16	19
McKean	5	7	9	7	18	30
Mercer	1	1	6	4	13	14
Mifflin	4	3	6	6	3	1
Monroe	11	9	13	4	7	20
Montgomery	36	36	48	40	92	118

Table 4.3.19-6 Number of Hazardous Material Release Incidents in Pennsylvania Counties 2006 -2011 (PEMA Pennsylvania Hazardous Material Emergency Planning and Response Act Annual Reports)

COUNTY	NO. OF INCIDENTS IN 2006	NO. OF INCIDENTS IN 2007	NO. OF INCIDENTS IN 2008	NO. OF INCIDENTS IN 2009	NO. OF INCIDENTS IN 2010	NO. OF INCIDENTS IN 2011
Montour	2	1	1	2	2	1
Northampton	15	38	41	38	147	210
Northumberland	2	5	4	8	23	27
Perry	4	2	0	1	6	3
Philadelphia	20	25	21	35	52	99
Pike	2	4	2	3	1	5
Potter	0	3	4	1	4	2
Schuylkill	7	12	8	9	12	14
Snyder	4	3	6	3	5	5
Somerset	8	12	15	8	16	16
Sullivan	0	0	0	0	2	11
Susquehanna	5	3	1	11	10	18
Tioga	0	2	0	2	10	2
Union	2	2	2	5	8	10
Venango	7	10	5	6	10	6
Warren	3	10	10	15	20	13
Washington	13	25	16	21	34	45
Wayne	1	2	0	3	6	2
Westmoreland	17	23	35	27	31	41
Wyoming	5	2	2	1	17	9
York	50	71	73	77	118	113
TOTAL	***665***	***862***	***950***	***952***	***1,639***	***2,026***

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. The PHMSA reports that between 1998 and June 2013, there were over 13,000 highway-related incidents resulting in over 100 injuries, three fatalities, and over $34 million in damages (Table 4.3.19-7).

Table 4.3.19-7 Highway-Related Hazardous Material Release Incident Statistics (PHMSA).

YEAR	NO. OF INCIDENTS	MAJOR INJURIES	MINOR INJURIES	FATALITIES	DAMAGES
2013*	266	0	0	0	$81,8840
2012	745	1	2	0	$2,444,939
2011	670	1	4	0	$3,193,758
2010	695	0	3	0	$2,161,339

Table 4.3.19-7 Highway-Related Hazardous Material Release Incident Statistics (PHMSA).

YEAR	NO. OF INCIDENTS	MAJOR INJURIES	MINOR INJURIES	FATALITIES	DAMAGES
2009	738	1	9	0	$926,492
2008	868	1	6	0	$1,537,665
2007	1,010	2	5	0	$1,647,508
2006	967	0	0	0	$1,099,858
2005	807	0	1	1	$2,239,128
2004	930	2	5	0	$2,709,110
2003	954	2	5	0	$3,288,340
2002	912	0	4	0	$1,906,095
2001	1,012	1	6	0	$1,387,098
2000	1,065	0	11	0	$2,436,090
1999	880	2	15	0	$1,483,702
1998	864	0	14	2	$4,995,143
Total	**13,383**	**13**	**90**	**3**	**$34,275,105**

**2013 events totaled through June 30.*

A number of severe rail events involving the release of hazardous materials have also occurred in Pennsylvania including a derailment of a Norfolk Southern Railway Company train in October of 2006 which resulted in the release of hazardous materials and caused a fire in New Brighton, Pennsylvania (NTSB, 2010). The PHMSA also tracks rail incidents that result in the release of hazardous materials. Between 1998 and 2013, there were approximately 384 rail-related incidents resulting in five injuries, one fatality, and over $7 million in damages (Table 4.3.19-8).

Table 4.3.19-8 Rail-Related Hazardous Material Release Incident Statistics (PHMSA).

YEAR	NO. OF INCIDENTS	MAJOR INJURIES	MINOR INJURIES	FATALITIES	DAMAGES
2013*	11	0	0	0	$2,500
2012	19	0	0	0	$177,003
2011	27	0	1	0	$83,562
2010	22	0	1	0	$14,650
2009	17	0	0	0	$19,500
2008	29	1	0	1	$88,270
2007	36	0	1	0	$79,132
2006	17	0	0	0	$2,265,786
2005	33	0	1	0	$1,316,900
2004	18	0	0	0	$20,712
2003	16	0	0	0	$5,508
2002	15	0	0	0	$1,500,250
2001	21	0	0	0	$10,000

Table 4.3.19-8 Rail-Related Hazardous Material Release Incident Statistics (PHMSA).					
YEAR	**NO. OF INCIDENTS**	**MAJOR INJURIES**	**MINOR INJURIES**	**FATALITIES**	**DAMAGES**
2000	35	0	0	0	$502,193
1999	37	0	0	0	$9,005
1998	31	0	0	0	$1,065,535
Total	**384**	**1**	**4**	**1**	**$7,160,506**
**2013 events totaled through June 30.*					

There have been 352 air-related incidents resulting in ten injuries, one fatality, and over $100,000 in damages (Table 4.3.19-9). There have only been two water-related incident since 1998 occurring in 2005 and 2011.

Table 4.3.19-9 Air-Related Hazardous Material Release Incident Statistics (PHMSA).					
YEAR	**NO. OF INCIDENTS**	**MAJOR INJURIES**	**MINOR INJURIES**	**FATAILITIES**	**DAMAGES**
2013*	7	0	0	0	$0
2012	21	0	8	0	$6,500
2011	42	0	0	0	$1,500
2010	33	0	0	0	$880
2009	33	0	0	0	$0
2008	29	1	0	1	$88,270
2007	40	0	1	0	$1,500
2006	28	0	0	0	$0
2005	21	0	0	0	$7,280
2004	7	0	0	0	$1,287
2003	*not available*	*not available*	*not available*	*not available*	*not available*
2002	12	0	0	0	$0
2001	18	0	0	0	$50
2000	15	0	0	0	$0
1999	29	0	0	0	$1,000
1998	17	0	0	0	$0
Total	**352**	**1**	**9**	**1**	**$108,267**
**2013 events totaled through June 30.*					

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 4.3.26.3 contains information on injuries, fatalities, and property damage from gas distribution and transmission incidents and hazardous liquid incidents.

Coal Mining

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 tracks mining accidents and injuries. From 2006 to 2011, there were 1,347 operator injuries (including 5 deaths) reported in Pennsylvania resulting from surface and underground coal mining activities (MSHA, 2013). Although there have been many mining accidents in Pennsylvania early mining history from the 1800's, there is no comprehensive database that tracks the data. 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 (PADEP, 2010).

Conventional Oil and Gas Well Incidents

Pennsylvania has a long history of oil and gas well drilling and though relatively infrequent many accidents and incidents have occurred related to the extraction of these natural resources. No comprehensive list of oil and gas related incidents exist for the Commonwealth. Conventional oil and gas extraction has occurred in Pennsylvania since the mid- to late- 1800s. Conventional oil and gas well incidents are more common northwestern Pennsylvania Counties. The hazards associated with each incident vary widely and encompass damages including serious injury, explosion, fire and water contamination.

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

There is no comprehensive database of unconventional oil and gas well incidents in Pennsylvania. However, the FracTracker Alliance, a non-profit organization dedicated to enhancing the public's understanding of the oil and gas industry, has made data available on incidences where DEP has confirmed causality between an incident and an oil and gas well. From 2007 until September 2012, there were 162 hazardous materials or explosion incidents that have been linked to oil and gas extraction. The bulk of these incidents occurred in Bradford County (36 incidents), Susquehanna County (29 incidents), McKean County (26 incidents), and Lycoming County (11 incidents). Full event details are not attached to this incidence data. However, Table 4.3.19-10 displays some oil and gas incidents that occurred in Pennsylvania and were found through search of news reports to represent the kinds of events associated with oil and gas wells. Please note these incidents have not been specifically been divided into conventional versus unconventional incidents, but incidents specifically involving drilling or frac fluid contamination can be assumed to be unconventional well incidents.

Table 4.3.19-10 Oil and gas incidents in Pennsylvania between 2009 and 2010.

DATE	COUNTY	HAZARD TYPE	DESCRIPTION
September, 2008	Clinton County	Gas storage well fire	A gas storage well on the Greenlick Field caught on fire and burned for two weeks.
April 2009	McKean County	Domestic drinking water well contamination	Twenty-six oil and gas wells were drilled in Bradford Township contaminating 2 water wells with methane and five wells with high levels of iron and manganese.
September 14, 2009	Susquehanna County	Surface water contamination	Dimock Township, 8,000 gallons of toxic drilling fluid at a natural gas well was released into a nearby stream and wetland.
December 2009	Bradford County	Hazardous materials release, soil contamination	295 gallons of hydrochloric acid spilled from a tank at a natural gas well site in Asylum Township.
January 28, 2010	Bradford County	Natural gas explosion	Tuscarora Township, an eruption caused by equipment failure during extraction at a natural gas well site. Two minor injuries and one serious injury.
March 2010	Washington County	Natural gas fire	Impoundment used to collect waste water from natural gas drilling operation ignited. No injuries or damage reported.
June 3, 2010	Clearfield County	Eruption, hazardous materials release	Natural gas and hydraulic fracturing fluid shot 75 feet into the air. No injuries, property damage or surface water contamination.
March 2012	Susquehanna County	Explosion, flash fire, hazardous materials release	Natural gas compressor station exploded, blowing a hole in the roof and releasing a small amount of gas. No injuries reported.
March 14, 2013	Wyoming	Gas well spill	Waste water flowing from a gas well forced the evacuation of three families. No injuries.

4.3.19.4. Future Occurrence

Hazardous Materials Release

While many hazardous material 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 4.3.22. Risk associated with hazardous materials release is expected to remain moderate. Hazardous materials release incidents occur annually in Pennsylvania so a 100 percent annual probability is anticipated.

Coal Mining

It is difficult to forecast the severity and frequency of coal mining accidents and environmental damage in Pennsylvania. Although throughout time, the government has strengthened mining

and reclamation operation and environmental regulations, permitting, and inspection criteria, 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 deepmine 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. However, until then a 100 percent annual probability is anticipated for coal mining hazards as incidents occur annually in the Commonwealth.

Conventional Oil and Gas Well Incidents

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 DEP will reduce the likelihood of potential impacts to the community and the environment. Risk associated with conventional oil and gas drilling is expected to remain moderate, with some of the highest risk emerging from very old conventional wells that are not properly mapped or whose caps and protective features have begun to deteriorate.

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

As is the case with conventional wells, it remains difficult to predict the number or frequency of Marcellus 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). As the number of oil and gas wells remains steady moving forward, the probability of occurrence is likely to stabilize, though it remains high.

Overall, the probability of future environmental hazards events is *highly likely* as defined by the Risk Factor Methodology (See Section 4.1).

4.3.19.5. Environmental Impacts

Hazardous Materials Release

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

Coal Mining

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 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.

Conventional Oil and Gas Well Incidents

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.

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

There are serious water contamination and pollution concerns associated with unconventional oil and gas wells like Marcellus and Utica Shale wells. Additional potential environmental impacts of Marcellus Shale play drilling include surface water depletion and the accompanying damage to aquatic ecosystems; and contaminated surface, groundwater, and soil resulting from hydraulic fracturing, the recovery of contaminated hydraulic fracturing fluid and solid toxic waste produced from treatment. The overall environmental impacts of unconventional oil and gas wells are still being uncovered, as the industry is still new and environmental impacts continue to be uncovered.

On a much larger scale, American Rivers, a leading national river conservation organization, placed two of Pennsylvanian's rivers on the list of the top ten Most Endangered Rivers in America. Number one on the list is the Upper Delaware River and the Monongahela River is listed as number seven. Both rivers are listed as threatened by natural gas extraction specifically related to Marcellus Shale. Combined these water bodies supply drinking water to more than 17 million people.

4.3.19.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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 vulnerability of jurisdictions to environmental hazards differs based on the type of environmental hazard being examined. Based on typical hazardous material releases, vulnerability is defined as jurisdictions and/or critical facilities located within one quarter mile of major Interstate, U.S., and Pennsylvania highways and rail lines or located within 1.5 miles of hazardous materials sites identified in FEMA's Comprehensive Data Management System. For coal mining incidents, vulnerability is defined as jurisdictions or facilities located within 1.5 miles of coal mines. Similarly, jurisdictions and facilities located within 1.5 miles of oil and gas wells are vulnerable to oil and gas well incidents.

In total, 54 Pennsylvania counties have identified environmental hazards as a significant concern in their current HMP, as seen in Table 4.3.19-11. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 27 counties which currently have calculated risk factor values for environmental hazards, the average value is 2.6; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for Environmental Hazards is 2.3, while the Pennsylvania THIRA scored Environmental Hazards as a 6 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.19-11 Counties profiling environmental hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.5
Allegheny	X		High	2.5
Armstrong	X		Not Ranked	No RF
Beaver	X		High	3.2
Bedford	X		High	2.9
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks	X		High	2.8
Butler	X		High	2.9
Cambria	X		High	2.9
Cameron	X		High	2.8
Carbon		X		
Centre	X		High	2.6
Chester		X		
Clarion		X		
Clearfield	X		Low	1.8
Clinton	X		High	2.5
Columbia	X		Medium	2.1
Crawford	X		Medium	2.2
Cumberland	X		High	2.6
Dauphin		X		
Delaware	X		High	2.8
Elk	X		High	2.5
Erie	X		High	2.6
Fayette	X		High	2.9
Forest	X		Not Ranked	No RF
Franklin		X		
Fulton	X		High	2.9
Greene	X		Medium	2.2
Huntingdon	X		Not Ranked	No RF
Indiana		X		
Jefferson	X		High	2.5

Table 4.3.19-11 Counties profiling environmental hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Juniata	X		Medium	2.3
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Medium	2.3
Lawrence	X		High	3.3
Lebanon*	X		Not Ranked	7.5
Lehigh	X		High	2.6
Luzerne	X		Not Ranked	No RF
Lycoming	X		High	2.6
McKean	X		High	2.5
Mercer	X		High	2.9
Mifflin	X		Not Ranked	No RF
Monroe	X		High	2.9
Montgomery	X		High	2.9
Montour*		X		
Northampton	X		High	2.6
Northumberland	X		Medium	2.1
Perry*	X		Not Ranked	7.5
Philadelphia**		X		
Pike	X		Medium	2.1
Potter		X		
Schuylkill	X		Not Ranked	No RF
Snyder	X		Medium	2.2
Somerset	X		High	3.5
Sullivan		X		
Susquehanna	X		High	2.7
Tioga	X		High	2.5
Union	X		Not Ranked	No RF
Venango	X		High	2.9
Warren	X		High	2.5
Washington		X		
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		High	2.5

Table 4.3.19-11 Counties profiling environmental hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

Hazardous Materials Release

The vulnerability of the community and environment to a spill or release of an extremely hazardous substance at a facility or from a transportation accident is a factor of many variables. These include: the specific chemical, the amount subject to a spill or release, the proximity of waterways, and the number of people residing in a radius from the facility or accident location which can reasonably be expected to be adversely affected.

Furthermore, the vulnerability of the community and environment to a hazardous material release from a transportation incident is directly related to several specific variables; namely the mode and class of transportation. Each mode is further subject to several categories of hazard. Each mode of transportation (truck, aircraft, rail, watercraft, or pipeline) has separate and distinct factors affecting the vulnerability. Transportation carriers must have response plans in place to address accidents, otherwise the local emergency response team will step in to secure and restore the area. Quick response minimizes the volume and concentration of hazardous materials that disperse 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. Since there are more than 3,300 SARA Title III facilities in Pennsylvania that store extremely 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 road.

In order to determine jurisdictional vulnerability for hazardous materials releases, GIS analysis was conducted to isolate jurisdictions located within one-quarter mile of highways and rail lines as well as within 1.5 miles from hazardous materials sites identified in FEMA's Comprehensive Data Management System. Using these measures, 66 jurisdictions are vulnerable to hazardous materials releases. These jurisdictions are home to 4,983 vulnerable critical facilities, as shown in Table 4.3.19-12.

Table 4.3.19-12 Number of State Critical Facilities impacted by hazardous materials releases in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	37	Juniata	14
Allegheny	528	Lackawanna	145
Armstrong	79	Lancaster	127
Beaver	129	Lawrence	57
Bedford	32	Lebanon	83
Berks	119	Lehigh	62
Blair	69	Luzerne	195
Bradford	60	Lycoming	80
Bucks	105	McKean	44
Butler	86	Mercer	84
Cambria	108	Mifflin	24
Cameron	6	Monroe	22
Carbon	51	Montgomery	169
Centre	57	Montour	15
Chester	103	Northampton	75
Clarion	31	Northumberland	89
Clearfield	75	Perry	22
Clinton	39	Philadelphia	112
Columbia	67	Pike	16
Crawford	72	Potter	17
Cumberland	61	Schuylkill	174
Dauphin	149	Snyder	21
Delaware	129	Somerset	71
Elk	20	Sullivan	10
Erie	64	Susquehanna	34
Fayette	101	Tioga	45
Forest	5	Union	14
Franklin	38	Venango	40
Fulton	14	Warren	40
Greene	23	Washington	118
Huntingdon	36	Wayne	34
Indiana	56	Westmoreland	228
Jefferson	42	Wyoming	20

PEMA assigned chemical facility ratings and transportation threat ratings for counties in Pennsylvania in its 20007 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 4.3.19-13. 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 4.3.19-13 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
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

Table 4.3.19-13 Pennsylvania county chemical facility and transportation threat ratings (PEMA, 2007a).

COUNTY	CHEMICAL FACILITY RATING	TRANSPORTATION THREAT RATING	NO. OF EMERGENCY RESPONSE TEAMS
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
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

Table 4.3.19-13 Pennsylvania county chemical facility and transportation threat ratings (PEMA, 2007a).

COUNTY	CHEMICAL FACILITY RATING	TRANSPORTATION THREAT RATING	NO. OF EMERGENCY RESPONSE TEAMS
Westmoreland	Moderate	Moderate	1
Wyoming	Low	Low	1
York	Moderate	Moderate to High	1

Coal Mining

Jurisdictional vulnerability to coal mining incidents is defined as jurisdictions that are located within 1.5 miles of an active or abandoned coalmine; see Figure 4.3.19-2. These vulnerable jurisdictions are home to 1,478 state critical facilities (Table 4.3.19-14).

Table 4.3.19-14 Number of state critical facilities vulnerable by coal mine incidents in each county.

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Allegheny	132	Jefferson	30
Armstrong	56	Lackawanna	93
Beaver	40	Lawrence	26
Bedford	2	Luzerne	163
Berks	1	McKean	1
Bradford	2	Mercer	11
Butler	49	Monroe	1
Cambria	98	Montgomery	2
Carbon	14	Northumberland	39
Centre	8	Potter	1
Clarion	27	Schuylkill	173
Clearfield	69	Somerset	77
Columbia	3	Sullivan	2
Crawford	2	Susquehanna	1
Dauphin	10	Tioga	1
Elk	5	Venango	6
Erie	3	Warren	1
Fayette	69	Washington	54
Greene	29	Westmoreland	121
Huntingdon	6	Wyoming	1
Indiana	49	***Grand Total***	***1478***

Conventional Oil and Gas Well Incidents

Jurisdictional vulnerability to oil and gas well incidents is defined as jurisdictions located within 1000 yards of an oil or gas well. This buffer is what DEP uses as their "zone of culpability" for oil and gas well incidents. Of these vulnerable jurisdictions, Allegheny County has by far the most vulnerable critical facilities impacted by oil and gas well incidents; many other counties in the west and southwest portions of the Commonwealth also host high numbers of vulnerable critical facilities (Table 4.3.19-15).

Table 4.3.19-15 Number of State Critical Facilities impacted by conventional oil and gas well incidents in each county.

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Allegheny	221	Jefferson	28
Armstrong	91	Lawrence	10
Beaver	13	Luzerne	1
Berks	1	Lycoming	1
Bradford	18	McKean	30
Butler	34	Mercer	60
Cambria	19	Potter	4
Centre	1	Somerset	2
Clarion	32	Sullivan	1
Clearfield	29	Susquehanna	8
Clinton	4	Tioga	8
Crawford	45	Venango	23
Elk	5	Warren	42
Erie	56	Washington	93
Fayette	57	Wayne	1
Forest	3	Westmoreland	145
Greene	33	Wyoming	1
Indiana	63	***Grand Total***	***1183***

The following is a list of legislation and programs which when administered appropriately can reduce Pennsylvania's vulnerability to oil and gas well hazards:

- **Oil and Gas Act of 1984, Amended 2012**– includes provisions for well permits, groundwater protection, water supply protection, well plugging, reporting and safety. The Amendments to the Oil and Gas Act enacted stronger environmental standards, authorized local governments to adopt an impact fee and built upon the Commonwealth's efforts to move towards energy independence.
- **PA DEP Orphan Oil and Gas Wells and the Orphan Well Plugging Fund** – provides funding to locate and properly plug orphan wells which were abandoned prior to the Oil and Gas Act of 1984**.**
- **Solid Waste Management Act –** regulations for pollution prevention pertaining to solid waste disposal including solid waste generated from hydraulic fracturing and treatment.

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

Jurisdictional vulnerability to oil and gas well incidents is defined as jurisdictions located within 1000 yards of an unconventional oil or gas well. This buffer is what DEP uses as their "zone of culpability" for oil and gas well incidents. Of these vulnerable jurisdictions, Bradford County has the most vulnerable critical facilities impacted by oil and gas well incidents (Table 4.3.19-15).

Table 4.3.19-16 Number of State Critical Facilities impacted by oil and gas well incidents in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Allegheny	5	Lycoming	1
Armstrong	8	Sullivan	1
Beaver	2	Susquehanna	5
Berks	1	Tioga	3
Bradford	16	Washington	10
Butler	5	Westmoreland	7
Fayette	4	Wyoming	1
Greene	6	***Grand Total***	***77***
Indiana	2		

Act 9 of 2012 directs PEMA and DEP to adopt emergency regulation directing the operators of all unconventional wells to adopt and share addresses for unconventional well sites and access roads, develop emergency response plans, and post well information at the entrance of the site. Act 9 is expected to increase local and state emergency response capability in responding to unconventional well sites and reduce the wider vulnerability of communities to Marcellus and other Shale formation well site incidents.

Additional requirements exist within the drainage area of Special Protection Waters in the Delaware River Basin as the DRBC requires that natural gas extraction projects including exploratory wells must be approved by the commission.

Pennsylvania's Environmental Quality Board approved regulations to protect the state's waters from negative impacts of natural gas drilling on May 17, 2010. The regulations limit TDS concentrations in drilling wastewater (PADEP, 1010a).

The Upper Delaware River and the Monongahela River have been placed on American River's 2010 top ten list of America's Most Endangered River's due to threats from natural gas extraction. Combined, these water bodies supply drinking water to more than 17 million people.

It is important to note that DEP monitors and inspects gas wells through the following: Waste Management Program, Oil and Gas Program, Air Quality Program, Radiation Protection Division, and Water Quality Program. Combined, these programs' inspections help to reduce overall vulnerability to incidents caused by unsafe conditions and provide broad-based oversight of oil and gas wells.

4.3.19.7. State Facility Vulnerability Assessment

Hazardous Materials Release

Roughly 80% of all identified state critical facilities are vulnerable to hazardous materials releases, as illustrated in Table 4.3.19-18. Additionally, water treatment facilities and water suppliers are 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.

Table 4.3.19-17 State critical facilities vulnerable to hazardous materials releases by critical facility type.

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	97
Banking	23
Chemical	9
Commercial Facilities	49
Communications	3
Critical Manufacturing	3
Dams	14
Defense Industrial Base	20
Education	111
Emergency Services	80
Energy	28
Fire Departments (Non-HSIP)	2070
Government Facilities	33
Healthcare & Public Health	35
Hospital (Non-HSIP)	202
Information Technology	3
Manufacturing	1
National Monuments & Icons	3
Nuclear Reactors, Materials & Waste	4
Police (Non-HSIP)	992
Postal & Shipping	7
School (Non-HSIP)	1107
Transportation	57
Water	32
Grand Total	***4983***

Coal Mining

State critical facility vulnerability assessment is defined as state critical facilities located within 1.5 miles of an active or abandoned coal mine. In examining the types of critical facilities vulnerable to coal-related hazards, 633 of the 1,478 vulnerable facilities are fire departments, as illustrated in Table 4.3.19-19.

Table 4.3.19-18 State Critical Facilities vulnerable to coal mine incidents by Critical Facility Type	
STATE CRITICAL FACILITY TYPE	**NUMBER OF IMPACTED FACILITIES**
Agriculture	14
Banking	1
Chemical	2
Commercial Facilities	8
Dams	6
Defense Industrial Base	3
Education	19
Emergency Services	13
Energy	12
Fire Departments (Non-HSIP)	633
Government Facilities	5
Healthcare & Public Health	3
Hospital (Non-HSIP)	35
National Monuments & Icons	1
Nuclear Reactors, Materials & Waste	1
Police (Non-HSIP)	271
School (Non-HSIP)	439
Transportation	9
Water	3
Grand Total	***1478***

Conventional Oil and Gas Well Incidents

As shown in Table 4.3.19-19, there are a total of 1,183 state facilities vulnerable to oil and gas well incidents at the current time, but this is constantly in flux as more and more Marcellus Shale wells are drilled. In the case of an explosion or other catastrophic incident at an oil or gas well, these facilities are all somewhat vulnerable. Because the impacts of oil and gas incidents are largely on water quality and water supply, though, the water critical facilities may be more vulnerable.

Table 4.3.19-19 State Critical Facilities vulnerable to oil and gas well incidents by critical facility type	
STATE CRITICAL FACILITY TYPE	**NUMBER OF IMPACTED FACILITIES**
Agriculture	8
Banking	3
Chemical	2
Commercial Facilities	6
Critical Manufacturing	1
Dams	11

Table 4.3.19-19 State Critical Facilities vulnerable to oil and gas well incidents by critical facility type	
STATE CRITICAL FACILITY TYPE	**NUMBER OF IMPACTED FACILITIES**
Defense Industrial Base	2
Education	13
Emergency Services	15
Energy	10
Fire Departments (Non-HSIP)	470
Government Facilities	3
Healthcare & Public Health	3
Hospital (Non-HSIP)	34
Nuclear Reactors, Materials & Waste	1
Police (Non-HSIP)	197
Postal & Shipping	3
School (Non-HSIP)	391
Transportation	4
Water	6
Grand Total	**1,183**

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

As shown in Table 4.3.19-20, there are a total of 77 state facilities vulnerable to oil and gas well incidents at the current time, but this is constantly in flux as more and more Marcellus Shale and Utica Shale wells are drilled.

Table 4.3.19-20 State Critical Facilities vulnerable to oil and gas well incidents by critical facility type	
STATE CRITICAL FACILITY TYPE	**NUMBER OF IMPACTED FACILITIES**
Emergency Services	1
Energy	1
Fire Departments (Non-HSIP)	33
Healthcare & Public Health	1
Hospital (Non-HSIP)	1
Police (Non-HSIP)	10
School (Non-HSIP)	30
Grand Total	**77**

4.3.19.8. Jurisdictional Loss Estimation

Hazardous Materials Release

Jurisdictional losses from hazardous materials releases come from damage to buildings and infrastructure as well as the cost of cleanup. In terms of building exposure and losses,

Philadelphia is most threatened by hazardous materials releases with 663,758 exposed buildings worth about $173 billion (Table 4.3.19-21). Allegheny County is also one of the most threatened jurisdictions with 478,572 potentially impacted buildings worth $118 billion. Sullivan County is least threatened by hazardous materials releases with 1,738 exposed buildings worth $302 million.

Table 4.3.19-21 Estimated jurisdictional losses due to hazardous materials releases.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	22,298	$5,732,352.00
Allegheny	478,572	$118,677,526.00
Armstrong	33,547	$6,891,203.00
Beaver	68,710	$16,175,251.00
Bedford	5,624	$1,107,285.00
Berks	133,813	$34,617,490.00
Blair	47,770	$10,218,827.00
Bradford	15,547	$3,006,981.00
Bucks	179,353	$58,175,582.00
Butler	58,460	$15,458,946.00
Cambria	55,213	$12,414,437.00
Cameron	9,660	$1,882,252.00
Carbon	28,553	$6,168,228.00
Centre	36,754	$9,882,759.00
Chester	167,001	$54,963,205.00
Clarion	2,549	$880,796.00
Clearfield	29,898	$5,984,075.00
Clinton	3,867	$1,030,151.00
Columbia	34,566	$7,590,777.00
Crawford	21,193	$4,670,612.00
Cumberland	97,794	$25,404,534.00
Dauphin	83,684	$19,546,448.00
Delaware	200,280	$57,318,281.00
Elk	10,451	$2,320,411.00
Erie	103,228	$24,254,435.00
Fayette	56,361	$11,619,956.00
Forest	4,967	$799,714.00
Franklin	43,138	$9,591,529.00
Fulton	3,851	$720,601.00
Greene	11,158	$2,176,283.00
Huntingdon	8,115	$1,611,402.00
Indiana	47,050	$10,173,028.00
Jefferson	19,428	$3,878,413.00

Table 4.3.19-21 Estimated jurisdictional losses due to hazardous materials releases.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Lackawanna	95,079	$21,623,172.00
Lancaster	160,148	$41,765,432.00
Lawrence	29,861	$6,513,309.00
Lebanon	52,725	$12,345,983.00
Lehigh	141,678	$37,859,918.00
Luzerne	119,716	$26,380,359.00
Lycoming	42,691	$9,015,082.00
McKean	8,009	$1,647,020.00
Mercer	47,068	$10,217,860.00
Mifflin	12,340	$2,202,751.00
Monroe	26,165	$7,077,044.00
Montgomery	354,817	$114,074,080.00
Montour	10,963	$2,657,194.00
Northampton	134,543	$36,565,231.00
Northumberland	42,088	$9,107,851.00
Perry	18,734	$4,695,542.00
Philadelphia	663,758	$173,138,663.00
Pike	18,137	$4,257,805.00
Potter	6,160	$1,063,212.00
Schuylkill	62,377	$13,775,034.00
Snyder	9,060	$2,175,374.00
Somerset	20,842	$4,155,854.00
Sullivan	1,738	$302,314.00
Susquehanna	4,344	$942,426.00
Tioga	4,729	$955,074.00
Union	17,023	$3,967,079.00
Venango	27,261	$5,262,878.00
Warren	16,325	$3,429,243.00
Washington	74,621	$16,926,639.00
Wayne	16,431	$3,159,706.00
Westmoreland	186,867	$42,893,516.00
Wyoming	10,684	$2,119,108.00
York	145,796	$36,642,030.00
Grand Total	***4,705,231***	***$1,203,857,553.00***

Coal Mining

As shown in Table 4.3.19-22, Allegheny, Luzerne, Lackawanna, Westmoreland, and Cambria Counties are most threatened by coal mining hazards in terms of the number of exposed buildings and associated dollar values. Wayne County, on the other hand, is the least threatened of the vulnerable jurisdictions; it has fewer than 1,500 impacted buildings worth a total of $300 million.

Table 4.3.19-22 Estimated jurisdictional losses due to coal mine incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Allegheny	106,014	$25,616,753.00
Armstrong	49,493	$9,837,825.00
Beaver	25,362	$5,802,851.00
Bedford	3,144	$490,696.00
Berks	5,091	$1,225,581.00
Blair	5,728	$1,139,127.00
Bradford	2,705	$524,784.00
Butler	69,592	$16,028,459.00
Cambria	70,723	$14,819,931.00
Cameron	2,501	$511,003.00
Carbon	9,038	$1,943,506.00
Centre	22,466	$3,930,301.00
Chester	3,166	$1,238,194.00
Clarion	33,768	$6,776,248.00
Clearfield	41,812	$7,821,961.00
Clinton	4,802	$909,050.00
Columbia	8,969	$1,947,630.00
Dauphin	8,436	$1,806,515.00
Elk	9,574	$1,732,166.00
Erie	3,249	$918,506.00
Fayette	60,345	$11,675,724.00
Greene	18,980	$3,588,525.00
Huntingdon	4,610	$750,414.00
Indiana	52,534	$10,105,651.00
Jefferson	25,414	$5,016,069.00
Lackawanna	70,721	$15,563,796.00
Lawrence	32,610	$6,812,603.00
Luzerne	113,165	$24,220,709.00
Mercer	16,063	$3,571,814.00
Mifflin	3,016	$439,834.00
Montgomery	6,757	$2,550,245.00
Northumberland	24,764	$4,853,040.00

Table 4.3.19-22 Estimated jurisdictional losses due to coal mine incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Schuylkill	61,140	$13,105,558.00
Somerset	35,858	$7,294,962.00
Sullivan	3,099	$569,719.00
Venango	24,158	$4,813,533.00
Washington	57,507	$13,177,711.00
Wayne	1,452	$300,076.00
Westmoreland	101,447	$22,360,030.00
York	1,822	$379,262.00
Grand Total	***1,201,095***	***$256,170,362.00***

Conventional Oil and Gas Well Incidents

The total estimated jurisdictional losses associated with both conventional and Marcellus/Utica Shale oil and gas well incidents have the potential to impact over 1.3 million buildings worth $289.3 billion, displayed in Table 4.3.19-23. Allegheny County is the most threatened jurisdiction in the case of oil and gas well incidents with 202,255 potentially impacted building worth over $50.6 billion.

Table 4.3.19-23 Estimated jurisdictional losses due to oil and gas well incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Allegheny	202,255	$50,632,336.00
Armstrong	69,076	$13,772,618.00
Beaver	9,993	$2,814,155.00
Blair	1,690	$326,476.00
Bradford	23,461	$4,128,880.00
Butler	51,353	$12,018,756.00
Cambria	11,726	$2,290,916.00
Cameron	7,008	$1,214,456.00
Centre	9,302	$1,887,728.00
Clarion	25,836	$5,044,012.00
Clearfield	34,949	$6,474,387.00
Clinton	5,409	$1,030,775.00
Crawford	50,149	$9,839,118.00
Elk	14,394	$3,070,697.00
Erie	125,355	$28,573,831.00
Fayette	64,766	$12,387,148.00
Forest	14,772	$2,526,590.00

Table 4.3.19-23 Estimated jurisdictional losses due to oil and gas well incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Greene	26,740	$5,228,870.00
Indiana	69,122	$14,179,933.00
Jefferson	47,152	$9,051,021.00
Lawrence	6,887	$1,645,704.00
Luzerne	1,126	$814,360.00
Lycoming	3,391	$552,207.00
McKean	26,402	$5,069,540.00
Mercer	67,365	$14,560,553.00
Potter	9,379	$1,597,253.00
Somerset	5,321	$959,454.00
Susquehanna	11,666	$2,285,915.00
Tioga	7,186	$1,166,207.00
Venango	42,153	$8,147,749.00
Warren	40,883	$8,127,706.00
Washington	79,031	$17,105,949.00
Westmoreland	164,439	$38,952,869.00
Wyoming	9,917	$1,803,519.00
Grand Total	***1,339,654***	***$289,281,688.00***

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

The total estimated jurisdictional losses associated with both conventional and Marcellus/Utica Shale oil and gas well incidents have the potential to impact over 100,000 buildings worth nearly $23 billion, displayed in Table 4.3.19-24. Bradford County is the most threatened jurisdiction in the case of Marcellus and other shale formation oil and gas well incidents with 19,622 potentially impacted buildings.

Table 4.3.19-24 Estimated jurisdictional losses due to unconventional oil and gas well incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Allegheny	2,627	$677,326
Armstrong	9,097	$1,884,481
Bradford	19,622	$3,457,724
Butler	6,668	$1,462,231
Centre	1,676	$295,072
Clearfield	1,514	$314,532
Elk	1,205	$221,841
Fayette	13,313	$2,841,070

Table 4.3.19-24 Estimated jurisdictional losses due to unconventional oil and gas well incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Greene	3,631	$667,829
Indiana	1,735	$310,490
Jefferson	2,494	$469,353
Lycoming	5,628	$954,437
Susquehanna	10,005	$1,899,823
Tioga	7,186	$1,166,207
Washington	16,080	$3,562,452
Westmoreland	5,774	$1,386,257
Wyoming	8,179	$1,396,155
Grand Total	***116,434***	***$22,967,280***

4.3.19.9. State Facility Loss Estimation

Hazardous Materials Release

Not all state facilities will experience equal losses in the case of a hazardous materials release. Losses will depend upon 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. Nonetheless, the estimated replacement cost of all State Critical Facilities located in hazardous materials release hazards zones is $35,843,635,910.

Coal Mining

Coal mining hazards can cause state facility losses in the form of mine subsidence or explosion, water supply contamination, or mine fires. Overall, the estimated replacement cost of all State Critical Facilities located in coal hazard areas is $11,178,301,357.

Conventional Oil and Gas Well Incidents

The magnitude of loss for state facilities impacted by oil and gas wells will range based upon the type and size of each individual incident. For instance, water pollution associated with drilling affects natural landscapes and drinking water supplies while a well explosion could cause structural damage or fire in surrounding buildings. In total, the estimated replacement cost of all state critical facilities located in both conventional and Marcellus/Utica Shale oil and gas well hazard areas is $10,221,885,008.

Marcellus Shale and Other Shale Formation Oil and Gas Well Incidents

The magnitude of loss for state facilities impacted by oil and gas wells will range based upon the type and size of each individual incident. For instance, water pollution associated with drilling affects natural landscapes and drinking water supplies while a well explosion could cause structural damage or fire in surrounding buildings. In total, the estimated replacement cost of all state critical facilities located in both conventional and Marcellus/Utica Shale oil and gas well hazard areas is $713,482,640.

4.3.20. Levee Failure

4.3.20.1. Location and Extent

FEMA completed an inventory of all known levees across Pennsylvania in 2009 with an update in 2012, known as the Mid-Term Levee Inventory (MLI). The MLI contains levee data gathered first and foremost for structures designed to protect from the 1%-annual-chance flood event. The area behind a maintained and certified levee that is designed to protect from a 1%-annual-chance flood is called a Levee Protected Area. The MLI also frequently includes levees that were not designed to protect against this base flood, but the MLI does not include every levee in every county – especially small levees and agricultural levees not engineered or able to be accredited to the 1%-annual-chance event (FEMA, 2011). FEMA's inventory was compiled using all effective Flood Insurance Rate Maps and Flood Insurance Study reports in Pennsylvania, the USACE levee inventory, the DEP's Flood Control Project summaries, information from local governments, aerial photography, and additional information such as news articles and websites.

A total of 317 levee segments and 63 floodwall segments levees have been identified throughout Pennsylvania via the MLI, with at least one levee in 51 of 67 counties (FEMA-Region III, 2012). Figure 4.3.20-1 shows the locations of the levee systems along with any levee protected areas identified in the MLI while Figure 4.3.20-2 shows all Pennsylvania flood protection projects sponsored by DEP and the USACE, most of which are levee systems. These state- and federally-constructed levees are included in the MLI but are shown separately to demonstrate DEP's work in designing and constructing structural flood protection throughout Pennsylvania. Note that generally levees protect small areas that may not be able to be seen on the map. The distribution of these systems is relatively scattered throughout the Commonwealth with most 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.

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 they were designed and built to protect. Maintenance responsibility belongs to a variety of entities including local, state and federal government and private land owners. Well maintained levees may obtain certification through independent inspections. Levee owners need to both maintain levees and pay for an independent inspection in order to have the levee certified as providing flood protection. The impacts of an un-certified levee include levee failure and insurance rate increases because FEMA identifies that the structures are not designed to protect to the 1%-annual-chance flood height on Flood Insurance Rate Maps.

Figure 4.3.20-1 Location of levees and floodwalls identified in the Mid-Term Levee Inventory throughout Pennsylvania.

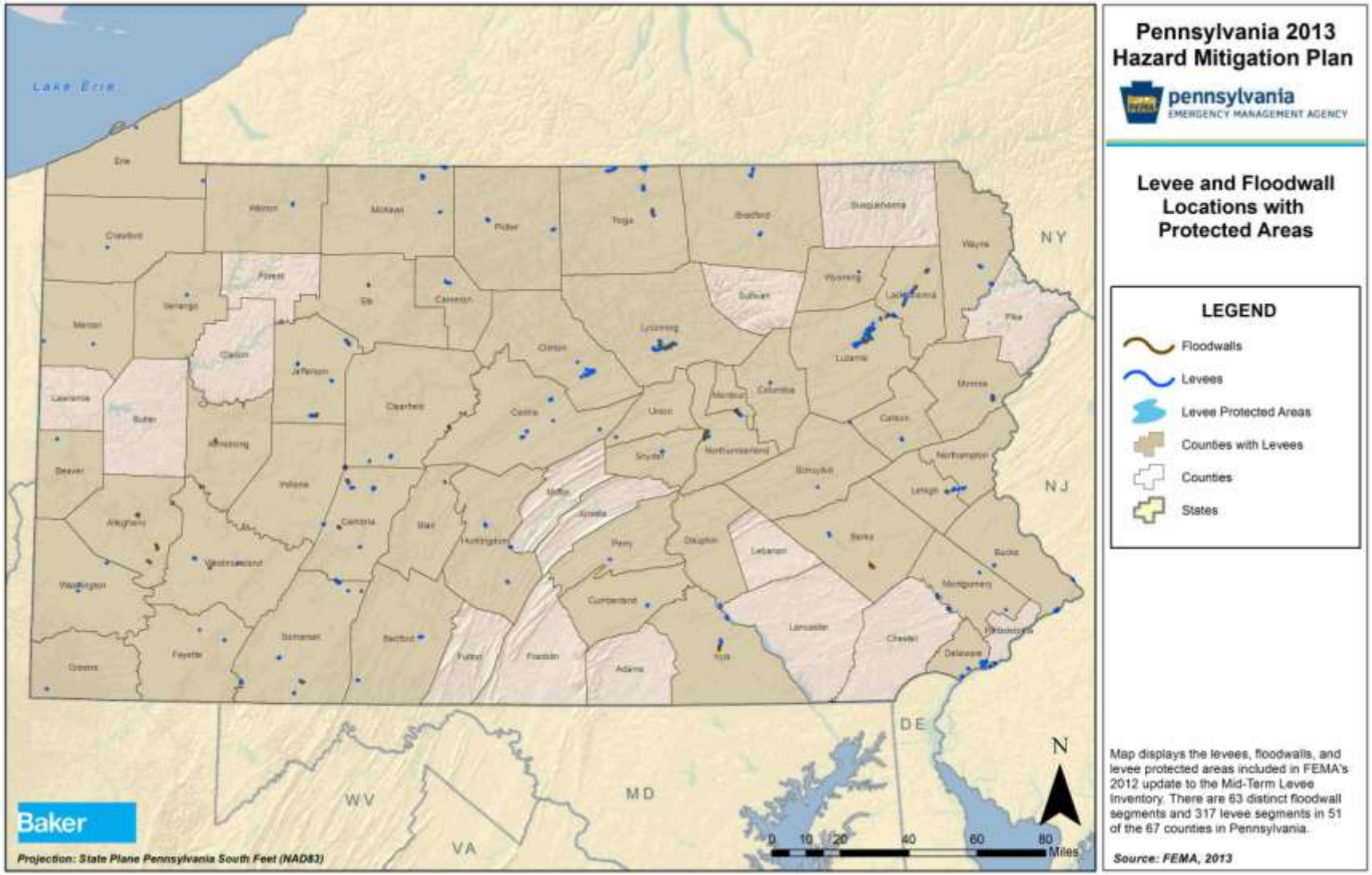
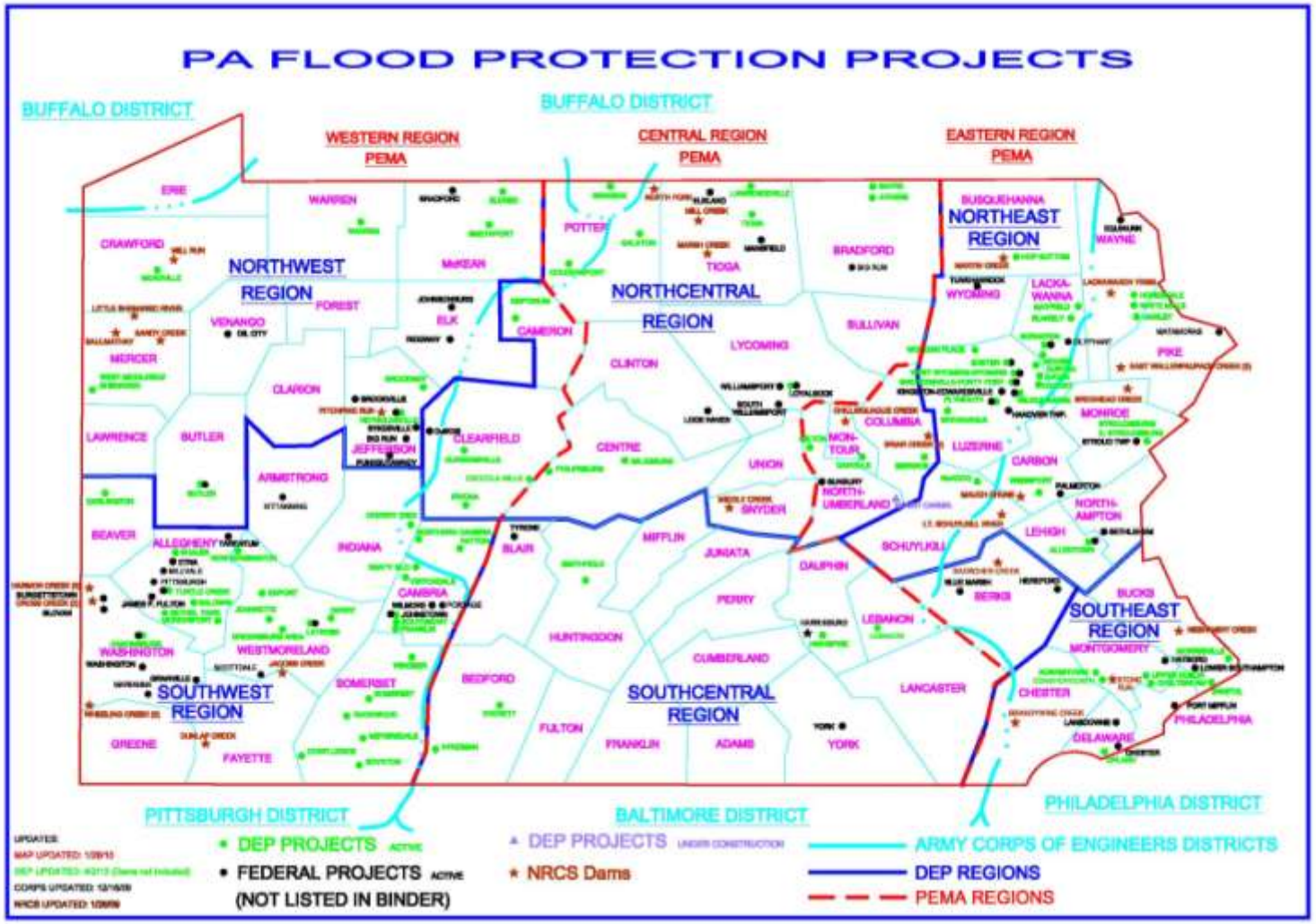


Figure 4.3.20-2 Location of PA Flood Protection Projects with Federal and State Sponsorship (DEP, 2013)



4.3.20.2. Range of Magnitude

For levees designed and constructed by DEP, after construction the levee system is 'sponsored' by the municipality in which it resides. Sponsorship indicates the party that is responsible for the levee's operations and maintenance; the sponsor is usually a municipality or a municipal authority. PA DEP covers large repair and rehabilitation efforts, but the municipal sponsor is responsible for routine operations and maintenance as well as minor repairs. Major rehabilitation projects are identified in the capital budget for the Commonwealth but may take years to complete depending on the size of a project.

Flood-related hazards due to levees range in magnitude from overtopping, when the water level rises over the top of the levee, to back-ending, when water flows around the back of the levee outside of the edge of the levee system, to total failure as seen during Hurricane Katrina. Levees are typically designed with three feet of freeboard to prevent overtopping, but older levees were not built to that standard.

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 for which the structure is designed 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. If an abrupt failure occurs, the rushing waters of a flood wave could result in catastrophic losses.

Properties located in the area of reduced-risk landward of a levee system are not subject to the mandatory flood insurance purchase requirement of the National Flood Insurance Program. Thus, regardless of whether a levee is accredited, there is concern that properties in these areas lack flood insurance. In the event of a failure, it is likely that inundated properties will not be insured.

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 these levees with large protected areas that have the potential to cause the most damage. 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 worse than it was.

4.3.20.3. Past Occurrence

There is no comprehensive list of levee failures in Pennsylvania, and historically few, if any, have been reported. However, Tropical Storm Lee in 2011 exceeded the design storm level for many levees in Pennsylvania. Lee placed extreme stress on Pennsylvania's levees since the event was relatively long in duration and the ground was already saturated from 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. 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. As of July 2013, the Chemung levee repairs are under construction with an 80/20 federal/state match. The Sayre levee repairs are being completed by the USACE, and Pennsylvania's H_2O program is covering the cost to repair the pump station.

4.3.20.4. Future Occurrence

Similarly 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 not maintained. Most levees are designed to operate safely at 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 it has been adequately constructed and maintained.

4.3.20.5. Environmental Impacts

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 waste water 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.

4.3.20.6. Jurisdictional Vulnerability Assessment

0lists the 16 counties that have profiled levee failure in their HMP along with any hazard ranking. Lawrence County profiled dams and levees together; while defining levees in the profile Lawrence did not identify any levees as a hazard in their county. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Fourteen of the counties profiling levee failure have a calculated risk factor, the average of which is 1.9. The State Risk Factor for levee failure is 1.7. The Pennsylvania THIRA merged levee failure with dam failure and rated levee failure as a 5 of 10. For more details on the State Risk Factor and THIRA, please see Section 4.1.

Table 4.3.20-1 Counties profiling levee failure with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny	X		Low	1.9
Armstrong		X		
Beaver	X		Low	1.7
Bedford	X		Medium	2.4
Berks		X		
Blair		X		
Bradford		X		
Bucks		X		
Butler		X		
Cambria	X		High	2.9
Cameron		X		
Carbon		X		
Centre		X		
Chester		X		
Clarion		X		
Clearfield	X		Low	1.7
Clinton	X		Low	1.9
Columbia	X		Low	1.8
Crawford		X		
Cumberland	X		Low	1.2
Dauphin		X		
Delaware	X		Low	1.7
Elk		X		
Erie		X		
Fayette		X		
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon		X		
Indiana		X		
Jefferson	X		Low	1.7

Table 4.3.20-1 Counties profiling levee failure with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Juniata		X		
Lackawanna		X		
Lancaster		X		
Lawrence	X		Low	1.9
Lebanon*		X		
Lehigh	X		High	2.5
Luzerne		X		
Lycoming		X		
McKean		X		
Mercer		X		
Mifflin		X		
Monroe	X		Low	1.7
Montgomery	X		Low	1.3
Montour*		X		
Northampton	X		High	2.5
Northumberland	X		Medium	2.1
Perry*		X		
Philadelphia**		X		
Pike		X		
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan		X		
Susquehanna		X		
Tioga		X		
Union		X		
Venango		X		
Warren		X		
Washington		X		
Wayne		X		
Westmoreland		X		
Wyoming		X		
York		X		

Table 4.3.20-1 Counties profiling levee failure with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As stated in Section 4.2.2, 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 tracts 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.

As of 2012, 317 levee segments and 63 floodwall segments exist within 51 of the 67 Pennsylvania counties. 82 state critical facilities have been identified that fall within the known 105 Levee Protected Areas. The Levee Protected Areas were obtained from FEMA Region III's Midterm Levee Inventory database (as of 2012). However, not all levees have Levee Protected Areas identified, leaving a gap in the analysis. Actions 1-5a and 1-5b address improving the levee data and outreach regarding levee regulations in the Commonwealth. To accommodate for the non-existent protected areas, a secondary vulnerability analysis was be performed on all levees in the Commonwealth, seeking out critical facilities that fall within 2,000 feet from the levee system. While this will provide an overestimation of the risk to a levee failure, the 2,000 feet measurement was selected based on a review of the Levee Protected Areas. This review found the 2,000 feet was approximately the typical size of the identified Levee Protected Areas. Both the Levee Protected Areas and the 2,000 feet based analysis is approximate analysis based on the best available data. Table 4.3.20-2 accounts for the number of critical facilities falling within Levee Protected Areas and within the 2,000 foot GIS buffer of the levee systems. Counties with the most levees are Lackawanna, Cambria, Snyder and Jefferson having over 10 each. Luzerne is most vulnerable having the highest number of critical facilities falling within vulnerable zones (49).

Table 4.3.20-2 Number of State Critical Facilities falling within levee Protected Areas and 2,000-foot GIS buffer of levees in each county

COUNTY	CRITICAL FACILITIES LEVEE PROTECTED AREA OR IN 2,000 FOOT LEVEE GIS BUFFER
Allegheny	2
Armstrong	7
Bedford	3

Table 4.3.20-2 Number of State Critical Facilities falling within levee Protected Areas and 2,000-foot GIS buffer of levees in each county

COUNTY	CRITICAL FACILITIES LEVEE PROTECTED AREA OR IN 2,000 FOOT LEVEE GIS BUFFER
Berks	1
Blair	2
Bradford	7
Bucks	6
Cambria	13
Cameron	4
Carbon	2
Centre	4
Chester	1
Clearfield	3
Clinton	12
Crawford	1
Delaware	7
Erie	3
Greene	1
Huntingdon	7
Indiana	1
Jefferson	14
Lackawanna	23
Lehigh	5
Luzerne	49
Lycoming	12
McKean	3
Mercer	1
Monroe	4
Montour	7
Northampton	2
Northumberland	17
Philadelphia	1
Pike	2
Potter	5
Schuylkill	4
Snyder	4
Somerset	15
Tioga	12
Warren	1
Wayne	3
Westmoreland	14

Table 4.3.20-2 Number of State Critical Facilities falling within levee Protected Areas and 2,000-foot GIS buffer of levees in each county	
COUNTY	**CRITICAL FACILITIES LEVEE PROTECTED AREA OR IN 2,000 FOOT LEVEE GIS BUFFER**
York	3
Grand Total	***288***

4.3.20.7. State Facility Vulnerability Assessment

The majority of facilities falling in these GIS buffered levee areas are fire departments, police departments and schools (Table 4.3.20-3).

Table 4.3.20-3 State Critical Facilities vulnerable to levee failure by Critical Facility Type	
STATE CRITICAL FACILITY TYPE	**CRITICAL FACILITIES LEVEE PROTECTED AREA OR IN 2,000 FOOT LEVEE GIS BUFFER**
Agriculture	4
Education	4
Emergency Services	5
Energy	1
Fire Departments (Non-HSIP)	134
Healthcare & Public Health	1
Hospital (Non-HSIP)	6
Police (Non-HSIP)	78
Postal & Shipping	1
School (Non-HSIP)	54
Grand Total	***288***

4.3.20.8. Jurisdictional Loss Estimation

Jurisdictional loss estimates were identified at the tract level and aggregated at the county level to show the possible losses per county. Due to the fragmentation of the levees, GIS was used to buffer 2,000 feet from the levees for a better representation of losses. It was identified that the Commonwealth has a total of 138,872 potentially impacted buildings with over $32 billion in exposure in 26 counties. Luzerne County is the most threatened jurisdiction with over 33,000 vulnerable buildings and over $7 billion in possible losses stemming from levee failure. Table 4.3.20-4 illustrates the number of impacted buildings and their associated dollar value of exposure by county. It should be noted that only the GIS buffer exposure value was presented in jurisdictional loss estimates, since the Levee Protected Areas do not exist for all levees. The GIS buffer method considers all existing levees. Jurisdictional loss estimates were identified at the tract level and aggregated at the county level to show the possible losses per county.

Table 4.3.20-4 Estimated jurisdictional losses in 2,000 foot Levee GIS buffer areas.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Allegheny	2,102	$411,689.00
Armstrong	1,237	$272,827.00
Blair	3,486	$694,269.00
Bradford	1,352	$258,539.00
Bucks	1,636	$734,678.00
Cambria	2,775	$525,910.00
Cameron	1,273	$298,105.00
Chester	2,293	$550,676.00
Clearfield	3,282	$598,452.00
Clinton	3,867	$1,030,151.00
Delaware	3,506	$981,258.00
Elk	1,527	$275,797.00
Erie	3,174	$715,794.00
Jefferson	5,229	$1,108,980.00
Lackawanna	10,549	$2,015,249.00
Lehigh	5,686	$1,436,192.00
Luzerne	33,110	$7,277,187.00
Lycoming	16,115	$3,736,522.00
Mercer	633	$101,276.00
Montgomery	8,298	$3,065,329.00
Northampton	4,088	$935,153.00
Northumberland	7,435	$1,903,122.00
Philadelphia	1,397	$483,484.00
Somerset	5,385	$1,022,485.00
Westmoreland	3,943	$789,195.00
York	5,494	$1,122,326.00
Grand Total	***138,872***	***$32,344,645.00***

4.3.20.9. State Facility Loss Estimation

The estimated replacement cost of all State Critical Facilities located in levee vulnerability areas is $1,559,284,911.

4.3.21. Mass Food and Animal Feed Contamination

4.3.21.1. 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 (CDC, 2013). 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 over 7,000 dairy farms, the highest concentration of snack food production in the country, and retail food establishments from corner convenience marts to farmers' markets to large grocery store chains.

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 or not the product comes from Pennsylvania. An interruption in the food supply would be a major vulnerability for the health and survival of Pennsylvania communities.

4.3.21.2. 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, according to the CDC's 2011 foodborne illness estimates, Norovirus is responsible for over 5 million illnesses each year but the number of deaths it causes is significantly lower (149 in 2011).

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 but would also have a crippling effect on the state's poultry production and farm-based economy.

4.3.21.3. 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, Pennsylvania has been involved in the following outbreak events:

- 2013 - Live Poultry - *Salmonella*
- 2013 – Ground Beef – *Salmonella*
- 2012 – Live Poultry – *Salmonella*
- 2012 – Dry Dog Food – *Salmonella*
- 2012 – Raw Clover Sprouts at Jimmy John's Restaurants – *E. coli*
- 2011 – Kosher Broiled Chicken Livers – *Salmonella*
- 2011 – Turkish Pine Nuts – *Salmonella*

- 2011 – Ground Turkey – *Salmonella*
- 2011 – Papaya – *Salmonella*
- 2011 – Lebanon Bologna – *E. coli*
- 2010 – Alfalfa Sprouts – *Salmonella*
- 2010 – Romaine Lettuce – *E. coli*

This is not an exhaustive list of past occurrences but illustrates that Pennsylvanians have been sickened by contaminations in other states. However, Pennsylvania has not been the origin or cause of a mass food or animal feed contamination.

4.3.21.4. Future Occurrence

The CDC estimates that one in six people gets sick from contaminated food each year, but those events are expected to be individualized and small in scope. The focus of this as a hazard is on large-scale contamination and illness. With the aggressive testing and food safety outreach the Department of Agriculture conducts, the overall probability of a mass food or animal feed contamination event is *unlikely* according to the Risk Factor Methodology (see Section 4.1).

4.3.21.5. Environmental Impacts

The major identified environmental impact of mass food and animal feed contamination is, if there were to be a mass kill of animals, how to deal with the waste disposal of what could be a significant number of animals. If this waste disposal is not planned for, rotting carcasses could cause environmental degradation in the form of, in particular, water pollution. They might also have a role in spreading infections disease. Additionally, there are primary impacts on 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.

4.3.21.6. Jurisdictional Vulnerability Assessment

No communities in Pennsylvania currently profile mass food and animal feed contamination. However, 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.

4.3.21.7. State Facility Vulnerability Assessment

State facilities generally are no more or less vulnerable to mass food and animal feed contamination than the general population. However, the 106 agricultural critical facilities are likely to be the most vulnerable to a food or animal feed contamination event as they are responsible for the growing, processing, and/or oversight of food production in the Commonwealth.

4.3.21.8. Jurisdictional 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.

4.3.21.9. State Facility Loss Estimation

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.

4.3.22. Nuclear Incident

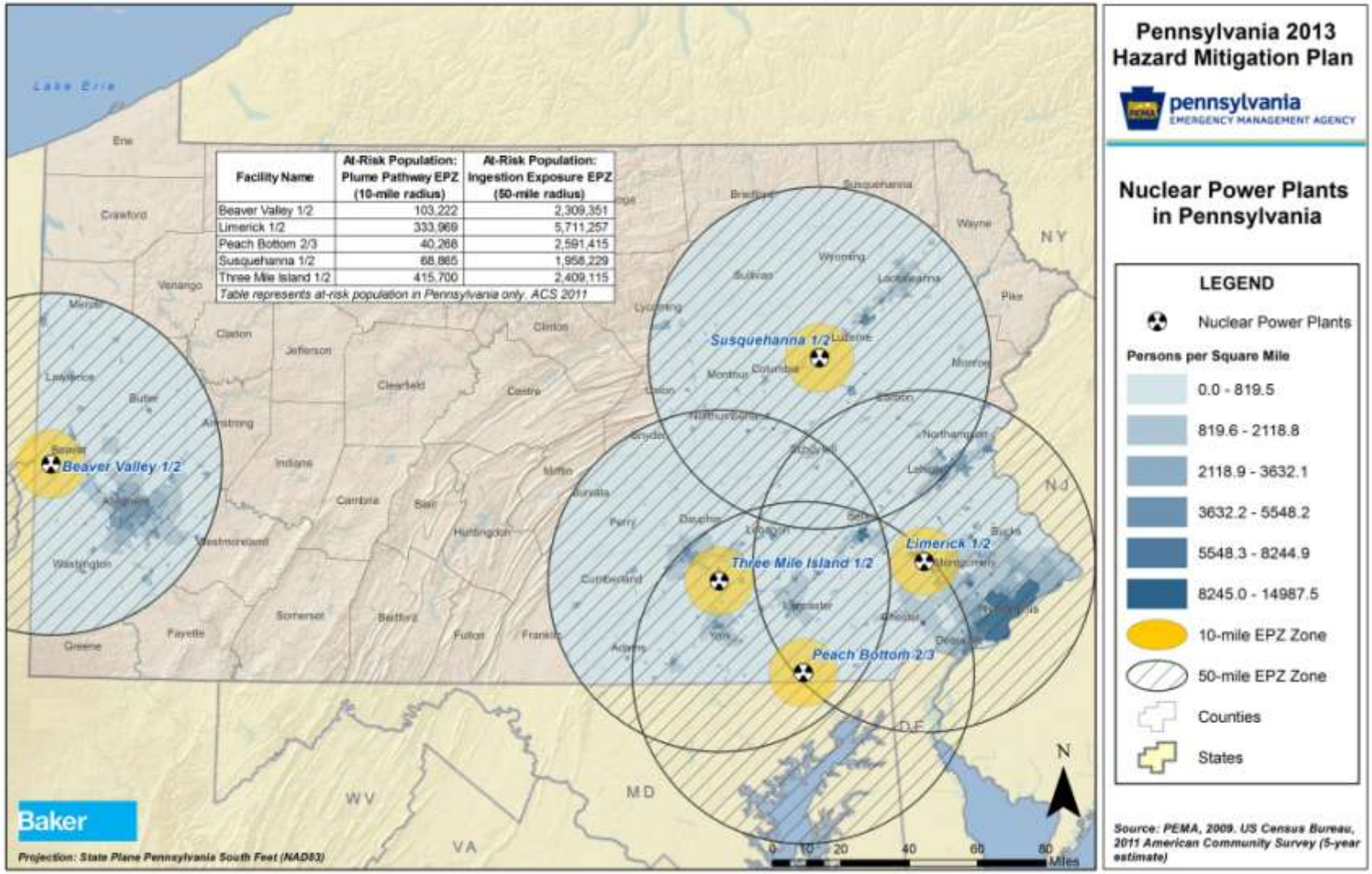
4.3.22.1. Location and Extent

Nuclear power is an important source of energy in the Commonwealth, and there are five nuclear power stations in Pennsylvania:

- Beaver Valley Power Station, Shippingport Borough, Beaver County;
- Limerick Generating Station, Limerick Township, Montgomery County;
- Peach Bottom Atomic Power Station, Peach Bottom Township, York County;
- Susquehanna Steam Electric Station, Salem Township, Luzerne County; and
- Three Mile Island Nuclear Generating Station, Londonderry Township, Dauphin County.

Most of these generating stations are concentrated in the eastern portion of the state, as seen in Figure 4.3.22-1. Four of the five nuclear power plants in the Commonwealth have two operating licensed units. Three Mile Island (TMI) has only one operating license with the second unit in a state of Post-Defueling Monitored Storage (PDMS).

Figure 4.3.22-1 Location of Pennsylvania nuclear power stations, their Emergency Planning Zones (EPZs), and the population density of affected municipalities (PEMA, 2009 and Census, 2011).



Facility Name	At-Risk Population: Plume Pathway EPZ (10-mile radius)	At-Risk Population: Ingestion Exposure EPZ (50-mile radius)
Beaver Valley 1/2	103,222	2,309,351
Limerick 1/2	333,969	5,711,257
Peach Bottom 2/3	40,268	2,591,415
Susquehanna 1/2	68,865	1,958,229
Three Mile Island 1/2	415,700	2,409,115

Table represents at-risk population in Pennsylvania only. ACS 2011

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. 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.

PEMA estimates the populations located in the Plume Exposure Pathway EPZ, showing that they range from 25,173 at Peach Bottom Atomic Power Station to 244,146 at Limerick Generating Station, as shown in Table 4.3.22-1 (Pennsylvania populations only). In all five Plume Exposure EPZs, approximately 640,000 Pennsylvanians are at risk. As indicated in Figure 4.3.22-1, 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 11,654,347 Pennsylvanians live within the five Ingestion Pathway EPZs. This comprises about 95% 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 4.3.22-1 Population located in the Plume Exposure and Ingestion EPZs for PA nuclear power generating stations (PEMA, 2009).

FACILITY	AT-RISK POPULATION: PLUME EXPOSURE EPZ (10-MILE RADIUS)	AT-RISK POPULATION: INGESTION EXPOSURE EPZ (50-MILE RADIUS)
Beaver Valley Power Station	89,132	2,451,000
Limerick Generating Station	244,146	5,814,000
Peach Bottom Atomic Power Station	36,405	2,452,000
Susquehanna Steam Electric Station	68,503	2,051,000
Three Mile Island Nuclear Generating Station	201,894	3,034,000

4.3.22.2. 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.

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.
- **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 (Nuclear Regulatory Commission, 2008):

- **Unusual Event:** Under this category, events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation occurs.
- **Alert:** If an alert is declared, events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the EPA Protective Action Guides (PAGs).
- **Site Area Emergency:** A site area emergency involves events in process or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed the EPA PAGs except near the site boundary.
- **General Emergency:** A general emergency involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area.

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.

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 (Nuclear Regulatory Commission, 2008). 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. 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.

4.3.22.3. 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. 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."

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. However, one study conducted by the DOH's Three Mile Island Health Research Program did find evidence of psychological stress, "lasting in some cases for five to six years." According to the program chief, "the people suffering from stress perceived their health as being poorer than it actually was when the Health Department checked the medical records."

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. 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 2007 Plan. However, 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 March11, 2011. An earthquake in the area resulted in a series of equipment failures, nuclear meltdowns and releases of radioactive materials. These failures and releases were largely attributed to the water that penetrated the structures following the tsunami that was generated by the earthquake. The flooding caused the failure of multiple generators meant to keep the systems operating safely after the automatic shutdown. No deaths have been directly attributed to the incidents at the reactor at this time. 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.

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. 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.

4.3.22.4. 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 4.3.22: Terrorism.

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.

4.3.22.5. Environmental Impacts

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. 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.

4.3.22.6. Jurisdictional Vulnerability Assessment

In Pennsylvania, 145 municipalities and 61 school districts in eleven counties are located in the 10-mile Plume Exposure Pathway EPZs of the five Pennsylvania nuclear power generating stations. The breakdown of jurisdictional vulnerability is shown in Table 4.3.22-2. 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 4.3.22-2 Counties and municipalities located within each the 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
	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

Table 4.3.22-2 Counties and municipalities located within each the 10-mile Plume Exposure Pathway EPZ (DEP Bureau of Radiation Protection, 2009)

LIMERICK GENERATING STATION			
Risk County	**Risk Municipalities**		
Berks County	Amity Township	Douglass Township	Washington Township
	Boyertown Borough	Earl Township	
	Colebrookdale Twp.	Union Township	
Risk County	**Risk Municipalities**		
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.
Risk County	**Risk Municipalities**		
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	
Risk County	**Risk Municipality**		
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	
THREE MILE ISLAND NUCLEAR GENERATING STATION			
Risk County	**Risk Municipalities**		
Cumberland County	Lower Allen Township	New Cumberland Borough	

Table 4.3.22-2 Counties and municipalities located within each the 10-mile Plume Exposure Pathway EPZ (DEP Bureau of Radiation Protection, 2009)			
Risk County	**Risk Municipalities**		
Dauphin County	Conewago Township	Londonderry Township	Royalton Borough
	Derry Township	Lower Paxton Township	South Hanover Township
	Harrisburg City	Lower Swatara Township	Steelton Borough
	Highspire Borough	Middletown Borough	Swatara Township
	Hummelstown Borough	Paxtang Borough	
Risk County	**Risk Municipalities**		
Lancaster County	Conoy Township	Elizabethtown Borough	West Donegal Township
	East Donegal Township	Mount Joy Township	
Risk County	**Risk Municipalities**		
Lebanon County	South Londonderry Township		
Risk County	**Risk Municipalities**		
York County	Conewago Township	Hellam Township	Newberry Township
	Dover Township	Lewisberry Borough	Springettsbury Township
	East Manchester Township	Manchester Borough	Warrington Township
	Fairview Township	Manchester Township	York Haven Borough
	Goldsboro Borough	Mount Wolf Borough	

Beyond the identified risk municipalities, Table 4.3.22-3 lists which counties did and did not profile nuclear incidents, along with any ranking provided. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 19 counties which currently have calculated risk factor values for nuclear incidents, the average value is 2.3; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for Nuclear Incident is 2.4, while the Pennsylvania THIRA scored Nuclear Incidents as a 7 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.22-3 Counties profiling nuclear incidents with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.1
Allegheny	X		High	2.6
Armstrong		X		
Beaver	X		High	2.7

Table 4.3.22-3 Counties profiling nuclear incidents with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Bedford		X		
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks		X		
Butler	X		High	2.5
Cambria		X		
Cameron		X		
Carbon	X		Medium	2.4
Centre	X		Low	1.6
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia	X		Medium	2.3
Crawford		X		
Cumberland	X		Medium	2.1
Dauphin		X		
Delaware		X		
Elk		X		
Erie	X		Medium	2.1
Fayette		X		
Forest	X		Not Ranked	No RF
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon	X		Not Ranked	No RF
Indiana		X		
Jefferson	X		Low	1.6
Juniata		X		
Lackawanna	X		Not Ranked	No RF
Lancaster	X		Low	1.7
Lawrence	X		High	3.1

Table 4.3.22-3 Counties profiling nuclear incidents with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Lebanon*	X		Not Ranked	2.9
Lehigh	X		Low	1.4
Luzerne	X		Not Ranked	No RF
Lycoming	X		High	2.6
McKean	X		Medium	2.3
Mercer	X		High	2.6
Mifflin	X		Not Ranked	No RF
Monroe	X		Medium	2.3
Montgomery		X		
Montour*	X		Not Ranked	2.9
Northampton	X		Low	1.4
Northumberland		X		
Perry*	X		Not Ranked	2.9
Philadelphia**		X		
Pike	X		Low	1.9
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan		X		
Susquehanna		X		
Tioga		X		
Union	X		Not Ranked	No RF
Venango		X		
Warren		X		
Washington		X		
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming		X		
York	X		High	2.7

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

As stated in Section 4.2.2, 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 tracts 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.

As shown in Table 4.3.22-4, 299 state critical facilities are located within the 10-mile EPZ of Pennsylvania's 5 nuclear facilities. Dauphin and Beaver Counties have the most vulnerable state facilities in their jurisdictions, followed by Montgomery County, which hosts 36 facilities.

Table 4.3.22-4 Number of State Critical Facilities impacted by the 10-mile EPZ in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Beaver	84	Lancaster	13
Berks	11	Luzerne	30
Chester	18	Montgomery	36
Columbia	18	Northampton	1
Cumberland	7	York	11
Dauphin	70		

Nuclear incidents create secondary hazard zones in the form of the 50-mile EPZ, or plume ingestion pathway. Because the primary danger in this zone is the ingestion of nuclear radiation, Pennsylvania's food and agriculture-related critical facilities are primarily vulnerable. Table 4.3.22-5 displays the number of food and agriculture-related critical facilities per county that fall within the 50-mile ingestion pathway.

Table 4.3.22-5 Number of food and agriculture State Critical Facilities impacted by the 50-mile EPZ in affected counties

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	5	Lebanon	3
Allegheny	4	Lehigh	1
Berks	8	Luzerne	1
Bradford	1	Lycoming	2
Bucks	1	Mercer	1
Chester	3	Montgomery	3
Columbia	2	Northampton	2
Cumberland	4	Northumberland	5
Dauphin	12	Philadelphia	4

Table 4.3.22-5 Number of food and agriculture State Critical Facilities impacted by the 50-mile EPZ in affected counties

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Delaware	1	Schuylkill	4
Juniata	1	Snyder	2
Lackawanna	1	Susquehanna	1
Lancaster	18	**TOTAL**	**94**

4.3.22.7. State Facility Vulnerability Assessment

The state facilities vulnerable to nuclear incidents are overwhelmingly fire departments, police stations, and schools; there are fewer than ten facilities in each of the other categories. Interestingly, even with its proximity to Three Mile Island, only two government facilities is vulnerable to nuclear incidents, as seen in Table 4.3.21-6.

Table 4.3.22-6 State Critical Facilities vulnerable to nuclear incidents by critical facility type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	6
Banking	1
Chemical	3
Commercial Facilities	1
Dams	1
Education	8
Emergency Services	2
Energy	2
Fire Departments (Non-HSIP)	117
Government Facilities	2
Healthcare & Public Health	1
Hospital (Non-HSIP)	7
Nuclear Reactors, Materials & Waste	5
Police (Non-HSIP)	68
School (Non-HSIP)	73
Transportation	1
Water	1
Grand Total	***299***

As stated in section 4.3.21.6, the 94 food and agriculture critical facilities located in the 50-mi EPZ are vulnerable in the case of a nuclear incident. These facilities encompass farms and growers, food manufacturers, seed producers, and dairies.

4.3.22.8. Jurisdictional Loss Estimation

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.

If there were to be some kind of catastrophic event at the nuclear facilities in the Commonwealth, combined jurisdictional losses could surpass $114.5 billion (Table 4.3.22-7). Montgomery County is the one jurisdiction most threatened by nuclear incidents, with over 85,000 buildings worth $28.8 billion.

Table 4.3.22-7 Estimated jurisdictional losses due to nuclear incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Beaver	46,031	$11,063,057.00
Berks	17,719	$5,352,463.00
Chester	58,168	$19,180,745.00
Columbia	15,478	$2,956,233.00
Cumberland	8,814	$2,364,177.00
Dauphin	63,271	$15,664,555.00
Lancaster	35,081	$8,588,222.00
Lebanon	5,499	$1,315,053.00
Luzerne	28,009	$6,025,056.00
Montgomery	87,393	$28,845,999.00
Washington	1,744	$381,588.00

Table 4.3.22-7 Estimated jurisdictional losses due to nuclear incidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
York	50,567	$12,804,997.00
Grand Total	**417,774**	**$114,542,145.00**

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 4.3.22-8 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 4.3.22-8 Estimated 50-mile EPZ jurisdictional losses relating to agricultural production.

COUNTY	IMPACTED FARMLAND ACREAGE	MARKET VALUE OF ALL AGRICULTURAL PRODUCTS
Adams	174,595	$216,994,000
Allegheny	38,023	$9,514,000
Beaver	67,075	$15,187,000
Berks	222,119	$367,840,000
Bucks	75,883	$70,573,000
Butler	129,850	$38,664,000
Carbon	20,035	$8,944,000
Chester	166,891	$553,290,000
Columbia	122,621	$45,874,000
Cumberland	157,388	$132,803,000
Dauphin	89,533	$82,887,000
Delaware	4,361	$9,455,000
Juniata	97,681	$91,658,000
Lackawanna	39,756	$16,216,000
Lancaster	425,336	$1,072,151,000
Lawrence	92,391	$35,639,000
Lebanon	113,486	$257,097,000
Lehigh	84,643	$72,059,000
Luzerne	66,577	$18,151,000
Mercer	171,860	$60,655,000
Monroe	29,165	$7,819,000
Montgomery	41,908	$30,028,000
Montour	50,252	$36,193,000
Northampton	68,252	$31,762,000
Northumberland	147,660	$110,978,000

Perry	144,375	$105,052,000
Philadelphia	262	$487,000
Schuylkill	118,501	$124,752,000
Snyder	100,179	$109,041,000
Sullivan	27,821	$7,240,000
Union	63,795	$90,497,000
Washington	211,053	$28,649,000
Wyoming	77,957	$13,496,000
York	292,507	$212,634,000
TOTAL	***3,733,791***	***$4,084,279,000***

4.3.22.9. State Facility Loss Estimation

The estimated replacement cost of all State Critical Facilities located within the 10-mile plume exposure pathway EPZ is $1,819,008,224. Because most of the food and agriculture-related critical facilities are privately held, the replacement value of these facilities is unknown.

4.3.23. Terrorism

4.3.23.1. Location and Extent

Terrorism is a threat everywhere, but there are a number of important considerations in evaluating terrorism hazards, such as the existence of facilities, landmarks, or other buildings of international, national, or regional importance. High-risk targets for acts of terrorism include military and civilian government facilities, international airports, large cities, and high-profile landmarks. Terrorists might also target large public gatherings, water and food supplies, utilities, and corporate centers. Furthermore, terrorists are capable of spreading fear by sending explosives or chemical and biological agents through the mail (FEMA, April 2009). Nonetheless, terrorism can take many forms and terrorists have a wide range of personal, political, or cultural agendas. Therefore, there is no location that is not 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. This hazard is addressed in full in Section 4.3.19.

4.3.23.2. Range of Magnitude

The term “terrorism” refers to intentional, criminal, malicious acts, but the functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the CFR as “…the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social

objectives" (28 CFR §0.85). Terrorists use threats to create fear, to try to convince citizens of the powerlessness of their government, and/or to get publicity for their cause.

Terrorist attacks can take many forms, including agriterrorism, arson/incendiary attack, armed attack, assassination, biological agent, chemical agent, cyberterrorism, conventional bomb, hijackings, intentional hazardous material release, kidnapping, nuclear bomb and radiological agent (FEMA April 2009). Explosives have been the traditional method of conducting terrorism, but intelligence suggests that the possibility of biological or chemical terrorism is increasing. 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. Some biological agents cannot be easily detected and may take time to develop. Therefore, it can be 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. Protection of databases and infrastructure appear to be the main goals at this point in time. 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 "Anonymous." They have been known to overtake websites, 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.

Active shooters, as defined by the US Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area; in most cases, active shooters use firearm[s] and there is no pattern or method to their selection of victims. Recent high-profile incidents involving active shooters include; the Sandy Hook Elementary school shootings in Newtown, Connecticut, the shooting in the Aurora, Colorado movie theater and the shooting in Tucson, Arizona involving U.S. Representative Gabrielle Giffords. Historical active shooter events include the Virginia Tech shootings, the Columbine High School shootings and the University of Texas, Austin shootings. No substantive research has yet been compiled to address the potential vulnerability to an active shooter incident. As a very open, public society,

these incidents are easier to accomplish for those bent on doing harm. Some of these incidents have occurred in public places, and some in places that are considered more restricted (like elementary schools and high schools). There is no discernible pattern to the location chosen by the shooter.

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, DC. They failed to reach their destination, and all 40 passengers and crew members on board perished.

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.

4.3.23.3. Past Occurrence

There has been a high consciousness of terrorist activity in the press with few catastrophic events. 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 recent terrorist event was the detonation of a pair of homemade pressure cooker bombs at the finish line of the 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 targets; the PEMA was on a state of heightened alert for the Philadelphia Marathon, which occurred shortly after the bombing in Boston.

Pennsylvania experiences threats and suspected terrorist activity frequently as reported to PEIRS. This is evidenced in Table 4.3.23-1.

Table 4.3.23-1 Threat and suspected terrorist activity events reported to PEIRS, 2001-2009 (PEIRS)

THREAT/SUSPECTED TERRORIST ACTIVITY TYPE	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Biological Threat	2	0	0	0	0	0	1	0	0
Bomb Found	6	15	7	17	17	14	16	10	4
Bomb Threat	336	240	194	167	167	166	185	132	49
Cyber Attacks	1	4	1	2	0	1	0	1	0
Hostage Situation	16	5	7	5	7	6	6	8	2
Sabotage	2	1	0	1	1	3	0	0	0
School Bomb Threat	0	0	0	72	111	121	204	170	73
Suspected Terrorism	2	0	0	5	1	1	1	1	0

Table 4.3.23-1 Threat and suspected terrorist activity events reported to PEIRS, 2001-2009 (PEIRS)									
THREAT/SUSPECTED TERRORIST ACTIVITY TYPE	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009***
Terroristic Threat	117	9	12	16	9	18	37	19	9
Terrorist Activity - totals	***482***	***274***	***221***	***285***	***313***	***330***	***450***	***341***	***137***
**Events totaled through June 2009*									

In addition, suspicious activity plays into terrorism hazards because of the uncertainty associated with those events. Table 4.3.23-2 displays suspicious activity events as reported to PEIRS from January 2001-June 2009.

Table 4.3.23-2 Threat and suspected suspicious activity events reported to PEIRS, 2001-2009 (PEIRS)									
THREAT/SUSPECTED SUSPICIOUS ACTIVITY TYPE	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009***
Suspicious Activity	74	41	42	59	52	77	110	62	20
Suspicious Device	21	16	42	56	86	86	95	34	43
Suspicious Package	374	67	60	82	96	77	77	61	24
Suspicious Substance	637	15	15	41	30	42	33	21	5
Terrorist Activity - totals	***1106***	***139***	***159***	***238***	***264***	***282***	***315***	***178***	***92***
**Events totaled through June 2009*									

WebEOC, the emergency incident reporting system in place from 2010-2012, does not include a separate category for terrorist activities, threats, or suspicious activities. As a result, while it is likely that they have continued to occur since 2009, there is no comprehensive county of these activities.

4.3.23.4. 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.

4.3.23.5. Environmental Impacts

The impacts of terrorism can vary in severity from nominal to catastrophic and are contingent upon the method of the attack, the volume of force applied, and the population density of the attack site. There may be significant loss of life for humans and animals as well as economic losses. Additionally, the impact of the attack itself may be exacerbated by the fact that human services agencies like community support programs, health and medical services, public assistance programs, and social services can experience physical damage to facilities, supplies,

and equipment and disruption of emergency communications. There may also be ancillary effects of terrorism such as urban fires or, in the case of a radiological device, radioactive fallout that can multiply the impact of a terrorist event.

4.3.23.6. Jurisdictional Vulnerability Assessment

All communities in the Commonwealth are vulnerable on some level, directly or indirectly, to a terrorist attack. However, communities where the previously mentioned potential targets are located should be considered more vulnerable. 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.

Table 4.3.lists which of the 32 counties that did and the 35 counties that did not profile terrorism, along with any ranking provided. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 24 counties which currently have calculated risk factor values for terrorism, the average value is 2.0; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for Terrorism is 2.0, while the Pennsylvania THIRA scored terrorism as a 6 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.23-3 Counties profiling terrorism with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.2
Allegheny		X		
Armstrong		X		
Beaver	X		Medium	2.0
Bedford	X		Low	1.4
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks		X		
Butler		X		
Cambria	X		Medium	2.3
Cameron	X		Low	1.2
Carbon		X		

Table 4.3.23-3 Counties profiling terrorism with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Centre	X		Medium	2.2
Chester		X		
Clarion		X		
Clearfield	X		Low	1.1
Clinton		X		
Columbia		X		
Crawford		X		
Cumberland	X		Medium	2.1
Dauphin		X		
Delaware		X		
Elk	X		Low	1.8
Erie		X		
Fayette	X		Low	1.7
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon	X		Not Ranked	No RF
Indiana	X		Low	1.9
Jefferson	X		Low	1.3
Juniata	X		Low	1.9
Lackawanna		X		
Lancaster		X		
Lawrence	X		High	2.5
Lebanon*	X		Not Ranked	2.9
Lehigh	X		Low	1.9
Luzerne		X		
Lycoming	X		High	2.7
McKean	X		Low	1.6
Mercer	X		Low	1.6
Mifflin	X		Not Ranked	No RF
Monroe		X		
Montgomery	X		Medium	2.4

Table 4.3.23-3 Counties profiling terrorism with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Montour*		X		
Northampton	X		Low	1.9
Northumberland		X		
Perry*	X		Not Ranked	2.9
Philadelphia**		X		
Pike	X		High	2.5
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset	X		Not Ranked	No RF
Sullivan		X		
Susquehanna		X		
Tioga		X		
Union	X		Not Ranked	No RF
Venango		X		
Warren	X		Medium	2.2
Washington		X		
Wayne	X			
Westmoreland	X			
Wyoming		X		
York	X		Medium	2.3

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

4.3.23.7. State Facility Vulnerability Assessment

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?

When considering cyber terrorism or cyber-attack, According to Carnegie Mellon University's CyLab, locations with publicly accessible or shared computer workstations are more vulnerable to malicious internet outages, as open access allows for easier access to shared data and system information.

4.3.23.8. Jurisdictional Loss Estimation

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, while intending to remain for the day or staying overnight, are anticipated to require evacuation assistance. While Pennsylvania's cities are certainly smaller than New York, losses could still be severe.

4.3.23.9. State Facility Loss Estimation

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 $47,154,997,513.00.

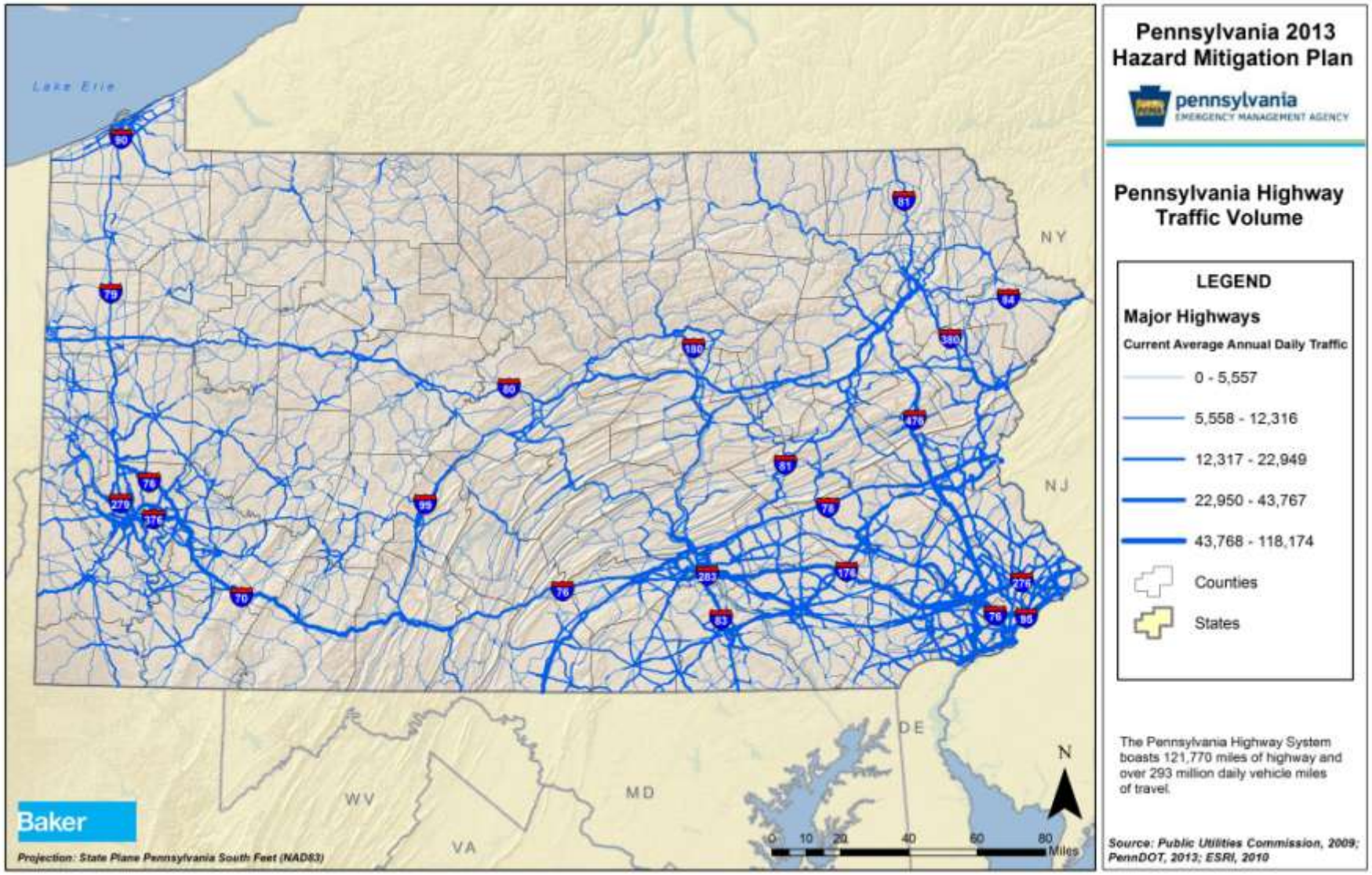
4.3.24. Transportation Accident

4.3.24.1. Location and Extent

Transportation accidents are defined as accidents involving highway, air, and rail travel. These incidents are collectively the most costly 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 (Federal Highway Administration, 2011). Pennsylvania's highway transportation network consists of 119,686 linear miles of roadway, of which Pennsylvania Department of Transportation (PennDOT) is responsible for 41,166 miles, and 31,400 bridges, of which 25,000 are owned by PennDOT. Daily vehicle miles traveled (DVMT) on the Pennsylvania highway system is 277,293,041; 66% of this total occurs in urban areas while 33% occurs in rural areas (PennDOT, 2012).The sheer amount of roadway coupled with the high volume of traffic creates the potential for serious accidents along the Commonwealth's roads and bridges.

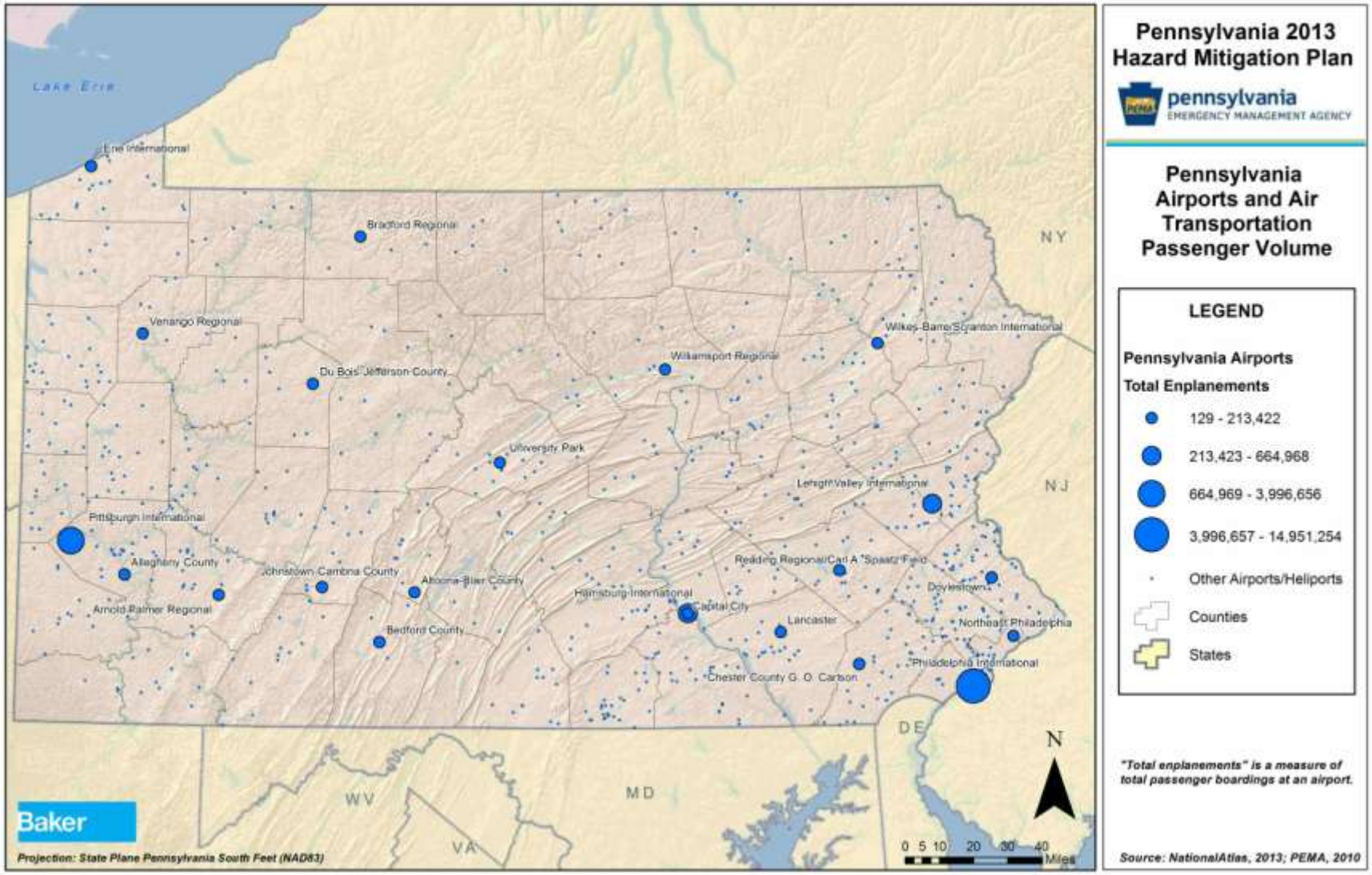
Pennsylvania's highway transportation network encompasses a number of key routes for the movement of goods and people, including Interstates 76 (PA Turnpike), 78, 80, 81, 95, and 476 (PA Turnpike Northeast Extension) and US Routes 15, 22, 30, and 202. Figure 4.3.24-1 illustrates the average annual daily traffic for Pennsylvania roads; this map highlights the volume of traffic on these and other key routes.

Figure 4.3.24-1 Average annual daily traffic on the Pennsylvania highway system (PennDOT 2013).



With 134 public access airports (including 22 commercial airports), 313 private-use airports and 290 private-use heliports across the Commonwealth. 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 sites (Aircraft Owners and Pilots Association Air Safety Foundation, 2009). Figure 4.3.24-2 illustrates Pennsylvania's major airports and their associated yearly commercial passenger enplanements.

Figure 4.3.24-2 Pennsylvania major airports and their associated passenger volumes (National Atlas, 2013).



Rail transportation accidents are generally classified as one of three types:

- Derailment – an accident on a railway in which a train leaves the rails;
- Collision – an accident in which a train strikes something such as another train or highway motor vehicle; and
- Other – accidents caused by other circumstances like obstructions on rails, fire, or explosion (Federal Railway Administration, 2010).

Rail accidents can occur anywhere along the more than 6,000 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). A total of 67 railroad companies operate in Pennsylvania.

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 2011 included a barge carrying benzene which resulted in a bridge being shut down and triggered local, state and federal salvage efforts.

4.3.24.2. Range of Magnitude

Significant passenger vehicle, air, and rail transportation accidents 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 ten people are injured in a car crash, and every seven hours someone dies as a result of a car crash (PennDOT, 2012). Most fatal crashes occur in the summer months of July, and August, and September.

Railway and roadway accidents in particular have the potential to result in hazardous materials release (See Section 4.3.19). Transportation accidents can also result in broader infrastructure damage.

The worst transportation accident 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.

4.3.24.3. Past Occurrence

Vehicular transportation accidents are a daily occurrence in the Commonwealth. According to PennDOT, in 2009, there was an average of 332 reportable crashes daily, and in 2012, there

was an average of 340 reportable traffic crashes daily. Reportable crashes are crashes resulting in a death within 30 days of the crash; crashes resulting in injury in any degree to any person involved; or crashes resulting in damage to any vehicle serious enough to require towing. In 2009, there were 121,242 reportable crashes resulting in 1,256 deaths and 87,126 injuries. Of the injuries, just over 2.8% were classified as major. This was the lowest number of crashes since 1951. In 2012, there were 124,092 reportable crashes (a 1.0% decrease from 2011) resulting in 1,310 deaths (a 1.9% increase over 2011) and 86,846 injuries (a decrease of 1.1% from 2011). Of the injuries, just over 3.9% were classified as major. Table 4.3.23-1 illustrates trends in crashes, deaths, and injuries from 2004-2012.

Table 4.3.24-1 Pennsylvania vehicular transportation accident trends, 2004-2012 (PennDOT, 2012)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Reported Crashes	137,410	132,829	128,342	130,675	125,327	121,242	121,312	125,395	124,092
Total Deaths	1,490	1,616	1,525	1,491	1,468	1,256	1,324	1,286	1,310
Total Injuries	105,222	100,381	96,597	94,633	88,709	87,126	87,949	87,839	86,846
Major Injury	*4,365*	*4,324*	*4,200*	*4,087*	*3,831*	*3,483*	*3,555*	*3,409*	*3,458*
Moderate Injury	*19,580*	*17,740*	*16,514*	*16,004*	*14,306*	*13,783*	*14,036*	*13,815*	*13,519*
Minor Injury	*63,888*	*56,975*	*52,740*	*50,535*	*46,704*	*45,306*	*44,564*	*43,980*	*43,441*
Unknown Severity	*17,389*	*21,612*	*23,143*	*24,007*	*23,868*	*24,554*	*25,794*	*26,635*	*26,428*
Deaths per 100 Million Vehicle-Miles	**1.40**	**1.51**	**1.41**	**1.38**	**1.35**	**1.17**	**1.28**	**1.27**	**1.31**

Aviation accidents are the least frequent type of transportation accident. The National Transportation Safety Board, the federal agency responsible for aviation accident information, indicates that from 2001-2012, there were 356 air transportation accidents in Pennsylvania. Most of these accidents involved small aircraft and many resulted in only minimal injuries. Of the total accidents, 74 were fatal, resulting in 161 deaths including the victims of United Flight 93 on September 11, 2001.

Aviation accidents are the least frequent type of transportation accident. The National Transportation Safety Board, the federal agency responsible for aviation accident information, indicates that from 2001-2012, there were 356 air transportation accidents in Pennsylvania. Most of these accidents involved small aircraft and many resulted in only minimal injuries. Of the total accidents, 74 were fatal, resulting in 161 deaths including the victims of United Flight 93 on September 11, 2001.

According to the Federal Railroad Administration, there has been an average of approximately 89 rail accidents per year from 2001-2012 in the Commonwealth. In 2012, there were reported a total of 53 incidents; there were 7 injuries but no deaths in these accidents. Table 4.3.24-2 provides an accounting of recent rail accidents and their associated damages.

Table 4.3.24-2 Rail incidents by county from 2010-2013 (Federal Railway Administration, 2013).

COUNTY	2010 INCIDENTS	2010 DAMAGES	2011 INCIDENTS	2011 DAMAGES	2012 INCI-DENTS	2012 DAMAGES	2013 INCI-DENTS	2013 DAMAGES	TOTAL INCI-DENTS	TOTAL DAMAGE
Allegheny	7	$360,907.00	4	$ 56,208.00	6	$179,994.00	2	$ 63,971.00	19	$ 661,080.00
Armstrong	1	$32,000.00	0	$0	0	$0	0	$0	1	$ 32,000.00
Beaver	9	$849,811.00	8	$180,939.00	11	$479,342.00	7	$ 79,476.00	35	$1,589,568.00
Berks	1	$24,000.00	1	$ 30,100.00	0	$ -	0	$0	2	$ 54,100.00
Blair	2	$48,316.00	0	$0	0	$0	1	$157,194.00	3	$ 205,510.00
Bucks	10	$483,446.00	5	$ 44,168.00	6	$186,024.00	1	$ 52,644.00	22	$ 766,282.00
Butler	1	20,000.00	0	$0	0	$0	0	$0	1	$ 20,000.00
Cambria	3	27,366.00	1	$ 71,812.00	1	$ 12,100.00	0	$0	5	$ 111,278.00
Carbon	0	$0	2	$145,963.00	0	$0	2	$ 21,531.00	4	$ 167,494.00
Chester	8	$84,417.00	0	$0	1	$ 21,000.00	0	$0	9	$ 105,417.00
Columbia	0	$0	2	$550,385.00	0	$0	0	$0	2	$ 550,385.00
Crawford	0	$0	0	$0	0	$0	3	$156,100.00	3	$ 156,100.00
Cumberland	4	$109,500.00	6	$130,635.00	7	$113,535.00	2	$ 55,300.00	19	$ 408,970.00
Dauphin	3	$ 98,249.00	4	$191,700.00	2	$ 32,050.00	0	$0	9	$ 321,999.00
Delaware	5	$ 57,668.00	5	$232,652.00	1	$ 11,519.00	2	$ 15,747.00	13	$ 317,586.00
Erie	0	$0	1	$255,181.00	0	$0	0	$0	1	$ 255,181.00
Fayette	1	$ 13,926.00	0	$0	1	$ 15,000.00	0	$0	2	$ 28,926.00
Greene	0	$0	0	$0	1	$ 10,000.00	1	$ 23,111.00	2	$ 33,111.00
Indiana	0	$0	1	$ 24,428.00	0	$0	0	$0	1	$ 24,428.00
Jefferson	0	$0	0	$0	1	$ 22,000.00	0	$0	1	$ 22,000.00
Lackawanna	0	$0	0	$0	1	$ 35,105.00	1	$ 31,770.00	2	$ 66,875.00
Lancaster	1	$ 15,000.00	2	$115,906.00	2	$286,000.00	1	$ 35,550.00	6	$ 452,456.00
Lawrence	1	$ 69,400.00	1	$ 10,503.00	0	$0	1	$ 14,439.00	3	$ 94,342.00
Lehigh	5	$ 53,950.00	3	$ 64,510.00	2	$ 68,500.00	0	$0	10	$ 186,960.00
Luzerne	0	$0	0	$0	2	$ 35,578.00	0	$0	2	$ 35,578.00
Lycoming	0	$0	0	$0	1	$ 10,958.00	0	$0	1	$ 10,958.00

Table 4.3.24-2 Rail incidents by county from 2010-2013 (Federal Railway Administration, 2013).

COUNTY	2010 INCIDENTS	2010 DAMAGES	2011 INCIDENTS	2011 DAMAGES	2012 INCI-DENTS	2012 DAMAGES	2013 INCI-DENTS	2013 DAMAGES	TOTAL INCI-DENTS	TOTAL DAMAGE
Mercer	0	$0	0	$0	1	$ 41,050.00	0	$0	1	$ 41,050.00
Mifflin	3	$ 62,421.00	0	$0	0	$0	0	$0	3	$ 62,421.00
Monroe	0	$0	0	$0	1	$ 22,551.00	0	$0	1	$ 22,551.00
Montgomery	6	$ 65,760.00	5	$102,985.00	2	$ 35,802.00	0	$0	13	$ 204,547.00
Northampton	3	$ 34,900.00	1	$ 30,600.00	0	$0	1	$ 34,000.00	5	$ 99,500.00
Northumberland	0	$0	1	$ 29,700.00	3	$ 60,100.00	0	$0	4	$ 89,800.00
Philadelphia	16	$201,395.00	15	$452,908.00	9	$556,851.00	5	$172,761.00	45	$1,383,915.00
Somerset	1	$ 2,576,191.00	2	$ 21,297.00	2	$178,863.00	0	$0	5	$2,776,351.00
Union	1	$ 13,500.00	0	$0	0	$0	0	$0	1	$ 13,500.00
Washington	1	$204,270.00	1	$ 20,850.00	0	$0	1	$ 23,500.00	3	$ 248,620.00
Westmoreland	1	$169,487.00	1	$ 25,440.00	0	$0	1	$ 93,992.00	3	$ 288,919.00
Wyoming	0	$0	0	$0	1	$ 25,825.00	0	$0	1	$ 25,825.00
York	1	$ 19,000.00	0	$0	1	$180,000.00	0	$0	2	$ 199,000.00
TOTAL	***95***	***$5,694,880.00***	***72***	***$2,788,870.00***	***66***	***$ 2,619,747.00***	***32***	***$ 1,031,086.00***	***265***	***$ 12,134,583.00***

4.3.24.4. Future Occurrence

With the volume of goods and people moving through Pennsylvania, transportation accidents will continue to occur routinely, especially passenger vehicle accidents. At the same time, though, five year trends indicate that rail and motor vehicle transportation accidents have been decreasing across the board. In the case of highway accidents, PennDOT has taken great strides to reduce the number of highway transportation accidents 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 accidents. Likewise, the number of rail accidents nationally has been falling for the last five years; in 2012, the nationwide rail accident rate was 2.34 accidents per million rail miles. Additionally, the probability of aviation accidents nationwide is 7.20 accidents per 100,000 flight hours, meaning that the likelihood of air transportation accidents in the Commonwealth remains low. Overall, the probability of future transportation accidents is *highly likely* as defined by the Risk Factor Methodology (see Section 4.1).

4.3.24.5. Environmental Impacts

Like the range of magnitude, the environmental impacts of transportation accidents can vary greatly. In the case of a simple motor vehicle crash, train derailment, or aviation accident, the environmental impact is minimal. However, if the accident 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. For a complete discussion of the environmental impacts of hazardous materials releases, see Section 4.3.19.5.

4.3.24.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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.

Jurisdictional vulnerability for transportation accidents is different for each of the three major modes of transportation in the Commonwealth. For this analysis, vulnerability for highway accidents was defined as jurisdictions falling within a ¼ mile of Interstate and US highways, the high-speed roads likely to yield deadly crashes. Vulnerability for air traffic accidents is defined as jurisdictions falling within five miles of both public and private airports and heliports with at least one runway. Similar to highway accidents, jurisdictions that are vulnerable to rail accidents are those located within ¼ mile of rail lines. Using these definitions, all 67 counties are vulnerable to at least one type of transportation accident.

In addition to this geographic analysis, Table 4.3.24-3 lists which counties did and did not profile transportation accidents, along with any ranking provided. 46 counties profile this hazard. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other

analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 33 counties which currently have calculated risk factor values for transportation accidents, the average value is 2.3; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for transportation accidents is 2.4, while the Pennsylvania THIRA scored transportation accidents as a 6 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.24-3 Counties profiling transportation hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny	X		Medium	2.2
Armstrong		X		
Beaver	X		Medium	2.0
Bedford	X		Medium	2.2
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks	X		Medium	2.3
Butler	X		Medium	2.0
Cambria	X		Medium	2.2
Cameron		X		
Carbon	X		Medium	2.2
Centre	X		Low	1.9
Chester		X		
Clarion		X		
Clearfield	X		Medium	2.1
Clinton	X		Medium	2.2
Columbia		X		
Crawford		X		
Cumberland	X		Medium	2.2
Dauphin		X		
Delaware	X		Medium	2.2
Elk	X		Medium	2.2
Erie	X		Medium	2.2

Table 4.3.24-3 Counties profiling transportation hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Fayette	X		High	2.5
Forest		X		
Franklin		X		
Fulton	X		High	2.8
Greene	X		Medium	2.2
Huntingdon	X		Not Ranked	No RF
Indiana	X		Medium	2.2
Jefferson	X		Medium	2.4
Juniata	X		Medium	2.2
Lackawanna		X		
Lancaster	X		Medium	2.4
Lawrence		X		
Lebanon*	X		Not Ranked	8.0
Lehigh	X		Medium	2.2
Luzerne		X		
Lycoming	X		High	2.8
McKean	X		Medium	2.2
Mercer	X		Low	1.8
Mifflin	X		Not Ranked	No RF
Monroe	X		High	2.8
Montgomery	X		High	2.5
Montour*	X		Not Ranked	2.9
Northampton	X		Medium	2.2
Northumberland	X		Medium	2.2
Perry*	X		Not Ranked	3.0
Philadelphia**		X		
Pike	X		High	2.5
Potter		X		
Schuylkill	X		Not Ranked	No RF
Snyder	X		Medium	2.2
Somerset		X		
Sullivan		X		
Susquehanna	X		Medium	2.2

Table 4.3.24-3 Counties profiling transportation hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Tioga	X		Medium	2.2
Union	X		Not Ranked	No RF
Venango		X		
Warren	X		Medium	2.2
Washington		X		
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York		X		

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

For highway accidents, PennDOT statistics show that 53% of all reportable crashes occur in only 10 counties: Allegheny, Berks, Bucks, Chester, Delaware, Lancaster, Lehigh, Montgomery, Philadelphia, and York. Additionally, almost 42% of the total traffic deaths in 2012 occurred in only 10 counties: Allegheny, Berks, Bucks, Lancaster, Lehigh, Luzerne, Montgomery, Philadelphia, Schuylkill, , and Westmoreland. 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.

With highway accidents, there is an added vulnerability that stems from the age and upkeep of bridges throughout the Commonwealth. Pennsylvania has the largest number of deficient bridges in the nation with over 6,000 structurally deficient bridges and 3,708 functionally obsolete bridges. These bridges have a sufficiency rating of 80 or less; these bridges are in need of costly repairs. Unrepaired deficient bridges may be more likely to break, thus leading to highway transportation damages or deaths. Table 4.3.24-4 displays Pennsylvania's bridge inventory in table form; Figure 4.3.23-4 illustrates the distribution of structurally deficient and functionally obsolete bridges. Cameron, Fayette, Indiana, McKean, Monroe, Potter and Susquehanna, all have at least 25% of their bridges rated as structurally deficient; Allegheny County has by far highest number of deficient bridges with 541. Montour, Snyder, Sullivan, Tioga and Union Counties have the lowest proportion of deficient bridges with between 12-14% total deficient bridges.

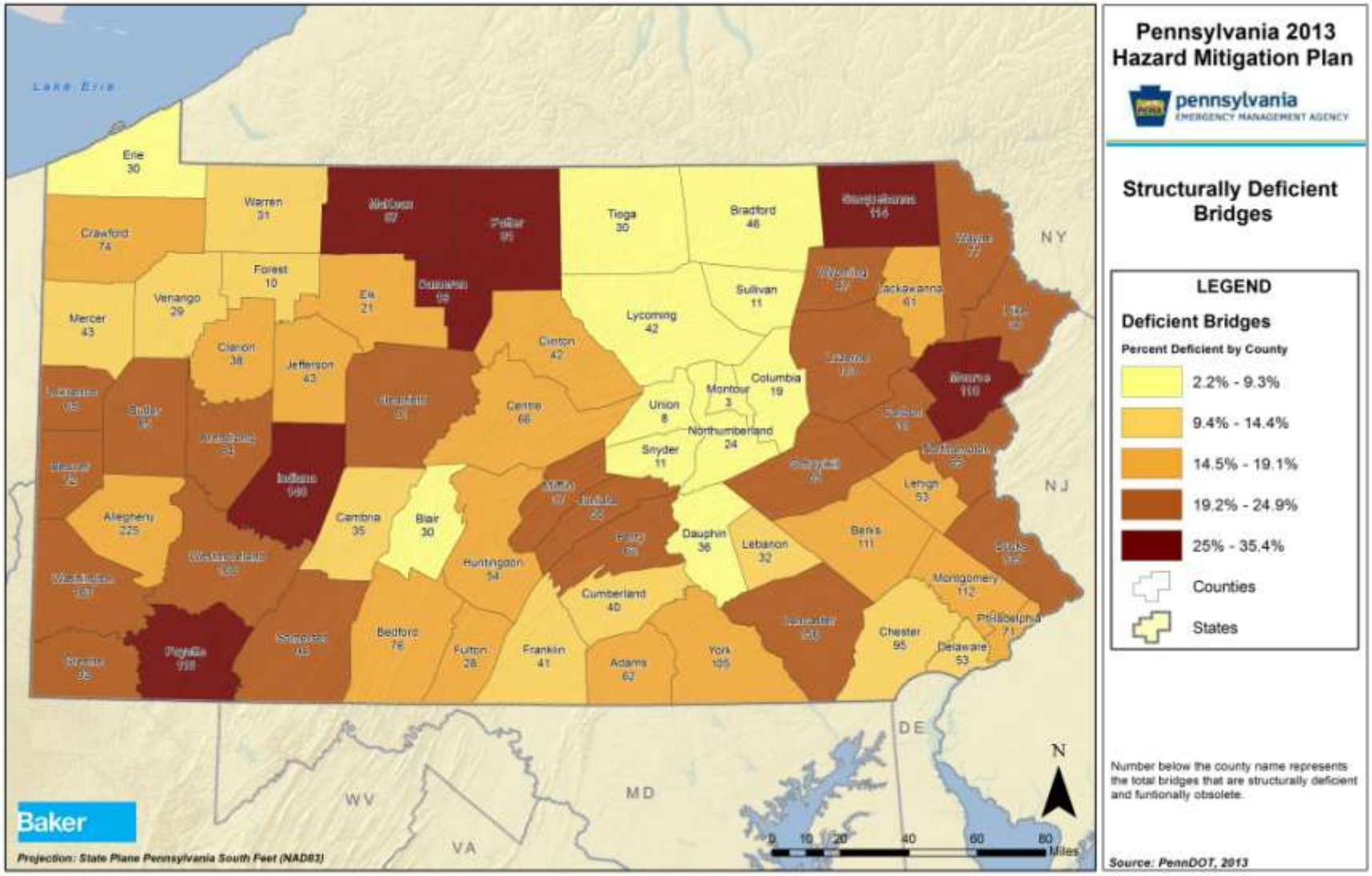
Table 4.3.24-4 Pennsylvania Bridge Inventory (Federal Highway Administration, 2012)

COUNTY	TOTAL BRIDGES	STRUCTURALLY DEFICIENT BRIDGES	FUNCTIONALLY OBSOLETE BRIDGES	TOTAL DEFICIENT BRIDGES
Adams	383	62	32	94
Allegheny	1,177	225	316	541
Armstrong	371	84	24	108
Beaver	337	72	45	117
Bedford	458	76	51	127
Berks	636	111	152	263
Blair	322	30	28	58
Bradford	509	46	30	76
Bucks	654	135	155	290
Butler	355	85	63	148
Cambria	332	35	30	65
Cameron	71	19	1	20
Carbon	135	31	23	54
Centre	433	66	36	102
Chester	668	95	178	273
Clarion	208	38	12	50
Clearfield	387	91	22	113
Clinton	247	42	26	68
Columbia	303	19	41	60
Crawford	498	74	52	126
Cumberland	369	40	80	120
Dauphin	438	36	94	130
Delaware	373	53	108	161
Elk	124	21	10	31
Erie	577	30	68	98
Fayette	429	118	61	179
Forest	75	10	5	15
Franklin	323	41	55	96
Fulton	181	28	23	51
Greene	399	93	47	140
Huntingdon	317	54	20	74
Indiana	428	140	46	186
Jefferson	264	43	13	56
Juniata	254	56	10	66
Lackawanna	411	61	59	120
Lancaster	723	156	142	298
Lawrence	282	69	24	93

Table 4.3.24-4 Pennsylvania Bridge Inventory (Federal Highway Administration, 2012)

COUNTY	TOTAL BRIDGES	STRUCTURALLY DEFICIENT BRIDGES	FUNCTIONALLY OBSOLETE BRIDGES	TOTAL DEFICIENT BRIDGES
Lebanon	222	32	30	62
Lehigh	349	53	105	158
Luzerne	562	113	78	191
Lycoming	515	42	56	98
McKean	246	87	12	99
Mercer	422	43	53	96
Mifflin	184	37	28	65
Monroe	365	110	47	157
Montgomery	635	112	161	273
Montour	134	3	13	16
Northampton	311	65	88	153
Northumberland	341	24	54	78
Perry	275	62	25	87
Philadelphia	421	71	196	267
Pike	177	36	18	54
Potter	247	81	5	86
Schuylkill	342	85	41	126
Snyder	243	11	24	35
Somerset	474	94	43	137
Sullivan	139	11	9	20
Susquehanna	409	114	21	135
Tioga	522	30	34	64
Union	197	8	19	27
Venango	224	29	24	53
Warren	264	31	14	45
Washington	775	183	84	267
Wayne	309	77	19	96
Westmoreland	735	168	87	255
Wyoming	200	47	6	53
York	654	105	132	237
TOTALS	**25,344**	**4,449**	**3,708**	**8,157**

Figure 4.3.24-3 Deficient Bridges in Pennsylvania (PennDOT 2013).



Of all vehicular crashes in Pennsylvania, PennDOT estimates that over one-third involve a vehicle striking a stationary object such as a pole, guard rail, or building. As a result, the 3,500 state critical facilities located one-quarter mile or less from a major highway are vulnerable to the effects of vehicular crashes (Table 4.3.24-5). On average, each county affected by highway accidents hosts 52 vulnerable critical facilities. Allegheny County has the most critical facilities in areas vulnerable to highway accidents. At the other end of the spectrum, Forest County is home to only five vulnerable state critical facilities.

Table 4.3.24-5 Number of State Critical Facilities impacted by highway accidents in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	31	Lackawanna	82
Allegheny	239	Lancaster	105
Armstrong	64	Lawrence	46
Beaver	90	Lebanon	62
Bedford	29	Lehigh	31
Berks	88	Luzerne	97
Blair	54	Lycoming	48
Bradford	40	McKean	33
Bucks	74	Mercer	65
Butler	61	Mifflin	16
Cambria	67	Monroe	19
Cameron	6	Montgomery	103
Carbon	38	Montour	8
Centre	51	Northampton	45
Chester	75	Northumberland	64
Clarion	28	Perry	19
Clearfield	58	Philadelphia	68
Clinton	34	Pike	15
Columbia	56	Potter	17
Crawford	61	Schuylkill	147
Cumberland	45	Snyder	18
Dauphin	96	Somerset	62
Delaware	73	Sullivan	10
Elk	19	Susquehanna	31
Erie	58	Tioga	40
Fayette	67	Union	13
Forest	5	Venango	28
Franklin	35	Warren	31
Fulton	14	Washington	90
Greene	20	Wayne	33
Huntingdon	34	Westmoreland	158

Table 4.3.24-5 Number of State Critical Facilities impacted by highway accidents in each county			
COUNTY	**NUMBER OF CRITICAL FACILITIES**	**COUNTY**	**NUMBER OF CRITICAL FACILITIES**
Indiana	45	Wyoming	19
Jefferson	35	York	73
Juniata	14	**TOTAL**	**3,500**

As mentioned earlier, because most aviation incidents occur during take-off and landing, jurisdictions located within 5 miles of airports are more vulnerable to air transportation accidents. In order to combat the hazards of aviation incidents, the Pennsylvania Legislature enacted Act 164 of 1984. According to this law, municipalities within the Federal Aviation Administration Federal Regulation 14 CFR Part 77 areas around an airport are required to have ordinances that restrict the height of objects that could interfere with airport regulations and navigation. This restriction on development 10,000 feet around airports is designed to prevent the creation of airport hazard areas. In its Zoning Status Report dated April 28, 2010, PennDOT's Bureau of Aviation estimated that 680 municipalities are affected by this regulation but only 30% had adopted the airport zoning ordinance. The remaining 70% of municipalities with CFR Part 77 surfaces in their community continue to be more vulnerable to air transportation accidents.

Jurisdictional vulnerability for air transportation accidents is not limited to the largest airports in the Commonwealth. With 877 public and private airports with at least one runway as well as heliports, it is unsurprising that over 5,300 critical facilities are located within the five-mile hazard zone around airports. In fact, each county has an average of 79 state critical facilities in these hazard zones. Again, Allegheny County by far has the most vulnerable critical facilities located in air transportation hazard zones with nearly three times the number of vulnerable facilities as the next-highest county, Westmoreland. Juniata County, on the other hand, is home to the least number of critical facilities – only one – as seen in Table 4.3.24-6.

Table 4.3.24-6 Number of State Critical Facilities impacted by air accidents in each county			
COUNTY	**NUMBER OF CRITICAL FACILITIES**	**COUNTY**	**NUMBER OF CRITICAL FACILITIES**
Adams	48	Lackawanna	159
Allegheny	694	Lancaster	101
Armstrong	74	Lawrence	70
Beaver	159	Lebanon	105
Bedford	18	Lehigh	73
Berks	145	Luzerne	225
Blair	82	Lycoming	77
Bradford	48	McKean	22
Bucks	123	Mercer	86
Butler	99	Mifflin	24

Table 4.3.24-6 Number of State Critical Facilities impacted by air accidents in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Cambria	117	Monroe	31
Cameron	6	Montgomery	201
Carbon	62	Montour	15
Centre	63	Northampton	84
Chester	121	Northumberland	88
Clarion	31	Perry	17
Clearfield	73	Philadelphia	117
Clinton	37	Pike	14
Columbia	74	Potter	7
Crawford	56	Schuylkill	202
Cumberland	67	Snyder	18
Dauphin	184	Somerset	55
Delaware	139	Sullivan	7
Elk	7	Susquehanna	33
Erie	59	Tioga	32
Fayette	106	Union	14
Franklin	38	Venango	39
Fulton	2	Warren	40
Greene	22	Washington	126
Huntingdon	13	Wayne	38
Indiana	46	Westmoreland	235
Jefferson	31	Wyoming	26
Juniata	1	York	95

Rail incidents impact 65 of Pennsylvania's 67 counties. Table 4.3.23-7 illustrates the number of vulnerable critical facilities in each county impacted by rail incidents. Allegheny, Westmoreland, Luzerne, Lackawanna, Washington, and Delaware Counties are the most vulnerable to rail transportation incidents. Schuylkill County also ranks among the jurisdictions most vulnerable to rail incidents with 108 potentially impacted critical facilities.

Table 4.3.24-7 Number of State Critical Facilities impacted by rail accidents in each county

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Adams	11	Lackawanna	72
Allegheny	215	Lancaster	45
Armstrong	44	Lawrence	16
Beaver	59	Lebanon	31
Bedford	4	Lehigh	28
Berks	56	Luzerne	92
Blair	38	Lycoming	41
Bradford	25	McKean	20
Bucks	34	Mercer	34
Butler	26	Mifflin	11
Cambria	58	Monroe	4
Cameron	4	Montgomery	63
Carbon	19	Montour	6
Centre	16	Northampton	30
Chester	51	Northumberland	48
Clarion	15	Perry	9
Clearfield	51	Philadelphia	51
Clinton	20	Pike	4
Columbia	29	Schuylkill	208
Crawford	22	Snyder	8
Cumberland	24	Somerset	28
Dauphin	58	Sullivan	1
Delaware	83	Susquehanna	17
Elk	11	Tioga	1
Erie	19	Union	12
Fayette	49	Venango	15
Forest	3	Warren	26
Franklin	17	Washington	71
Greene	8	Wayne	15
Huntingdon	24	Westmoreland	109
Indiana	26	Wyoming	6
Jefferson	18	York	27
Juniata	4		

4.3.24.7. State Facility Vulnerability Assessment

There are 3,500 state critical facilities vulnerable to highway vehicular crashes, as shown in Table 4.3.24-8. Of these, the majority fall into three categories: fire departments, police departments, and schools. Some of the 43 transportation facilities impacted are components of

Pennsylvania's highway and bridge network; these facilities may be disproportionately vulnerable to vehicular crashes.

Table 4.3.24-8 State Critical Facilities vulnerable to highway accidents by critical facility type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	71
Banking	12
Chemical	5
Commercial Facilities	36
Communications	2
Dams	10
Defense Industrial Base	10
Education	74
Emergency Services	61
Energy	15
Fire Departments (Non-HSIP)	1550
Government Facilities	21
Healthcare & Public Health	20
Hospital (Non-HSIP)	111
Information Technology	2
Manufacturing	1
Nuclear Reactors, Materials & Waste	2
Police (Non-HSIP)	734
Postal & Shipping	2
School (Non-HSIP)	699
Transportation	43
Water	19
Grand Total	***3500***

With the large number of airports in Pennsylvania, it is unsurprising that over 85% of all critical facilities are vulnerable to air transportation accidents, seen in Table 4.3.24-9.

Table 4.3.24-9 State Critical Facilities vulnerable to air transportation accidents by critical facility type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	97
Banking	26
Chemical	8
Commercial Facilities	58
Communications	4
Critical Manufacturing	3
Dams	24
Defense Industrial Base	20
Education	134
Emergency Services	82
Energy	31
Fire Departments (Non-HSIP)	2038
Government Facilities	39
Healthcare & Public Health	35
Hospital (Non-HSIP)	230
Information Technology	3
Manufacturing	1
National Monuments & Icons	5
Nuclear Reactors, Materials & Waste	7
Police (Non-HSIP)	1071
Postal & Shipping	8
School (Non-HSIP)	1309
Transportation	56
Water	32
Grand Total	***5321***

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. Table 4.3.24-10 provides a breakdown of the state facility vulnerability to rail transportation accidents.

Table 4.3.24-10 State critical facilities vulnerable to rail transportation accidents by critical facility type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	53
Banking	11
Chemical	8
Commercial Facilities	17
Communications	3
Critical Manufacturing	3
Dams	7
Defense Industrial Base	14
Education	43
Emergency Services	39
Energy	18
Fire Departments (Non-HSIP)	1006
Government Facilities	16
Healthcare & Public Health	11
Hospital (Non-HSIP)	58
Manufacturing	1
Nuclear Reactors, Materials & Waste	2
Police (Non-HSIP)	516
Postal & Shipping	4
School (Non-HSIP)	321
Transportation	22
Water	17
Grand Total	***2190***

4.3.24.8. Jurisdictional Loss Estimation

Jurisdictional losses due to transportation accidents will be proportional to the number of road miles in any given jurisdiction. Losses will likewise be proportional to the number and severity of vehicular transportation accidents. However, on a statewide level, PennDOT estimates annual economic loss due to reportable motor vehicle crashes. In 2012, this total economic loss exceeded $14.8 billion. This equates to a per-person economic cost of $1,164.

In examining potential losses jurisdiction-by-jurisdiction, counties in southeastern Pennsylvania are the most threatened by vehicular transportation accidents. This area has a high concentration of Interstate and US highways and is a major thoroughfare for not only Pennsylvania but for the entire East Coast. Allegheny County is also at risk of experiencing significant losses due to vehicular accidents with 178,562 potentially impacted buildings worth nearly $45 billion. Counties with a smaller concentration of highways less threatened by highway accidents, as displayed in Table 4.3.24-11.

Table 4.3.24-11 Estimated jurisdictional losses due to highway accidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	18,732	$4,787,993.00
Allegheny	178,562	$45,238,791.00
Armstrong	14,807	$2,943,337.00
Beaver	44,602	$10,785,553.00
Bedford	2,962	$555,010.00
Berks	70,245	$17,966,144.00
Blair	32,290	$6,984,269.00
Bradford	6,751	$1,228,716.00
Bucks	79,073	$26,840,501.00
Butler	21,395	$4,898,321.00
Cambria	41,578	$9,116,712.00
Cameron	5,863	$1,167,114.00
Carbon	8,128	$1,823,890.00
Centre	19,091	$6,199,445.00
Chester	88,638	$30,013,285.00
Clarion	2,549	$880,796.00
Clearfield	13,067	$2,529,111.00
Clinton	1,092	$217,630.00
Columbia	22,961	$5,099,692.00
Crawford	8,927	$1,991,123.00
Cumberland	51,301	$13,118,234.00
Dauphin	36,428	$8,161,718.00
Delaware	82,844	$25,900,561.00
Elk	6,752	$1,629,217.00
Erie	68,134	$15,898,091.00
Fayette	30,680	$6,157,398.00
Forest	4,967	$799,714.00
Franklin	31,036	$6,653,350.00
Fulton	1,272	$201,127.00
Greene	6,197	$1,292,216.00
Huntingdon	6,843	$1,410,275.00
Indiana	23,007	$5,461,626.00
Jefferson	13,600	$2,604,740.00
Lackawanna	39,028	$9,155,313.00
Lancaster	102,369	$26,155,108.00
Lawrence	23,253	$5,251,670.00
Lebanon	41,294	$9,822,459.00

Table 4.3.24-11 Estimated jurisdictional losses due to highway accidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Lehigh	38,269	$11,459,179.00
Luzerne	43,266	$9,156,327.00
Lycoming	23,463	$4,987,727.00
McKean	6,211	$1,327,663.00
Mercer	20,394	$4,133,127.00
Mifflin	8,420	$1,502,047.00
Monroe	11,133	$2,865,150.00
Montgomery	152,481	$48,899,342.00
Montour	4,955	$989,748.00
Northampton	60,774	$15,616,422.00
Northumberland	23,119	$5,116,648.00
Perry	15,747	$3,976,530.00
Philadelphia	212,795	$59,486,215.00
Pike	16,432	$3,826,256.00
Potter	6,160	$1,063,212.00
Schuylkill	39,522	$8,458,552.00
Snyder	4,007	$901,637.00
Somerset	8,678	$1,857,789.00
Sullivan	1,738	$302,314.00
Susquehanna	3,174	$711,507.00
Tioga	1,849	$438,972.00
Union	12,471	$2,747,309.00
Venango	16,257	$2,919,404.00
Warren	11,888	$2,475,890.00
Washington	43,626	$9,518,282.00
Wayne	16,431	$3,159,706.00
Westmoreland	93,379	$21,087,614.00
Wyoming	10,684	$2,119,108.00
York	79,976	$19,348,169.00
Grand Total	**2,237,617**	**$571,392,096.00**

While air transportation accidents are infrequent compared to highway and rail incidents, they potentially threaten a larger portion of the Commonwealth, impacting over 7 million buildings worth over $1.8 trillion. Of these vulnerable jurisdictions, Allegheny and Philadelphia are the most threatened because of the number of airports in and around Pittsburgh and Philadelphia, respectively. Allegheny County has 701,366 potentially impacted buildings worth $12.9 billion

while Philadelphia's potential losses stand at 778,715 impacted buildings worth $201.3 billion, as seen in Table 4.3.24-12.

Table 4.3.24-12 Estimated jurisdictional losses due to air transportation accidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	72,228	$17,026,688.00
Allegheny	701,366	$179,027,007.00
Armstrong	63,771	$12,899,103.00
Beaver	121,767	$30,434,814.00
Bedford	15,812	$2,882,984.00
Berks	219,337	$57,169,490.00
Blair	66,200	$14,009,583.00
Bradford	17,032	$3,329,257.00
Bucks	321,764	$108,123,710.00
Butler	116,178	$29,775,721.00
Cambria	71,531	$15,923,104.00
Cameron	4,777	$905,333.00
Carbon	64,595	$14,508,369.00
Centre	63,100	$15,531,734.00
Chester	257,886	$88,830,732.00
Clarion	23,204	$4,492,750.00
Clearfield	46,483	$8,857,579.00
Clinton	14,325	$3,031,864.00
Columbia	57,010	$12,161,212.00
Crawford	45,215	$9,620,807.00
Cumberland	140,062	$35,908,025.00
Dauphin	155,473	$38,022,863.00
Delaware	272,799	$84,044,731.00
Elk	12,255	$2,550,197.00
Erie	129,463	$30,263,525.00
Fayette	75,827	$15,257,575.00
Forest	12,347	$2,089,286.00
Franklin	79,158	$17,268,598.00
Fulton	6,619	$1,126,525.00
Greene	15,644	$3,190,704.00
Huntingdon	27,695	$5,321,857.00
Indiana	38,580	$8,333,525.00
Jefferson	26,297	$5,358,398.00
Juniata	26,496	$4,945,357.00

Table 4.3.24-12 Estimated jurisdictional losses due to air transportation accidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Lackawanna	121,761	$27,703,362.00
Lancaster	198,259	$51,380,465.00
Lawrence	61,583	$13,038,163.00
Lebanon	83,445	$20,249,745.00
Lehigh	215,489	$59,007,585.00
Luzerne	169,264	$38,063,364.00
Lycoming	57,028	$12,095,053.00
McKean	9,031	$1,668,379.00
Mercer	75,370	$16,418,459.00
Mifflin	28,437	$5,440,172.00
Monroe	110,057	$28,051,785.00
Montgomery	484,549	$160,866,480.00
Montour	25,070	$5,707,083.00
Northampton	181,973	$50,378,288.00
Northumberland	71,222	$15,136,546.00
Perry	56,060	$12,823,966.00
Philadelphia	778,715	$201,276,171.00
Pike	53,940	$12,658,196.00
Potter	2,596	$590,902.00
Schuylkill	105,874	$23,128,882.00
Snyder	29,642	$6,576,585.00
Somerset	45,417	$9,854,528.00
Sullivan	3,391	$552,207.00
Susquehanna	24,246	$4,678,491.00
Tioga	15,864	$2,906,922.00
Union	34,623	$7,953,288.00
Venango	42,109	$8,524,113.00
Warren	26,801	$5,407,739.00
Washington	119,376	$29,827,254.00
Wayne	58,553	$12,311,065.00
Westmoreland	225,619	$52,993,858.00
Wyoming	25,121	$5,311,987.00
York	224,772	$56,005,682.00
Grand Total	***7,147,553***	***$1,840,809,772.00***

Rail accidents have the potential to cause nearly $426.6 trillion in damages to 1.7 million buildings in 65 counties, as seen in Table 4.3.24-13. Philadelphia, Allegheny, Montgomery,

Delaware, and Westmoreland Counties, with their strong passenger and freight rail networks, are the most threatened by rail incidents with 716,657 impacted buildings worth over $193 billion.

Table 4.3.24-13 Estimated jurisdictional losses due to rail accidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Adams	3,239	$718,821.00
Allegheny	170,972	$41,980,937.00
Armstrong	18,933	$3,898,538.00
Beaver	20,789	$4,706,474.00
Berks	61,413	$14,941,867.00
Blair	12,091	$2,507,471.00
Bradford	4,664	$950,024.00
Bucks	31,669	$10,638,972.00
Butler	11,604	$2,274,786.00
Cambria	18,253	$4,209,417.00
Cameron	1,273	$298,105.00
Carbon	17,913	$3,751,897.00
Centre	3,146	$525,784.00
Chester	58,590	$18,109,062.00
Clarion	2,549	$880,796.00
Clearfield	16,789	$3,510,734.00
Clinton	1,092	$217,630.00
Columbia	11,257	$2,386,553.00
Crawford	7,526	$1,662,101.00
Cumberland	50,221	$13,275,389.00
Dauphin	28,861	$6,622,984.00
Delaware	95,790	$26,765,363.00
Elk	5,064	$1,027,471.00
Erie	25,387	$5,964,717.00
Fayette	32,461	$6,862,710.00
Franklin	10,223	$2,540,199.00
Greene	7,582	$1,326,397.00
Huntingdon	4,119	$707,901.00
Indiana	23,391	$5,304,400.00
Jefferson	7,369	$1,549,155.00
Lackawanna	41,210	$9,508,120.00
Lancaster	31,621	$8,221,856.00
Lawrence	6,795	$1,517,583.00

Table 4.3.24-13 Estimated jurisdictional losses due to rail accidents.

COUNTY	NUMBER OF IMPACTED BUILDINGS	DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS (THOUSANDS $)
Lebanon	20,604	$4,511,032.00
Lehigh	43,314	$10,909,593.00
Luzerne	48,102	$10,717,778.00
Lycoming	20,532	$4,541,382.00
McKean	4,704	$1,037,266.00
Mercer	17,367	$3,634,078.00
Mifflin	2,594	$407,072.00
Montgomery	103,963	$31,657,897.00
Montour	4,968	$1,034,941.00
Northampton	60,406	$15,747,999.00
Northumberland	19,842	$4,391,235.00
Perry	12,413	$3,428,073.00
Philadelphia	275,976	$77,611,726.00
Schuylkill	22,951	$4,961,442.00
Snyder	6,773	$1,743,067.00
Somerset	11,177	$2,131,622.00
Susquehanna	1,170	$230,919.00
Tioga	2,880	$516,102.00
Union	9,213	$1,875,441.00
Venango	5,484	$1,110,030.00
Warren	8,224	$1,706,632.00
Washington	37,743	$8,439,233.00
Wayne	1,018	$201,123.00
Westmoreland	69,956	$15,711,959.00
Wyoming	1,631	$294,668.00
York	34,964	$8,699,200.00
Grand Total	***1,691,825***	***$426,615,724.00***

4.3.24.9. State Facility Loss Estimation

The ubiquitous nature of transportation accidents translates to high estimated state facility losses for all three kinds of transportation accidents. For highway vehicular accidents, the estimated replacement cost of all state critical facilities is $22,476,249,752. Loss estimates for state facilities impacted by air accidents is highest at $40,551,632,447. Finally, the estimated replacement cost of all state critical facilities impacted by rail transportation accidents is $12,776,400,116.

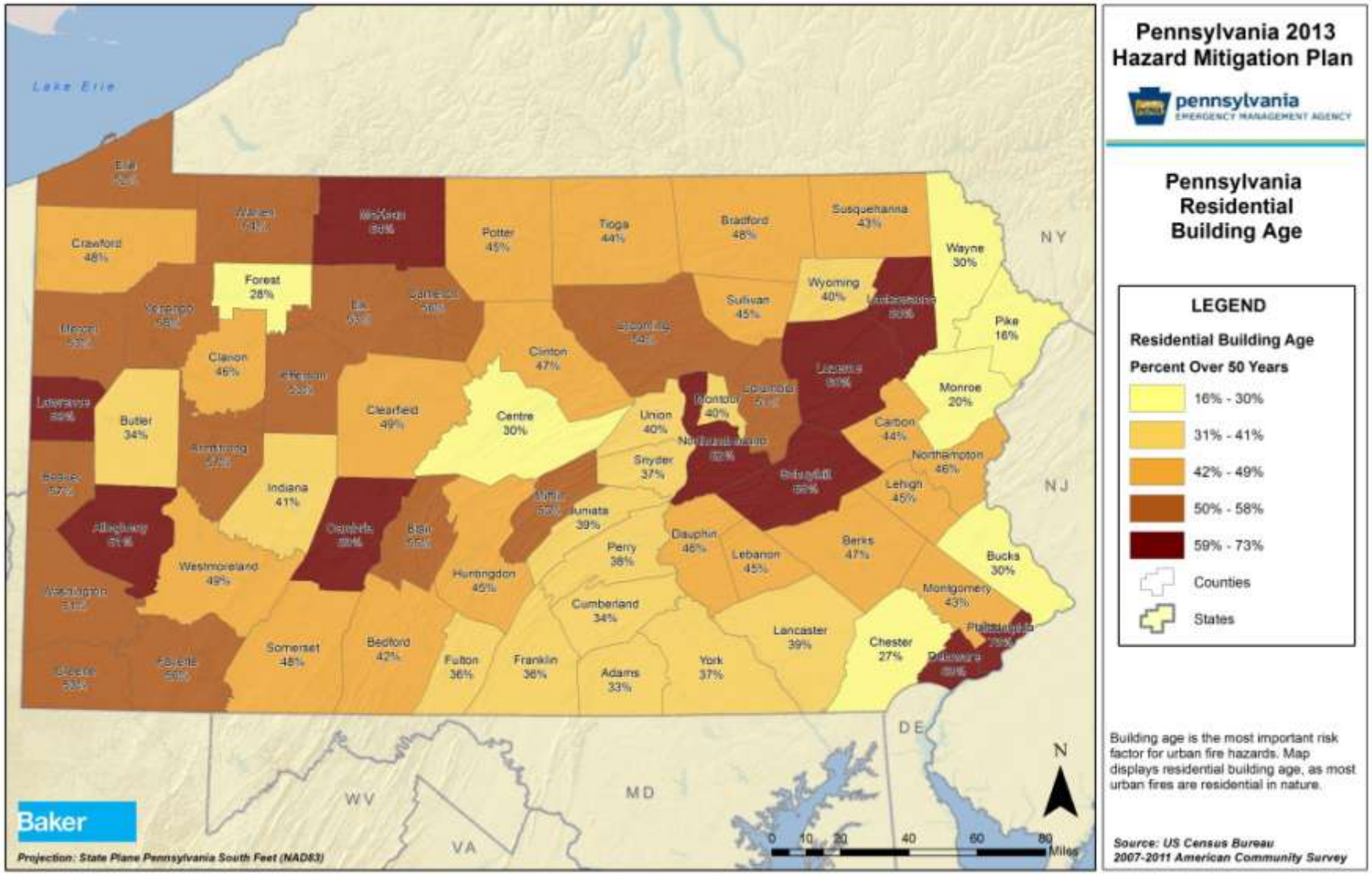
4.3.25. Urban Fire and Explosion

4.3.25.1. Location and Extent

Urban fire and explosion hazards incorporate 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 (US Fire Administration, 2009). Urban fires can more easily spread from building to building in these denser areas. Furthermore, urban fires are a more significant threat in the many areas of the Commonwealth with a significant proportion of buildings over 50 years of age. Figure 4.3.25-1 illustrates the concentration of residential structures over 50 years old 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 4.3.25-1 Percent of residential buildings older than 50 years (US Census, 2008b).



4.3.25.2. Range of Magnitude

In general, the current 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 1.35 deaths per million residents, or about 172 fire-related deaths per year. This is the 21th highest fire mortality rate in the nation and is higher than the national average of 11.1 deaths per million residents (US Fire Administration, 2010).

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.

4.3.25.3. Past Occurrence

Urban fire events occur daily in communities across Pennsylvania. According to the Office of the State Fire Commissioner, there were 51,743 building fires, 10,560 vehicle fires, and 1,925 explosions reported to the Pennsylvania Fire Information Reporting System (PennFIRS) in Pennsylvania from 2010-2012. This represents a reduction from the previous reporting period from 2005-2009.

In addition, PEIRS collects information from local emergency managers on structure fires and explosions. Note that this data source is not as comprehensive as PennFIRS reports. Table 4.3.25-1 enumerates PEIRS urban fire and explosion events from 2001-2009.

Table 4.3.25-1 Urban fire and explosion events reported to PEIRS, 2001-2009 (PEIRS)

	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Structure Fires	395	398	452	535	521	642	1058	1081	605
Vehicle Fires	8	6	18	25	35	42	66	58	28
Explosions	3	0	0	0	0	0	0	0	9
Urban Fire and Explosion Hazards - totals	***406***	***404***	***470***	***560***	***556***	***684***	***1124***	***1139***	***642***

**Events totaled through June 2009*

WebEOC, PEMA's incident reporting system from 2010-2012, does not have categories related to urban fires and explosions. While it is expected that these events have occurred in similar numbers to previous years, there is no formal accounting of these events.

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. Additionally, many fire events warranted Small Business Administration disaster Declarations. For more details, see Section 4.2.1.

4.3.25.4. 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. However, the probability of future occurrences may decrease with the construction of new buildings to building codes that address fire prevention, detection, and extinguishments. 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.

4.3.25.5. Environmental Impacts

The impact of urban fire and explosion events vary based on the size of the incident and the population and structure density where it occurs. There may be environmental impacts related to hazardous materials when a fire event or explosion releases dangerous materials.

There are additional economic consequences related to this hazard. 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, and an overwhelming load of victims who are suffering from the effects of the urban fire, including loss of their home or place of business.

4.3.25.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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.

Jurisdictional vulnerability to urban fires and explosions is defined as areas that have the highest population densities coupled with the oldest residential buildings. GIS analysis indicated that the vulnerability thresholds for Pennsylvania jurisdictions are those counties with 60 percent or more of residential structures older than 50 years. In the Commonwealth, areas that meet this criterion are concentrated in nine counties: Allegheny, Cambria, Delaware, Lackawanna, Luzerne, McKean, Northumberland, Philadelphia, and Schuylkill Counties.

Table 4.3.25-2 lists which counties did and did not profile urban fire and explosion, along with any ranking provided. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 21 counties which currently have calculated risk factor values for urban fire and explosion, the average value is 2.2; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for urban fire and explosion is 1.9, while the Pennsylvania THIRA scored urban fire and explosion as a 6 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.25-2 Counties profiling urban fire and explosion hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams	X		High	3.4
Allegheny	X		Medium	2.2
Armstrong		X		
Beaver	X		Low	1.8
Bedford		X		
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks	X		Medium	2.3
Butler	X		Low	1.9
Cambria		X		
Cameron	X		Low	1.9
Carbon		X		

Table 4.3.25-2 Counties profiling urban fire and explosion hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Centre	X		Low	1.7
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia		X		
Crawford		X		
Cumberland	X		Low	1.9
Dauphin		X		
Delaware	X		Medium	2.2
Elk	X		Medium	2.1
Erie	X		Medium	2.2
Fayette	X		Medium	2.3
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon		X		
Indiana		X		
Jefferson	X		Low	1.9
Juniata		X		
Lackawanna		X		
Lancaster		X		
Lawrence	X		High	3.4
Lebanon*		X		
Lehigh	X		High	2.6
Luzerne		X		
Lycoming		X		
McKean	X		Low	1.9
Mercer	X		Low	1.9
Mifflin		X		
Monroe		X		
Montgomery	X		High	2.6

Table 4.3.25-2 Counties profiling urban fire and explosion hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Montour*	X		Not Ranked	7.5
Northampton	X		Medium	2.2
Northumberland		X		
Perry*	X		Not Ranked	15
Philadelphia**		X		
Pike	X		High	13.3
Potter		X		
Schuylkill		X		
Snyder		X		
Somerset		X		
Sullivan	X		Not Ranked	No RF
Susquehanna		X		
Tioga	X		Medium	2.2
Union		X		
Venango		X		
Warren		X		
Washington		X		
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming	X		Not Ranked	No RF
York	X		Medium	2.3

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

The jurisdictions most vulnerable to urban fire and explosion hazards host 1,685 critical facilities, the majority of which are located in Allegheny County, as illustrated in Table 4.3.24-3.

Table 4.3.25-3 Number of State Critical Facilities impacted by urban fire and explosion in identified vulnerable jurisdictions

COUNTY	NUMBER OF CRITICAL FACILITIES	COUNTY	NUMBER OF CRITICAL FACILITIES
Allegheny	706	McKean	50
Cambria	144	Northumberland	96
Delaware	140	Philadelphia	122
Lackawanna	162	Schuylkill	208
Luzerne	251	**TOTAL**	**1,879**

4.3.25.7. State Facility Vulnerability Assessment

The vulnerability of state facilities is similar to that of buildings across the Commonwealth; older buildings located in dense urban and suburban communities are more vulnerable urban fires and explosions. Because building age data for state facilities is not available, state facility vulnerability can be more generally defined as facilities that are located in the most vulnerable jurisdictions in the Commonwealth, as urban fire hazards can quickly spread to surrounding structures. Table 4.3.25-4 illustrates the vulnerable state facilities by facility type. Notably, fire departments, schools, and police facilities rank highly among vulnerable facilities. Additionally, the three vulnerable chemical companies could present an additional fire risk if flammable chemicals are stored or used at those facilities.

Table 4.3.25-4 State Critical Facilities vulnerable to urban fires and explosions by Critical Facility Type

STATE CRITICAL FACILITY TYPE	NUMBER OF IMPACTED FACILITIES
Agriculture	21
Banking	12
Chemical	5
Commercial Facilities	29
Dams	6
Defense Industrial Base	12
Education	44
Emergency Services	13
Energy	10
Fire Departments (Non-HSIP)	675
Government Facilities	14
Healthcare & Public Health	14
Hospital (Non-HSIP)	84
National Monuments & Icons	3
Nuclear Reactors, Materials & Waste	1
Police (Non-HSIP)	356
Postal & Shipping	5
School (Non-HSIP)	520

Table 4.3.25-4 State Critical Facilities vulnerable to urban fires and explosions by Critical Facility Type	
STATE CRITICAL FACILITY TYPE	**NUMBER OF IMPACTED FACILITIES**
Transportation	34
Water	21
TOTAL VULNERABLE CRITICAL FACILITIES	***1,879***

4.3.25.8. Jurisdictional Loss Estimation

In the nine jurisdictions most vulnerable to urban fire and explosion events there are over two million potentially impacted buildings. These buildings have a combined replacement cost of $620 billion (Table 4.3.25-5). As the densest jurisdiction in the Commonwealth with the highest proportion of old housing stock, Philadelphia is the jurisdiction that is the most threatened by urban fire events. Philadelphia has over $200 billion of exposure and 778,715 impacted buildings.

Table 4.3.25-5 Estimated jurisdictional losses due to urban fires and explosions.		
COUNTY	**NUMBER OF IMPACTED BUILDINGS**	**DOLLAR VALUE OF EXPOSURE, BUILDING AND CONTENTS**
Allegheny	706,960	$180,606,811,000.00
Cambria	102,381	$21,746,588,000.00
Delaware	281,319	$86,856,472,000.00
Lackawanna	147,658	$33,533,470,000.00
Luzerne	217,160	$47,952,052,000.00
Northumberland	42,505	$8,092,723,000.00
Philadelphia	73,299	$15,599,858,000.00
Schuylkill	778,715	$201,276,171,000.00
TOTAL	***2,464,194***	***$620,706,349,000.00***

4.3.25.9. State Facility Loss Estimation

State facility losses will range in magnitude from small-scale damages resulting from smoke or water to complete destruction or collapse by fire or explosion. If the identified state facilities were to be destroyed in an urban fire or explosion incident, the replacement value of all facilities would be approximately $14,260,359,516.

4.3.26. Utility Interruption

4.3.26.1. 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 event, particularly transportation accidents, lightning strikes, extreme heat or cold events, and coastal and winter storms.

Utility interruptions occur throughout the Commonwealth but usually are small-scale, localized incidents. Utility interruptions are possible anywhere there is utility service. Figure 4.3.26-1 and Figure 4.3.26-2 illustrate the geographic extent and mileage of gas pipelines and liquid pipelines per county.

Figure 4.3.26-1 Liquid pipeline mileage per county (PHMSA, 2013).

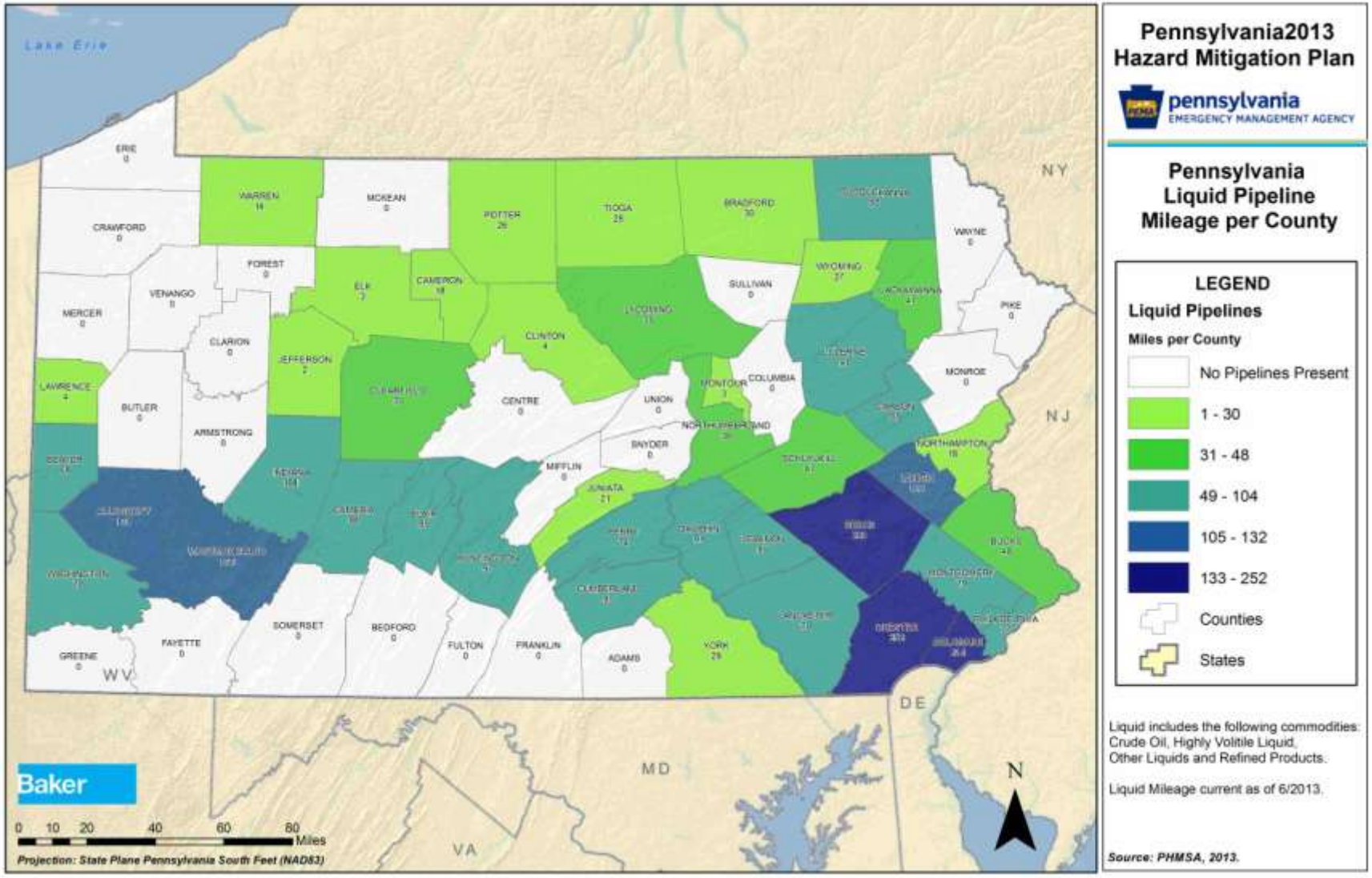
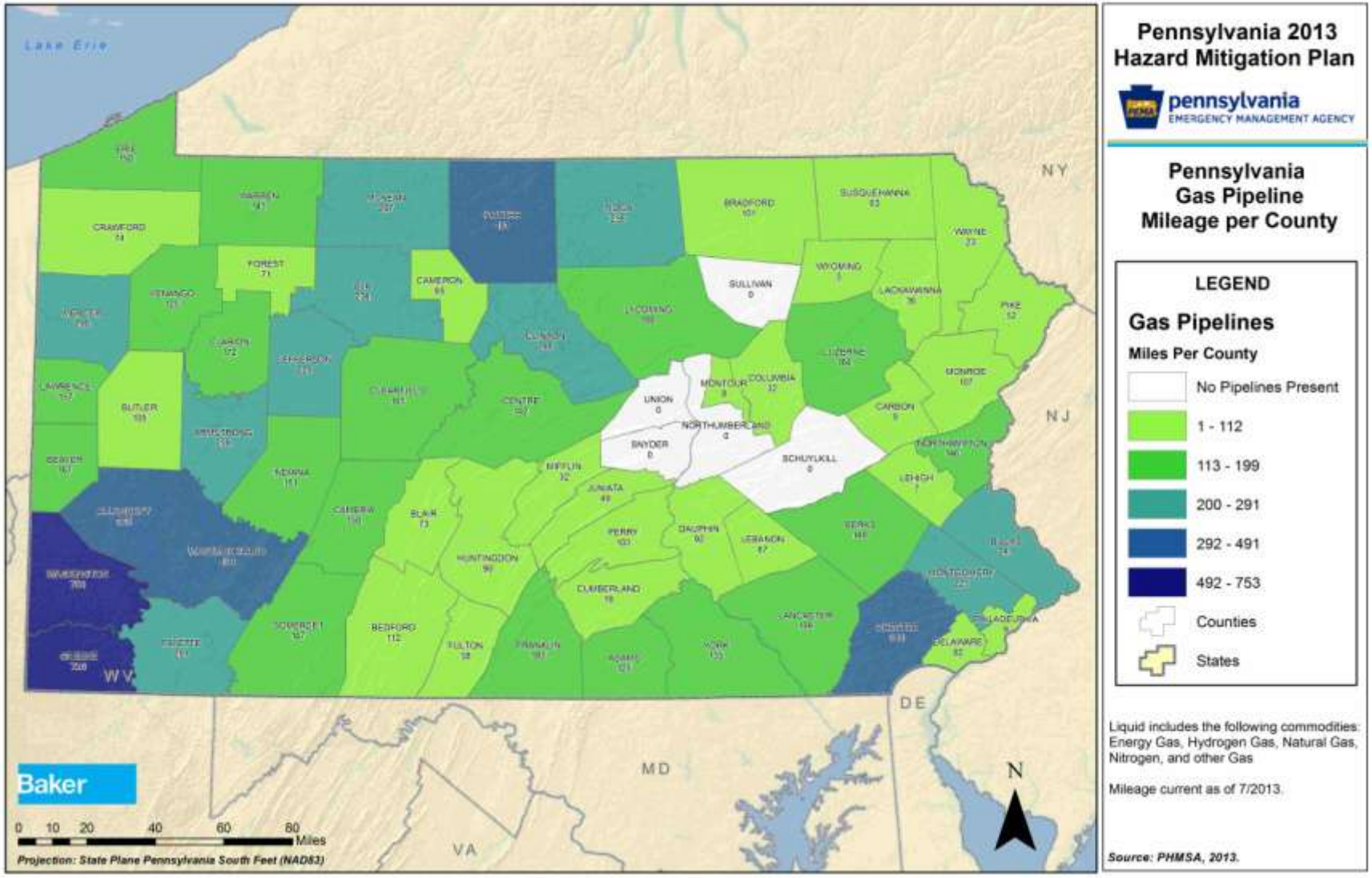


Figure 4.3.26-2 Gas pipeline mileage per county (PHMSA, 2013).



This hazard has the possibility to affect a significant number of Pennsylvanians. According to the 2011 estimates of the American Community Survey, there are 4.9 million occupied housing units in the Commonwealth; of these units, 51% use utility gas, 19.7% use fuel oil or kerosene, and 20.7% use electric power to heat their homes (US Census, 2008). This means that should a utility interruption occur statewide, nearly 4.6 million households could be without heat or cooling. Beyond home heating, PUC estimates that there are 8.7 million electric, gas, water, and waste customers under their purview in Pennsylvania; there are also 6.8 million telephone wire lines active. Table 4.3.26-1 illustrates these customers by utility.

Table 4.3.26-1 Snapshot of PUC users in Pennsylvania (PUC, 2012).*

UTILITY	NUMBER OF CUSTOMERS	NUMBER OF PROVIDERS
Electric	5,748,281	11
Natural Gas	2,888,230	23
Water	128,439	57
Waste	44,850	35

**Represents only customers under the jurisdiction of the PUC, not all utility customers in Pennsylvania.*

Beyond PUC, there are many other utility providers in Pennsylvania. The table below summarizes the populations of water utility users in each county as well as a breakdown of populations by primary source of water.

Table 4.3.26-2 Community Public Water Supply Populations by County and Primary Source (DEP, 2013)

COUNTY	GROUND	GROUND OR PURCHASED GROUND UNDER SWI	PURCHASED GROUND	PURCHASED SURFACE	SURFACE	GRAND TOTAL
Adams	23,783	550	0	0	16,183	40,516
Allegheny	21,076	0	3,405	193,467	1,217,833	1,435,781
Armstrong	15,917	300	400	7,175	18,949	42,741
Beaver	55,429	90	6,708	15,699	60,608	138,534
Bedford	8,553	1,102	115	0	7,810	17,580
Berks	108,856	10,558	413	58,316	130,118	308,261
Blair	15,223	90	0	15,864	69,340	100,517
Bradford	27,073	600	2,099	0	0	29,772
Bucks	90,715	2,489	1,704	300,241	153,978	549,127
Butler	18,900	0	2,500	46,423	44,644	112,467
Cambria	21,417	108	2,871	17,406	96,632	138,434
Cameron	0	0	0	0	3,558	3,558
Carbon	32,229	0	0	968	11,274	44,471
Centre	75,140	1,495	0	0	74,175	150,810
Chester	53,471	0	0	31,055	139,938	224,464

Table 4.3.26-2 Community Public Water Supply Populations by County and Primary Source (DEP, 2013)

COUNTY	GROUND	GROUND OR PURCHASED GROUND UNDER SWI	PURCHASED GROUND	PURCHASED SURFACE	SURFACE	GRAND TOTAL
Clarion	5,987	0	1,698	1,250	20,655	29,590
Clearfield	10,255	55	0	4,810	40,840	55,960
Clinton	5,932	539	0	10,040	32,456	48,967
Columbia	21,263	2,069	0	0	21,500	44,832
Crawford	34,361	0	1,100	225	2,363	38,049
Cumberland	27,689	2,070	35	0	168,056	197,850
Dauphin	19,042	0	993	0	232,794	252,829
Delaware	401	0	0	7,054	138,100	145,555
Elk	692	0	0	1,763	31,589	34,044
Erie	37,553	0	598	25,592	188,569	252,312
Fayette	2,550	0	0	44,616	261,213	308,379
Forest	4,645	0	0	0	0	4,645
Franklin	36,381	794	0	1,500	55,006	93,681
Fulton	399	2,000	0	0	0	2,399
Greene	0	0	0	1,700	49,895	51,595
Huntingdon	6,645	2,000	0	0	20,172	28,817
Indiana	4,113	0	0	1,371	41,001	46,485
Jefferson	1,646	0	0	2,120	23,383	27,149
Juniata	4,321	825	0	0	4,450	9,596
Lackawanna	7,569	0	0	0	150,225	157,794
Lancaster	62,848	43,886	0	17,810	190,838	315,382
Lawrence	3,478	0	0	5,300	60,140	68,918
Lebanon	10,618	9,500	0	6,751	57,000	83,869
Lehigh	51,641	0	1,081	77,514	122,450	252,686
Luzerne	35,356	0	185	2,488	240,459	278,488
Lycoming	17,808	1,585	0	0	60,025	79,418
Mc Kean	8,790	0	0	577	23,725	33,092
Mercer	17,429	0	940	5,979	58,970	83,318
Mifflin	1,072	0	461	0	27,070	28,603
Monroe	60,107	0	0	0	35,245	95,352
Montgomery	43,086	3,920	0	139,224	1,011,259	1,197,489
Montour	445	0	0	1,602	4,897	6,944
Northampton	19,063	0	725	7,754	273,762	301,304
Northumberland	1,909	625	0	0	83,859	86,393

Table 4.3.26-2 Community Public Water Supply Populations by County and Primary Source (DEP, 2013)

COUNTY	GROUND	GROUND OR PURCHASED GROUND UNDER SWI	PURCHASED GROUND	PURCHASED SURFACE	SURFACE	GRAND TOTAL
Perry	8,454	0	100	0	2,812	11,366
Philadelphia	0	0	0	0	1,600,000	1,600,000
Pike	43,420	2,400	0	0	0	45,820
Potter	5,834	1,150	0	0	1,370	8,354
Schuylkill	37,602	0	0	55	85,092	122,749
Snyder	12,155	1,965	0	0	4,950	19,070
Somerset	30,508	0	900	5,422	23,697	60,527
Sullivan	1,588	0	0	0	0	1,588
Susquehanna	3,812	0	0	0	8,399	12,211
Tioga	6,480	45	0	399	12,374	19,298
Union	1,479	0	0	333	3,690	5,502
Venango	33,674	0	6,903	0	2,076	42,653
Warren	21,751	0	0	0	1,040	22,791
Washington	0	0	0	5,030	36,880	41,910
Wayne	27,142	0	90	0	0	27,232
Westmoreland	1,185	0	0	5,815	241,633	248,633
Wyoming	8,172	0	0	0	0	8,172
York	35,918	0	0	37,822	213,669	287,409
(blank)	0	0	0	0	0	0
Grand Total	**1,412,050**	**92,810**	**36,024**	**1,108,530**	**8,014,688**	**10,664,102**

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.

4.3.26.2. Range of Magnitude

The most severe utility interruptions will be regional or widespread power and telecommunications outages. With the loss of power, electrical powered equipment and systems will not be operational. Examples may include: lighting; HVAC and ancillary support equipment; communication (i.e. public address systems, telephone, computer servers, and peripherals); ventilation systems; fire and security systems; refrigerators, sterilizers, trash compactors, office equipment; and medical equipment. This 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 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; for example, the Department of the Treasury no longer cuts checks except when absolutely necessary. Instead, payroll and invoicing is done electronically.

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.

4.3.26.3. Past Occurrence

Utility interruptions are largely minor, routine events, but there has been one Presidential Declaration of Emergency and two Gubernatorial Disaster Declarations in which a utility interruption was a major component of a disaster. A series of bankruptcies in 1972 led to the major steam heat provider in Lower Merion Township to cut off heat to residents with no intention to resume 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 more recent years, PEIRS collects information on utility interruption incidents. As show in Table 4.3.26-3, there have been 3,317 utility outage incidents reported by local jurisdictions.

Table 4.3.26-3 Utility outage events reported to PEIRS, 2001-2009 (PEIRS)

EVENT TYPE	2001	2002	2003	2004	2005	2006	2007	2008	2009*
Boil water	0	0	0	1	1	8	19	10	4
Energy shortages	0	1	3	2	3	1	2	0	3
Phone outages	70	51	53	77	90	79	113	159	84
Power outages	104	135	119	165	214	216	285	325	119
Underground utility	0	4	8	8	4	11	16	9	3
Water main break	35	36	42	42	53	63	178	217	72
Utility Outages - total	**209**	**227**	**225**	**295**	**365**	**378**	**613**	**720**	**285**

*****Events totaled through June 2009*

WebEOC, PEMA's emergency incident reporting software from 2010-2012, does not report specifically on utility interruptions. It is assumed that utility interruptions have continued in recent years, especially in conjuction with severe weather, but there is no specific count from PEMA.

The Public Utilities Commission also catalogs past occurrences of gas distribution and transmission incidents and hazardous liquid utility incidents. As shown in Table 4.3.26-4, there have been 150 of these incidents from 1999-2013 resulting in 16 deaths, 38 injuries, and $65,531,173 of property damage (PUC, 2013).

Table 4.3.26-4 Utility interruption events reported to Pennsylvania Public Utilities Commission, 2002-2013 (PUC, 2013).

GAS DISTRIBUTION INCIDENTS				
DATE	LOCATION	INJURIES	FATALITIES	PROPERTY DAMAGE ($)
01/11/2002	Palmer	0	0	$175,420
03/03/2002	Doylestown	0	0	$175,420
03/09/2002	Royersford	0	0	$233,893
09/12/2002	Huntingdon Valley	0	0	$233,893
09/16/2002	Mccalmont	2	0	$0
09/20/2002	Pittsburgh	0	1	$87,710
12/19/2002	Pittsburgh	4	0	$0
01/17/2003	Pittsburgh	1	0	$575,342
02/04/2003	Philadelphia	0	0	$230,136
02/12/2003	Jacobus	3	0	$287,671
03/11/2003	Ford City	0	1	$57,534
05/03/2003	Bridgeville	3	0	$115,068
05/22/2003	Conshohocken	0	0	$93,205
08/23/2003	Macungie	0	0	$155,342
11/01/2003	Beaver Falls	1	0	$11,506
12/17/2003	Trappe	0	2	$0
12/23/2003	Mount Oliver	0	1	$0
01/11/2004	Huntingdon Valley	0	0	$340,731
03/26/2004	Lancaster	1	0	$68,373
04/25/2004	Springdale	1	0	$178,770
05/10/2004	Rices Landing	0	0	$139,699
05/12/2004	Irwin	0	0	$206,494
06/29/2004	Ardmore	0	1	$0
08/21/2004	Pittsburg	1	0	$113,577
08/21/2004	Dubois	0	2	$852,963
08/29/2004	Irwin North Huntingdon	0	0	$94,563
09/17/2004	Mccandless Twp	0	0	$113,577
09/17/2004	Robinson Township	0	0	$272,584
09/18/2004	Mckees Rocks	0	0	$567,885
09/18/2004	Mckeesport	0	0	$128,120
09/21/2004	Pittsburgh	0	0	$592,892
09/21/2004	Penn Hills	0	0	$114,426
09/21/2004	Center	0	0	$128,584
02/07/2005	New Hope	0	0	$560,876
02/08/2005	Bensalem	0	0	$125,955
03/16/2005	Coraopolis	2	0	$185,555
03/23/2005	Bangor	0	0	$117,533

Table 4.3.26-4 Utility interruption events reported to Pennsylvania Public Utilities Commission, 2002-2013 (PUC, 2013).

GAS DISTRIBUTION INCIDENTS				
DATE	**LOCATION**	**INJURIES**	**FATALITIES**	**PROPERTY DAMAGE ($)**
09/25/2005	Philadelphia	1	1	$39,990
10/20/2005	Wall Borough	1	0	$0
06/03/2006	Richmond Twp.	1	0	$169,977
09/02/2006	West Lampeter	0	0	$268,543
12/09/2006	Allentown	0	0	$1,061,678
02/17/2007	Bethlehem	0	0	$415,451
02/19/2007	Pittsburgh	1	0	$0
02/28/2007	Spry	0	0	$212,918
08/22/2007	Ambridge	1	0	$223,493
08/28/2007	South Londonderry Twp	0	0	$94,730
01/05/2008	East Prospect	0	0	$203,250
02/07/2008	Philadelphia	0	0	$925,000
02/17/2008	Ringgold	1	0	$119,060
03/05/2008	Plum Borough	1	1	$702,000
05/21/2008	Hummelstown	0	0	$479,400
09/02/2009	Bedford Twp	0	0	$103,046
12/26/2009	Swedeland	0	0	$268,771
04/26/2010	Newston Square	1	0	$4,550
01/18/2011	Philadelphia	3	1	$378,802
02/09/2011	Allentown	3	5	$1,693,885
04/25/2011	Brookhaven	1	0	$0
10/31/2011	Millersville	0	0	$469,263
02/12/2013	Altoona	0	0	$264,479
GAS TRANSMISSION INCIDENTS				
DATE	**LOCATION**	**INJURIES**	**FATALITIES**	**PROPERTY DAMAGE ($)**
09/10/2003	Chester Springs	1	0	$0
09/28/2004	Aliquippa	0	0	$193,080
10/12/2004	Summit	0	0	$345,269
05/17/2005	Bedford	0	0	$228,691
05/31/2005	Wind Ridge	0	0	$148,235
08/24/2005	Washington	0	0	$129,768
04/09/2006	Delmont	0	0	$427,480
06/03/2006	Unknown	1	0	$59,025
09/18/2006	Addison	0	0	$230,516
12/18/2006	Hyner	0	0	$169,830
07/20/2007	Unknown	0	0	$281,641
12/01/2007	Harrison Valley	0	0	$837,456
02/18/2008	Mountain Top	0	0	$300,000
02/18/2008	Mountain Top	0	0	$510,000
09/30/2008	Delmont	0	0	$350,000
11/05/2008	Unknown	0	0	$1,849,692
01/15/2009	Elizabeth	0	0	$2,542,735
07/12/2009	Chester Springs	0	0	$100,113

Table 4.3.26-4 Utility interruption events reported to Pennsylvania Public Utilities Commission, 2002-2013 (PUC, 2013).

GAS DISTRIBUTION INCIDENTS				
DATE	**LOCATION**	**INJURIES**	**FATALITIES**	**PROPERTY DAMAGE ($)**
08/23/2009	Clearville	0	0	$106,037
11/04/2010	Jefferson Hills	0	0	$120,734
11/03/2011	Aretmas	0	0	$567,824
01/06/2012	Luthersburg	0	0	$121,301
04/13/2012	Marietta	1	0	$251,170
05/05/2013	Cummings Twp	0	0	$109,402
HAZARDOUS LIQUID INCIDENTS				
DATE	**LOCATION**	**INJURIES**	**FATALITIES**	**PROPERTY DAMAGE ($)**
01/01/2002	Greensburg	0	0	$962
02/21/2002	Tinicum	0	0	$2,409,102
07/21/2002	Sinking Spring	0	0	$102,913
09/26/2002	Emmaus	0	0	$445,800
10/28/2002	Montoursville	0	0	$118,116
03/19/2004	Lima	0	0	$459,419
06/25/2004	Nicholson	0	0	$87,397
07/10/2004	Moon	0	0	$132,430
07/22/2004	Emmaus	0	0	$943,541
08/02/2004	Allentown	0	0	$117,609
02/01/2005	Allentown	0	0	$5,668,293
10/17/2005	Emmaus	0	0	$17,538,392
11/23/2005	Sharon Hill	0	0	$277,858
12/27/2006	Sylvania	0	0	$6,368
05/16/2007	Shamokin	1	0	$2,935,165
04/21/2008	Boothwyn	0	0	$182,000
06/12/2008	Manheim	0	0	$92,400
06/26/2008	Coraopolis	0	0	$110,600
11/25/2008	Murrysville	0	0	$1,124,000
05/08/2009	Aston	0	0	$351,320
12/29/2009	Aston	0	0	$2,818,138
03/25/2010	Philadelphia	0	0	$102,089
02/02/2011	Nether Providence	0	0	$3,253
02/08/2011	Sharon Hill	0	0	$261,533
03/20/2011	Shippingport	0	0	$765,186
09/26/2011	Aston	0	0	$370,769
06/17/2012	Emmaus	0	0	$87,000
07/13/2012	Emmaus	0	0	$380,538
01/04/2013	Ainking Spring	0	0	$225,400

4.3.26.4. 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. These interruptions should be anticipated and first responders should be prepared during severe weather events.

Aging infrastructure also brings risk in the form of potential utility interruptions. Population growth, urbanization and climate change can put strain on existing assets used to deliver utilities. In many utility systems, significant portions of the equipment and facilities date from the growth periods of the 1950's and 1960's that followed World War II. As this equipment ages, it deteriorates from the constant wear and tear of service. As it ages, it 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. In addition as repairs have taken place along transmission routes, there is often a mix of new and old equipment along the line, as repair and not replacement is generally the choice made to resolve an issue.

The wholesale replacement of a system is not a feasible solution for utility companies. This would require the interruption of services while the replacement occurs, as well as accessing the existing system (which may lay under roads, private property, or other inconvenient places). Utility companies face the challenge of managing the issue of the aging infrastructure. They are tasked with reducing the effects of aging equipment while also controlling the deterioration of the existing system as much as possible. This balance will be tenuous as transmission equipment continues to age and break down. These breakdowns will likely lead to more frequent utility disruptions as time goes by.

4.3.26.5. Environmental Impacts

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, please see Section 4.3.19. 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.

4.3.26.6. Jurisdictional Vulnerability Assessment

As stated in Section 4.2.2, 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 tracts 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.

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.

Table 4.3.26-4 lists which counties did and did not profile utility interruptions, along with any ranking. As stated in Section 4.1, the decision by a county to profile a hazard is one indicator of the presence of risk from that hazard. This indicator should be viewed complementary to other analysis in this section. Together this analysis from reputable sources addresses different aspects of risk for a full risk profile.

Of the 28 counties which currently have calculated risk factor values for utility interruption, the average value is 2.3; this average does not include Lebanon, Montour, Perry, and Philadelphia, who use an alternate Risk Factor/Ranking system. The State Risk Factor for utility interruption is 22.8, while the Pennsylvania THIRA scored utility interruptions as a 7 out of 10. For more details on the State Risk Factor and THIRA rankings, please see Section 4.1.

Table 4.3.26-5 Counties profiling utility interruption hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Adams		X		
Allegheny		X		
Armstrong		X		
Beaver	X		Low	1.7
Bedford	X		High	3.0
Berks		X		
Blair		X		
Bradford	X		Not Ranked	No RF
Bucks	X		Low	1.9
Butler	X		Medium	2.0
Cambria	X		High	3.3
Cameron	X		High	3.2
Carbon	X		Medium	2.4
Centre	X		Medium	2.1
Chester		X		
Clarion		X		
Clearfield		X		
Clinton		X		
Columbia	X		Medium	2.0
Crawford		X		
Cumberland	X		Medium	2.0

Table 4.3.26-5 Counties profiling utility interruption hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Dauphin		X		
Delaware	X		Medium	2.0
Elk		X		
Erie	X		Medium	2.2
Fayette	X		High	2.5
Forest		X		
Franklin		X		
Fulton		X		
Greene		X		
Huntingdon	X		Not Ranked	No RF
Indiana	X		Medium	2.1
Jefferson	X		High	3.1
Juniata	X		Medium	2.2
Lackawanna		X		
Lancaster		X		
Lawrence		X		
Lebanon*	X		Not Ranked	9.5
Lehigh	X		High	2.5
Luzerne		X		
Lycoming	X		High	2.7
McKean	X		Medium	2.3
Mercer	X		High	2.5
Mifflin	X		Not Ranked	No RF
Monroe	X		Medium	2.4
Montgomery	X		High	2.6
Montour*	X		Not Ranked	9.5
Northampton	X		High	2.5
Northumberland	X		Medium	2.1
Perry*	X		Not Ranked	9.5
Philadelphia**		X		
Pike	X		Medium	2.3
Potter		X		
Schuylkill		X		

Table 4.3.26-5 Counties profiling utility interruption hazards with hazard ranking and risk factor (if available).

COUNTY	PROFILED HAZARD	DID NOT PROFILE HAZARD	RANKING (IF AVAILABLE)	RISK FACTOR (IF AVAILABLE)
Snyder	X		Medium	2.4
Somerset		X		
Sullivan		X		
Susquehanna	X		Medium	2.1
Tioga	X		Low	1.9
Union		X		
Venango		X		
Warren	X		Medium	2.0
Washington		X		
Wayne	X		Not Ranked	No RF
Westmoreland	X		Not Ranked	No RF
Wyoming		X		
York	X		Not Ranked	No RF

* Lebanon, Montour, and Perry use an alternate weighted ranking where Risk Factor = Frequency x [(0.25 x Critical facilities) + (0.40 x Social) + (0.25 x Economic) + (0.10 x Environmental)]. While this risk factor was used to comparatively rank hazards, the number does not correspond to a high-medium-low rating.

**Philadelphia uses an A, B, C rating system where A is high, B is medium, and C is low.

4.3.26.7. State Facility Vulnerability Assessment

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, the case of cyber-security threats, 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 this hazard. Additionally, efforts by DGS to complete COOP and COG plans for state agencies will help to reduce overall state facility/state agency vulnerability to utility interruptions, as these 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, including cyber-attacks, 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 55 energy facilities, 37 water facilities, and 59 chemical manufacturing facilities (which includes fuel producers) 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.

4.3.26.8. Jurisdictional Loss Estimation

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 the 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.

4.3.26.9. State Facility Loss Estimation

While unlikely that a utility interruption would cause damage to a critical facility beyond a short-term loss in power, HVAC systems, and/or productivity, the total replacement cost of all state critical facilities is $47,153,872,495.

4.4. Future Development and Vulnerability

Risk and vulnerability to natural and human-made hazard events are not static. Risk will increase or decrease as states, counties, and municipalities see changes in land use and development as well as changes in population. For Pennsylvania, these changes in risk and vulnerability are likely to differ greatly from one area of the Commonwealth to another.

Population change is perhaps the most significant indicator of changes in vulnerability in the future. Table 4.4-1 illustrates how the population of the Commonwealth is expected to change in the coming years. The DEP has projected Pennsylvania's reported 2010 Census population out for the years 2020, 2030, and 2040. According to this projection, Pennsylvania is expected to experience 9.94% growth by 2040. It is important to note that these population figures are projections only and are derived from birth rates, death rates, and migration information and may not fully capture population dynamics.

Table 4.4-1 Population Projections of Pennsylvania Counties (PADEP, 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

Table 4.4-1 Population Projections of Pennsylvania Counties (PADEP, 2012)

COUNTY	2010 CENSUS POPULATION	2020 PROJECTED POPULATION	2030 PROJECTED POPULATION	2040 PROJECTED POPULATION	PERCENT (%) CHANGE BETWEEN 2010 & 2040
Elk	31,946	30,920	28,953	27,523	-13.85
Erie	280,566	283,031	283,942	285,742	1.84
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

Table 4.4-1 Population Projections of Pennsylvania Counties (PADEP, 2012)					
COUNTY	**2010 CENSUS POPULATION**	**2020 PROJECTED POPULATION**	**2030 PROJECTED POPULATION**	**2040 PROJECTED POPULATION**	**PERCENT (%) CHANGE BETWEEN 2010 & 2040**
Union	44,947	48,195	51,486	54,752	21.81
Venango	54,984	53,118	50,963	48,974	-10.93
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***

As shown in Figure 4.4-2, Pennsylvania's overall growth is not evenly spatially distributed. In general, northeast Pennsylvania is expected to grow in population and development due to development pressure from New York City. This is evidenced by the projection data, where Pike and Monroe Counties are expected to have the highest population growth in the Commonwealth with growth rates of 50% and 45.5%, respectively. However, a close third is Forest County at 40.76%, presumably due to the emergence of Marcellus Shale natural gas industry.

From the population projections, 12 counties are expecting growth greater than 25% by 2040. In addition to Monroe and Pike, those counties are Adams, Berks, Centre, Chester, Cumberland, Forest, Franklin, Lancaster, Wayne and York. The majority of these counties are located in the south central and southeast regions of the Commonwealth, but Forest County in the northwest, Centre County in the central region, and Wayne County in the northeast near Pike and Monroe Counties are also expected to grow. These 12 counties are known for having large tracts of undeveloped land consisting of forest or agricultural uses. This could impact future hazards through an increase of wildfire from more human activity, as well as a decrease of hazardous threat of drought to land, hailstorm and/or invasive species as prime agricultural land is eliminated to make room for housing needs. Additionally, nearly 10% of Pike County is devoted to water and wetlands, largely in part due to the Delaware Water Gap National Recreation Area on the eastern border. While the population increases in these counties, natural and agricultural land is likely to decrease. A hazard that impacts both agriculture and people will likely have declining impacts on agricultural and increasing impacts on people.

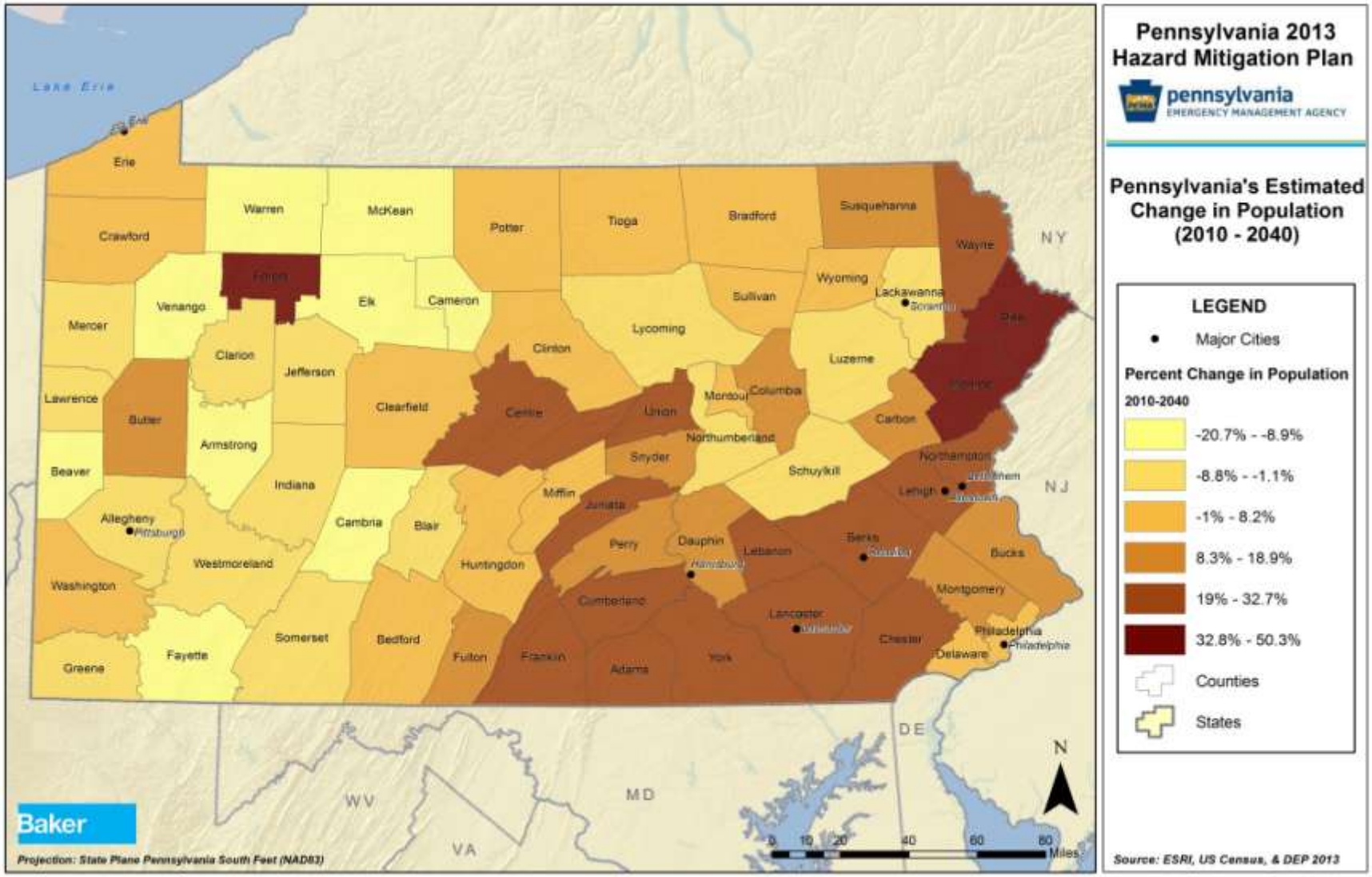
The development increases will likely create increases in loss estimates for drought impact on people; Flood, Flash Flood, Ice Jam; Tornado; and Winter Storm hazards which are profiled in all 12 of the counties with greater than 25% population increases by 2030. Wildfire is the next risk that will likely see increases in loss estimations because it is covered in 10 of these County HMPs. Environmental Hazard and Earthquakes are covered in 9 of these County HMPs,

Nuclear Incidents are covered in 8, and Dam Failure; Hurricane, Tropical Storm, Nor'easters are covered in 7 of these County HMPs. Finally, Civil Disturbance, Extreme Temperature, Hailstorm, Invasive Species, Landslide, Levee Failure, Lightning Strike, Pandemic, Radon Exposure, Subsidence/ Sinkhole, Terrorism, Transportation Accident, Urban Fire and Explosion, and Utility Interruption will also likely see increases in loss estimations because that are identified in 1-6 of the 12 counties. It should also be noted that Pennsylvania's critical infrastructure (roads, bridges, dams, levees) will become more vulnerable as they age. Meanwhile, governmental fiscal capacity to deal with these critical items has declined, forcing deferred maintenance of infrastructure (State Land Use and Growth Management Report, 2010). As population increases in these counties, hazards related to infrastructure (i.e. levee failure, dam failure, etc.) are likely to increase.

Overall, as counties experience a growth in population over the coming years, there needs to be an increase in public services provided to its citizens (schools, fire departments, police departments, etc). These jurisdictions should implement the proper land use planning tools to manage and direct their growth in order to minimize adverse impacts from both natural and human-made hazards.

It should be noted that population growth may intensify and expand to neighboring counties in the future if a proposed passenger rail link between northeast Pennsylvania and Manhattan materializes. Although there are no immediate plans to create a rail linkage between northeast Pennsylvania and Manhattan, Pennsylvania does have an Intercity Passenger and Freight Rail Plan for 2035 (PennDOT, 2010). It identifies opportunities for new rail linkages in the Commonwealth and improvements to existing rail lines and systems, including a Scranton to Hoboken/New York City link. These rail improvements could increase development and increase the populations exposed to hazards in areas where rail service passes.

Figure 4.4-2 Projected population change by county (PADEP, 2012).



South central Pennsylvania is experiencing a similar phenomenon to northeast Pennsylvania; development pressure and exurban sprawl originating from Baltimore, MD and Washington, DC is fueling explosive population growth and land conversion from farmland to developed land. In these areas, particularly Adams County where population growth is 31%, population growth coupled with rapid urban development is quickly increasing the amount of impervious surfaces and surface runoff seen in the Potomac River Basin. This can affect these counties' vulnerability towards flooding hazards, among others.

The greater Philadelphia region is expected to experience moderate growth in the next twenty years. While this would normally be cause for concern in terms of hazard vulnerability, SPT members have observed that southeastern Pennsylvania on the whole has been taking greater strides to remove people from flood-prone areas. Comprehensive planning and zoning efforts like Philadelphia's recent zoning code overhaul are taking hazard vulnerability into account more carefully in land planning process.

Additionally, jurisdictions recognize development pressure on their lands and they as well as land trusts are working to permanently preserve land and reduce vulnerability. In the Commonwealth, 5.4 million acres (18%) of land have been conserved for agricultural production, sustainable forestry, public recreation and other purposes. Pennsylvania State Forests make up 39% of the conserved lands. In addition, there are over 80 land trusts working in the Commonwealth to preserve land and they are responsible for preserving 4.3% of Pennsylvania's total acreage of preserved land (PA Land Trust Association, 2010).

On the other side of the spectrum, many rural counties in Pennsylvania are expected to lose population or experience only slight growth, especially in the northern tier of counties. In these locations, 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 promoting ecotourism in rural communities may decrease or stabilize these communities' hazard vulnerability.

In Allegheny, Armstrong, Beaver, Cambria, Cameron, Elk, Fayette, McKean, Venango, and Warren counties population is expected to decline by 7% or greater by 2040. The range of population loss is from -7.11% in Allegheny to -20.69% in Cameron. This loss will likely decrease loss estimations for Dam Failure, Drought, Environmental Hazard, Flood, Flash Flood, Ice Jam, Landslide, Tornado, and Winter Storm which are identified in all 10 County HMPs. Wildfire is identified in 9, Earthquakes and Transportation Accidents are identified in 8, Pandemic and Terrorism in 7, and, Subsidence/ Sinkhole, Urban Fire and Explosion, and Utility Interruption are in 6. Hurricane, Tropical Storm, Nor'easter, is identified in 5 of these County HMPs. Civil Disturbance, Extreme Temperature, Hailstorm, Levee Failure, Lightning Strike, Nuclear Incident, and Radon Exposure are all identified in 1-4 of these counties with population projected to decline. The result is the hazard loss estimations for these hazards have the potential to decline in these counties. The result of the decline in these counties is likely to not be seen as clearly in state-wide loss estimates because the growth is projected to be greater than loss overall.

In terms of evolving risk to human-made hazards in the Commonwealth, the increase of Marcellus Shale development in Pennsylvania, particularly in state forest lands, exposes the Commonwealth to increased vulnerability to environmental hazards as well as wildfire hazards (for more information on the impact of the Marcellus Shale, see Section 4.3.19.2). The impact of this hazard may be lessened if more jurisdictions adopt policies that require Marcellus Shale wells to have emergency locators, as Lycoming County in central Pennsylvania has done.

Finally, future conditions in Pennsylvania may change drastically due to the unknown impacts of climate change. Significant, broad evidence supports human influence to a long-term trend of global warming. This support comes from such areas of research as increased global temperature, sea level rise, Northern Hemisphere snow cover retreat, decreased glacial volume, and increased climate extremes. It has been difficult to predict how much, how fast, or how long global warming will occur, due to the large number of variables involved. According to the Pennsylvania Climate Impacts Assessment Report (2009), annual and seasonal average temperatures are expected to increase; with one scenario predicting almost a 7 °F increase in annual average temperature by the end of the 21st century. This will have a large impact on several environmental hazards, including drought, extreme temperatures, and flooding.

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.

The Commonwealth's 2013 SPT examined consequences for a range of scenarios addressing all hazards, natural and human-made, notice and no notice events at the 2013 Risk Assessment meeting. The focus of their discussion and analysis was on the three most recently declared disasters in the state: Sandy, Lee/Irene, and the 2010 Snowstorms. Careful consideration of how these major disasters played out contributed to the development of this consequence analysis. This consequence analysis considered the impact on:

1. The Public
2. First Responders
3. Continuity of Operations
4. Property, facilities, and infrastructure
5. Economic conditions
6. Public confidence in governance
7. The environment

The SPT estimated that overall, consequences will be highest for the public and economic conditions while consequences will be lowest for the environment. The consequence scores reported by each participating agency are provided in Table 4.5-1.

Table 4.5-1 Commonwealth Agency consequence scores on systems during disaster events

AGENCY	THE PUBLIC	FIRST RESPONDERS	CONTINUITY OF OPERATIONS	PROPERTY, FACILITIES, & INFRASTRUCTURE	ECONOMIC CONDITIONS	PUBLIC CONFIDENCE IN GOVERNANCE	THE ENVIRONMENT
Clearfield County	3	3	2	2	3	2	1
Department of Conservation and Natural Resources	5	0	2	2	2	2	0
Department of Environmental Protection *	4	3	3	3	3	3.5	3.5
Department of General Services	2.5	2	3	3	3	1	3
Department of Insurance	5	0	2	0	3	5	0
Department of Labor and Industry	4	4	0	3	3	3	3
Pennsylvania Department of Transportation	3	NP	2	2	4	4	2
Pennsylvania State System of Higher Education	1	1	1	1	1	0	0
Pennsylvania Housing Finance Agency	4	4	0	3	NP	NP	3.5
Pennsylvania Treasury	7.5		8.5	5.5	9.5	8.5	0
PENNVEST	0	0	0	0	0	0	0
Salvation Army	4	2	4	4	2	0	0
United States Army Corps of Engineers – Philadelphia	0	0	0	0	0	0	0
United States General Services Administration	1	1	5	5	3	5	1
United States Geological Survey – Pennsylvania Water Science Center	3	NP	3	2	2	3	NP
Overall Average	**3.1**	**1.8**	**2.3**	**2.3**	**2.8**	**2.9**	**1.5**

* The scores from multiple representatives were averaged. Values listed as NP were left blank by participants.

Impact on the Public

The impact of hazards on the public is connected with 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, flood, flash flood and ice jam hazards along with coastal storms, nuclear incidents, dam failure, and terrorism events could have critical impacts in terms of the number of individuals adversely affected. This widespread halt to the day-to-day lives of

Pennsylvanians was most closely seen during Tropical Storm Lee/Irene, when massive areas of the Commonwealth were flooded and people were stuck in their homes or in shelters for many days. These events mainly cause transportation issues and closings, utility interruptions, and property damage.

Impact on First Responders

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.

Impact on Continuity of Operations

Commonwealth agencies and communities develop Continuity of Operations Plans (COOP) plans 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 SSAHMP; it is unlikely that any single hazard event would inflict the maximum damages estimated in Section 4.3 in all vulnerable jurisdictions.

Impact on Economic Conditions

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 for 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 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. Finally, 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.

Impact on Public Confidence in State 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. 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 population, is not properly informed or helped. Additionally, public confidence can be swayed by the characterization of mitigation and response in the popular press. The hazards most likely to have a widespread impact on statewide public confidence are those that have 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, nuclear incidents, terrorism events, civil disturbance, and pandemic disease outbreaks.

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

5.1. 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 assessment has two primary components: an inventory of the Commonwealth's relevant plans, laws, regulations, policies and programs already in place and an analysis of its capacity to carry them out. A careful examination of capabilities will detect any existing gaps, shortfalls, or weaknesses associated with ongoing government activities that could hinder proposed mitigation activities and possibly exacerbate hazard vulnerability. The capability assessment also 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 5.3.3. The State Capability Assessment in the 2007 SSAHMP focused primarily on the presence of the Commonwealth's Emergency Operations Plan. The 2010 SSAHMP expanded the assessment to comprehensively describe other tools available related to hazard mitigation and development in hazard-prone areas. The 2013 SSAHMP includes the following significant updates and additions:

- 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, Firewise and StormReady information
- Addition of a more robust program and plan integration section.

A comprehensive list of existing planning policies, programs, and capabilities which support hazard mitigation activities is included in Section 5.3.1. This assessment was prepared based on information gathered from the SPT and county staff and through coordination with BORM staff. 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 other areas of the plan.

5.2.1. Federal Laws

Presidential Policy Directive 8 and Related Requirements

The Threat and Hazard Identification and Risk Assessment (THIRA) is a requirement for Homeland Security Grants and Emergency Management Performance Grants. The State Preparedness Report (SPR) is a self-assessment of preparedness conducted via a standardized survey and is required by the Post Katrina Emergency Management Reform Act of 2006 (PKEMRA). PEMA uses the THIRA and the SPR together to assess threats and hazards, examine 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). These products are all related to the Department of Homeland Security and Presidential Policy Directive 8: National Preparedness of 2011 (PPD-8), which details the national approach to preparing for threats and hazards posing a national security risk (PEMA, 2012).

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.

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. Over 21,000 communities participate in the NFIP.

Biggert-Waters Flood Insurance Reform Act

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. Rate increases began on January 1, 2013, for owners of subsidized policies on non-primary/secondary residences in a Special Flood Hazard

Area with 25% increases annually until rates reflect true risk. The same increases will apply 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 on October 1, 2013. Primary residences in the Special Flood Hazard Area will 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 will be phased out at a rate of 20% increase per year for five years when a community adopts a new, updated Flood Insurance Rate Map. In response to these changes, 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. BORM staff have been educating the public about these important changes to the NFIP by including the Biggert-Waters Flood Insurance Reform Act as a topic at all community trainings.

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.

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. In order 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 (FEMA, 2013):

- 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 (DCED)

The *Pennsylvania Flood Plain Management Act* (Act 166) is a state law requiring compliance with the federal National Flood Insurance Program (NFIP). Act 166 regulates major improvements in floodplains by requiring municipalities to enact floodplain management regulations which meet the minimum standards of the NFIP and also provides funding to implement the NFIP. DCED has model floodplain ordinances available for municipalities to adopt at their discretion based on the Home Rule system.

Pennsylvania Hazardous Material Emergency Planning and Response Act (DEP, PEMA and PA L&I)

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 agency. This includes many municipal swimming pools, waste treatment plants, and most industrial facilities in the Commonwealth. It then requires facilities 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, 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.

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 has proved effective.

PEMA estimates that there are greater than 3,200 SARA facilities throughout the Commonwealth with ninety-seven percent of these facilities having emergency plans in place

that have been reviewed by the PEMA and were found to adequately provide for the health and safety of public and the environment (PEMA, 2013)

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, and 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 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 distributed to municipalities. Funds are distributed based on grant applications submitted by counties to reimburse expenses involved in preparing plans, providing equipment, and expenses 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.

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, which applies to the construction, alteration, repair, demolition, or change of occupancy of buildings. Utilization of the Uniform Construction Code (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. The UCC was last updated in 2011. Across the Commonwealth, 2,409 or 94% of municipalities have opted to enforce the UCC locally. Only 153 or 6% of municipalities have opted not to enforce the UCC; in these 'opt-out' municipalities UCC enforcement is authorized to either the Pennsylvania Department of Labor & Industry (L&I) or to a third-party agency. Therefore, all of Pennsylvania is protected by the guidelines set forth in the UCC, with the majority of municipalities administering compliance locally (L&I, 2013).

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. The 2013/2014 approved state budget does not include a line item for Act 167 appropriations.

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 either the Susquehanna River Basin Commission or the Delaware River Basin Commission have authority to regulate the oil and gas industry in Pennsylvania in order to protect the environment and citizens of the Commonwealth. Permits and bonds must be provided at various stages including prior to pad construction, pipeline construction, drilling of the well, withdrawal or disposal of water, and impoundment of water. 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).

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). Sixty percent 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 spread out around the state for environmental and infrastructure projects (PA PUC, 2012). Table 5.2.2- shows the distribution of the more than $200 million in impact fees as reported by PA PUC.

Pennsylvania recently adopted Act 9 of 2012, mandating that DEP establish standards for well safety, and more specifically for emergency response for unconventional well sites.

Table 5.2.2-1 2012 Act 13 Impact Fee Distribution

RECEIVING ENTITY/PROGRAM	USE	AMOUNT
County Conservation Districts/State Conservation Commission	Directly to Conservation Districts	$5,000,000.00
Fish and Boat Commission	Cost relating to permitting	$1,000,000.00
PA Public Utility Commission	Fee and zoning administrative costs	$1,000,000.00
Department of Environment Protection	Enforcement and oversight relating to Clean Air Act, Clean Water Act, and Act 13	$6,000,000.00
PA Emergency Management Agency	Emergency response planning and training related to natural gas	$750,000.00
Office of State Fire Commissioner	Training and acquisition of equipment for first repsonders	$750,000.00
Department of Transportation	Rail freight assistance	$1,000,000.00
Natural Gas Energy Development Program	*(part of the Marcellus Legacy Fund)*	$7,500,000.00
Counties and Municipalities (Funds in excess of the Municipality Restriction are re-allocated to the Housing Affordability & Rehabilitations Enhancement Fund)	Infrastructure, repair and maintenance, emergency response, water preservation and reclamation, affordable housing, social services	$107,683,200.00
Marcellus Legacy Fund	Multiple agency and program distribution including Commonwealth Financing Authority, Environmental Stewardship Fund, PennDOT (highway/bridge improvement), etc.	$71,788,800.00
Total		***$202,472,000.00***

These are the top five counties receiving the most impact fee money in 2012:

- Bradford $6.9 million
- Washington $4.6 million
- Tioga $4.3 million
- Lycoming $4.3 million
- Susquehanna $4.1 million

Local governments can use their shares of the money 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 lowincome 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; and
- 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.

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 act anywhere that is 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 (http://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 also provides flood related information through the following programs/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)

Additionally, the 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 United States Army Corps of Engineers, 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 does table-top drills with partners.

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 United States Department of Homeland Security's 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.

5.3.1.2. Pennsylvania Emergency Management Agency

PEMA Pre-disaster Capability Overview

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.

Mitigation is managed through the BORM, which capably provides and participates in hazard mitigation and disaster trainings, disaster exercises, and conferences. BORM staff support the identification and implementation of potential mitigation projects and also 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.

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. Table 5.3.1-1 shows the name and location of the nineteen CERT and nineteen Citizen Corp groups in Pennsylvania. As a program Ready PA is a tool used by these groups, as well as, government and non-profit organizations to assist Pennsylvania citizens in becoming ready 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 the Department of Homeland Security's Federal Emergency Management Agency. In this capacity, FEMA works closely with other federal entities, state and local governments, first responders and emergency managers, the volunteer community, and the Corporation for National & Community Service.

Table 5.3.1-1 Pennsylvania CERT and Citizen Corp Groups (PEMA Bureau of Strategic Planning, 2013)

CERT	Citizen Corps
1. Allegheny County CERT	1. Allegheny County Citizen Corps/LEPC
2. Carbon County CERT	2. Blair County Citizen Corps Council
3. CERT Response Unit - GPSAR (Berks, Bucks, Chester, Delaware, Lancaster, Lehigh, Montgomery, Philadelphia and Schuylkill Counties)	3. Bradford County Citizen Corps
4. City of Williamsport	4. Cambria County Citizen Corps Council/LEPC
5. Cumberland County CERT	5. Carbon County Citizen Corps Council
6. Delaware County CERT Program	6. Chester County Citizen Corps Council
7. Erie County CERT	7. Citizens Corps of Fayette County
8. Fayette County CERT	8. Clarion County Citizen Corps Council
9. Franklin County CERT	9. Erie County Citizen Corps Council
10. Lawrence County CERT	10. Franklin County Citizen Corps
11. Lehigh County CERT	11. Huntingdon County Citizens Corps Council
12. Luzerne County CERT	12. Juniata County Citizen Corps
13. Lycoming County CERT	13. Lawrence County Citizen Corps
14. Millersville University-Community CERT	14. Lehigh County Citizen Corps
15. Northeast Search And Rescue CERT (Lackawanna, Monries, Pike, Susquehanna, and Wayne Counties)	15. Montgomery County Citizen Corps
16. RAND Corporation, Pittsburgh	16. Philadelphia Citizen Corps Council
17. Somerset County Citizens Emergency Response Team	17. Schuylkill County Citizen Corps Council
18. Western PA Search and Rescue Development Center (Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland Counties)	18. Wendell Fears Specialized Citizens Corps (Pittsburgh)
19. York County CERT	19. Williamsport Citizen Corps Council

The overall goal of the various projects taken on and funded through the Citizen Corps Grant Program is to ensure that the residents of the Commonwealth of Pennsylvania 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 of our 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 2000 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 which will was implemented in 2011 and translation for the web of ReadyPA materials into Russian, Korean, Chinese, and Vietnamese.

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.

The CERT Program 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.

PEMA has conducted CERT Train-the-Trainer classes as well as CERT Basic classes. The train-the-trainer classes allows those individuals with prior teach 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. Those 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 BORM'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 ASFPM, BORM will be able to provide more training, by partnering with USACE BORM 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 III's two 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.

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 5.3.1-1 and Figure 5.3.1-2 provide an

overview of PEMA's organizational structure and the current mitigation staffing within BORM. PEMA's Bureau of Administration provides funding for the Commonwealth's mitigation program while BORM performs pre-disaster activities such as administration of Hazard Mitigation Assistance grants and technical assistance and expertise for mitigation plan development. BORM's post-disaster responsibilities are summarized in Section 5.3.2.

Tom Hughes is the State Hazard Mitigation Officer (SHMO). As SHMO, he 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 normally has a small permanent staff of an engineer, a planner, and two project officers. In response to concurrent disasters 1898, 4003, 4025, 4030, and 4099, the PEMA hazard mitigation staff has grown to a team of 14 personnel made up of permanent HM personnel, cross-attached (borrowed) permanent personnel, and limited-term personnel and annuitants (recalled retirees) who 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.
2. Assist counties, municipalities, agencies, and organizations with identification of potential hazard mitigation projects and preparation of letters of intent and grant applications.
3. Process grant applications and coordinate with FEMA counterparts to ensure effective administration of programs.
4. Serve as project officer during life of grant to ensure compliance with all laws, regulations, and effective stewardship of resources.
5. Prepare briefings for State and other officials on progress of hazard mitigation activities.
6. During disasters work in State EOC or Disaster Response Centers.
7. Conduct Preliminary Damage Assessments in conjunction with FEMA.
8. Coordinate with FEMA and other government and private agencies to achieve unity of effort.

In addition, FEMA Region III 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 as well as Disaster Recovery and Mitigation activities.

Ernie Szabo, the current 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. Julie Yu, the division Engineer, provides technical support.

Current, permanent, full-time State Hazard Mitigation Project Officers include Don Smith, Bill Creason, and Greg Showers. 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 Severe Repetitive Loss 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 is 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 SSAHMP 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 BORM staff to utilize for tasks including project identification and tracking. PEMA is also looking forward to the results of a survey which will assess the current status of GIS data in each County that Dr. Thomas Mueller from PENNHAZUS and California University of Pennsylvania and Cynthia McCoy of FEMA Region III are collaborating to complete in November 2013. The results will provide understanding of what data is available for future risk assessments and the overall geospatial capabilities of the State and will be used by PEMA for situational awareness and to improve future risk assessments in the Commonwealth. A letter in support of the survey from Mr. Thomas Hughes to Dr. Thomas Mueller and a draft of the survey are found in Appendix C.

Additionally, cross-attached clerical personnel are temporarily stationed at the Joint Field Office to assist BORM. Contact information for the main points of contact for the State Hazard Mitigation Plan are provided in the table below:

Table 5.3.1-2 State Hazard Mitigation Plan Contact Information

TITLE	EMAIL	PHONE NUMBER
State Hazard Mitigation Officer	RA-shazmitoff@pa.gov	717-651-4579
State Hazard Mitigation Planner	---	717-671-2547
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

The nationwide recession has impacted all levels of government within Pennsylvania. In general, the budget crisis' impact for 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 fills 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. BORM'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.

BORM also coordinates with other departments within PEMA for technical expertise during shared missions and non-emergent activities. Commonly, BORM 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 SSAHMP stronger. The analysis in the complete SSAHMP will also be shared with the Bureau of Plans to assist in integrating the SSAHMP into other Commonwealth planning mechanisms.

Figure 5.3.1-1 Organizational structure for the Pennsylvania Emergency Management Agency (as of December 18, 2012)

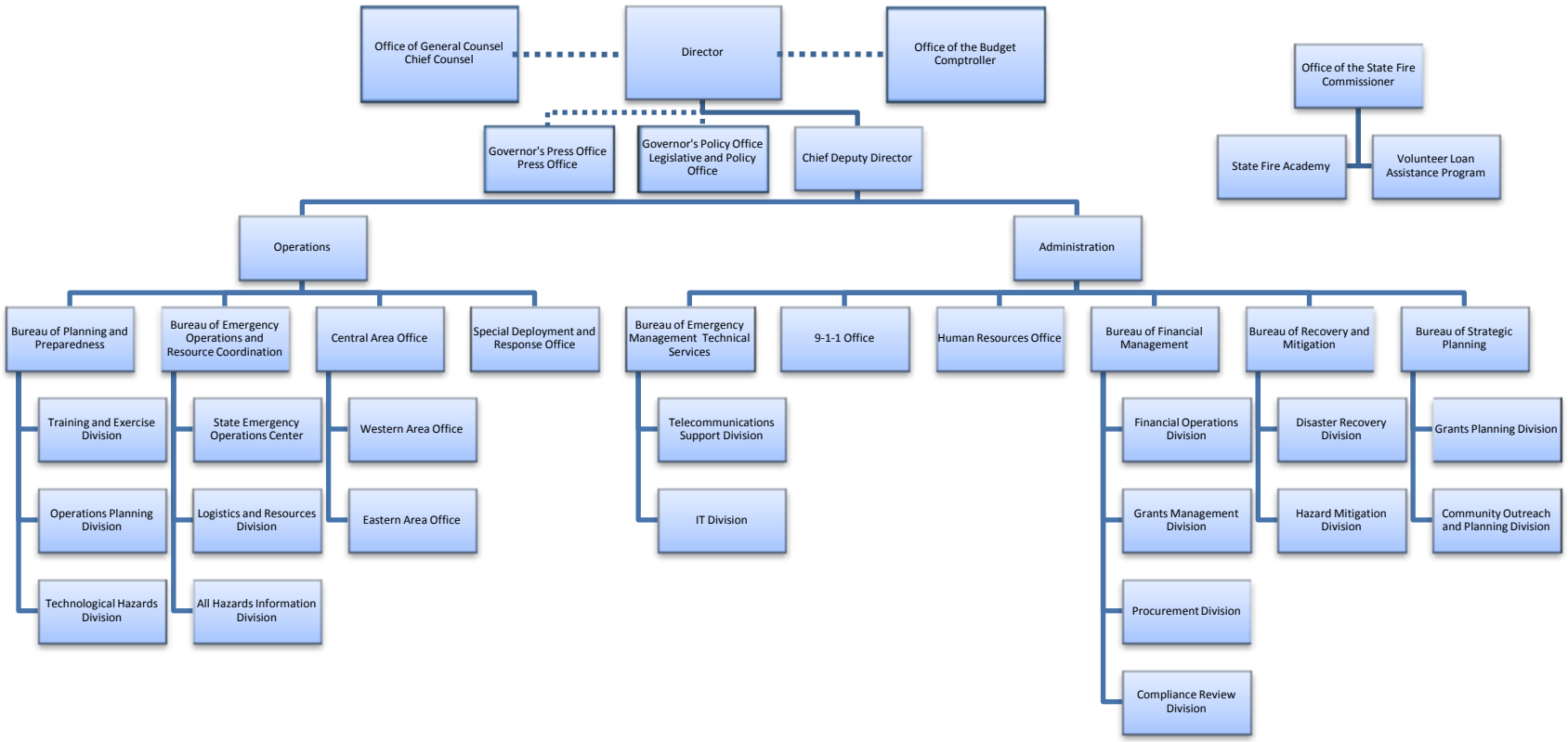
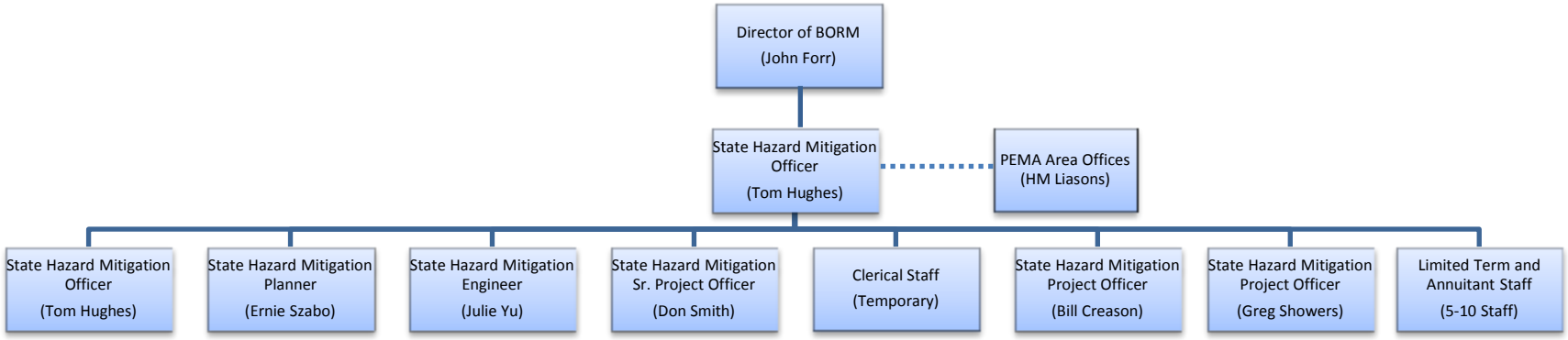


Figure 5.3.1-2 Mitigation staff structure for the Pennsylvania Emergency Management Agency, Bureau of Recovery and Mitigation (as of May 23, 2013).



PEMA Hazard Mitigation and Disaster Trainings

PEMA provides various trainings and presentations to community officials and local emergency management staff in support of local hazard mitigation 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. For example, in April 2013, PEMA provided a training session in York County at the County's request. BORM regularly presents on hazard mitigation planning and related grant program topics and also provides a fiscal brief to each hazard mitigation grant recipient in order to review how to administer the grant.

The following is a list of training hosted locally or promoted for Pennsylvania municipal, county, and state staff to attend at EMI. When available the location and number of attendees is provided in the following list. Please note that a Measure of Success for Action 3-2c is to, "Track training and technical assistance location, date, and attendance for next SSAHMP update", so more complete and detailed training statistic will be available in the next plan.

- **Annual State Training and Exercise Planning Workshop:** Workshop for state representatives to update the Multiyear Training and Exercise Plan for the Commonwealth of Pennsylvania 2013-17. The workshop is led and coordinated by PEMA.
- **EMI E/L212: Unified 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 E213: Unified 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 subapplication review. An overview of the grant award process is also included.
- **EMI E214: Unified Hazard Mitigation Assistance: Project Implementation and Programmatic 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 G318: Preparing and Reviewing Local Plans:** 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 G318 was taught at:

- PEMA HQ - July 28 and 29, 2010
- Allegheny County Emergency Operations Center - February 8 & 9, 2011
- Berks County Fire Academy - April 20-21, 2011
- State College - April 9 & 10, 2012

- **EMI IS-318: 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 G398: Mitigation and Recovery Exercises**: Training is provided to local government agencies. One day exercises are available focusing on earthquakes (G398.1), floods G398.2), or hurricanes (G398.3). The workshop is designed to prepared communities to deal with both immediate and long-term recovery issues associated with disasters.
- **EMI Independent Study:** PEMA encourages Independent Study course through EMI. Nearly one thousand courses completions have taken place between the 2010 and 2013 SSAHMP updates. The following list shows the titles and completion rates for several mitigation related Independent Study courses by Pennsylvanians:
  - IS-00030: Mitigation eGrants System for the Subgrant Applicant, 55 course completions
  - IS-00030.a: Mitigation eGrants System , 13 course completions
  - IS-00031.a Mitigation eGrants for the Grant Applicant: 12 course completions
  - IS-00208.a: State Disaster Management, 259 course completions
  - IS-00212: Intro to Unified Hazard Mitigation Assistance, 98 course completions
  - IS-00318: Mitigation Planning for Local and Tribal Communities, 36 course completions
  - IS-00323: Earthquake Mitigation Basics for Mitigation Staff, 40 course completions
  - IS-00328: Plan Review for Local Mitigation Plans, 28 course completions
  - IS-00393.a: Introduction to Hazard Mitigation, 453 course completions
- **FEMA R3 NFIP/SHMO Conference***:* Provides the opportunity for SHMO and NFIP officers from each state in Region III meet to share best practices, resources, and success stories.
  - The conference was held April 2nd and 3rd, 2013 and was physically attended by over 50 persons and virtually attended by an additional 23.
- **HAZUS-MH:** 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.
- **HAZUS E190 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.

- **L-212: Unified Hazard Mitigation Assistance (UHMA) Grant Program**: Developing Quality Mitigation Planning and Project Activities that will be delivered by a PEMA and FEMA III Hazard Mitigation approved/contracted instructor(s).
  - Workshop #1 - Butler County Dept. of Emergency Services - January 18, 2012
  - Workshop #2 - Blair County Dept. of Emergency Services - 2nd Week April 2012
  - Workshop #3 -Monroe County Office of Emergency Management - August 7, 2012
- **L-276: FEMA Benefits Cost Analysis Training:** Taught PEMA and local HM planners the basic of the benefits/cost Analysis process and use of FEMA software. The BCA course was taught by certified contractors at PEMA HQs on the following dates:
  - PEMA HQ - 1-5 January 2012 – 25 persons
  - PEMA HQ - 1-2 May 2012 - 7 persons
  - PEMA HQ - 12-13 June 2012 - 18 persons
  - PEMA HQ - 25-26 Sept 2012 - 5 persons
- **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.
  - This course was taught at PEMA HQs on April 1st and 2nd 2013 to 49 personnel from PEMA, FEMA, Municipal governments and industry.
- **PEMA Quarterly Training:** This training for targeted at County Emergency management staff provides an opportunity for BORM to brief on hazard mitigation. BORM has been engaged in these events as follows:
  - July 2011 - Pre-Conference Day and 4 HM Sessions at 2011 Conference were well attended. FEMA Region 3 & HQ provided support on the topics of NFIP, hazard mitigation, floodplain management, and environmental and historic preservation.
  - Oct 2011 - Attended PEMA C/A Quarterly Training/USACE Damage Assessment Course to update Eastern & Central Area counties on HM HMGP funding that will be available.
  - Jan 2012 - Attended PEMA C/A Quarterly Training/USACE Damage Assessment Course to update Eastern & Central Area counties on HM HMGP funding that will be available.
  - Nov 2012 – Sent teams to brief counties on grant application process for Disaster 4099, Sandy.
  - Super Quarterly Training, April 14 – 16, 2013 – PEMA hosted over 250 State and County EM professionals at a larger than normal quarterly training session with the them 'Back to Basics'. BORM-HM personnel presented a briefing on the Hazard Mitigation planning process and current issues in HM.
- **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. The one day workshop also gives an overview of floodplain management programs offered by FEMA/PEMA, USACE, and DCED in Pennsylvania.
  - Towanda - May 7, 2013
  - Plymouth - May 8, 2013
  - Bloomsburg - May 9, 2013

Figure 5.3.1-3 FEMA and PEMA staff speaking with West Pittston, PA residents at the Non-Structural Flood Proofing Workshop (Marisa Lewis, USACE Baltimore District, 2013).

PEMA also promotes training from other organizations and agencies easily when it addresses a topical hazard mitigation isse. One explample is to address Action 1-11c. Provide training that will enable counties to mitigate the negative impacts of Marcellus Shale extraction" PEMA will be promoting romote 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 particular 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

PEMA staff members attend meetings and trainings as requested. For example, Montgomery County requested that the DEP, DCED, FEMA NFIP staff, and PEMA attend and train community members in a recovery focused meeting in September 2009. Thirty-six municipalities attended. PEMA staff members have also provided local emergency planning training that addressed Radiological Plans, Emergency Operations Plans, and County Hazard Mitigation Plans. In 2011/2012 PEMA provided three webinar sessions for legislators and also

provided 18 webinars to compliment the 22 workshops hosted by DCED/FEMA for counties hit hardest by disasters.

In addition, there are numerous trainings which PEMA staff attends. Examples of some of the trainings BORM staff participate in are provided below. While these trainings apply only to BORM 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 BORM 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; and
- Human resources courses (i.e. equal opportunities, bio-hazard, etc…) are required once a month.

BORM would like to increase both internal and external staff trainings in the future, as staff availability and budget allow. Accordingly, BORM established three training goals in 2013. The first goal is to improve coordination between BORM 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 BORM staff in conjunction with an internal mentoring program.

PEMA Disaster Exercises

BORM 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. BORM staff members conduct joint field surveys with municipalities in order to assist with Benefit-Cost Analyses (BCAs). BORM's in-house survey equipment saves time in determining whether a property will meet the BCA by checking first floor elevations quickly and allowing BORM and municipalities to focus efforts on properties that will match grant requirements. The in house survey equipment may be viewed in us in Figure 5.3.1-4. 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 carries out floodplain management activities for the Commonwealth and supplies a list of repetitive loss properties to counties undertaking the hazard mitigation planning process. 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 repetitive loss 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 6.3.1. Project prioritization practices are discussed in Section 6.3.1.3. In addition, Section 5.3.3 discusses federal, state, local, private, and nonprofit sources of funding and technical assistance for local mitigation projects.

Figure 5.3.1-4 Mitigation staff using in-house survey equipment (BORM photos Summer 2013).

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. BORM 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 BORM 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 BORM 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.

The Director of PEMA provides yearly notifications to emergency management officials and planners about the fiscal availability of HMA Funds. PEMA Circular 2013-06 was sent to counties along with a list of their RL/SRL properties. 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 Section 5.3.3. The BORM 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.

BORM 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.

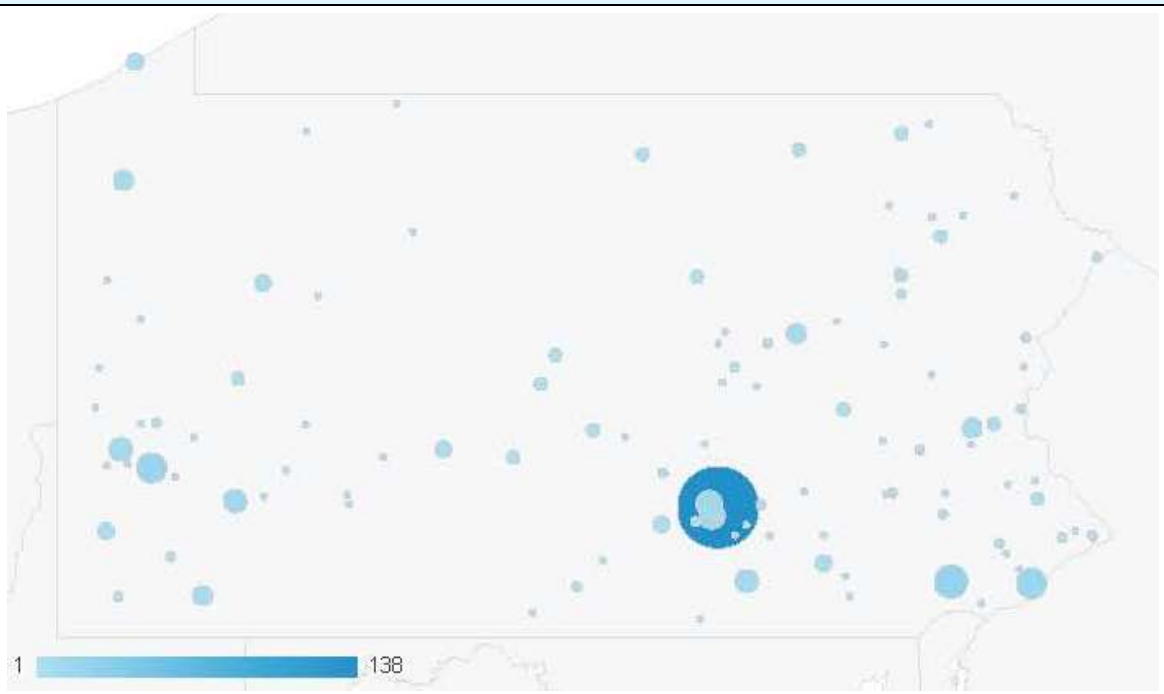
The SRL/RFC Pilot Program was launched in 2007, and the first application administered by PEMA took place in 2008. Some of the projects have now been completed successfully, as detailed in the following section. Due to these successes, the SRL/RFC Pilot Program was adopted on a permanent basis.

PEMA Hazard Mitigation Webpage

A webpage is maintained by PEMA that 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.

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; draft plans for review; and people may sign up for alerts to be notified when the page is updated. The SSAHMP project website www.PEMAHMP.com has received 580 unique visitors and 814 total visits since the project start. There have been a total of 2,292 page views, which are clicks on the homepage and various sub-pages, since project start. Figure 5.3.1-5 shows that hits were also spread throughout the Commonwealth; the largest cluster in Harrisburg reflects the participation of SPT members from agencies based in Harrisburg.

Figure 5.3.1-5 Web Analytics for www.PEMAHMP.com Location of Hits (Google 2013).



PEMA Conference Participation

BORM attends and presents at conferences to continue to build relationships through the Commonwealth that will be effective in implementing mitigation activities. For example, BORM staff recently attended the Mass Casualty Conference in Baltimore. BORM staff regularly present at the PEMA annual conference and since 2010 has presented at the Main Street Program at State College, the New Jersey Association for Floodplain Management, a Pennsylvania stormwater management conference, and the Pennsylvania Department of Environmental Protection Flood Protection Workshop. Additionally, BORM hosted the FEMA quarterly SHMO workshop in March 2013.

Conferences are also a mechanism to coordinate with the Pennsylvania State Association of Township Supervisors (PSATS), Pennsylvania State Association of Boroughs, the Pennsylvania League of Cities and Municipalities, KEMA, the American Planning Association, Greenway Associations and borough and township officials. BORM staff attends meetings and conferences for these organizations to provide presentations and outreach materials. An example of coordination with these organizations follows:

- SHMO presented at PSATS' 89th Annual Educational Conference and Trade Show, April 2011, Hershey, PA
- SHMO presented at PSATS' 90th Annual Educational Conference and Trade Show, April 2012, Hershey, PA
- SHMO presented at Pennsylvania Downtown Center (Conference includes Main St. and Elm St. organizations) , September 2012, State College
- SHMO presented at PSATS' 91st Annual Educational Conference and Trade Show, April 2013, Hershey, PA
- KEMA Participated in PEMA Super Quarterly Training, May 2013, Lancaster, PA
- SHMO presented at Susquehanna River Town Workshop, September 2013, Bloomsburg, PA

PEMA Emergency Management Accreditation Program Accreditation

PEMA first received EMAP accreditation in 2005 and was re-accredited in July 2010. Accreditation is valid for five years. The commonwealth is one of 22 other states and four jurisdictions to have its emergency management program fully accredited through EMAP. To qualify for EMAP accreditation, PEMA voluntarily completed a process of self and peer reviews and assessments that demonstrate that the emergency management program met or exceeded national standards. The result of the EMAP review found that PEMA met or exceeded 63 standards in the following 16 different areas of evaluation:

- Program Management
- Administration and Finance
- Laws and Authorities
- HIRA and Consequence Analysis
- Hazard Mitigation
- Prevention and Security
- Planning
- Incident Management
- Resource Management and Logistics
- Mutual Aid
- Communications and Warning
- Operations and Procedures
- Facilities
- Training
- Exercises, Evaluations, and Corrective Action
- Crisis Communications, Public Education, and Information

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. The Commonwealth last updated the SEOP in September 2012. PEMA is working on a new tool for EOPs and strategic planning and has a goal to synchronize the PA Hazard Mitigation Tool with emergency operations planning in the future.

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 in order 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 United States Army Corps of Engineers 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. Additionally, annual conferences have been held since 2010 with the 2012 conference hosted in Harrisburg. In 2011 the Pennsylvania Silver Jackets released the *Interagency Flood Mitigation Program Guide* in order to inform the public about flood risk related programs available through various agencies. In 2013 the Silver Jackets held a workshop on non-structural projects and released the Flood Risk Management Virtual Tool, which helps Pennsylvanians to stay informed before, during, and after a flood event. 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. SHMO Tom Hughes is an active member of the Silver Jackets. In February 2013, Silver Jackets opened a website titled *Flood Risk Management Resources* at http://www.nab.usace.army.mil/Home/SilverJackets.aspx. This site provides information on what to do before, during, and after a flood and has received 722 hits since February. The Silver Jackets also maintain a site for team coordination including meeting minutes at http://www.nfrmp.us/state/factPennsylvania.cfm. This site has received 1,118 hits in the last 3 years, and 403 of those within the last year.

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, who in turn coordinate with the Counties, local government, state agencies, the Department of Homeland Security 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 which speak other languages, many of the materials have been translated and are available in Spanish, and the Guide itself in Chinese. 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 State Emergency Registry of Volunteers in Pennsylvania. The ReadyPA site, www.readypa.org, went live with the portal site towards the end of December 2012. Since then the site has received 21,411hits, averaging over 2,000 hits per month.

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 concerning how to prepare and respond to disasters.

Pennsylvania Department of Community & Economic Development

The Pennsylvania DCED is responsible for coordinating the NFIP and related activities in Pennsylvania. Dan Fitzpatrick is the program coordinator. The DCED provides technical assistance to municipal officials in interpreting and administering floodplain ordinances and has developed a model ordinance which meets the minimum requirements of the NFIP and provides suggested provisions that are more restrictive. A detailed discussion of these suggested provisions and local participation is located in Section 5.3.4. DCED maintains a PA Floodmaps website at: http://pafloodmaps.pa.gov/. This sites provides flooding and map status information in a map viewer. In its first year from July 2012 to June 2013, the site received 13,133 hits.

DCED provides training and workshop throughout the Commonwealth to support floodplain management and other hazard mitigation as follows:

- **EMI E273: Managing Floodplain Development through the National Flood Insurance Program (NFIP):** Training for local officials who administer the local floodplain management ordinance. The training is two and a half days long and will focus on the NFIP, floodplain management, and flood insurance.
  - Aliquippa - November 15-18, 2010 - 29 attendees -12 CFM exam takers

  - Malvern - June 6-9, 2011- 30 attendees - 10 CFM exam takers
  - Scranton – March 26-29, 2012 - 35 attendees - 9 CFM exam takers
  - Sayre – September 17-20, 2012 - 30 attendees - 11 CFM exam takers
  - Enola – April 29-May 2, 2013 - 23 attendees - 12 CFM exam takers
- **PAFPM Conferences:** The NFIP Coordinator is a leader and founding member within the Pennsylvania Floodplain Managers Association. He provided presentations at each of the annual conferences with attendance as follows:
  - Williamsport – October 25-26, 2010 – 32 attendees
  - Johnstown – October 18-19, 2011 - 27 of attendees
  - Wilkes-Barre – October 23-24, 2012 - 55 attendees
- **Workshops/Trainings:** The NFIP coordinating office provide the following training with attendance as follows:
  - 5 CRS Trainings for 53 municipalities
  - 5 Disaster Trainings for 36 municipalities
  - 4 CCOs Workshops for 93 municipalities
  - 24 Floodplain Management Workshops 689 municipalities
  - 1 Substantial Damage Training for 129 municipalities

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 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, PA Transportation Security

Plan, and Winter Services Strategic Plan. The mitigation techniques uused in these plans are described in Table 5.5-1. PennDOT funding may be leveraged for mitigation projects so that a project accomplishes both transportation and mitigation benefits. PennDOTs scope of services, planning, training and outreach often includes aspects of hazard mitigation, examples from the PennDOT 2012 Annual Report follow:

- **Driving Safety Education**: PennDOT implemented the enhanced Special Point Examination study guide and exams to mitigate unsafe driving.
- **Automatic Red Light Enforcement**: This program has was implemented in Philadelphia starting in 2005 and includes 96 cameras at 21intersections. It is credited with a 50% reduction in red light violations thus mitigating transportation accidents. It will be expanded to second class and other select municipalities based on 2012 legislation.
- **Older Driver Information Center**: PennDOT approved online courses offered by The American Association of Retired Persons, the American Automobile Association, and Seniors for Safe Driving to mitigate transportation accidents for and by seniors.
- **Winter Storm Response**: PennDOT maintains nearly 96,000 snow-lane miles in the winter mitigating an impact of winter storms.
- **Bridge Improvements**: Structurally Deficient bridges have been reduced from 6,034 in 2008 to 4,476 in January of 2013 thus mitigating transportation accidents due to infrastructure collapse.

Pennsylvania Bureau of Labor & Industry

The Pennsylvania Bureau of Labor & Industry 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. Attendance in courses for each academic year was 2,916 in 2010-11, 3,160 in 2011-12, and 2,586 in 2012-13. The following table shows location and attendance at International Building Code (IBC) Essentials in the last three years.

Table 5.3.1-3 Location and participation in International Building Code Essentials Training in PA from 2010-2013 (PCCA, 2013)

Course Title	2010-11		2011-12		2012-13	
	Locations	Attended	Locations	Attended	Locations	Attended
IBC 101: IBC Essentials - Part I	Lancaster, Luzerne, and Westmoreland Counties	61	Allegheny and Montgomery Counties	28	Montgomery and York Counties	39
IBC 101: IBC Essentials - Part II	Lancaster, Luzerne, and Westmoreland Counties	59	Allegheny and Montgomery Counties	29	Montgomery and York Counties	33
IBC 101: IBC Essentials - Part III	Lancaster, Luzerne, and Westmoreland Counties	60	Allegheny and Montgomery Counties	29	Montgomery and York Counties	33
IBC 101: IBC Essentials - Part IV	Lancaster, Luzerne, and Westmoreland Counties	50	Allegheny and Montgomery Counties	31	Montgomery and York Counties	33
IBC 101: IBC Essentials - Part	Lancaster, Luzerne, and Westmoreland Counties	48	Allegheny and Montgomery Counties	28	Montgomery and York Counties	29
Total		**278**		**145**		**167**

Pennsylvania Department of Environmental Protection

DEP has a comprehensive mission to address many aspects of environmental protection and health and safety. DEP partners with individuals, organizations, governments and businesses to prevent pollution and restore our natural resources. The DEP's mission overlaps is integral to hazard mitigation in Pennsylvania as it implements flood control projects, monitors and conducts outreach for radon, participates 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, and DEP reviews H20 and flood mitigation grant applications for DCED. DEP also has numerous fact sheets on their programs and hosts annual flood protection workshops for municipal sponsors. DEP is in the process of finalizing Emergency Action Plan Guidelines for flood protection projects.

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.

The DEP Environmental Emergency Response provides response/monitoring, emergency contracting, technical assistance, policy/rulemaking, and support of the state emergency response. This Bureau has an Emergency Operations Plan and a Continuity of Operations

Plan. The Bureau sends representatives to the PEMA Emergency Operations Center; participates in PEMA/FEMA trainings, drills, and conferences; shares incident notification reports; has partnerships with neighboring states; and provides public outreach.

DEP's partnership with individuals, organizations, governments and businesses often comes in the form of training partners 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 highlighted in the *Governor's 2011-12 Report on State Performance* for DEP:

- **Dam Safety**: DEP approves dam emergency action plans, inspects dams for safety, and requires dams to be upgraded or repaired when warranted.
- **Natural Gas Safety**: DEP conducted 12,057 unconventional well inspections in 2011-12, which is 53% more than the previous year.
- **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**: In 2011-12, DEP's monitoring aided in reducing hazardous air pollutants 23% from the previous year. Monitoring air quality is a
- **Brownfields**: DEP supported cleaning 380 sites under the Environmental Cleanup and Brownfield's Voluntary Cleanup Program in 2011-12.

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 DCED 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 DCED 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.

5.3.2. Post-disaster Capability

As discussed in Section 5.3.1.2, Title 35 addresses PEMA's responsibilities before, during, and after a disaster.

Figure 5.3.2-1 2nd Version HMPO Handbook

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 BORM 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. BORM staff members are cross-trained so that they can fulfill multiple roles in the post-disaster environment. RL and SRL property mitigation is criteria prioritized in the HMGP state application review. As stated in Section 5.3.1.2, in any time period of limited budgets and staffing, additional funding and staff would be helpful in expanding PEMA and BORM'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 BORM staff to be ready when they need to respond. BORM is developing a 2nd version of the HMPO Handbook to be completed in September of 2013, which will improve and standardize training of HMPOs in the Joint Field Office (JFO).

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. PEMA has established a new office under Operations for Special Deployment and Response and increased its response capability with 6 new generators. 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 BORM, 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, the BORM staff also performs several post-disaster activities:

- Emergency Operations Center duties – BORM staff provide infrastructure and human services support in the event the Emergency Operations Center is activated.
- Field duties – BORM 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. BORM staff also may be called upon to staff disaster assistance centers in the field.
- Field briefings – BORM staff conduct field briefings to municipalities on Pennsylvania disaster funding, how it may be used, and how municipalities can fund eligible projects. For example, since 2010, field briefings, as well as webinars and teleconferences, were conducted following Hurricane Sandy (DR-4099), Hurricane Irene (4025-DR), Tropical Storm Lee (4030-DR), and severe storms and flooding (DR-4003).
- Continuity of Operations duties – BORM staff maintains their regular pre-disaster duties during a disaster to maintain continuity of operations.
- Preliminary damage assessment – BORM 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 – BORM 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, 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. For example, many of these organizations assisted in distributing announcements for the SSAHMP Public Forums as shown in Section 3.

Pennsylvania Emergency Operations Center (EOC)

The Commonwealth EOC 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 EOC 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 June 2013, the state agencies representing the ESF include Pennsylvania State Police, Pennsylvania Department of Military and Veteran’s Affairs, Pennsylvania Department of Transportation, Pennsylvania Department of Aging, Pennsylvania Utility Commission, Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Department of Environmental Protection, Pennsylvania Department of Agriculture, Pennsylvania Department of

General Services, Pennsylvania Department of Public Welfare, Pennsylvania Department of Health, Pennsylvania Department of Corrections, Pennsylvania Department of Community and Economic Development, Pennsylvania Department of Education and Pennsylvania State System of Higher Education, and Pennsylvania Department of Labor and Industry. As of June 2013, the federal and non-governmental organizations represented at the EOC include Federal Emergency Management Agency, United States Department of Agriculture, United States Army Corps of Engineers, American Red Cross, Civil Air Patrol, Radio Amateur Civil Emergency Services, and US Department of Homeland Security, Office of Infrastructure Protection's Protective Security Advisors.

At the county and local levels, EOCs 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.

Joint Field Office (JFO)

FEMA established a Joint Field Office in a leased facility in Harrisburg in support of Disasters 3339, 3340, 4003, 4025 and 4030. The JFO is a scalable facility that supported a staff of over 800 at its peak. This staff was composed of FEMA, PEMA and other personnel. FEMA provided 4 dedicated Core personnel to support PA HM activities. The JFO facilitates interagency cooperation between state and federal agencies. The JFO supports the temporary expansion of HM staff with augmented and limited term personnel who could not fit in PEMA HQs. FEMA continues to provide personnel to support Preliminary Damage Assessments, Public Assistance and HMA support.

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. The most recent Hazard Mitigation Grant Program Administrative Plan was approved by FEMA on January 3, 2012, for Tropical Storm Lee, which occurred September 3-October 15, 2011, (Disaster Declaration *FEMA-4030-DR-PA*).

Hazard Mitigation Grant Program Community Outreach

PEMA's Bureau of Recovery and Mitigation provides information sessions for county and municipal officials on the post-disaster grant funding application process. Most recently, the Bureau provided 12 WebEx information sessions for interested community officials who may be submitting an eligible application under the Hazard Mitigation Grant Program for a declared winter storm disaster (DR-1898), severe storms and flooding (DR-4003), Hurricane Irene (4025-

DR), Tropical Storm Lee (4030-DR), and Hurricane Sandy (DR-4099). Attendees were informed about how PEMA would be handling inquiries, Letters of Intent, HMGP applications, eligibility, state selection, and FEMA approval.

Repetitive Loss and Severe Repetitive Loss Capability

As stated in Section 5.3.1.2, BORM staff has a continuous 12-month approach to mitigating repetitive loss and severe repetitive loss properties. This continuous approach supports both pre- and post-disaster grant funding streams. Repetitive loss (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 percent of the value of the structure at the time of the flood event. Severe Repetitive Loss (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 10-year period, and must be greater than 10 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 are community members that provide services and care on a daily basis, so there ongoing support in communities 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 five hazard mitigation grant programs, known collectively as the Hazard Mitigation Assistance (HMA) programs. As stated in the FEMA's *Hazard Mitigation Assistance Unified Guidance* (July 2013), "The Hazard Mitigation Grant Program (HMGP) may provide funds to States, Territories, Indian Tribal governments, local governments, and eligible private non-profits (PNPs) following a Presidential major disaster declaration. The PDM, Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and Severe Repetitive Loss (SRL) programs may provide funds annually to States, Territories, Indian Tribal governments, and local governments." The HMA guidance replaces previous guidance and more efficiently manages hazard mitigation grants under one umbrella. The five FEMA hazard mitigation grants of the HMA program include:

Flood Mitigation Assistance Program

As stated in the FEMA's *Hazard Mitigation Assistance Unified Guidance* (July 2013), "The FMA program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended (NFIA), 42 U.S.C. 4104c, with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP)."

Funds are allocated to each state based on the total number of NFIP insurance policies and the total number of repetitive loss properties within the state. States may apply for funding in excess of their allocations; additional funds are awarded on a competitive basis pending availability of funds.

Pre-Disaster Mitigation Program

As stated in the FEMA' *Hazard Mitigation Assistance Unified Guidance (July 2013)*, "The PDM program is authorized by Section 203 of the Stafford Act, 42 U.S.C. 5133. The PDM program is designed to assist States, Territories, Indian Tribal governments, and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding from future disasters." However,

as of the writing of the 2013 Plan Update, PDM grant funding is unavailable. This program is effectively suspended until funding is restored. The status of this funding could change in the future. This program is effectively suspended until funding is restored. The status of this funding could change in the future.

Hazard Mitigation Grant Program

As stated in the FEMA's *Hazard Mitigation Assistance Unified Guidance (July 2013)*, "HMGP is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended (the Stafford Act), Title 42, United States Code (U.S.C.) 5170c. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is available, when authorized under a Presidential major disaster declaration, in the areas of the State requested by the Governor. The amount of HMGP funding available to the Applicant is based upon the estimated total Federal assistance to be provided by FEMA for disaster recovery under the Presidential major disaster declaration."

Pennsylvania has received several major disaster declarations since 2010. On April 16, 2010, a major disaster (FEMA-1898-DR) was declared for the severe winter storms and snowstorms that occurred February 5-11, 2010. The following counties were declared eligible to apply for assistance under the Hazard Mitigation Grant Program: Adams, Allegheny, Armstrong, Beaver, Bedford, Blair, Butler, Cambria, Chester, Cumberland, Dauphin, Delaware, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Juniata, Lancaster, Lebanon, Perry, Philadelphia, Somerset, Washington, Westmoreland, and York.

On July 13, 2011, a major disaster (FEMA-4003-DR) was declared for severe storms and flooding that took place in Northern Pennsylvania from April 25-28, 2011. The following counties were declared eligible to apply for Public Assistance: Bradford, Lycoming, Sullivan, Tioga and Wyoming. All counties in the Commonwealth of Pennsylvania were eligible to apply for assistance under the Hazard Mitigation Grant Program for this disaster.

On September 3, 2011, a major disaster (FEMA-4025-DR) was declared for Hurricane Irene for the incident period of August 26-30, 2011. Fourteen counties in Eastern Pennsylvania were affected. Eleven of these counties became eligible for Individual and Public Assistance, while three became eligible for Public Assistance only. All counties in the Commonwealth of Pennsylvania were eligible to apply for assistance under the Hazard Mitigation Grant Program for this disaster.

On September 12, 2011, a major disaster (FEMA-4030-DR) was declared for Tropical Storm Lee for the incident period of September 3 – October 15, 2011. Tropical Storm Lee affected 33 counties in Eastern and Central Pennsylvania. Ten of the affected counties became eligible for Individual and Public Assistance, 18 eligible for Individual Assistance only, and five eligible for Public Assistance only. All counties in the

Commonwealth of Pennsylvania were eligible to apply for assistance under the Hazard Mitigation Grant Program for this disaster.

On January 10, 2013, a major disaster (FEMA-4099-DR) was declared for Hurricane Sandy for the incident period of October 26 – November 8, 2012. Eighteen counties were affected and became eligible for Public Assistance. All counties in the Commonwealth of Pennsylvania were eligible to apply for assistance under the Hazard Mitigation Grant Program for this disaster.

A number of the above HMA programs require a match component. For HMGP, the Commonwealth or the local government (the sub-applicant) has provided the match from general funds. For PDM and FMA, the local government (or sub-applicant) or the homeowner has provided the matching funds. For SRL, the homeowner has been responsible for providing the matching funds. No match is required for RFC grants. Sometimes, funding is appropriated to PEMA by the Commonwealth for the purpose of the state 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.

Table 5.3.3-1 FEMA Grant Program Eligible Activities (FEMA Hazard Mitigation Assistance Unified Guidance, July 2013)

Mitigation Activity	HMA Program		
	HMGP	*PDM	FMA
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	√	√	
Wind Retrofit for One- and Two-Family Residences	√	√	
Infrastructure Retrofit	√	√	√
Soil Stabilization	√	√	√
Wildfire Mitigation	√	√	
Post-Disaster Code Enforcement	√		
Generators	√	√	
5 Percent Initiative Projects	√		

Table 5.3.3-1 FEMA Grant Program Eligible Activities (FEMA Hazard Mitigation Assistance Unified Guidance, July 2013)			
Mitigation Activity	HMA Program		
	HMGP	*PDM	FMA
Advance Assistance	√		
2.Hazard Mitigation Planning	√	√	√
3.Management Costs	√	√	√

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 the DCED. The NFIP includes Increased Cost of Compliance (ICC) coverage for new and renewed Standard Flood Insurance Policies. ICC is an effective way 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 percent Federal and 50 percent 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 III 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 percent non-federal match for all States receiving CAP-SSSE funds.

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 money 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.

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 in order to maximize flood loss reduction. FEMA will collaborate with Federal, State and local stakeholders to achieve 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 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 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 4 more years and added enhancements to the 1996 Act that are designed to safeguard dams against terrorist attacks.

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 U.S. 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 Corps of Engineers 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, Indian 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 Continuing Authorities Program 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 Corps and turned over to others for operation and maintenance, the operating entity is responsible for periodic inspection and evaluation. The Corps may conduct the inspection on behalf of the project sponsor provided appropriate reimbursement to the Corps is made. However, the Corps 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 the Corps of Engineers 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

Community Development Block Grant- Disaster Recovery (*CDBG-DR)* - The CDBG-DR 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-DR money can be used as matching funds for the FEMA HMA grant programs.

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.

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 the 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. NRCS Field Offices accepted applications from July 8, 2013 until September 2, 2013 for the 18 counties that were declared disaster counties due to Hurricane Sandy. These counties are: Philadelphia, Montgomery, Bucks, Northampton, Pike, Monroe, Dauphin, Juniata, Franklin, Fulton, Huntingdon, Bedford, Somerset, Potter, Cameron, Forest, Sullivan, and Wyoming. The Hurricane Sandy EWP relief is designated at $5,300,000 for the 11 impacted states. Previously, Pennsylvania received American Recovery and Reinvestment Act of 2009 funding from NRCS at $11,900,000 for EWP-Recovery and $1,559,460 for EWP-FPE.

Other federal programs that provide hazard funding and technical assistance are listed below. The comprehensive list was obtained from the Final Silver Jackets Interagency Flood Mitigation Program Guide (July 2011).

- Department of Commerce (DOC)/Economic Development Authority (EDA) Construction Grant Program
- DOC/EDA Planning Grants
- DOC/EDA Revolving Loan Fund
- DOC/EDA Technical Assistance Grants
- Department of Housing and Urban Development (HUD) 5-H Homeownership ProgramHUD Home Program
- HUD/Federal Housing Administration (FHA) Title I Home Repair Loan Program
- HUD/FHA Section 203(h) Mortgage Insurance for Disaster Victims
- HUD/FHA Section 203(k) Rehabilitation Mortgage Insurance Program
- HUD Partnership for Advancing Technology in Housing
- Department of Interior (DOI)/United States Geological Survey (USGS) Natural Hazards Program
- DOI/USGS Water Programs
- DOI/USGS Floods, Droughts, and Current Conditions

- DOI/USGS Flood Monitoring in Pennsylvania
- DOI/USGS Water Data from the Nation's Water Resources
- Department of Transportation (DOT)/Federal Highway Administration Emergency Relief Program
- Internal Revenue Service Casualty Loss-Special Disaster Provisions
- National Oceanic and Atmosphere Administration (NOAA) StormReady Program
- NOAA Weather Radio All Hazards (NWR)
- NOAA Damage Assessment, Remediation and Restoration Program
- NOAA Center for Operational Oceanographic Products and Services (CO-OPS) National Water Level Observation Network
- NOAA Coastal Services Center Land Cover Mapping
- NOAA Integrated Ocean Observing System Program IOOS Regional Association
- NOAA CO-OPS Delaware Bay Hydrodynamic Model
- NOAA CO-OPS Delaware River and Bay PORTS
- NOAA Office of Response and Restoration Regional Resource Coordinator (RRC)
- NOAA Office of Ocean and Coastal Resource Management (OCRM) Pennsylvania Coastal Management Program/Pennsylvania Department of Environmental ProtectionNOAA National Sea Grant College Program- Pennsylvania Sea Grant College Program
- NOAA Earth System Research Laboratory/Global Systems Division – Ground-Based GPS Meteorology
- NOAA Earth System Research Laboratory/Global Systems Division – Science On a Sphere – Whitaker Center
- NOAA Earth System Research Laboratory/Global Monitoring Division – Surface Radiation Measurement Network
- NOAA Great Lakes Environmental Research Laboratory – SLERL CoastWatch
- NOAA Air Resources Laboratory – Atmospheric Integrated Research Monitoring Network
- NOAA Air Resources Laboratory – Mercury Measurement Site
- NOAA Cooperative Institute for Limnology and Ecosystems Research (CILER), Penn State University
- NOAA Climate Reference Network – Avondale Station
- National Weather Service (NWS) multiple Forecast Centers and Forecast Offices
- NWS/Federal Aviation Administration (FAA)/Department of Defense (DOD) Automated Surface Observing Systems
- NWS Cooperative Observer Program (COOP)
- United States Department of Agriculture (USDA) Water and Waste Disposal Programs
- USDA/Farm Service Agency (FSA) Conservation Reserve Program
- USDA/FSA EM Program (Emergency Loans)
- USDA/FSA Emergency Conservation Program
- USDA/FSA Tree Assistance Program
- USDA/NRCS Emergency Watershed Protection Program
- USDA/NRCS Watershed Protection and Flood Prevention ProgramUSDA/NRCS Watershed Surveys and Planning Program
- USDA/NRCS Dam Rehabilitation Assistance
- USDA/Rural Business Service (RBS) Business and Industrial Loans
- USDA/Rural Housing Service (RHS) Community Facilities Loans and Grants
- USDA/RHS Rural Rental Loans
- USDA/RHS Section 502 Single-Family Housing Direct and Guaranteed Loans

- USDA/RHS Section 504 Repair Loans and Grants
- USDA Repair and Rehabilitation Loan
- USDA/RHS Self-Help Housing Loans
- USDA/Risk Management Agency (RMA) Federal Multi-Peril Crop Insurance
- USDA/RMA Noninsured Crop Disaster Assistance Program

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.

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 and it is administered by the Governor's Center for Local Government Services within the DCED.

CDB-DR – As discussed above, the CDGB-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 3rd class cities, urban boroughs & 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 Planning 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.

CAP - Pennsylvania provides technical assistance to local governments through county conservation districts and others. Technical assistance includes outreach and education, help with ordinance updates and ordinance administration and floodplain map interpretation and enhancement of FEMA flood maps. This program is financed with annual allocation provided by FEMA.

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 fund sewer, storm water 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. Storm water improvement projects by PENNVEST represent significant funding for Pennsylvania. The total funding from 1933-2013 is $135,495,342. The following table provides details on the location, title, and funding for each stormwater project.

Table 5.3.3-2 PENNVEST Stormwater Projects 1993-2013 (PENNVEST, 2013)

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- stormsewers 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
Schuykill	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 stormsewer lines, manholds, etc.	3/22/1995	$461,100
Tioga	Wellsboro Boro -Stormsewer 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
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 stormsewer pipe	3/20/1996	$94,182
Erie	Millcreek Twp. -replace stoemsewer 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 seperation 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 stromsewer	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

Table 5.3.3-2 PENNVEST Stormwater Projects 1993-2013 (PENNVEST, 2013)

County	Project Name	Approval Date	Amount
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
Allegheny	Baldwin Boro -strom 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 stormsewer pipe	3/20/2002	$271,000
Fayette	Uniontown City -stormwater seperattion 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

Table 5.3.3-2 PENNVEST Stormwater Projects 1993-2013 (PENNVEST, 2013)

County	Project Name	Approval Date	Amount
Berks	Exeter Twp - East Neversink Storm Sewer Project	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
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 Enviornmental 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

Table 5.3.3-2 PENNVEST Stormwater Projects 1993-2013 (PENNVEST, 2013)

County	Project Name	Approval Date	Amount
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 - OhioPyle 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, Nothampton	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
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
		Total Funding:	**$135,495,342**

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 the PennDOT in order 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.

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 in order to preserve and enhance river resources. Grants can be used for planning, implementation, development, and acquisition.

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.

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 continue to be a deterrent in the future because of the deep recession the American economy is continuing to experience. 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 also are a valuable local resource. Sixty-six of the sixty-seven 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 of 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 Table 5.5-1.

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 stormwater 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.

Pennsylvania is considered a Dillon Rule state in which the state legislature defines the powers of local government. Therefore, municipalities only have the powers that are expressly granted to them through state law, those that are necessarily implied from the grant of power, and those that are essential to the municipality's existence and functioning. 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 National Flood Insurance Program 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 III 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 Pennsylvania DCED is responsible for coordinating the NFIP and related activities in Pennsylvania; Dan Fitzpatrick is the program coordinator. DCED recently received HUD funding to support 3 new staff for 2 years to support the Long-Term Recovery Emergency Support Function. This additional staff will help address long-term recovery as Pennsylvania is recovering from 4 active flooding related Disaster Declarations. DCED also provides communities, based on their CFR, Title 44, Section 60.3 level of regulations, with a suggested ordinance document to assist municipalities in meeting the minimum requirements of the NFIP along with the Pennsylvania Flood Plain Management Act (Act 166). These suggested or model ordinances contain provisions that exceed minimum federal requirements.

Additionally, the DRBC's Flood Advisory Committee (FAC) has 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. It also establishes higher regulatory standards for hazardous materials and high risk land uses. As new DFIRMs are published, the Pennsylvania State NFIP Coordinator housed at DCED works with communities to ensure the timely and successful adoption of an updated floodplain management ordinance by reviewing and providing feedback on existing and draft ordinances. In addition, DCED provides guidance and technical support through Community Assistance Contacts (CAC) and Community Assistance Visits (CAV). In the last three years DCED has completed 6 CAVs, 28 CACs, and provided general technical assistance 558 times. FEMA completed 70 CAVs, 104 CACs, and provided general technical assistance 428 times. The following table provides detail on the location and number of CACs and Cavs for Pennsylvania during the 3 year period between SSAHMP updates.

Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from August 15, 2010 to August 15, 2013 (CIS, 2013)

	CAC				CAV			Grand Total
Community	**FEMA**	**OTHER**	**STATE**	**CAC Total**	**FEMA**	**STATE**	**CAV Total**	
ABINGTON, TOWNSHIP OF	1			1				1
ALTOONA, CITY OF					1		1	1
AMBLER, BOROUGH OF	2			2				2
ANNVILLE, TOWNSHIP OF	1			1				1
ATHENS, BOROUGH OF	3			3				3
ATHENS, TOWNSHIP OF	3			3				3
AUBURN, TOWNSHIP OF	1			1				1
BEAVER COUNTY*	1			1				1
BEAVER, BOROUGH OF						1	1	1
BEDFORD, BOROUGH OF					1		1	1
BEDFORD, TOWNSHIP OF					1		1	1
BENDERSVILLE, BOROUGH OF			1	1				1
BENSALEM, TOWNSHIP OF	1			1				1
BERWICK, BOROUGH OF	1			1				1
BLOOM, TOWNSHIP OF			1	1				1
BLOOMSBURG, TOWN OF	1			1				1
BOGGS, TOWNSHIP OF			1	1				1
BRAINTRIM, TOWNSHIP OF	1			1	1		1	2
BRIAR CREEK, TOWNSHIP OF	1			1				1
BRIDGEWATER, BOROUGH OF						1	1	1
BRISTOL, TOWNSHIP OF	1			1	1		1	2

Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from August 15, 2010 to August 15, 2013 (CIS, 2013)

	CAC				CAV			Grand Total
Community	**FEMA**	**OTHER**	**STATE**	**CAC Total**	**FEMA**	**STATE**	**CAV Total**	
BUTLER, TOWNSHIP OF					1		1	1
CANTON, TOWNSHIP OF	1			1				1
CHAMBERSBURG, BOROUGH OF					1		1	1
CHEST, TOWNSHIP OF			1	1				1
CONEWAGO, TOWNSHIP OF			2	2				2
CONYNGHAM, TOWNSHIP OF	1			1	1		1	2
COOPER, TOWNSHIP OF			1	1				1
COVINGTON, TOWNSHIP OF			1	1				1
CUMBERLAND, TOWNSHIP OF					1		1	1
CURWENSVILLE, BOROUGH OF					1		1	1
DERRY, TOWNSHIP OF	1		1	2				2
DOVER, TOWNSHIP OF	1			1				1
DOWNINGTOWN, BOROUGH OF					1		1	1
DURYEA, BOROUGH OF	2			2				2
EAST BRADFORD TOWNSHIP OF					1		1	1
EAST HEMPFIELD, TOWNSHIP OF					1		1	1
EAST LAMPETER, TOWNSHIP OF					1		1	1
EAST PENNSBORO TOWNSHIP OF					1		1	1
EATON, TOWNSHIP OF	2			2	1		1	3
ELDRED, TOWNSHIP OF	1			1				1
ELIZABETHVILLE, BOROUGH OF			1	1				1
ETNA, BOROUGH OF					1		1	1
EXETER, BOROUGH OF	1			1				1
FAIRVIEW, TOWNSHIP OF	1			1				1
FERGUSON, TOWNSHIP OF					1		1	1
FORKSTON, TOWNSHIP OF	1			1				1
FORTY FORT, BOROUGH OF					1		1	1
FRANKLIN, TOWNSHIP OF	1	1	1	3				3
FRANKSTOWN, TOWNSHIP OF					1		1	1
GERMANY, TOWNSHIP OF			1	1				1
GLASGOW,BOROUGH OF			1	1				1
GOSHEN, TOWNSHIP OF			1	1				1
GRAHAM, TOWNSHIP OF			1	1				1
GREENE, TOWNSHIP OF					1		1	1
HAMILTONBAN, TOWNSHIP OF		1		1				1
HAMPDEN, TOWNSHIP OF					1		1	1
HANOVER, TOWNSHIP OF					2		2	2
HARRISBURG,CITY OF					1		1	1
HATBORO, BOROUGH OF					1		1	1
HAVERFORD, TOWNSHIP OF					1		1	1
HELLAM, TOWNSHIP OF	1			1				1
HEMLOCK TOWNSHIP OF	1			1				1
HIGHSPIRE, BOROUGH OF	1			1	1		1	2
HUMMELSTOWN, BOROUGH OF	1			1				1
HUNTINGTON, TOWNSHIP OF			1	1				1
INDIANA, TOWNSHIP OF					1		1	1
JEFFERSON, TOWNSHIP OF			1	1				1
JENKINS, TOWNSHIP OF	1			1				1

Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from August 15, 2010 to August 15, 2013 (CIS, 2013)

	CAC				CAV			Grand Total
Community	**FEMA**	**OTHER**	**STATE**	**CAC Total**	**FEMA**	**STATE**	**CAV Total**	
JOHNSTOWN, CITY OF					1		1	1
JORDAN, TOWNSHIP OF			1	1				1
KINGSTON, BOROUGH OF					1		1	1
LACEYVILLE, BOROUGH OF	1			1				1
LACKAWAXEN, TOWNSHIP OF					1		1	1
LAFLIN, BOROUGH OF	1			1				1
LANCASTER, CITY OF					1		1	1
LATIMORE, TOWNSHIP OF		1		1				1
LEBANON, CITY OF					1		1	1
LEWISTOWN, BOROUGH OF					1		1	1
LIBERTY, TOWNSHIP OF		1		1				1
LONDONDERRY, TOWNSHIP OF	1			1	1		1	2
LOWER MERION, TOWNSHIP OF					1		1	1
LOWER MORELAND, TOWNSHIP OF					1		1	1
LOWER PAXTON, TOWNSHIP OF	1			1	1		1	2
LOWER SOUTHAMPTON, TOWNSHIP OF	1			1				1
LOWER SWATARA, TOWNSHIP OF	1			1				1
LOYALSOCK, TOWNSHIP OF	1			1				1
LYKENS, BOROUGH OF			1	1				1
MANHEIM, BOROUGH OF	1			1				1
MANHEIM, TOWNSHIP OF					1		1	1
MANOR, TOWNSHIP OF					1		1	1
MEHOOPANY, TOWNSHIP OF	1			1				1
MENALLEN, TOWNSHIP OF			1	1				1
MESHOPPEN, TOWNSHIP OF	1			1	1		1	2
MIDDLE PAXTON, TOWNSHIP OF	1			1	1		1	2
MIDDLETOWN, BOROUGH OF	1			1				1
MIDDLETOWN, TOWNSHIP OF	1			1				1
MONROE, TOWNSHIP OF	1			1				1
MONTOUR, TOWNSHIP OF	1			1				1
MT. LEBANON, MUNICAPILITY OF					1		1	1
MUNCY CREEK, TOWNSHIP OF	1			1				1
NEW BETHLEHEM, BOROUGH OF	1			1				1
NEW CUMBERLAND, BOROUGH OF					1		1	1
NEW WASHINGTON, BOROUGH OF			1	1				1
NORRISTOWN, BOROUGH OF					1		1	1
NORTH ANNVILLE, TOWNSHIP OF	1			1				1
NORTH LONDONDERRY, TOWNSHIP OF	1			1				1
NORTH TOWANDA, TOWNSHIP OF	1			1				1
NOXEN, TOWNSHIP OF	1			1	1		1	2
OKLAHOMA, BOROUGH OF					1		1	1
OLYPHANT, BOROUGH OF					1		1	1
ORANGE, TOWNSHIP OF	1			1				1
OXFORD, TOWNSHIP OF		1		1		1	1	2
PAXTANG, BOROUGH OF			1	1				1
PHOENIXVILLE, BOROUGH OF					1		1	1
PINE GROVE, BOROUGH OF	1			1				1
PINE GROVE, TOWNSHIP OF	1			1				1

Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from August 15, 2010 to August 15, 2013 (CIS, 2013)

	CAC				CAV			Grand Total
Community	**FEMA**	**OTHER**	**STATE**	**CAC Total**	**FEMA**	**STATE**	**CAV Total**	
PLAINS, TOWNSHIP OF	2			2	1		1	3
PLYMOUTH, TOWNSHIP OF	2			2	2		2	4
RAMEY, BOROUGH OF			1	1				1
RAPHO, TOWNSHIP OF	1			1				1
READING, TOWNSHIP OF			1	1		1	1	2
RIDGEBURY, TOWNSHIP OF	1			1				1
ROME, BOROUGH OF	1			1				1
ROME, TOWNSHIP OF	1			1				1
ROSEVILLE, BOROUGH OF					1		1	1
ROYALTON, BOROUGH OF			1	1				1
SAYRE, BOROUGH OF	2			2				2
SCOTT, TOWNSHIP OF	2			2				2
SCRANTON, CITY OF					1		1	1
SHAMOKIN, CITY OF	1			1				1
SHESHEQUIN, TOWNSHIP OF	3			3				3
SHICKSHINNY, BOROUGH OF	1			1	1		1	2
SHIREMANSTOWN, BOROUGH OF					1		1	1
SMITHFIELD, TOWNSHIP OF					1		1	1
SOLEBURY, TOWNSHIP OF	1			1				1
SOUTH HANOVER, TOWNSHIP OF	1		1	2				2
SOUTH LEBANON, TOWNSHIP OF	1			1				1
SPRINGVILLE, TOWNSHIP OF	1			1				1
STATE COLLEGE, BOROUGH OF					1		1	1
SUSQUEHANNA COUNTY*	1			1				1
SUSQUEHANNA, TOWNSHIP OF	1			1	1		1	2
SWATARA, TOWNSHIP OF	1			1				1
TERRY, TOWNSHIP OF	3			3				3
TOWANDA, BOROUGH OF	1			1				1
TROY, TOWNSHIP OF	1			1				1
TUNKHANNOCK, BOROUGH OF					1		1	1
TUNKHANNOCK, TOWNSHIP OF	1			1				1
TYRONE, TOWNSHIP OF		1		1				1
ULSTER, TOWNSHIP OF	1			1				1
UNION, TOWNSHIP OF	1			1				1
UPPER ALLEN, TOWNSHIP OF					1		1	1
UPPER DUBLIN, TOWNSHIP OF					1		1	1
UPPER GWYNEDD, TOWNSHIP OF	1			1				1
UPPER LEACOCK, TOWNSHIP OF	1			1				1
UPPER MORELAND, TOWNSHIP OF	1			1	1		1	2
WARRINGTON, TOWNSHIP OF	1			1				1
WARWICK, TOWNSHIP OF					1		1	1
WASHINGTON, TOWNSHIP OF			1	1				1
WAYNE, TOWNSHIP OF			1	1				1
WEST CHESTER, BOROUGH OF					1		1	1
WEST CHILLISQUAQUE, TOWNSHIP OF	1			1				1
WEST GOSHEN, TOWNSHIP OF					1		1	1
WEST LAMPETER, TOWNSHIP OF					1		1	1
WEST NORRITON, TOWNSHIP OF						1	1	1

Table 5.3.4-1 Total CACs and CAVs in Pennsylvania from August 15, 2010 to August 15, 2013 (CIS, 2013)								
	CAC				CAV			Grand Total
Community	FEMA	OTHER	STATE	CAC Total	FEMA	STATE	CAV Total	
WEST PITTSTON, BOROUGH OF	1			1	1		1	2
WHITEMARSH, TOWNSHIP OF						1	1	1
WILKES-BARRE, CITY OF	1			1				1
WOLF, TOWNSHIP OF	2			2				2
WYALUSING, TOWNSHIP OF	1			1				1
WYSOX, TOWNSHIP OF	1			1				1
YARDLEY, BOROUGH OF	1			1	1		1	2
Grand Total	**104**	**6**	**28**	**138**	**70**	**6**	**76**	**214**

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-percent and reductions for properties located in Special Flood Hazard Areas of up to 45-percent. These discounts can be obtained by undertaking public information, mapping and regulations, flood damage reduction, and flood preparedness activities.

The Commonwealth also has policies to regulate construction standards for new construction and substantially renovated buildings. Building codes regulate construction standards for new construction and substantially renovated buildings. Standards can be adopted that require resistant or resilient building design practices to address hazard impacts common to a given community.

In 2004, the Commonwealth of Pennsylvania implemented Act 45 of 1999, the Uniform Construction Code (UCC), a comprehensive building code that establishes minimum regulations for most new construction, including additions and renovations to existing structures. Municipalities are required to adhere to the UCC and enforce building code regulations for all building permits. According to Pennsylvania L&I, more than 90% of Pennsylvania municipalities administer and enforce the UCC at a local level. L&I has no code enforcement authority in these jurisdictions. However, L&I is responsible for commercial code enforcement in any municipality that has elected to not administer the UCC locally. For residential code enforcement in jurisdictions that do not locally administer the UCC, a certified third party agency must be hired by the property owner or the contractor to do so (L&I 2013).

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 using a Standard Operating Guide provided by PEMA. These plans are developed in conjunction with their municipalities, and coordinated with other major stakeholders within the county, such as employers, educational and health institutions, adjacent Counties, and State and Federal agencies. 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. Shortages of County planning personnel and the extensive coordination requirements lead to some plans expiring before the update process is

complete. At any one time there are 5 -8 county plans which have expired. PEMA closely tracks the expired plans because municipalities without a current plan are ineligible for HMGP and some other forms of disaster assistance. Townships and boroughs are required to participate in the county planning process and adopt the approved county plan in order to be eligible for HMGP and other aid.

Figure 5.4.1-1 shows the expiration dates and status of each county's HMP according to PEMA records from May 15, 2013. Note that this information summarizes the FEMA Region III 322 plan status table combined with contracting and Adoption Pending Approval data tracked by PEMA. This data is constantly changing as communities adopt and plans gain approval but is generally representative of the state of county-level hazard mitigation planning. Figure 5.4.1-2 also shows the approval status of county hazard mitigation plans in Pennsylvania.

Figure 5.4.1-1 Pennsylvania county HMP expiration dates (PEMA, 2013).

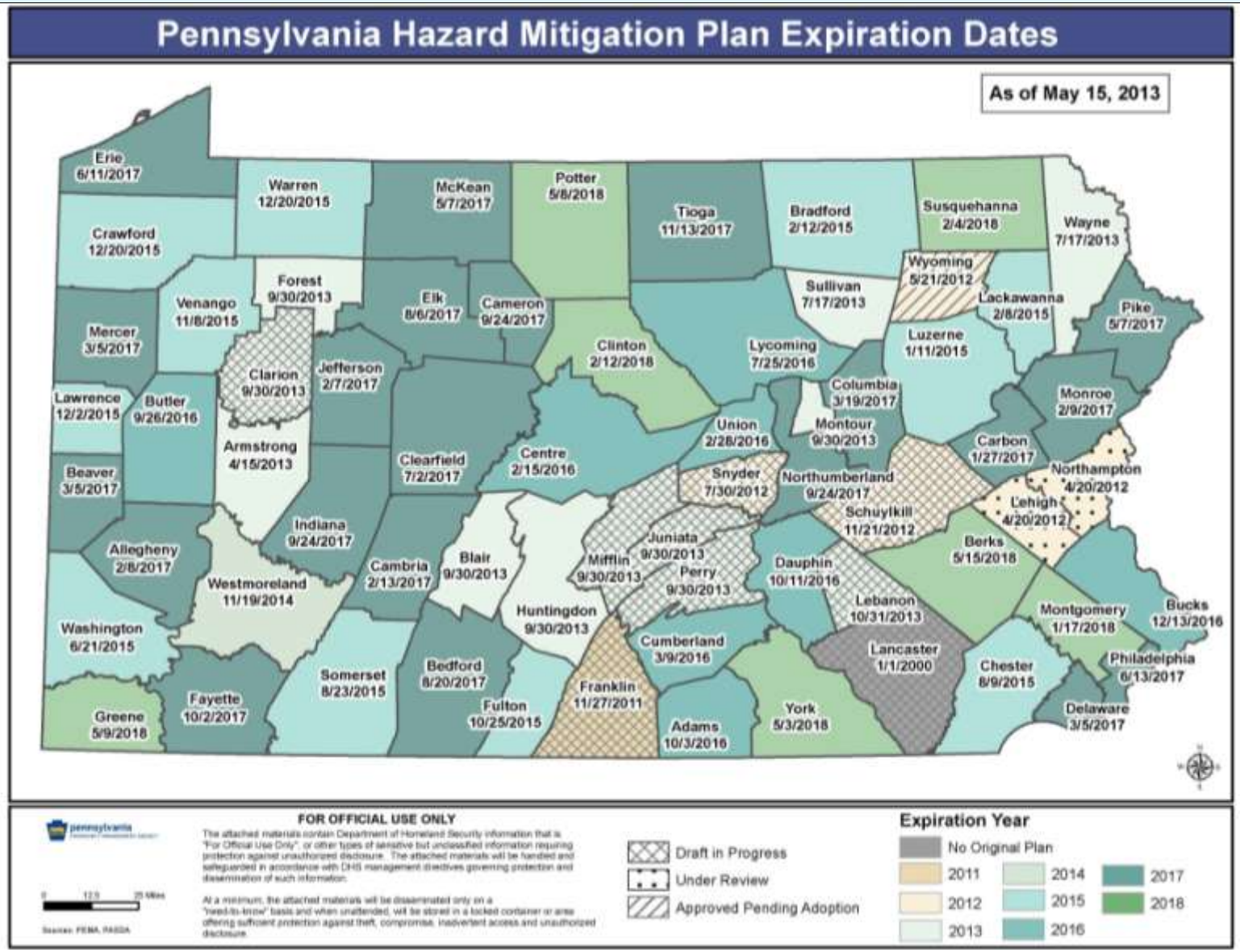
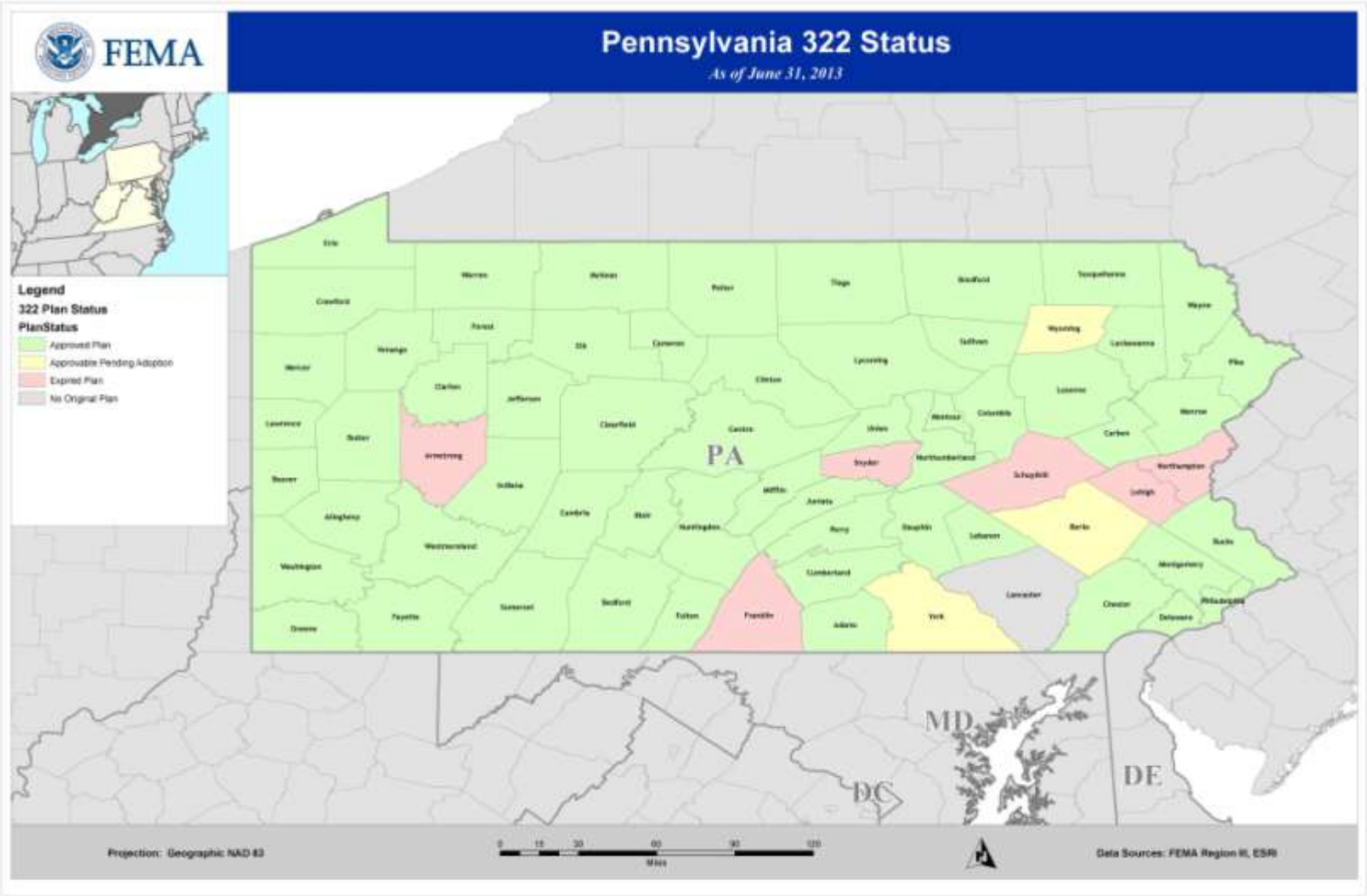


Figure 5.4.1-2 Status of county hazard mitigation plans in Pennsylvania (FEMA, 2013).



In addition to local HMPs, there are a number of university hazard mitigation plans in Pennsylvania (Table 5.4.1-1). These plans were done for the member institutions of the Pennsylvania State System of Higher Education (PASSHE) through one contract funded with FEMA Pre-disaster Mitigation grant funds. PASSHE is working to update these plans in 2013-2014. Alan Margraf is the PASSHE point of contact for PEMA for hazard mitigation planning.

Those colleges and universities that have not chosen to develop their own HMP are encouraged to participate in the HM planning of their respective counties. Both public and private universities have been participating in local county HMPs. For example, Bloomsburg University participated in and has mitigation actions in the 2011 Columbia County HMP; Lehigh University, Lafayette College, DeSales University, and Northampton County Community College participated in the joint Lehigh-Northampton HMP; and Holy Family University and Philadelphia Biblical University participated in the Bucks County HMP. Additionally, staff from Millersville University participated in the 2013 SSAHMP. 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.

Table 5.4.1-1 University Hazard Mitigation Plan Status

UNIVERSITY	APPROVAL DATE
Bloomsburg	July 2010
California	July 2010
Cheyney	July 2010
Clarion	October 2009
East Stroudsburg	December 2009
Edinboro	July 2010
Indiana	July 2010
Kutztown	June 2007
Lock Haven	February 2006
Mansfield	July 2010
Millersville	July 2010
Shippensburg	July 2010
Slippery Rock	December 2009
West Chester	August 2010
Dixon University Center	August 2010

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 through 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 HM Toolkit. The HM Toolkit, 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 entered into an online database via the PA Tool and can then be easily extracted, evaluated and combined for the purposes of the SSAHMP. The HM Toolkit 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.

The Project Catalog, a feature of the PA Tool, makes it possible for local entities to track and maintain information on projects and associated properties by inputting it into the online database. Maintaining project information in this manner will continue to increase county and municipal mitigation project implementation capability but also provide Pennsylvania with a better method for assessing local mitigation capabilities.

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 hazards in Pennsylvania. PEMA is very active in

mitigation efforts especially those concerning flooding. Since 1996, some 1,400 homes and an estimated 3,500 people have been removed from dangerous flood areas through mitigation projects (PEMA, 2013). 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. For example in Montgomery County, Abington Township, Hatboro Borough, Lower Moreland Township, Springfield Township, Upper Moreland Township, and Whitemarsh Township have conducted buyouts and Upper Providence and West Norriton Townships completed elevation projects. The installation of road closure gates as a safety measure during floods has also occurred Springfield and Whitemarsh Townships.

Currently, local capability information that is tracked on a federal or state level can be evaluated and reported most effectively. As stated in Section 4.1, flooding poses the highest risk to Pennsylvania communities and therefore flood related capabilities are of the utmost importance. Participation in the NFIP provides one mechanism for assessing flood hazard mitigation capabilities.

All 67 Pennsylvania counties have the majority of their municipalities participating in the NFIP. Table 5.4.2-1 below provides a list of counties with corresponding number of jurisdictions and the percentage participating in the NFIP. Of Pennsylvania's 67 counties, 28 have 100 percent jurisdictional participation in the NFIP (see highlighted counties) while 35 counties have at least 90 percent participation. Only three counties have less than 90 percent participation in the NFIP and those are Adams, Clarion and Sullivan Counties with 82, 86 and 85 percent participation, respectively. It is important to note that many communities in Pennsylvania do not participate in the NFIP program because they have no designated 100 or 500-year floodplain mapped areas 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, 2013).

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	28	82	6	0
Allegheny	130	128	98	0	0
Armstrong	45	41	91	4	0
Beaver	54	52	96	2	0
Bedford	38	38	100	0	0
Berks	73	73	100	0	0
Blair	25	24	96	1	0
Bradford	51	50	98	1	0

Table 5.4.2-1 Community Participation in the NFIP (FEMA, 2013).

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
Bucks	54	50	93	4	0
Butler	57	52	91	5	0
Cambria	63	58	92	5	0
Cameron	7	7	100	0	0
Carbon	23	23	100	0	0
Centre	35	35	100	0	0
Chester	73	72	99	0	1
Clarion	35	30	86	5	0
Clearfield	51	49	96	2	0
Clinton	29	29	100	0	0
Columbia	34	33	97	1	0
Crawford	51	51	100	0	0
Cumberland	33	33	100	0	0
Dauphin	40	39	97	1	0
Delaware	49	49	100	0	0
Elk County	12	12	100	0	0
Erie	39	37	95	2	0
Fayette	43	40	93	3	0
Forest	9	9	100	0	0
Franklin	22	21	95	1	0
Fulton	13	13	100	0	0
Greene	26	25	96	1	0
Huntingdon	48	47	98	1	0
Indiana	38	37	97	1	0
Jefferson	34	33	97	1	0
Juniata	17	17	100	0	0
Lackawanna	40	40	100	0	0
Lancaster	60	58	97	2	0
Lawrence	27	27	100	0	0
Lebanon	26	25	96	1	0
Lehigh	25	25	100	0	0
Luzerne	76	75	99	1	0
Lycoming	52	52	100	0	0
McKean	22	21	95	1	0
Mercer	48	46	96	2	0

Table 5.4.2-1 Community Participation in the NFIP (FEMA, 2013).

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
Mifflin	16	15	94	1	0
Monroe	20	20	100	0	0
Montgomery	62	61	98	1	0
Montour	11	11	100	0	0
Northampton	38	37	97	1	0
Northumberland	36	34	94	1	1
Perry	30	29	97	1	0
Philadelphia	1	1	100	0	0
Pike	13	13	100	0	0
Potter	30	30	100	0	0
Schuylkill	67	67	100	0	0
Snyder	21	21	100	0	0
Somerset	50	47	94	3	0
Sullivan	13	11	85	2	0
Susquehanna	40	40	100	0	0
Tioga	39	39	100	0	0
Union	14	13	93	1	0
Venango	31	29	93	2	0
Warren	27	25	93	2	0
Washington	67	61	91	4	0
Wayne	28	28	100	0	0
Westmoreland	65	61	93	2	2
Wyoming	23	23	100	0	0
York	72	66	92	6	0

*Note that shaded counties have 100% NFIP compliance.

As of August 1, 2013, DCED has compiled local floodplain management ordinance information for 220 communities in 15 counties within the Commonwealth. This collection effort includes tracking communities that adopt floodplain management ordinances that contain provisions which exceed the minimum requirements. These 18 restrictive provisions are documented in the model floodplain management ordinances that DCED provides to communities and described below. A comprehensive list of all municipalities and corresponding restrictive provisions is available in Appendix K.

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. Figure 5.4.2-2 shows communities for which data has been collected, that included this provision in their floodplain management ordinance.

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). Figure 5.4.2-3 shows communities for which data has been collected, that included this provision in their floodplain management ordinance.

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 fifty (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 fifty (50) feet landward from the top-of-bank of any watercourse. Figure 5.4.2-4 shows communities for which data has been collected, that included this provision in their floodplain management ordinance.

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 fifty (50) percent 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 fifty (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.

Figure 5.4.2-2 Map showing the municipalities, for which data is available, that have included a Conservation District permit review requirement in their floodplain management ordinance.

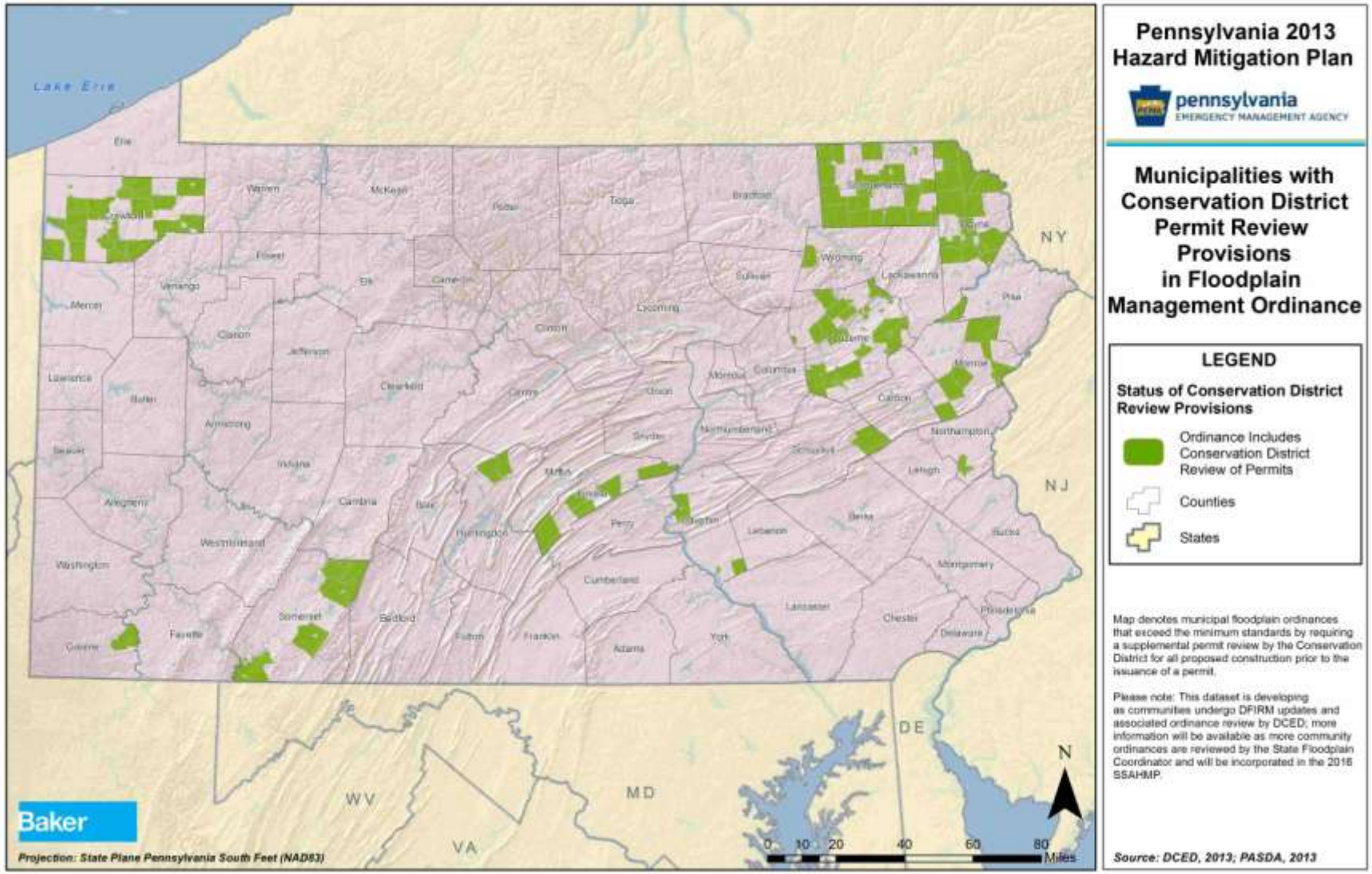


Figure 5.4.2-3 Map showing the municipalities, for which data is available, that have included a freeboard provision in their floodplain management ordinance.

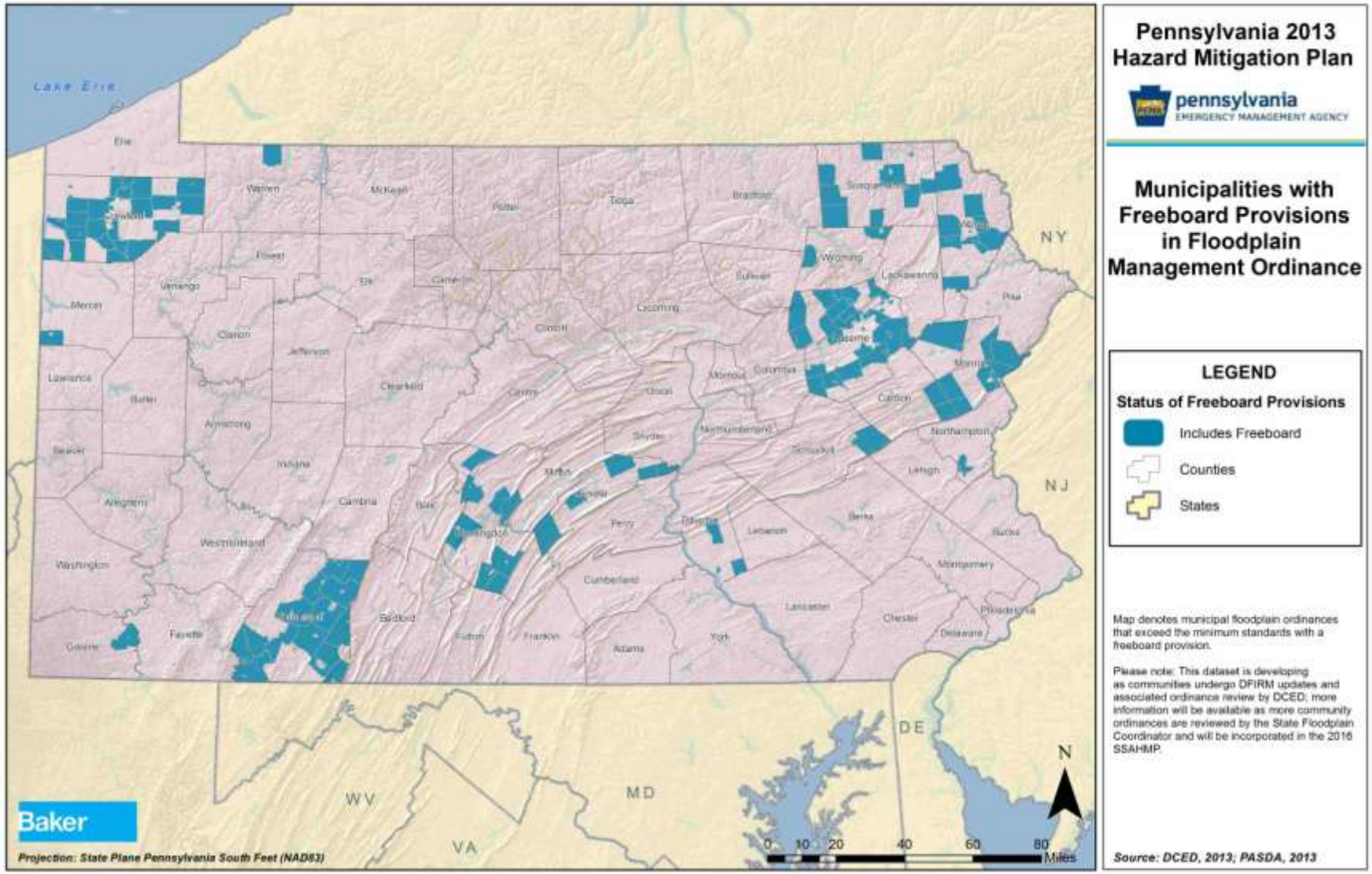


Figure 5.4.2-4 Map showing the municipalities, for which data is available, that have included a provision in their floodplain management ordinance which prohibits new construction or development within the area measured fifty (50) feet landward from the top-of-bank of any watercourse.

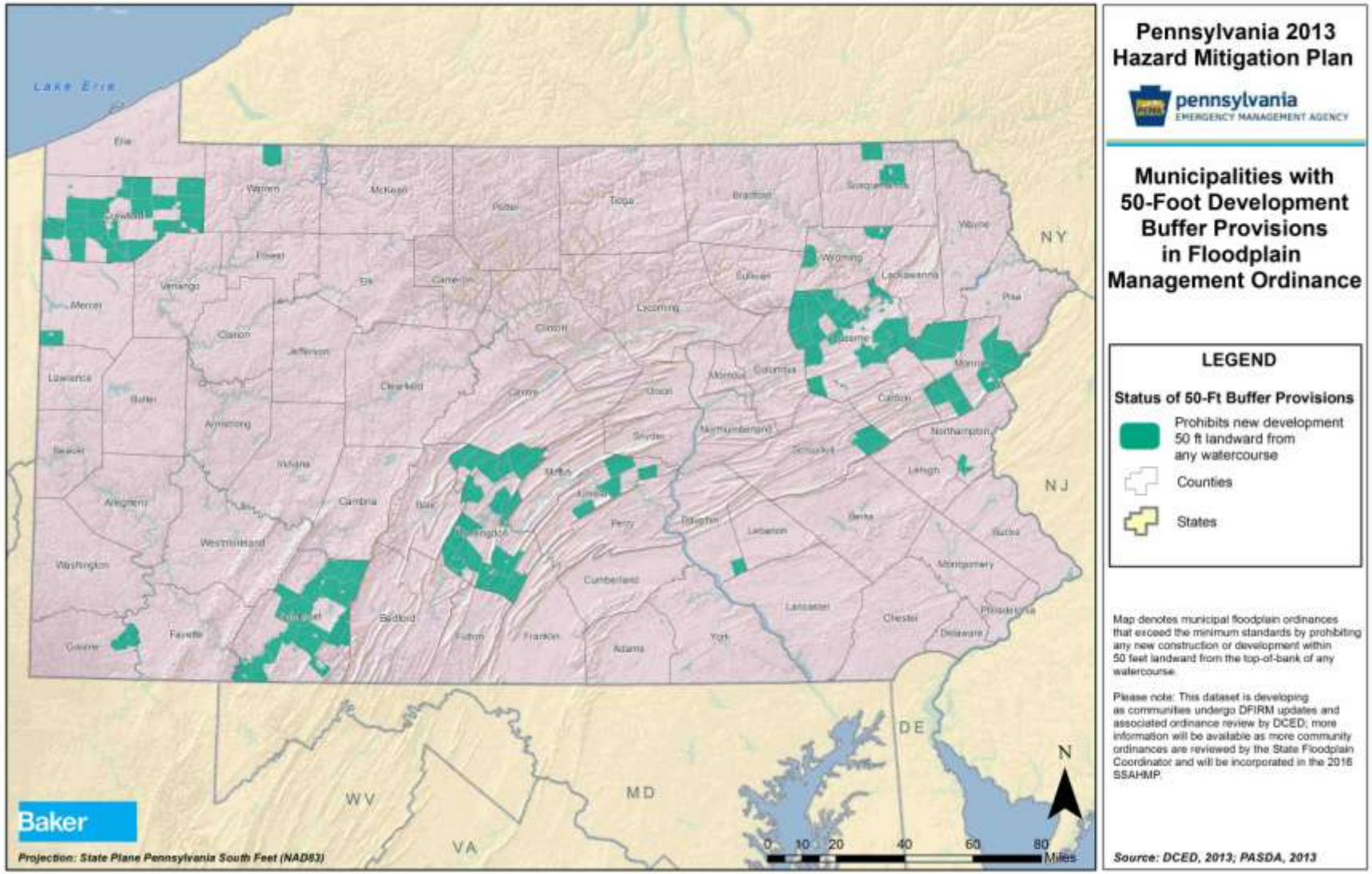


Table 5.4.2-2 summarizes the percentage of municipalities, for which data has been collected, that included the restrictive provisions listed above, in their most recently adopted floodplain management ordinance. The majority of municipalities have incorporated a freeboard requirement and prohibit any new construction or development within the area measured fifty (50) feet landward from the top-of-bank of any watercourse.

Table 5.4.2-2 The percentage of municipalities, of which data has been collected, that adopted extra, more restrictive provisions in their floodplain management ordinance.

PROVISION*	PERCENTAGE OF MUNICIPALITIES ADOPTED**
Community Identified Flood Hazard Areas	39%
Conservation District Review	59%
Fill Prohibited	21%
Freeboard	86%
Manufactured Homes Prohibited in the Floodway	19%
Manufactured Homes Prohibited in any SFHA	24%
Manufactured Homes Prohibited – 50 ft. Buffer	52%
New Construction Prohibited in the Floodway	10%
New Construction – 50 ft. Buffer	83%
No Enclosures	1%
Recreational Vehicles Prohibited in the Floodway	21%
Recreational Vehicles Prohibited in any SFHA	1%
Repetitive Loss Review	63%
Less than 50%	59%
Special Permits Prohibited	41%
Substances Prohibited	40%
Substances Prohibited – 50 ft. Buffer	52%
Smaller Subdivisions	4%

*Provisions are defined above.
**Percentages based on number of municipalities out of a total of 220 reporting.

Currently there are a total of 8 jurisdictions in the Commonwealth which have been suspended from the NFIP. These communities are listed in Table 5.4.2-3. 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. West Pittston Borough is the only Pennsylvania community on probation at this time; the borough was placed on probation in December of 2012.

Table 5.4.2-3 Communities Suspended from the NFIP.

COUNTY	COMMUNITY NAME	SUSPENSION DATE
Allegheny	Borough of Avalon, Borough of North Braddock	10/04/95
Centre	Borough of Snow Shoe	5/07/2009

Table 5.4.2-3 Communities Suspended from the NFIP.

COUNTY	COMMUNITY NAME	SUSPENSION DATE
Chester	Township of Highland	11/20/1996
Delaware	Borough of Rutledge	11/25/2009
Northumberland	Township of Jackson	4/03/2013
Northumberland	Township of West Cameron	7/17/2008
Susquehanna	Borough of Uniondale	7/05/1993
Westmoreland	Borough of Youngstown	08/05/1997

Community participation in the NFIP allows for 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. Table 5.4.2-4 provides a list of counties with the number of flood insurance policies that exist in that county.

Table 5.4.2-4 NFIP policies and total dollar amount of coverage per county (FEMA, August 2013).

COUNTY	NUMBER OF NFIP POLICIES	TOTAL COVERAGE ($)
Adams	600	$ 113,739,000
Allegheny	4,043	$ 865,169,800
Armstrong	556	$ 74,466,700
Beaver	513	$ 85,149,500
Bedford	672	$ 70,932,900
Berks	1,306	$ 277,380,600
Blair	1,280	$ 180,871,700
Bradford	848	$ 142,048,700
Bucks	4,873	$ 1,174,339,200
Butler	669	$ 113,923,500
Cambria	1,172	$ 168,695,900
Cameron	189	$ 15,605,800
Carbon	342	$ 57,368,000
Centre	509	$ 74,986,300
Chester	1,891	$ 440,751,300
Clarion	126	$ 19,667,700
Clearfield	485	$ 62,672,800
Clinton	927	$ 97,702,000
Columbia	1,316	$ 156,543,100
Crawford	697	$ 102,144,600
Cumberland	1,404	$ 242,879,500
Dauphin	3,502	$ 612,793,900
Delaware	2,431	$ 524,250,000
Elk	222	$ 24,830,600
Erie	524	$ 107,936,500

Table 5.4.2-4 NFIP policies and total dollar amount of coverage per county (FEMA, August 2013).

COUNTY	NUMBER OF NFIP POLICIES	TOTAL COVERAGE ($)
Fayette	487	$ 64,582,400
Forest	44	$ 5,049,300
Franklin	418	$ 86,638,600
Fulton	40	$ 6,344,500
Greene	156	$ 21,576,000
Huntingdon	590	$ 67,915,800
Indiana	429	$ 54,540,000
Jefferson	330	$ 48,046,700
Juniata	271	$ 25,477,900
Lackawanna	1,296	$ 201,941,100
Lancaster	1,431	$ 266,492,500
Lawrence	293	$ 44,573,500
Lebanon	605	$ 107,243,700
Lehigh	878	$ 187,035,800
Luzerne	8,839	$ 1,987,625,700
Lycoming	2,626	$ 313,658,500
McKean	341	$ 38,277,000
Mercer	147	$ 29,787,000
Mifflin	761	$ 72,952,500
Monroe	621	$ 153,387,000
Montgomery	4,894	$ 1,073,695,200
Montour	230	$ 37,365,800
Northampton	1,131	$ 230,117,700
Northumberland	1,481	$ 197,706,000
Perry	491	$ 59,664,100
Philadelphia	4,342	$ 935,162,000
Pike	390	$ 98,019,200
Potter	343	$ 30,140,600
Schuylkill	1,336	$ 148,652,800
Snyder	531	$ 65,380,700
Somerset	686	$ 84,924,000
Sullivan	121	$ 13,637,900
Susquehanna	473	$ 67,295,400
Tioga	362	$ 47,038,000
Union	866	$ 107,883,000
Venango	244	$ 40,570,400
Warren	309	$ 40,082,400
Washington	1,010	$ 160,273,900
Wayne	338	$ 71,095,900
Westmoreland	1,430	$ 238,676,300
Wyoming	483	$ 76,224,600
York	1,474	$ 262,465,100

Appendix K includes policies and coverage by municipality. There are 13 municipalities in Pennsylvania that have over 100 million dollars in coverage shown in the table below. These municipalities represent 25% of the NFIP coverage in the Commonwealth.

Table 5.4.2-5 NFIP policies and total dollar amount of coverage for municipalities with greater than $100 million in coverage (FEMA, August 2013).

COUNTY	MUNICIPALITY	NUMBER OF NFIP POLICIES	TOTAL COVERAGE ($)
Allegheny	PITTSBURGH, CITY OF	478	$157,207,500
Bucks	BRISTOL, TOWNSHIP OF	728	$145,920,800
Bucks	LOWER MAKEFIELD, TOWNSHIP OF	396	$109,675,100
Cambria	JOHNSTOWN, CITY OF	669	$111,386,100
Dauphin	HARRISBURG,CITY OF	1,216	$261,578,900
Luzerne	FORTY FORT, BOROUGH OF	839	$208,785,900
Luzerne	HANOVER, TOWNSHIP OF	540	$114,297,000
Luzerne	KINGSTON, BOROUGH OF	2,566	$643,540,200
Luzerne	SWOYERSVILLE, BOROUGH OF	622	$133,124,300
Luzerne	WILKES-BARRE, CITY OF	1,861	$413,372,200
Montgomery	ABINGTON, TOWNSHIP OF	451	$106,115,800
Montgomery	LOWER MERION, TOWNSHIP OF	1,085	$143,739,700
Philadelphia	PHILADELPHIA, CITY OF	4,342	$935,162,000
		15,793	**$3,483,905,500**

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 5.4.2-6 summarizes the number of credit points associated with each corresponding CRS class.

Table 5.4.2-6 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, 27 of Pennsylvania's 2,576 municipalities are participating in CRS. Upper Allen Township, Loyalsock Township, Limestone Township, Kingston Township, Point Township, and Union Township recently shifted to rescinded status. 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 1,181 communities participating in CRS with an average of 24 communities per state or commonwealth. Within FEMA Region III, there are a total of 67 communities participating in CRS, or an average of 13 communities per state or commonwealth. Figure 5.4.2-5 and Table 5.4.2-7 below provide additional details about the CRS program.

Figure 5.4.2-5 NFIP Community Rating System Participation (FEMA, 2012).

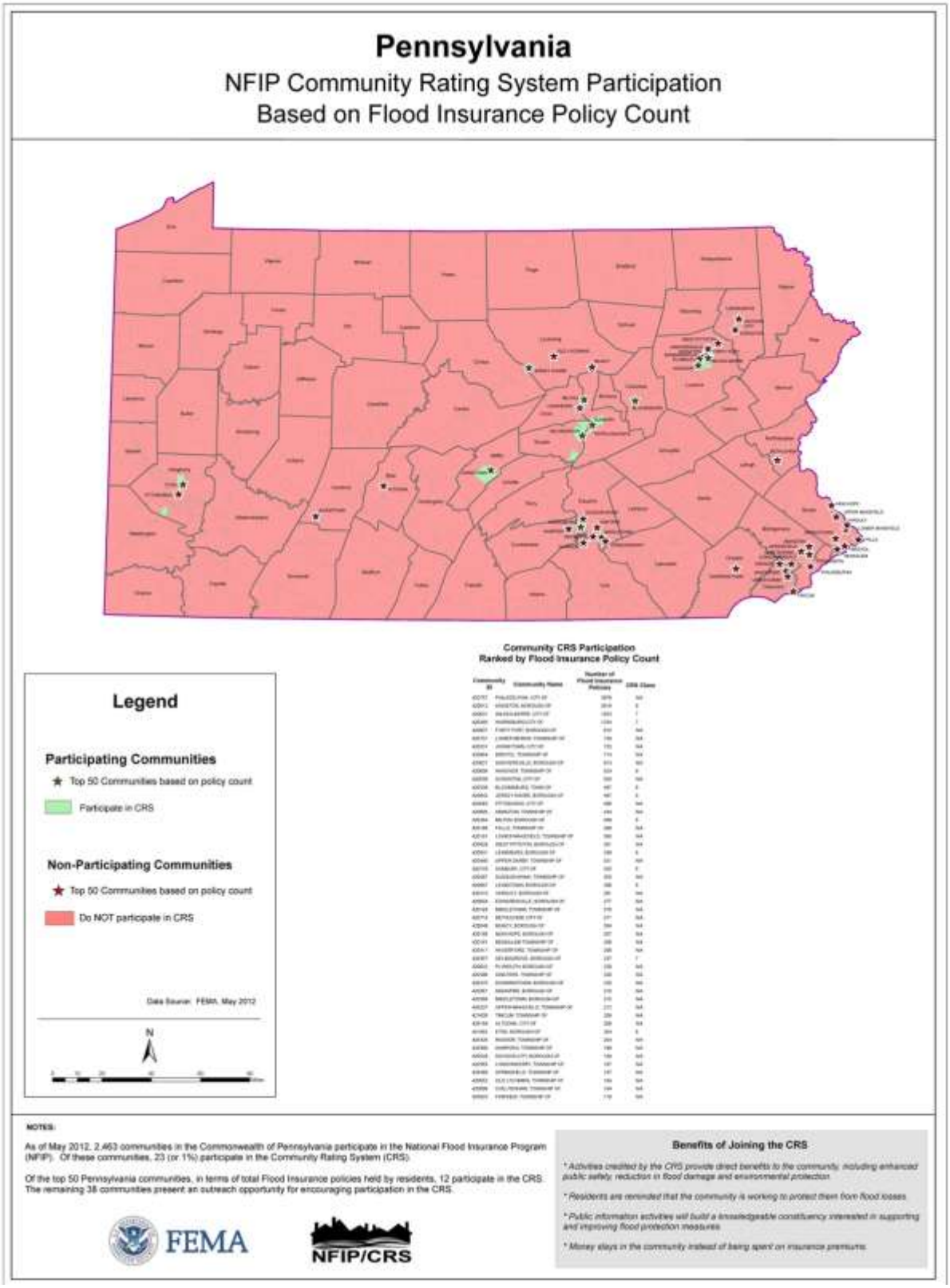


Table 5.4.2-7 Jurisdictional participation in FEMA's CRS program (FEMA, 2013).

JURISDICTION	COUNTY	*CRS CLASS	ORIGINAL ENTRY DATE
Etna Borough	Allegheny	8	10/01/1996
Shaler Township	Allegheny	8	10/01/1994
Upper St. Clair Township	Allegheny	8	10/01/1998
City of Altoona	Blair	8	10/1/2012
Chapman Township	Clinton	9	10/01/2007
Town of Bloomsburg	Columbia	8	10/01/1993
Hanover Township	Dauphin	9	10/01/2010
City of Harrisburg	Dauphin	6	10/01/1991
Kingston Borough	Luzerne	9	10/01/1992
City of Wilkes-Barre	Luzerne	7	10/01/1992
Jersey Shore Borough	Lycoming	9	10/01/1993
Loyalsock Township	Lycoming	10	10/01/1994
Granville Township	Mifflin	9	10/01/1993
Lewistown Borough	Mifflin	9	10/01/1993
Danville Borough	Montour	8	10/01/2006
Herndon Borough	Northumberland	8	10/01/2007
Milton Borough	Northumberland	8	10/01/1992
Northumberland Borough	Northumberland	8	10/01/2007
Point Township	Northumberland	8	10/01/2007
City of Sunbury	Northumberland	8	10/01/2007
Upper Augusta Township	Northumberland	8	10/01/2007
Newport Borough	Perry	9	10/01/1994
Monroe Township	Snyder	9	10/01/2007
Penn Township	Snyder	8	10/01/2007
Selinsgrove Borough	Snyder	7	10/01/2007
Lewisburg Borough	Union	8	10/01/1993

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 stormwater flow during excessive rainfall events, Act 167 Stormwater Management Plans can be an effective tool in evaluating and mitigating stormwater-related flooding. Act 167 requires counties to develop stormwater management plans for its watersheds and requires municipalities to adopt the plans and adopt or amend stormwater 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. Stormwater management plans greatly enhance mitigation capabilities needed to address flood and transportation hazards.

A number of Pennsylvania communities have taken steps to reduce their wildfire vulnerability 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 36 Firewise communities, many of which are located in the Pocono Mountains.

Table 5.4.2-8 Pennsylvania Firewise Communities.

FIREWISE COMMUNITY	CITY
Bear Creek Lakes Civic Association	Jim Thorpe
Bear Run Property Association	Lancaster
Big Bass Lake	Gouldsboro
Black Forest Acres	Lock Haven
Cornelius Development	Fort Loudon
Deer Lake	Chalk Hill
Emerald Lakes Community Association	Long Pond
Fieldstone Ridge Development	Pike County
Forkston Mountain Property Association	Tunkhannock
Green Forest Association	Huntington
Hemlock Farms Community Association	Lords Valley
Hemlock Springs POA	Shickshinny
Hickory Run Land and Homeowners Association	Jim Thorpe
Indian Mountain Lake Civic Association	Albrightsville
Julian Woods	Julian
Juniata Forest Community	McAlisterville
Lake Aleeda	Bear Creek Twp.
Lake Harmony Home Owners Association	Lake Harmony
Laurel Brook Estates	Bear Creek Twp.
Meadow Run and Mountain Lake Park Association	Bear Creek
Mt. Pocahontas Property Owners Association	Albrightsville
Office of Govermental Affairs	University Park
Penn Forest Estates Neighborhood Group	Jim Thorpe
Penn Forest Streams Property Owners Association	Jim Thorpe
Perry Heritage Association	Ickesburg
Pine Township	Templeton
Pleasant Valley West Club	Jim Thorpe
Roamingwood Sewer and Water	Lake Ariel
Roaring Creek Property Owners Association	Catawissa
Sierra View association	Blakeslee
Thornhurst Country Club Estates	Thornhurst
Towamensing Trails Property Owners Association	Albrightsville
Valley View Estates POA	Albrightsville
White Rock Acres Civic Association	Mill Hall
White Rock Property Owner's Association	Mill Hall
Windsor Hill Landview Property	Dallas

There are 78 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.

Table 5.4.2-9 Pennsylvania StormReady Communities.

GOLD SHADING: STORMREADY COUNTY		
• Allegheny • Beaver • Bedford • Blair • Bradford • Cambria • Cameron • Centre • Chester • Clearfield • Columbia • Crawford • Cumberland • Dauphin • Elk • Fayette • Franklin	• Fulton • Greene • Huntingdon • Indiana • Jefferson • Juniata • Lancaster • Lebanon • Lehigh • Luzerne • Lycoming • McKean • Mercer • Mifflin • Monroe • Montgomery • Northumberland	• Perry • Potter • Schuylkill • Snyder • Somerset • Sullivan • Susquehanna • Tioga • Union • Venango • Warren • Washington • Wayne • Westmoreland • Wyoming • York
Blue Dot: StormReady Community	**Purple Dot: StormReady University**	**Brown Dot: StormReady Military Site**
• Cogan House • Fawn Grove • Fawn Township • Hamilton • Heidelberg • Monaca • Paradise • Pine • Pittsburgh • Tunkhannock • West Lebanon • Whitehall Township • Williamsport • York	• California University of Pennsylvania • Carnegie Mellon University • Penn State University	• Carlisle Barracks
	Red Dot: StormReady Commercial Community	
	• Dorney Park/ Wildwater Kingdom • Excela Health Latrobe Hospital • Frick Hospital • Hershey Entertainment Complex	• RAND Corp. • The Boeing Company • Westmoreland and Jeannette Hospital • Westmoreland Hospital • York Hospital
	Supporter	
	• Longwood Gardens • Mountain Productions Inc.	

Act 167 was enacted in 1978 in order to address stormwater runoff resulting from land development which results in water pollution, soil erosion and an increase in flooding frequency. Act 167 requires counties to prepare and adopt stormwater management plans and municipalities to adopt and implement ordinances to regulate development in conjunction with these plans.

Act 167 and supporting regulations require the development of stormwater management plans in an effort to promote health, safety, and welfare within the municipality and its watershed by minimizing the harms and maximizing the benefits of an effective stormwater management plan. Figure 5.4.2-6 illustrates the state watersheds with approved Act 167 stormwater management plans. Table 5.4.2-10 illustrates high priority counties throughout Pennsylvania. High priority counties are those counties with large number of municipalities that have not enacted ordinances for stormwater management plans. While this data is from 2011, DEP has confirmed that it is the most recent information about Act 167 plans statewide.

Figure 5.4.2-6 Act 167 Watersheds (PADEP, 2011).

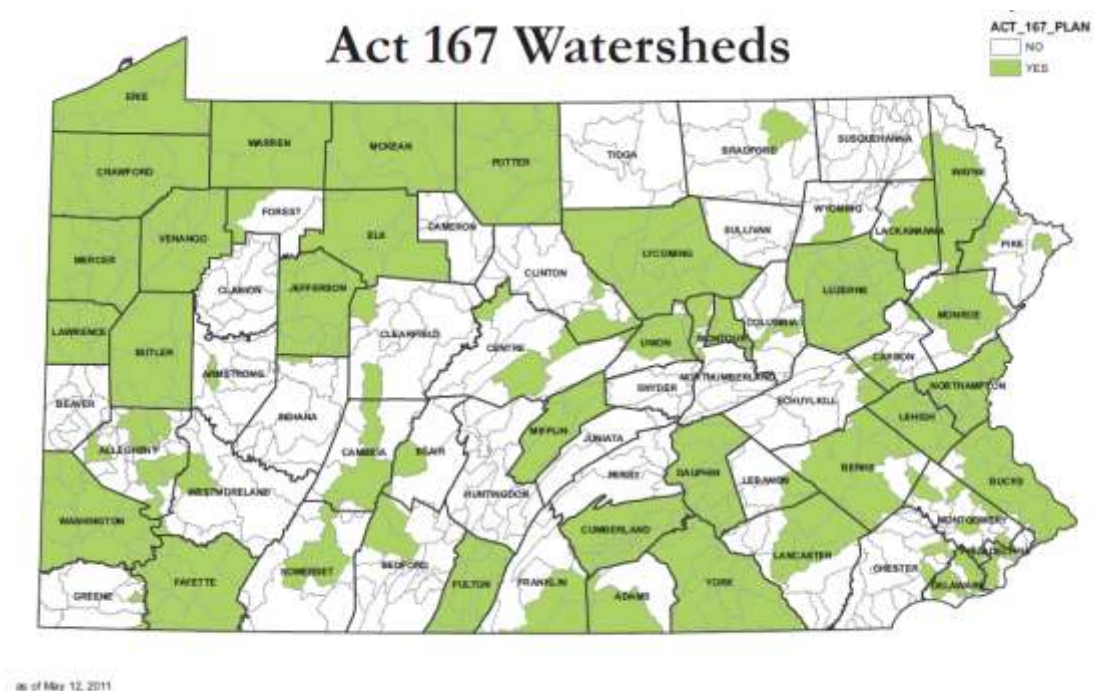


Table 5.4.2-10 Act 167 Plan Status in Pennsylvania (PADEP, 2011).

COUNTY	NUMBER OF MUNICIPALITIES	MUNICIPALITIES WITH ACT 167 PLANS	ENACTED	PAST DUE
Adams	34	17	17	0
Allegheny	128	72	58	21
Armstrong	45	6	4	2
Beaver	53	0	0	0

Table 5.4.2-10 Act 167 Plan Status in Pennsylvania (PADEP, 2011).

COUNTY	NUMBER OF MUNICIPALITIES	MUNICIPALITIES WITH ACT 167 PLANS	ENACTED	PAST DUE
Bedford	38	11	1	10
Berks	73	43	39	5
Blair	24	10	10	1
Bradford	51	10	9	1
Bucks	54	53	50	7
Butler	57	57	21	36
Cambria	63	46	32	34
Cameron	7	0	0	0
Carbon	23	9	4	5
Centre	35	18	12	7
Chester	73	17	9	3
Clarion	34	0	0	0
Clearfield	50	17	8	11
Clinton	29	13	13	4
Columbia	33	15	3	13
Crawford	51	51	6	45
Cumberland	33	33	13	20
Dauphin	40	40	31	9
Delaware	49	44	43	1
Elk	12	12	6	6
Erie	38	38	0	0
Fayette	42	42	1	41
Forest	9	0	0	0
Franklin	22	15	12	6
Fulton	13	13	9	4
Greene	26	0	0	0
Huntingdon	48	2	2	0
Indiana	38	4	0	4
Jefferson	34	34	26	8
Juniata	17	0	0	0
Lackawanna	40	32	31	3
Lancaster	60	34	30	17
Lawrence	27	27	18	9
Lebanon	26	8	5	3
Lehigh	25	25	25	23
Luzerne	76	76	43	40
Lycoming	52	52	9	43

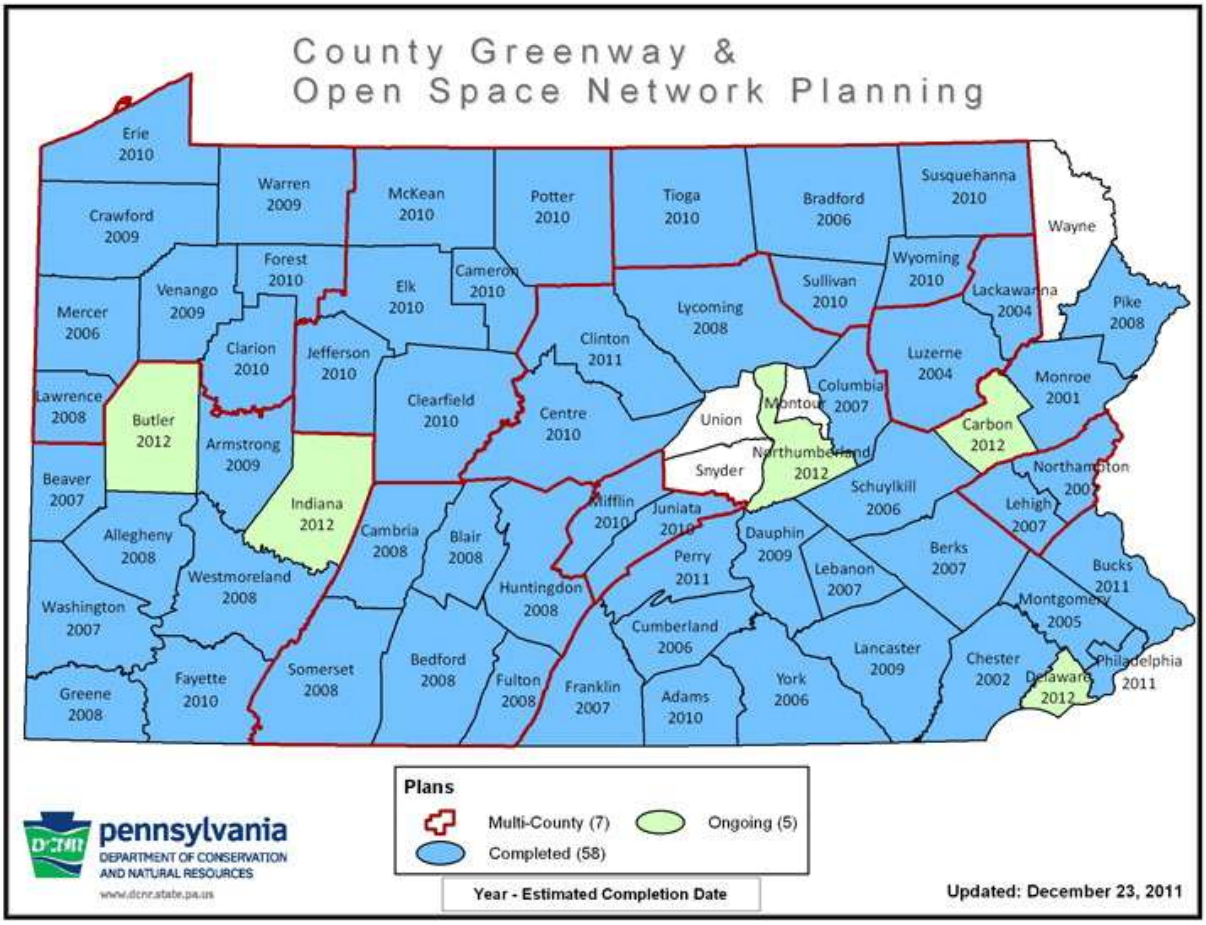
Table 5.4.2-10 Act 167 Plan Status in Pennsylvania (PADEP, 2011).

COUNTY	NUMBER OF MUNICIPALITIES	MUNICIPALITIES WITH ACT 167 PLANS	ENACTED	PAST DUE
McKean	22	22	0	22
Mercer	48	48	20	0
Mifflin	16	16	2	14
Monroe	20	17	17	2
Montgomery	62	38	23	15
Montour	11	11	4	7
Northampton	38	38	38	15
Northumberland	36	0	0	0
Perry	30	0	0	0
Philadelphia	1	1	1	1
Pike	13	8	7	1
Potter	30	30	7	23
Schuylkill	67	3	2	2
Snyder	21	0	0	0
Somerset	50	25	9	18
Sullivan	13	0	0	0
Susquehanna	40	5	2	3
Tioga	39	0	0	0
Union	14	12	12	0
Venango	31	31	23	8
Warren	27	27	22	5
Washington	66	66	24	42
Wayne	28	24	22	7
Westmoreland	65	13	10	3
Wyoming	23	0	0	0
York	72	72	0	0

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, open space and

greenway planning can work hand-in-hand with mitigation projects. Figure 5.4.2-7 shows the status of greenway and open space planning in counties across Pennsylvania.

Figure 5.4.2-7 County Greenway and Open Space Planning Efforts (DCNR, 2011).



From a state perspective, PEMA has seen the following general improvements in local capability since the last SSAHMP update:

- 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 web page.
- 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 percent 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 in order 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 5.3.4). According to FEMA's *Integrating Hazard Mitigation into Local Planning,* local integration is specific to each community. Since, in Pennsylvania, much 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.

A discussion of how each county integrates other planning mechanisms into its hazard mitigation plan and how the hazard mitigation plan will strengthen and support other planning mechanisms is built into the Pennsylvania Standard Operating Guide. Additionally, the Pennsylvania Model Plan Outline establishes integration between local planning mechanisms as a key part of local hazard mitigation plans. The following excerpt from Section 7.3 of the *Pike County 2012 Hazard Mitigation Plan Update* provides an example of hazard mitigation plan integration from a recently completed county hazard mitigation plan:

> *Since 2006, the County HMP was incorporated into several municipal comprehensive plans. Blooming Grove Township, Lackawaxen Township, Palmyra Township, Porter Township, and Shohola Township all reference the 2006 HMP in their comprehensive plans. Moving forward, the HMSC understands that the 2012 HMP update will be highly useful when updating and developing other planning mechanisms in the County. Specific documents that the HMSC will actively incorporate information from the 2012 HMP update into include:*
>
> - *<u>Pike County Comprehensive Plan</u>: Section 4.4.4, Future Development and Vulnerability, will provide information for the development of the next County Comprehensive Plan in 2016 by making available specific risk and vulnerability information for the entire county but more specifically the potential areas of growth.*

- *Pike County Emergency Operations Plan: The 2012 HMP update will provide information on risk and vulnerability that will be extremely important to consider and incorporate into the next County EOP. Probability and vulnerability can direct emergency management efforts and response.*
- *Pike County Hazard Vulnerability Analysis: Pike County Emergency Management Coordinator will consider the County's Hazard Mitigation Plan during its biennial review of the County Hazard Vulnerability Analysis. The County EMA's HVA and the County HMP update are mutually beneficial plans that are used together to better understand risk and vulnerability. Just as the existing County HVA was used to supplement the development of this plan, the 2012 HMP update will be used to aid in goal and objective development, hazard identification, and risk assessment in the next County HVA.*
- *Municipal Local Land Use Regulations: The Hazard Mitigation Plan provides an opportunity to contribute to local land use regulations to steer development away from hazard-prone areas.*
- *Act 167 Stormwater Management Plan: This plan is currently under development. The results of the 2012 HMP update vulnerability analysis, particularly for flooding, will be taken into consideration when finalizing this stormwater management plan.*

Other countywide integration efforts include:

- Lancaster County HMP (under development) discusses County Comprehensive plan, its goals and objectives in planning process for HM plan. Special discussion of county growth management policies discussed vis-à-vis their role in preventing development in hazard-prone areas.
- Lehigh-Northampton Joint Plan includes detailed list of specific agencies at Federal, State, municipal level that will be partners in integrating hazard mitigation with other kinds of planning. Plan also includes neighboring counties and discusses the role of regional thinking in plan integration and in building more resilient communities.
- Wyoming County Plan not only mentions the other plans used to develop the hazard mitigation, but cited specific information from those plans and each of their impacts on the mitigation plan.
- Bucks County is participating in a Plan Integration pilot project that held a kick-off meeting in August 2013. This project provides the opportunity for hazard mitigation to be integrated into other planning mechanisms at the county and local level and ultimately be a best practice for the Nation.

5.5. State-Level Program and Plan Integration

While most planning and development in Pennsylvania occurs at the most local level, the ideas of plan integration are also important at the state level. 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 and can improve the overall resilience of the Commonwealth.

Plan integration at the state level includes two key components: the contributions of federal, regional, and state planning mechanisms and programs to the hazard mitigation plan, and the connections between the hazard mitigation plan and other key state-level planning processes.

5.5.1. Integration with Existing Mechanisms

At the state level, there are connections between Pennsylvania's efforts in hazard mitigation, sustainability, flood protection, and emergency management via numerous federal, state and local planning mechanisms. These mechanisms are consistent with and support the achievement of Pennsylvania hazard mitigation goals. A summary of these various mechanisms is provided in Table 5.5-1. This includes a brief assessment of how these tools are integrated into Commonwealth hazard mitigation efforts as well as FEMA mitigation programs.

For purposes of strengthening plan integration since 2010, 22 plans/programs were added and the most salient mitigation techniques in each plan were listed. The next step in plan integration is reviewing requirements across plans, de-conflict techniques, synchronize efforts and finally fully integrate plans. Action 4-3a is focused on improving plan integration moving forward.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Act 537 Sewage Facilities- Planning Authorizations	DEP	24-Jan-66	Statewide	DEP) provides technical assistance, financial assistance, and oversight to support municipalities in implementing the Act 537 Program to improve sewage disposal problems and prevent future problems. The leading mitigation activity associated with Act 537 is that it prevents the siting of sewage treatment facilities in sensitive areas like the floodplain, areas susceptible to landslides, and on certain kinds of soils. These planning restrictions help overall reduce risk from a sewage break and require sewage systems to be planned, approved and properly constructed.
CDBG Disaster Recovery Assistance	DCED	Continuous	Statewide	This program makes funding available to prevent further damage to an affected area after a disaster. The focus is on assisting communities in low-income areas. The goals of the program align with those in the SSAHMP, especially in regard to Pennsylvanians most at risk. Although this program is focused on the recovery process, the leading mitigation technique for this funding program is Plans and Regulations through code enforcement and slum/blight prevention after a disaster occurs.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Commonwealth Critical Infrastructure Protection Program	Governor's Office of Homeland Security	2009	Statewide	The Critical Infrastructure Protection Program focuses on 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/key resources by helping set security goals, identify assets, assess vulnerabilities, prioritize investments, and implement outreach programs. The information from this program is integrated into the SSAHMP as it is used to complete the vulnerability and loss estimates of state critical facilities. The Critical Infrastructure Program data is spatial mapped and compared to known hazards so that the SSAHMP identifies which Critical Infrastructure is in the floodplain or and risk for other spatially based hazards. This program to identify Critical Infrastructure falls clearly in 2 categories of mitigation techniques; it is a *Plans and Regulations* action to influence how buildings are developed and protected and it is the first step to identifying *Structure and Infrastructure Projects* that may be needed to protect the Commonwealth's Critical Infrastructure.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Comprehensive Land Use Plans	Counties, Municipalities, Regions	Varies	Varies	Governor's Executive Order 1999-1 provides the basis for integrating hazard mitigation into comprehensive and land use planning. Comprehensive Land Use Plans define how and where a community, region, or area should be developed. Land use plans also often include an assessment and associated mapping of the respective area's vulnerability to location-specific hazards. PEMA's participation in this process assists in the integration of mitigation strategies into the goals and objectives of the land use planning process. Comprehensive plans may include many mitigation techniques, including potentially the integration of mitigation actions directly from a local hazard mitigation plan. Other leading mitigation techniques in a comprehensive plan may include steering new development away from hazard-prone areas such as floodplains and steep slopes; identifying hazard areas as opportunities for acquisition or preservation for recreation or open space purposes; and encouraging natural system preservation (such as wetlands) so that a buffer is provided between hazard areas and developed areas to help mitigate the effects of some hazards.
Comprehensive Plan for the Water Resources of the Susquehanna River Basin	Susquehanna River Basin Commission (SRBC)	June 2013	Susquehanna River Basin (Eastern and Central Pennsylvania)	Provides a framework for the Susquehanna River Basin Commission to manage and develop the basin's water resources and serves as a guide for all SRBC programs and activities. This plan is also intended as a resource for the SRBC's member jurisdictions, water resource managers, private sector interests, and others in the basin. Flooding is a key focus of the plan, and flood damage reduction is a key program area of the SRBC. The SRBC is a member of the State Planning Team. The leading mitigation technique in this plan is Plans and Regulations and includes goals pertaining to drought impact mitigation, Flood Forecast and Warning System (SFFWS) implementation, floodplain management promotion, flood preparedness education and outreach, and interagency coordination for flood forecasting and drought emergency.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Delaware River Basin Baseline Monitoring and Characterization	DRBC	May 2010	Delaware River Basin (Eastern PA)	DRBC is collecting pre-gas drilling baseline conditions in the upper section of the Delaware River Basin. They are collecting biological samples, reanalyzing frozen samples, and deploying continuous conductivity meters in order to minimize impacts from future natural gas development and provide baseline data to contrast changing conditions if/when impacts occur. The leading mitigation technique in this plan is Plans and Regulations aimed at establishing existing conditions in order to guide regulation and permitting for natural gas development.
Delaware River Basin Interstate Flood Mitigation Task Force	DRBC	July 2007	Delaware River Basin (Eastern PA)	The Task Force establishes areas of priority funding for acquisition, elevation, flood-proofing; develops interoperable reservoir operating plan; develops and implements comprehensive floodplain regulations across the entire Delaware River Basin; and enables stormwater utilities. DRBC sits on State Planning Team, and DRBC members hosted an outreach presentation for the plan and provided feedback on plan goals, objectives, and actions. The leading mitigation techniques in the Action Plan are Plans and Regulations, and Structure/Infrastructure pertaining to flooding. Specifically the plan focusses on floodplain mapping and regulations, stormwater management, and acquisition/elevation.
Disaster-Resistant Universities	FEMA	August 2003	Statewide higher education entities	The Disaster-Resistant Universities initiative is a joint effort between higher education institutions and FEMA to define and address issues that will improve the ability of campuses to withstand disaster threats. Fifteen state schools in PA have created mitigation plans through this initiative. The State System of Higher Education administers this program. The leading mitigation techniques from Disaster Resistant University plans are often structural mitigation actions to retrofit existing structures to make them less hazard-prone; protecting existing equipment from hazards; engaging in public education and awareness of students, faculty, and staff to the risk of hazards; and the installation of warning systems and backup generators.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Federal Energy Regulatory Commission (FERC) Dam Plans	FERC	Various	Statewide	Each dam regulated by the FERC has its own safety plan; these dam plans cover all types of dams with all levels of dam safety risk. Since dam failure has been identified as a hazard of significant concern, these plans are crucial in mitigating the risk associated with dam failure. The leading mitigation technique in a FERC Dam Safety Plans is the development and implementation of a dam safety monitoring program for the dam to outline procedures for surveillance, monitoring, testing, inspection, warning and safety devices, and reporting.
Firewise	DCNR BOF	Ongoing	Statewide	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 lessen the risk of interface wildfires. The ultimate goal of Firewise is to reduce susceptibility of homes, communities, and structures to wildfire through cooperative education and mitigation techniques. The DCNR BOF contributed to the risk assessment for wildfire hazards in the 2010 SSAHMP update. DCNR BOF established Firewise Medal Communities in order 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 for activities such as approved emergency action plans or seasonal wildland fire safety awareness programs. The leading mitigation techniques for this program are teaching homeowners how to prepare their homes for wildfires and preventative yard and home maintenance for minimizing the risks of wildfire. Other top techniques include holding safety committee meetings along with fire and safety educational training programs to better educate residents and first responders.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Flood Protection Program	DEP	Ongoing	Statewide	This program plans long term structural solutions, including levees, through evaluation, hydrologic and hydraulic analysis, environmental impacts analysis, and cost benefit analysis. Feasible projects move into an implementation phase including design and construction by DEP. The leading mitigation technique for this program is the design and construction of cost-effective flood protection projects like stormwater detention facilities, concrete channels, concrete floodwalls, levees, channel improvements, or other structural flood control solutions. Other leading mitigation techniques include analysis of flooding patterns and outreach to local municipalities to sponsor and maintain properly placed and constructed flood protection projects.
Floodplain Land Use Assistance Program	DCED	Ongoing	Statewide	This program ensures municipal compliance with minimum National Flood Insurance Program (NFIP) and PA Act 166 floodplain development regulations. Staff from DCED which administer the NFIP are also participants in State Planning Team. The leading mitigation technique implemented through this program is Plans and Regulations as it focuses on local floodplain management. Education and Awareness about the NFIP and floodplain management regulation are also a part of this program.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Floodplain Management Services Program, Section 22 Program, Civil Works Program	USACE	Ongoing	Statewide	These programs provide technical services for mitigation projects. Additionally, the Civil Works Program provides the study, design, and construction of the flood mitigation program as well as tackling water resource development, flood risk management, and emergency response. USACE staff sits on the State Planning Team and participate in the prioritization of projects that may be eligible for assistance under these programs. The leading mitigation techniques employed by USACE in this program are responsive development and management of water resources infrastructure and protection, restoration and management of the environment in an environmentally, economical and technically sound manner. Mitigation actions are typically developed through a Planning Process which formulates, evaluates, and compares alternative plans before selecting the most effective plan. As it relates to flood risk management and where applicable to a specific program, both structural and non-structural mitigation techniques will be considered.
Hazard Mitigation Assistance Program	FEMA	Ongoing	Statewide	The 2013 SSAHMP is designed to meet requirements needed for Pennsylvania to be eligible for funding under the various federal mitigation grant programs. Representatives from FEMA Region III sit on the SPT. PEMA uses FEMA repetitive loss and severe repetitive loss data to identify projects for funding under the HMA guidance. PEMA manages these HMA programs, which provide a significant portion of the mitigation funding resources to implement mitigation activities. Funding from the PDM and HMGP programs are used as funds to assist in developing state and local hazard mitigation plans. The HMA program provides for the use of grant funds for pre- and post-disaster mitigation activities to reduce the risk to individuals and property from hazards. PEMA manages the HMA programs, which provide a significant portion of the mitigation funding resources to implement mitigation activities. Funding from the PDM and HMGP programs are used as funds to assist in developing state and local hazard mitigation plans.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Heat Wave Plan	PEMA	2008	Statewide	The Heat Wave Plan is intended to assist municipalities in the prevention of deaths and serious health conditions caused by extreme heat events. It establishes mitigation criteria and networks of support for those most vulnerable to heat events. Information from this plan informed vulnerability information for the Extreme Temperatures hazard profile. The leading mitigation techniques outlined in plan are developing distribution points for fans or air conditioners, by setting up cooling stations, and by developing volunteer programs to check-in with at-risk individuals during extreme heat events.
Keystone Principles and Criteria for Growth, Investment, and Resource Conservation	Interagency Effort	Ongoing	Statewide	While not legally binding, the Principles and Criteria are designed to encourage multifaceted project development that will integrate programs and funding sources across agencies. The leading mitigation technique associated with this statewide guidance is Planning and Regulation as it establishes core criteria that prevent major growth and investment projects in high-hazard areas.
Land Use Planning and Technical Assistance Program	DCED	Ongoing	Statewide	The Land Use Planning and 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 Plans and Regulations as it provides funding to amend or develop comprehensive plan to include an assessment of hazard vulnerability and take appropriate mitigation measures.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Levees and the National Flood Insurance Program: Improving Policies and Practices	National Research Council of the National Academy of Sciences	March 2013	Statewide	This report examines how the NFIP address levees and risk for properties located behind levees. The report finds that the Levee Analysis and Mapping Procedures (LAMP) are, "founded on sound algorithms with sound science and engineering behind them and follows established approaches to hydrology and hydraulics". Recognition that LAMP will provide more accurate risk information is the first of several mitigation techniques recommended by the study. Mapping, communicating, regulating and insuring to the newly defined risk is asset of mitigation strategies that will support mitigation of the impacts of levee failures. The release of the study is complemented by a FEMA lead pilot project to implement the LAMP approach in about 10% of the current on-hold studies.
Local Hazard Mitigation Planning	County Officers	Various	Statewide	Local entities are encouraged to review the Commonwealth SSAHMP; state mitigation planner reviews all local plans for consistency with state plan and federal planning requirements. Local plan data reviewed and integrated into the state plan. Local hazard mitigation plans have many mitigation techniques; however, the top ranked actions in the majority of local plans in Pennsylvania have to do with Education and Awareness Programs and Plans and Regulations. Additionally, most local mitigation actions in Pennsylvania pertain to flooding.
National Flood Insurance Program/Proof of Loss/Claims Filed	FEMA	2012	Statewide	Proof of loss claims must be filed within a specified time of the flood incident; if claims are denied, lawsuits may be filed only if proof of loss was filed. The National Flood Insurance Program/Proof of Loss/Claims Filed process ensures a timely processing of flood insurance claims so that damaged property can be replaced or repaired.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
NFIP and State Floodplain Management Program	DCED	Ongoing	Statewide	Pennsylvania relies on the NFIP as the comprehensive flood protection/mitigation source available to assist with reconstruction, elevation, or buyout of floodprone properties. 2,460 Pennsylvania municipalities participate in the NFIP. NFIP principles are integrated closely with the Commonwealth's mitigation goals, objectives, and actions. The program coordinator from DCED sits on the SPT. The leading mitigation technique associated with the State Floodplain Management Program is Plans and Regulations to reduce vulnerability to flooding through the regulation of new and improved construction.
Nuclear/Radiological Plan	DEP, PEMA	2008	Statewide	The Commonwealth Nuclear/Radiological Plan addresses the many components of mitigation planning for nuclear facilities. The data in this plan was integrated starting with the 2010 SSAHMP update. The leading mitigation technique outlined in the plan is to require strict accounting for all licensed radioactive sources and provide a robust response when necessary.
Pennsylvania Chapter 106 – Floodplain Management	PA DEP & FEMA	September 1996	Statewide	Outlines the permit process and regulations for development within the floodplain, in support of the NFIP, protection of people and property within floodplains, and with the goal for future reduction of losses by restoration of the natural floodplain. The leading mitigation technique outlined in the plan is to analyze impacts of proposed municipal and other public utility floodplain developments to ensure protection of properties and consistency with local flood plain management requirements. It includes the establishment of permitting requirements for floodplain obstructions, design criteria for construction or modification of obstructions, construction requirements, and operations and maintenance criteria.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Pennsylvania Climate Change Action Plan	PA DEP	December 2009	Statewide	The Climate Change Action Plan is an initial step in establishing a basis for moving forward on the implementation of climate change actions in Pennsylvania. Evaluation of key factors such as cost effectiveness, economic impacts, and harmonization with other Pennsylvania programs and policies will be critical to the next stage of climate change policy implementation. The leading mitigation technique discussed in the Climate Change Action Plan is a 20-year reduction of greenhouse gas emissions that will reduce Pennsylvania's contributions to global warming and its effects, including those that exacerbate many natural hazards. Other leading mitigation strategies include requirements for greening state facilities, transportation systems, and residential/commercial structures and encouraging less reliance on fossil fuels, all of which contribute to a reduction in hazard risk. The plan also advocates for advanced public outreach related to climate change.
Pennsylvania Coastal Zone Enhancement Program Assessment Strategy	PA DEP	February 2011	Statewide	Part of the Coastal Resources Management Program. Self-evaluation of program and critical needs for the Coastal Zone Enhancement Grants Program, Section 309 of the Coastal Zone Management Act. Outlines priority areas for the state. The leading mitigation techniques of this strategy include the protection and improvement of coastal wetlands, continued assessment of coastal bluff recession hazards, and advocating for sound land use planning and zoning that minimizes cumulative and secondary impacts to coastal zones.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Pennsylvania Dam Safety Program	DEP	Ongoing	Statewide	The Dam Safety Program has statutory authority for permitting and monitoring dams and levees under the jurisdiction of the DEP in Pennsylvania. Note that USACE and Federal Energy Regulatory Commission dams are not included under this program. Members of the Bureau of Waterways Engineering, the office in charge of the Program, are active participants in the SPT. The leading mitigation technique outlined in the plan is to inspect and monitor properly placed and constructed dams and to require Emergency Action Plans from all owners of High Hazard Dams as well as requiring immediate drawdown and/or breaching of dams which develop structural problems.
Pennsylvania Drought Management Plan	PEMA & PA DEP	March 2012	Statewide	The Drought Management Plan outlines the public water supplier's sources of water and identifies watch, warning, and emergency conditions within the water supply system based on the water levels in those sources. Response actions appropriate to the individual water supply system are identified for each of the drought stages, including contingency plans and water rationing. Leading mitigation techniques discussed in this plan include drought contingency plans, non-essential water use restriction policies, drought declaration guidelines, water rationing, and inter-agency planning coordination.
Pennsylvania Energy Harvest Program	Pennsylvania Office of Energy and Technology	2003	Statewide	Grant program for green roof and other energy saving projects. Delivered $500,000 to green roof projects statewide in 2007. The leading mitigation technique associated with this program is Structure and Infrastructure directly and indirectly associated with utility interruption and environmental hazards. The majority of funded projects involve wind and solar energy which can mitigate interruptions to power and indirectly reduce environmental hazards associated with natural resource extraction.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Pennsylvania Greenways Initiative	DCNR	2001-2012 (Varies by county)	Statewide	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. Less critical floodplain areas may be preserved or protected via local ordinance. The leading mitigation technique for the Pennsylvania Greenways Initiative is 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. Less critical floodplain areas may be preserved or protected via local ordinance.
Pennsylvania Invasive Species Management Plan	Governor's Council on Invasive Species; PA DCNR	2011	Statewide	This plan establishes strategic goals in combating invasive species threats and will establish a robust statewide risk assessment of invasive species hazards. Data from the plan was used in the 2013 SSAHMP update. The leading mitigation techniques outlined in plan include encouraging residents to select native plants for landscaping, managing existing on-site invasive species to prevent their spread, and by conducting annual inspections for invasive species outbreaks.
Pennsylvania Mobility Plan & the Pennsylvania Transportation Security Plan	PennDOT	September 2006	Statewide	PA Mobility Plan outlines vision for direction and investment into transportation across the state from 2006 to 2030. Includes goals for safety that aim to mitigate transportation accidents. PA Transportation Security Plan outlines goals to mitigate both transportation accidents and terrorist threats or attacks. The salient mitigation techniques from the documents include implementing Pennsylvania's Comprehensive Strategic Highway Safety Improvement Plan to reduce fatalities and crashes; improving the security of high-risk transportation facilities; and developing comprehensive and coordinated plans and procedures for emergency response and recovery.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Pennsylvania Pandemic Influenza Outbreak Plan	Department of Health (DOH)	2010	Statewide	This plan establishes response protocol for a pandemic event. Information in the plan was used in the 2013 SSAHMP; DOH staff provided feedback and review for the pandemic hazard profile and actively participated in the SPT. Mitigation activities for influenza focus on minimizing exposure and treating patients. The following DOH activities are identified in the plan to overcome challenges associated with influenza: • Assessing and reviewing capacity plans and working with acute and long-term health care facilities to prepare for an increase in the patient capacity resulting from influenza stricken individuals. • Providing technical assistance on maintaining current plans for care of mass casualties. • Providing guidance and review emergency preparedness response plans to integrate and maintain critical business functions in the event of a pandemic. • Reviewing pandemic plans by hospitals and nursing care facilities to ensure that they meet the needs of a pandemic. Developing emergency response plans with adjoining states for collaboration of public services, health care personnel and security services.
Pennsylvania Radon Mitigation Standards	DEP	November 1997	Statewide	Provides standards to be referred to by certified mitigation contractors for installation of radon mitigation systems. Guidelines to ensure effective and uniform protection against radon for homeowners utilizing the systems. The leading mitigation technique outlined in the plan is to test for radon in residential, commercial and industrial buildings, delineate on public maps the areas with increased radon levels, and assist in the installation of radon reduction systems within structures that have increased levels of radon.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Pennsylvania State Plan on Aging	PA Department of Aging	2012	Statewide	The State Plan on Aging's goals, objectives, and strategies advance a vision characterized by three strategic directions: to help ensure that Pennsylvanians will age and live well and that communities will be places to help them age and live well; to ensure access to care at the right time, in the right setting, and at the right intensity; to bring the best of Pennsylvania to Pennsylvanians. The most successful mitigation techniques outlined in the plan include the Healthy Steps for Older Adults falls prevention program and requiring each Area Agency on Aging to have a local plan for emergency response on file with the Department of Aging.
Pennsylvania's Management of State Homeland Security Program	Governor's Office of Homeland Security	September 2012	Statewide	The report addresses the Commonwealth of Pennsylvania's management of State Homeland Security Program and Urban Areas Security Initiative grants. The Homeland Security Program supports strategies to address, "planning, organization, equipment, training, and exercise needs to prevent, protect against, mitigate, respond to, and recover from acts of terrorism and other catastrophic events." Awards are based on Investment Justifications aligned with the State THIRA. The funding streams associated with this program focuses on preventing, preparing, responding, and recovering from disasters as to mitigate the impacts of terrorism or catastrophic events. Techniques funded that support mitigation include Commonwealth and regional fusion centers to share intelligence, Business Coalitions to support 'Whole Community' preparedness, outreach information the public, planning and training for first and second responders, and supporting the State VOAD.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Pennsylvania's Statewide Historic Preservation Plan 2012-2017	Pennsylvania Historical & Museum Commission, Bureau of Historic Preservation	2012	Historic properties statewide	The plan lays out strategies for government, nonprofits, and individuals to address historic properties in Pennsylvania. Several actions in the plan will better prepare local municipalities to identify and survey important local resources, improve data sharing amongst communities and agencies, to integrate preservation priorities into hazard mitigation, emergency management and other planning mechanisms. The leading mitigation technique in the plan is the collaboration between PA Historic Preservation with PEMA and FEMA to identify at-risk communities for natural disasters in order to create emergency management plans for their historic resources.
Philadelphia Heat Island Initiative	City of Philadelphia, EPA, The Energy Coordinating Agency (ECA) of Philadelphia, and Public Health Department	Varies	Citywide	City of Philadelphia started the Cool Roof Ordinance in May of 2010 mandating the use of white or highly reflective roof material or white roof coverings for all new construction, excluding projects involving vegetation, solar thermal or photovoltaic equipment is exempt from the law. The city was first to implement the Heat/Health Watch Warning System involving news reports to cover the dangers, appointed block captains to check on elderly neighbors, and the Department of Health to conduct home visits. The ECA has been implementing weatherization on city buildings by applying cool roof coatings to reduce building temperatures. The leading mitigation techniques for Philadelphia are to increase the use of white material for roof coverings and to increase vegetation to help reduce overall temperatures.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Silver Jackets	USACE	July 2011	Statewide	Silver Jackets is a pilot program that began in 2006. Pennsylvania has an interagency team that works to reduce flood losses in the Commonwealth by mitigating SRL/RL properties and providing outreach and education programs. USACE provides expertise and resources to develop comprehensive local flood mitigation strategies. Various members of the State Planning Team participate in this program. The most salient mitigation technique is the effective and continuous collaboration between state and federal agencies. This is critical to successfully reducing the risk of flooding and other natural disasters in the United States and enhancing response and recovery efforts when such events do occur. No single agency has all the answers, but often multiple programs can be leveraged to provide a cohesive solution.
SRBC Water Resources Program	SRBC	Fiscal Years 2014-2015 (adopted June 20, 2013)	Susquehanna River Basin (Eastern and Central Pennsylvania)	SRBC annually adopts the water resources program which consists of planned projects SRBC and partnering agencies aim to accomplish in the following fiscal years in order to meet water resources needs within the basin. Consistent with the “Actions Needed” list from the comprehensive plan and cover six priority management areas including water supply, water quality, flooding, ecosystems, the Chesapeake Bay, coordination, cooperation, and public information. The leading mitigation technique associated with this program is Plans and Regulations that pertain to drought and flooding. Projects including drought coordination planning, low flow prevention policies, erosion control stream restoration, aquatic invasive species monitoring, stormwater management, flood forecast and warning system planning, and flood damage reduction alternative develop are all included in the program.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
State Emergency Operations Plan	PEMA	September 2012	Statewide	An updated State Emergency Operations Plan ensures that disaster response can prevent or reduce damage and injuries from expected hazards or disasters. It is considered a major capability for implementing hazard mitigation activities. This plan has concurrence with the Emergency Plans of 20 state agencies, most of which sit on the SPT. For more information, please see Section 5.2. The EOP's most salient mitigation technique is the premise that the goal of an EOP is to prevent, prepare, respond, and recovery from disasters in such a way as to mitigate the impacts of a disaster of residents, property, and natural responses. It is a tool for accomplishing all the goals, and especially the 1st Goal, of the SSAHMP. By having a plan to respond the Commonwealth is able to save lives, protect property and the natural environment. The EOP also promotes and has actions related to public outreach and mitigation programs including the NFIP.
State Recreation Plan	DCNR	2009	Statewide	The plan presents 28 programmatic and 5 funding recommendations to enhance the delivery of outdoor recreation facilities and services, organized under 4 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. The most salient mitigation techniques identified in the plan are the Land and Water Conservation Fund, along with education and awareness programs aimed at better informing residents of their role in environmental conservation.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
State Water Plan	DEP	March 2009	Statewide	Act 220 of 2002 requires that the DEP produce and regularly update a State Water Plan every five years. The current plan is a functional planning tool that delineates 104 watersheds in Pennsylvania's six major river basins and assures adequate quantity and quality of water. The plan monitors drought, connects storm water management to floodplain management & flood protection to mitigate local flooding. State Water Plan data was used in the 2013 SSAHMP update. The leading mitigation techniques used in the State Water Plan include reducing conflicts between water users and natural resource protection and forecasting water use and supply to protect Pennsylvania in times of flooding and drought. The plan advocates for flood protection, sustainable water use, and water supply protection by disseminating water resources information, adopting an integrated approach to water management, and adopting technological advances that can conserve and enhance water resources. The plan also advocates for advanced public outreach related to water resources.
Stream gauging in Pennsylvania	USGS Pennsylvania Water Science Center (PaWSC)	1894 (beginning of stream gauging program in U.S.)	Statewide	The Pa WSC operates 279 continuous-record stream gages offering real-time stage and discharge information for streams in the Commonwealth. The gages are operated and maintained with cooperation from about 53 Federal, State, and local partners. The most salient mitigation technique for this program is the function of stream gages as a warning system by alerting residents when stream flows are above normal.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
Threat and Hazard Identification and Risk Assessment	FEMA	March 2012	Statewide	The THIRA is an all-hazards capability-based assessment tool suited for use by all jurisdictions. The THIRA allows a jurisdiction to understand its threats and hazards and how their impacts may vary according to time of occurrence, seasons, locations, and community factors. This knowledge allows a jurisdiction to establish informed and defensible capability targets and commit appropriate resources drawn from the whole community to closing the gap between a target and a current capability or for sustaining existing capabilities. The THIRA uses hazard information from the SSAHMP. It adds in a threat component and chooses natural, technological, and adversarial hazards that will stress the "overall system" the most. For example, there are over 20+ hazards profiled in the SSAHMP, however only 10 may be able to stress the system the most. The link between the THIRA and mitigation is that actions taken to reduce gaps and build, maintain, and sustain a capability will mitigate the impacts of disaster.
Uniform Construction Code	Local governments or PA Department of Labor and Industry (if local governments opt out)	December 2012	Statewide	The Pennsylvania Construction Code Act (Act 45 of 1999) established the basic requirements for the Uniform Construction Code. The leading mitigation technique in this plan is Plans and Regulations as codes ensure uniform, modern construction standards which reduce vulnerability to various natural and human-made hazard events including flooding, wind, tornado, earthquake, fire, utility interruption, and others.
USACE Dam Safety Program	USACE	Various	Statewide	Twenty-six dams in Pennsylvania fall under the jurisdiction of the 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. The leading mitigation techniques are continuous and periodic project inspections and evaluations to make risk-informed decisions; communication of risk-related issues; collaboration with Federal, State and Local partners to share information and develop solutions.

Table 5.5-1 Summary of other local, state and federal planning mechanisms.

PLANNING MECHANISM NAME	LEAD AGENCY/ AGENCIES	DATE OF APPROVAL	SCOPE	SUMMARY OF MECHANISM APPLICATION TO HAZARD MITIGATION
USACE Levee Safety Program	USACE	2007 (National Levee Database)	National	Congress authorized the USACE to develop the National Levee Database in 2007 in order to organize levee inspection information, flood plain management, risk assessments, and flood risk communication. The most salient mitigation techniques are inspection and assessment of existing levees, and using the data to prioritize action; communication of risk-related issues; collaboration with Federal, State and Local partners to share information and develop solutions.
Winter Services Strategic Plan (WSSP)	PennDOT	2012	Statewide	This 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 a pilot program on 15 snow routes across the state using transportation-focused management software.

5.5.2. SSAHMP Integration into Other Planning and Program Initiatives

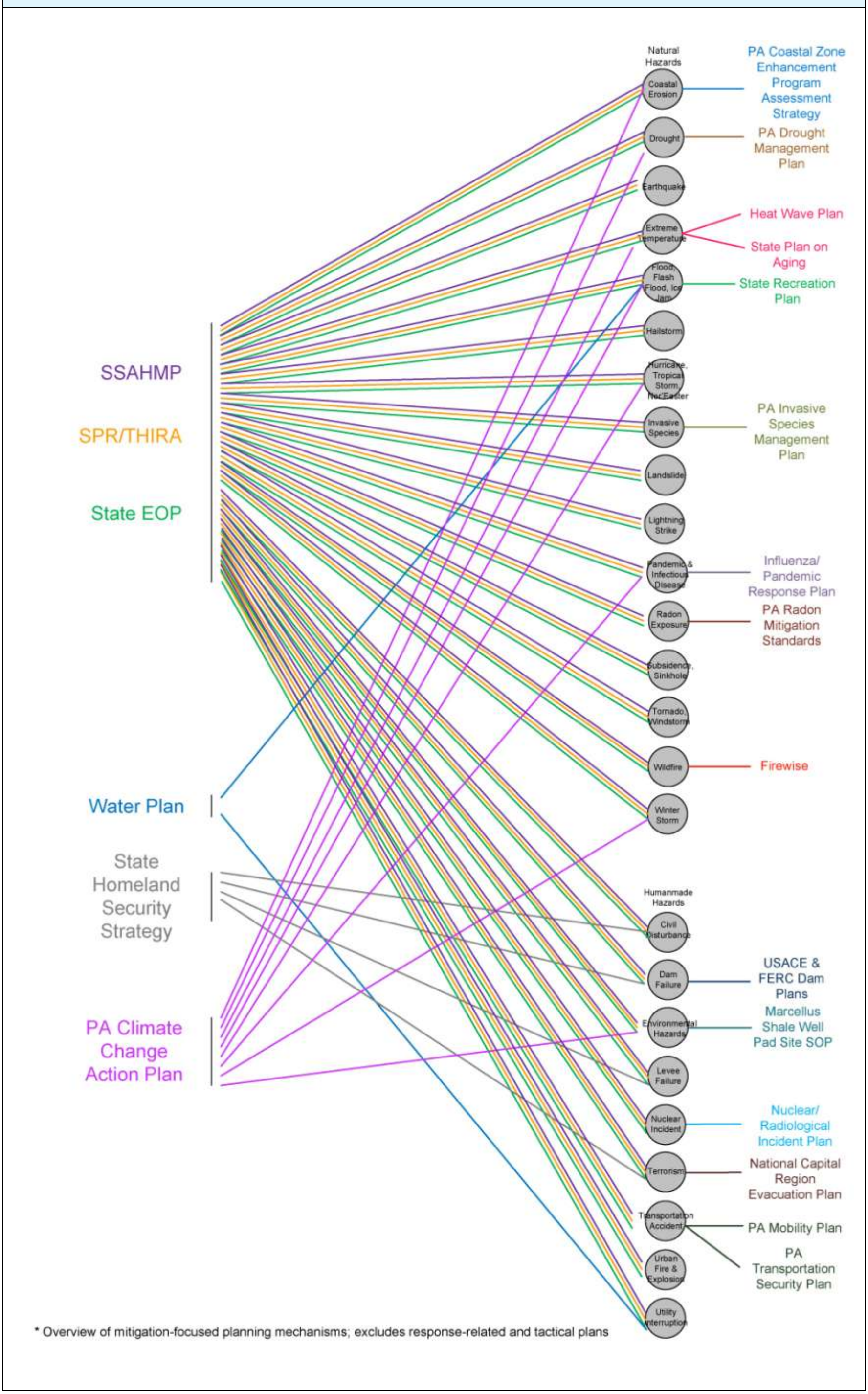
The SSAHMP is one of many planning mechanisms that address hazards and attempt to mitigate risk to life and property statewide. Integrating related planning mechanisms is an important part of the update process. By integrating planning efforts, each plan can have an independent focus but reference other plans to cover the risks, capability, and mitigation of specific hazards.

Figure 5.5-1 illustrates some of the key state planning mechanisms whose integration will strengthen Pennsylvania's resilience. The State Preparedness Report/THIRA, for example, integrate with the SSAHMP by using the THIRA ranking as a 'check' on each hazard's Risk Factor; additionally, the worst-case planning mentality of the THIRA was used to more fully understand the range of magnitude of each hazard event. The State EOP helped understand the Commonwealth's capabilities. The State Homeland Security Strategy assisted with understanding critical infrastructure and particular human-made hazards frequently linked to homeland security, like civil disturbance and intentional dam failures. The State Water Plan expressly focuses on creating synergy amongst various state agencies, planning programs, and planning mechanisms such as the State Recreation Plan, water supply planning and stormwater management plans in order to promote consistency across efforts. The outreach efforts for the SSAHMP reflect the importance of this connection in particular; the outreach sessions in Pittsburgh made the effort to connect Allegheny County's significant stormwater management issues to urban and small stream flooding, thus encouraging mitigation using either stormwater management funding or HMA grants. Finally, the Pennsylvania Climate Change Action Plan takes a comprehensive approach to connecting climate change to resilience and climate adaptation, which has been integrated into the appropriate hazard profiles in this SSAHMP.

The overall goal of integrating the SSAHMP with the planning mechanisms as illustrated in Figure 5.5-1 is consistency across agencies via the Silver Jackets Initiative. As an inter-agency consortium of experts, the Silver Jackets are uniquely positioned to champion an overall integrated approach between and among plans and policies. The Silver Jackets are working to reduce disparities between plans and programs. For example, hazard mitigation has long favored a "patchwork quilt" approach where smaller projects can be aggregated together for larger long-term resilience. However, agencies like the Natural Resources Conservation Service (NRCS) want to avoid a patchwork approach to addressing hazards, so there is more disconnect between the Hazard Mitigation plan and NRCS planning mechanisms. The Silver Jackets hope to come to consensus among mitigation-related agencies to create a unified approach to mitigation.

Another benefit to integration is that it may aid in project identification throughout Pennsylvania; the ideal circumstance would allow for integration between local and state government, allowing for state government and their plans to integrate local county government needs and plans for future mitigation projects. More closely integrated planning efforts may also contribute to stronger grant applications where efforts under one planning mechanism may be rewarded during the grant application under a different agency/mechanism.

Figure 5.5-1 State-Level Plan Integration – Hazards covered by respective plans



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6. Mitigation Strategy

6.1. Update Process Summary

The Commonwealth's Mitigation Strategy serves as the blueprint for reducing or avoiding long-term vulnerabilities to the identified hazards identified in the Risk Assessment (Chapter 0). This Strategy sets forth the Commonwealth's prioritized goals, objectives, and actions for reducing loss of life and property. For the purposes of this strategy, the following definitions based on FEMA's *State and Local Mitigation Planning How-To Guide* were used:

- *Goals* are general guidelines that explain the Commonwealth would like to achieve. They are usually broad policy-type statements, long term, and represent global visions.
- *Objectives* define specific and measureable strategies or implementation steps that must be implemented in order to attain identified goals.
- *Mitigation Actions* are more specific than objectives, and have identified responsible parties, timeframes, and potential funding sources. They are the specific actions to achieve goals and objectives.

The 2010 Commonwealth of Pennsylvania SSAHMP adopted five overarching goals:

- Goal 1:Protect lives, property, environmental quality, and resources of the Commonwealth, including RL and SRL 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 support and secure funding for mitigation efforts;
- Goal 5: Increase awareness, understanding, and preparedness across all sectors.

These goals were supported by 28 objectives and 116 actions, each of which was assigned to at least one Commonwealth Agency.

The creation of the mitigation strategy for the 2013 Plan Update was a dynamic, interactive process by which the SPT reviewed and updated goals, objectives, and actions. The SPT began by reviewing the 2010 agency actions and indicating where progress had and had not been made; for more information, please see Chapter 3. The SPT began its review of these mitigation actions starting in March 2013 at the SSAHMP kickoff meeting. At that meeting participants were given physical copies of agency actions and asked to complete their review that day or to send in an email of reviewed actions detailing agency efforts since 2010. The SPT then held a Mitigation Strategy Workshop on May 21, 2013. The purpose of the workshop was to review the 2010 Mitigation Strategy and suggest revisions as needed. An overview of the Hazard Identification and Risk Assessment was also provided to give context for the reconsideration of the goals and objectives.

During the 2013 update, another element of strategy evaluation was added to the review process in an effort to ensure the 2013 Mitigation Strategy appropriately targets the Commonwealth's top hazards and priorities. The 2010 mitigation actions were categorized by characteristics such as mitigation technique, hazard type, top hazards according to number of mitigation actions developed versus those hazards ranked by risk, and agency responsibility. By

examining the mitigation actions within these different categorizations, the SPT was able to better understand how closely the 2010 Mitigation Strategy reflected the Commonwealth's known risks and priorities and where adjustments might be necessary for the 2013 Mitigation Strategy. An overview of this information is provided in Figure 1.3.1-1. As can be seen in the pie chart, over 50 percent of the 2010 mitigation actions fall within the Education and Awareness Programs mitigation technique, followed by Plans and Regulations (35%), Structure and Infrastructure Projects (9%) and Natural Systems Protection (1%). This breakdown indicates the 2010 plan overwhelmingly favors the Education and Awareness Programs mitigation technique.

Table 6.1-1 2010 Actions categorized by mitigation Technique

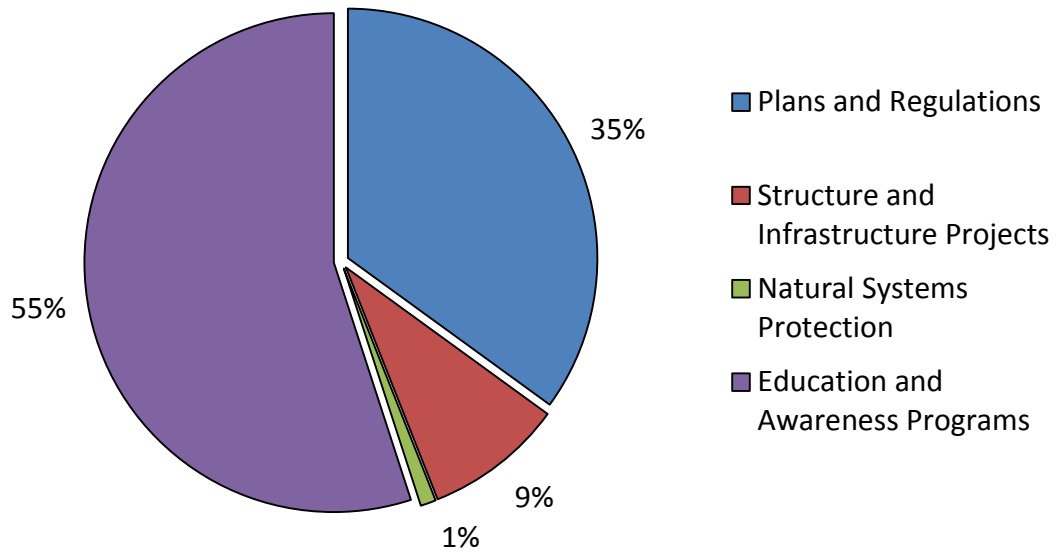
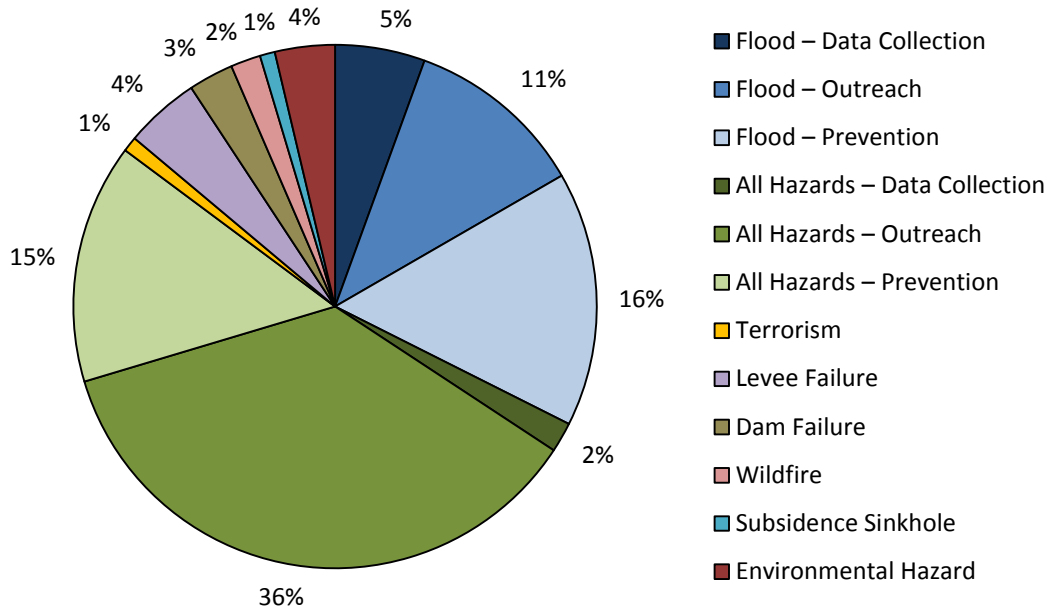


Figure 1.3.1-2 below indicates that 53 percent of mitigation actions in the 2010 SSAHMP address All Hazards. When the All Hazards category is subdivided further, these actions have a focus on Outreach (36%), Prevention (15%) or Data Collection (2%). Another 32 percent of actions are associated with the Flooding hazard. When the Flooding hazard category is subdivided further, these actions have a focus on Prevention (16%), Outreach (11%) or Data Collection (5%). The remaining hazards that feature actions in the 2010 Plan include Terrorism (1%), Levee Failure (4%), Dam Failure (3%), Wildfire (1%), Subsidence Sinkhole (1%) and Environmental Hazard (4%).

Table 6.1-2 2010 Actions categorized by hazard



All Hazards comes in as the top hazard with 53 percent of the total number of related actions associated with it; however, since All Hazards is not a distinct hazard category it is not listed in Table 1.3.1-1 and the Flood hazard is elevated to the top spot.

When comparing the top five hazards related to number of actions in the SSAHMP to the top five hazards identified by the 2010 Risk Assessment there is a slight divergence between the two lists. While the Flood hazard tops both lists, and the Wildfire hazard also ranks high, the rest of the top five hazards are different when comparing overall risk for certain hazards in the Commonwealth to the number of mitigation actions assigned to hazards in the plan.

Table 6.1-3 2010 Mitigation vs. Risk Evaluation

Top 5 Hazards Related to Number of Actions	Top 5 Hazards Ranked by Risk
1. Flood	1. Flood
2. Environmental Hazard	2. Winter Storm
3. Levee Failure	3. Hurricane
4. Dam Failure	4. Wildfire
5. Wildfire	5. Utility Interruption

Table 1.3.1-2 below shows the breakdown of mitigation actions categorized by responsible entity. PEMA is by far the most frequent agency assigned a lead or supporting role for the mitigation actions (nearly 80% of actions). Local Counties, DEP, USACE-Silver Jackets and FEMA round out the top five entities assigned responsibility for leading or supporting mitigation actions. The table shows which groups the Commonwealth relies on most heavily on for

implementation of the SSAHMP. The 2010 distribution of assigned actions raises the question of whether or not the SSAHMP needs an adjustment in its 2013 strategy such as utilizing new agencies or organizations, or perhaps utilizing different combinations of responsible entities.

Table 6.1-4 2010 Actions categorized by responsible entity.

Agency or Organization	Number of Assigned Actions	Agency or Organization	Number of Assigned Actions
PEMA	86	NRCS	1
Local County	35	VOAD	1
DEP	20	Department of Banking and Department of Insurance	1
USACE-Silver Jackets	15	Department of Revenue	1
DCED	14	Regional Task Forces	1
FEMA	7	PA State Police	1
DCNR	6	Chamber of Commerce & RTF B & LIC	1
DGS	5	Governor's Office Communications & Press	1
Department of Labor and Industry	5	PA CCC & PA ACU	1
Office of State Fire Commission	3	PAFPM	1
OA	3	Office of General Counsel	1
PDE	2	Public Safety Agencies	1
USDA	1		

By examining the mitigation actions within these different categorizations, the SPT was able to better understand how closely the 2010 Mitigation Strategy reflected the Commonwealth's known risks and priorities. This exercise helped the SPT to determine if adjustments in the 2013 overall strategy were required.

In reviewing the goals and objectives for the 2013 Plan Update, the SPT revisited the goals and objectives developed for the 2010 Plan. Their purpose was to review, discuss and determine if the goals and objectives still met the Commonwealth's priorities for hazard mitigation. The SPT largely agreed that the existing 2010 goals and objectives remained valid for the 2013 Plan Update and voted to continue them.

After the goals and objectives were considered and validated in the May 2013 Mitigation Strategy Workshop, the SPT agreed to provide additional feedback on three additional items via email:

1. Risk Factor Rankings – The SPT reviewed the updated risk factor rankings for all hazards to be profiled in the 2013 Plan Update, and provided comments.
2. PA STEEL Action Feasibility – The SPT reviewed the PA STEEL evaluation of mitigation actions for feasibility in the 2013 Plan Update, and provided comments.

3. Multi-Objective Mitigation Action Prioritization – The SPT rated each mitigation action in the 2013 Plan Update using five criteria. These ratings determined the cumulative scores for mitigation actions and informed their prioritization in the 2013 Plan Update.
    1. Effectiveness – The extent to which an action reduces the vulnerability of people and property.
    2. Efficiency – The extent to which time, effort, and cost is well used as a means of reducing vulnerability.
    3. Multi-Hazard Mitigation – The action reduces vulnerability for more than one hazard.
    4. Addresses High Risk Hazard – The action reduces vulnerability for people and property from a hazard(s) identified as high risk.
    5. Addresses Critical Communications/Critical Infrastructure – The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.

By providing feedback on these items the SPT ensured the 2013 Plan Update reflects the Commonwealth's true risk for a variety of hazards and features a mitigation strategy that is both feasible and appropriately prioritized.

6.2. State Mitigation Strategy

6.2.1. Mitigation Goals and Objectives

The Mitigation Strategy is designed to guide the selection of activities to mitigate and reduce potential losses. It includes long-term goals and objectives, but also establishes short-term activities. Through the implementation of this Mitigation Strategy, BORM strives to establish a successful statewide mitigation program.

The keystones of this Mitigation Strategy are the Commonwealth of Pennsylvania's mitigation goals and their associated objectives. These five goals establish a focused vision for the process and implementation of hazard mitigation for the Commonwealth in the coming years. This vision is supplemented by a number of objectives that bring Pennsylvania's ideals of hazard mitigation into sharper focus, in many cases establishing targets and quantifying benchmarks that will indicate progress towards accomplishing the goals.

The SPT evaluated the 2010 mitigation goals and objective during the 2013 Mitigation Strategy Meeting. Table 6.2.1-1 shows the 2010 mitigation goals and objectives with the corresponding SPT evaluation. The *Identification and Analysis of Mitigation Techniques* is discussed in Section 6.2.2. The mitigation actions are described in full detail in Section 6.2.4.

Table 6.2.1-1 Goals and Objectives for 2010 SSAHMP	**SPT Evaluation**
Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including RL and SRL properties.	15 out of 18 continue 3 out of 18 abstain
Objective 1-1: By 2013, reduce flood-related losses (with an emphasis on reducing repetitive loss and severe repetitive loss properties by 5%) through promotion of the Commonwealth's flood protection program through county, state, and federal partners.	9 out of 18 continue 3 out of 18 change 6 out of 18 abstain
Objective 1-2: Increase by 5% the number of projects implemented by the	10 out of 18 continue

Table 6.2.1-1 Goals and Objectives for 2010 SSAHMP	SPT Evaluation
Commonwealth that will mitigate the most vulnerable structures against hazards by 2013.	1 out of 18 change 7 out of 18 abstain
Objective 1-3: Identify and work toward implementation of 5 feasible and cost-effective projects related to the mitigation of critical buildings, state facilities, and infrastructure.	10 out of 18 continue 8 out of 18 abstain
Objective 1-4: Increase all-hazards advance warning provided by the Commonwealth by 10% by 2013.	11 out of 18 continue 7 out of 18 abstain
Objective 1-5: By 2020, minimize risk to communities posed by levee structures by requiring compliance of all levees with National Levee Safety Program standard, focusing on planning and certification.	9 out of 18 continue 9 out of 18 abstain
Objective 1-6: By 2013, increase outreach and training opportunities for local building code enforcers by 100 individuals within the Commonwealth.	8 out of 18 continue 1 out of 18 delete 9 out of 18 abstain
Objective 1-7: Increase coordination, prioritization, and funding availability to address community needs for dam hazards with special emphasis on inundation zone evaluation by 2013.	12 out of 18 continue 6 out of 18 abstain
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 by 10% by 2013.	11 out of 18 continue 1 out of 18 change 6 out of 18 abstain
Objective 1-9: Promote increased implementation of urban-wild land interface (wildfire) mitigation projects by local communities by 2011.	10 out of 18 continue 8 out of 18 abstain
Objective 1-10: Enhance Commonwealth efforts to address surface mine-related hazards by increasing inter-agency cooperation by 2011.	10 out of 18 continue 7 out of 19 abstain 1 out of 18 change
Objective 1-11: Enable the Department of Environmental Protection to fully characterize hazard issues from Marcellus Shale natural gas extraction operations and explore mitigation options by 2012.	12 out of 18 continue 2 out of 18 change 4 out of 18 abstain
Objective 1-12: Manage all Repetitive Loss and Severe Repetitive Loss databases, providing updates to FEMA at least annually in order to more efficiently identify properties to be mitigated.	11 out of 18 continue 7 out of 18 abstain
Objective 1-13: By 2013, compare properties within the Commonwealth that are known to have been mitigated with the FEMA-provided data sets for SRL and RL properties on an annual basis, and complete FEMA Form AW-501 to support update of the FEMA SRL and RL property databases.	10 out of 18 continue 8 out of 18 abstain
Goal 2: Enhance consistent coordination, collaboration, and communications among stakeholders.	8 out of 18 continue 10 out of 18 abstain
Objective 2-1: Promote development of COOP and COG plans for critical infrastructure within the Commonwealth by 2013.	13 out of 18 continue 5 out of 18 abstain
Objective 2-2: Promote integration of mitigation goals, objectives, and actions where appropriate in other federal, state and local planning initiatives by 2013.	12 out of 18 continue 6 out of 18 abstain

Table 6.2.1-1 Goals and Objectives for 2010 SSAHMP	SPT Evaluation
Objective 2-3: Support Pennsylvania Emergency Management Agency in developing mitigation data strategies for decision-makers by 2012.	11 out of 18 continue 7 out of 18 abstain
Objective 2-4: Identify local Hazard Mitigation Officers and increase participation by local community representatives in the Commonwealth's Mitigation Planning Team by 75% by 2015.	11 out of 18 continue 7 out of 18 abstain
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.	11 out of 18 continue 7 out of 18 abstain
Goal 3: Provide a framework for active hazard mitigation planning and implementation.	10 out of 18 continue *8 out of 18 abstain*
Objective 3-1: Identify 10 opportunities for regional organizations, businesses, and universities to be engaged in hazard mitigation planning by 2013.	10 out of 18 continue 8 out of 18 abstain
Objective 3-2: Enable the Pennsylvania Emergency Management Agency to encourage each participating jurisdiction to secure funding and initiate one mitigation action by 2013.	10 out of 18 continue 8 out of 18 abstain
Goal 4: Build legislative support and secure funding for mitigation efforts.	10 out of 18 continue 8 out of 18 abstain
Objective 4-1: Provide opportunities for education of all State, county and local government officials and legislators about hazard risk and mitigation by Pennsylvania Emergency Management Agency and County Emergency Management Agencies by 2013.	10 out of 18 continue 8 out of 18 abstain
Objective 4-2: By 2013, expand working relationships with at least two volunteer and professional organizations to improve mitigation efforts within the Commonwealth.	10 out of 18 continue 8 out of 18 abstain
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 2013.	10 out of 18 continue 1 out of 18 change 7 out of 18 abstain
Objective 4-4: Encourage inclusion of at least 5 relevant mitigation projects in the Commonwealth's Capital Improvement Program by the next plan revision.	9 out of 18 continue 1 out of 18 change 8 out of 18 abstain
Goal 5: Increase awareness, understanding, and preparedness across all sectors.	12 out of 18 continue 6 out of 18 abstain
Objective 5-1: By 2015, develop an all-hazards mitigation and preparedness program to educate private and public stakeholders, academia, government employees and elected officials on the hazards pertinent to the Commonwealth.	10 out of 18 continue 8 out of 18 abstain
Objective 5-2: By 2011, identify a Silver Jackets sub-committee to address the development of a hazard mitigation strategic communications plan to provide guidance to municipal officials and the public.	10 out of 18 continue 8 out of 18 abstain
Objective 5-3: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications by 2013.	10 out of 18 continue 8 out of 18 abstain

All five goals remain unchanged and will carry over into the 2013 SSAHMP update. Minor changes to objectives including updated target completion dates and quantitative measures were made and Objective 1-14 was added. The 2013 goals and objectives are listed in Section 6.2.4, Mitigation Action Plan along with corresponding mitigation actions.

6.2.2. Identification & Analysis of Mitigation Techniques

The goals and objectives of each plan update sets a strategic course for hazard mitigation in the Commonwealth for the following years. However, in order to make a tangible change in losses experienced and reduce risk, the goals and objectives must be supported by mitigation actions.

In the 2010 Plan Update, the mitigation actions generally fell into the six broad categories of mitigation techniques outlined in *FEMA's State and Local Mitigation Planning how-to guide: Developing the Mitigation Plan (April 2003)*. It is important to note a mitigation action can fall in multiple technique categories, for instance maintenance of an existing flood control structure would be both *Prevention* and *Structural Project Implementation*. The six categories include:

- *Prevention:* Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning, zoning, building codes, subdivision regulations, hazard specific regulations (such as floodplain regulations), capital improvement programs, properly operating and maintaining existing mitigation structures (levees/dams), and open-space preservation and stormwater regulations.
- *Property Protection:* Actions that involve modifying or removing existing buildings or infrastructure to protect them from a hazard. Examples include the acquisition, elevation and relocation of structures, structural retrofits, flood-proofing, storm shutters and shatter-resistant glass. Most of these property protection techniques are considered to involve "sticks and bricks;" however, this category also includes insurance.
- *Public Education and Awareness:* Actions to inform and educate citizens, elected officials and property owners about potential risks from hazards and potential ways to mitigate them. Such actions include hazard mapping, outreach projects, library materials dissemination, real estate disclosures, the creation of hazard information centers and school age / adult education programs.
- *Natural Resource Protection:* Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, forest and vegetation management, wetlands restoration or preservation, slope stabilization, and historic property and archeological site preservation.
- *Structural Project Implementation:* Mitigation projects intended to lessen the impact of a hazard by using structures to modify the environment. Structures include stormwater controls (culverts); dams, dikes and levees; and safe rooms.
- *Emergency Services:* Actions that typically are not considered mitigation techniques but reduce the impacts of a hazard event on people and property. These actions are often taken prior to, during, or in response to an emergency or disaster. Examples include warning systems, evacuation planning and management, emergency response training and exercises, and emergency flood protection procedures.

Mitigation Strategies that are statewide in scope typically include actions that foster capacity building at the local level and coordination among agencies and levels of government.

For the 2013 Plan Update, four new FEMA mitigation technique categories outlined in the *Local Mitigation Planning Handbook* (March 2013) were utilized. These mitigation technique categories are expected to be adopted in forthcoming guidance on State-level hazard mitigation planning. 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 Projects*: These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.
- *Natural Systems Protection*: These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.
- *Education and Awareness Programs*: These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.

The 2013 Commonwealth Mitigation strategy will employ these four categories of techniques to address each of the hazards that affect the Commonwealth, shown in Table 6.2.2-1. The specific actions associated with these techniques are included in Section 6.2.4. In an effort to enhance consistency across hazard mitigation plans, PEMA has also encouraged local communities to classify their mitigation actions using these four categories. More information on local plan actions can be found in Section 6.3.2.

Table 6.2.2-1 Mitigation Technique used for each hazard in Pennsylvania.

HAZARD (ORDERED FROM HIGHEST RISK TO LOWEST RISK FACTOR) NATURAL (N) OR MAN-MADE (M)	MITIGATION TECHNIQUE			
	PLANS AND REGULATIONS	STRUCTURE AND INFRASTRUCTURE PROJECTS	NATURAL SYSTEMS PROTECTION	EDUCATION AND AWARENESS PROGRAMS
Flood, Flash Flood, Ice Jam (N)	✓	✓	✓	✓
Winter Storm (N)		✓		
Utility Interruption (M)		✓		✓
Hurricane, Tropical Storm, Nor'easter (N)	✓	✓		
Dam Failure (M)	✓	✓		✓
Nuclear Incident (M)	✓			✓
Transportation Accident (M)	✓			✓
Wildfire (N)	✓	✓	✓	✓

Table 6.2.2-1 Mitigation Technique used for each hazard in Pennsylvania.

HAZARD (ORDERED FROM HIGHEST RISK TO LOWEST RISK FACTOR) NATURAL (N) OR MAN-MADE (M)	MITIGATION TECHNIQUE			
	PLANS AND REGULATIONS	STRUCTURE AND INFRASTRUCTURE PROJECTS	NATURAL SYSTEMS PROTECTION	EDUCATION AND AWARENESS PROGRAMS
Environmental Hazard (M)	✓	✓		✓
Extreme Temperature (N)			✓	
Coastal Erosion (N)	✓	✓		
Landslide (N)	✓	✓	✓	✓
Lightning Strike (N)		✓		✓
Tornado, Wind Storm (N)	✓	✓		✓
Invasive Species (N)	✓		✓	✓
Radon Exposure (N)	✓			✓
Civil Disturbance (M)		✓		
Drought (N)	✓	✓	✓	✓
Pandemic (N)				✓
Terrorism (M)		✓		✓
Earthquake (N)	✓	✓		✓
Hailstorm (N)		✓		✓
Urban Fire and Explosion (M)	✓	✓		✓
Levee Failure (M)	✓	✓		✓
Mass Food/Animal Feed Contamination (M)	✓			
Subsidence, Sinkhole (N)	✓		✓	✓

6.2.3. Assessment of Mitigation Actions

The Interim Criteria of the DMA requires that state plans identify, evaluate, and prioritize cost effective, environmentally sound, and technically feasible mitigation actions and activities the state will consider for implementation. The DMA also states that the plan must explain how each action item contributes to the state's overall mitigation strategy. In order to best evaluate the overall feasibility of the 2013 Plan Update mitigation actions, the Commonwealth chose to first evaluate all mitigation actions using the PA STEEL Method. The considerations of this method are as follows:

- *Political:* Does the action have public and political support?
- *Administrative:* Is there adequate staffing and funding available to implement the action in a timely manner?

- *Social:* Will the action be acceptable by the community or will it cause any one segment of the population to be treated unfairly?
- *Technical:* How effective will the action be in avoiding or reducing future losses?
- *Economic:* What are the costs and benefits of the action and does it contribute to community economic goals?
- *Environmental:* Will the action provide environmental benefits and will it comply with local, state and federal environmental regulations?
- *Legal:* Does the community have the authority to implement the proposed measure?

An example of the PA STEEL worksheet used in the 2013 Plan Update can be found in Figure 6.2.3-1. The Commonwealth strongly encourages local communities to also employ this method, which uses the same criteria as the STAPLEE process advocated in FEMA's mitigation how-to series, to evaluate mitigation actions on the local level. The use of this method by all local plans and the Commonwealth's plan will facilitate the overall ranking and prioritization of projects statewide.

The SPT provided scores and an evaluation each mitigation action based on the seven criteria and 23 associated sub-criteria using a (+), (-), (N) basis. An evaluation of (+) was calculated as one point; an evaluation of (–) was calculated as negative one point while an evaluation of N received no points. The benefits and costs of an action were weighted at three times the importance of the other sub-criteria; therefore, either three or negative three points were awarded to these sub-criteria. The scores from participating SPT members were added together for each of the 23 sub-criteria then a total was calculated for each action. Each sub-criteria was then assigned a (+) and considered feasible if the sum of the evaluation was a positive number, or a (-) if the evaluation score was a negative number and considered non-feasible. An overview of this evaluation reveals that most often Administrative issues including staffing and funding followed by Political considerations seem to be limiting factors to the success and feasibility of many mitigation actions. The complete PA STEEL evaluation is available in *Appendix I*.

Figure 6.2.3-1 Sample PA STEEL worksheet

PA STEEL CRITERIA CONSIDERATIONS (+) Favorable (-) Less Favorable (N) Not Applicable			
	Mitigation Actions		
	ACTION	ACTION	ACTION
P Political			
Political Support			
Local Champion			
Public Support			
A Administrative			
Staffing			
Funding Allocation			
Maintenance / Operations			
S Social			
Community Acceptance			
Effect on Segment of Population			
T Technical			
Technically Feasible			
Long-Term Solution			
Secondary Impacts			
E Economic			
Benefit of Action (x3)			
Cost of Action (x3)			
Contributes to Economic Goals			
Outside Funding Required			
E Environmental			
Effect on Land / Water			
Effect on Endangered Species			
Effect on HAZMAT / Waste Site			
Consistent w/ Community Environmental Goals			
Consistent w/ Federal Laws			
L Legal			
State Authority			
Existing Local Authority			
Potential Legal Challenge			
SUMMARY (EQUAL WEIGHTING)	(+) ____ (-) ____ (N) ____	(+) ____ (-) ____ (N) ____	(+) ____ (-) ____ (N) ____
SUMMARY (BENEFITS & COSTS PRIORITIZED)	(+) ____ (-) ____ (N) ____	(+) ____ (-) ____ (N) ____	(+) ____ (-) ____ (N) ____

After evaluating the 2013 Plan Update mitigation actions using the PA STEEL method, the actions were prioritized according to five criteria agreed upon and ranked in importance by the

SPT. These ratings determined the cumulative scores for the mitigation actions and informed their prioritization in the 2013 Plan Update. They include:

1. Effectiveness (20% of score) – The extent to which an action reduces the vulnerability of people and property.
2. Efficiency (30% of score) – The extent to which time, effort, and cost is well used as a means of reducing vulnerability.
3. Multi-Hazard Mitigation (20% of score) – The action reduces vulnerability for more than one hazard.
4. Addresses High Risk Hazard (15% of score) – The action reduces vulnerability for people and property from a hazard(s) identified as high risk.
5. Addresses Critical Communications/Critical Infrastructure (15% of score) – The action pertains to the maintenance of critical functions and structures such as transportation, supply chain management, data circuits, etc.

Each mitigation action was given a priority ranking between zero and three. Priority assignment is as follows:

- Low priority (green) = 0 – 1.8
- Medium priority (yellow) = 1.9 – 2.4
- High priority (red) = 2.5 – 3

Actions and associated numerical rankings are included in *Appendix I – Mitigation Action Evaluation.*

On July 17, 2013 a Red Team Review was held with key SPT members to evaluate the results of the prioritization exercise and finalize the mitigation action plan.

6.2.4. Mitigation Action Plan

An evaluation of 2010 Mitigation Actions is provided in Table 6.2.4-1. Each lead and support agency was asked to provide an update or evaluation of activities completed to date. Not all entities responded. The Mitigation Action Plan was updated by incorporating comments and evaluations from the SPT which resulted in revised and new actions. A list of updated goals, objectives and actions is provided in Table 6.2.4-2.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-1a. Support new state-funded flood protection projects.	Flood	Pennsylvania Emergency Management Agency (PEMA); DGS; DEP	Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Programs; US Army Corp of Engineers (USACE); US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS); PennDOT; DEP	July 2013	Secure funding for at least three new state-funded flood protection projects by March 2012.	Continue. State funded projects: • Bloomsburg Airport – runway elevation (PennDOT, FAA) • Oil City Ice Boom • Conair manufacturing plant floodwall

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-1b. Support the maintenance of existing flood protection projects and construction of new state-funded flood protection projects and/or the rehabilitation of existing flood protection projects.	Flood	Department of Environmental Protection (DEP); Department Of Community And Economic Development (DCED); USACE; USDA; NRCS; Local Communities	DEP Flood Protection Line Item (currently unavailable); H20 PA Grant Program; Flood Mitigation Grant Program (DCED) Capital Budget, Clean Water Fund, USACE, USDA NRCS	July 2013; Ongoing	Secure funding to construct at least 5 new projects and/or rehabilitate existing projects by March 2012. Ensure existing flood protection projects are being operated and maintained to ensure a state of readiness. Provide annual workshops for Project Sponsors to discuss maintenance tips and latest technology.	Continue and update MOS. Secured funding to 17 projects including new and rehabilitation projects. Projects funded by the Capital Budget, H2O PA Flood Control Grant Program through DCED and remaining funds from DEP's Flood Protection Grant Line Item (Currently unavailable). 2 new flood protection projects were recently completed in Upper Dublin Township, Montgomery County, and Export Borough, Westmoreland County. Both projects were funded by the capital budget. Other investments we made in 2011 and 2012 in PL84-99 rehabilitation projects following major storms. DEP also contributed the 25 cost share required for all emergency watershed protection projects by NRCS following Hurricane Irene and Tropical Storm Lee. H2O PA funded the following: $1,042,199 to Sayre, Bradford Co., to make repairs and upgrades to an existing pump station; $1.1 million to DCNR to address structural deficiencies of the spillway located at the existing Marsh Creek Dam in Upper Uwchlan, Chester Co.; and $466,730 to Coudersport, Potter Co. for improvements to the Allegheny River and Mill Creek levees. DEP held a flood protection workshop in April 2012 in Johnstown, PA. The next flood protection workshop will be held in the Spring of 2014.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-1c. Provide non-federal match to project sponsors for FEMA Hazard Mitigation Assistance, NRCS, USACE and other federal funding sources.	Flood	PEMA, DEP Governor's Office	Agency Operating Budget, Capital Budget, DEP Flood Protection Line Limit (currently unavailable)	July 2013	Allocate FY 2011 funds for the non-federal match for the projects listed in Action 1-1a.	Continue. Secured funding to 17 projects including new and rehabilitation projects. Projects funded by the Capital Budget, H2O PA Flood Control Grant Program through DCED and remaining funds from DEP's Flood Protection Grant Line Item (Currently unavailable). 2 new flood protection projects were recently completed in Upper Dublin Township, Montgomery County, and Export Borough, Westmoreland County. Both projects were funded by the capital budget. Other investments we made in 2011 and 2012 in PL84-99 rehabilitation projects following major storms. DEP also contributed the 25 cost share required for all emergency watershed protection projects by NRCS following Hurricane Irene and Tropical Storm Lee. H2O PA funded the following: $1,042,199 to Sayre, Bradford Co., to make repairs and upgrades to an existing pump station; $1.1 million to DCNR to address structural deficiencies of the spillway located at the existing Marsh Creek Dam in Upper Uwchlan, Chester Co.; and $466,730 to Coudersport, Potter Co. for improvements to the Allegheny River and Mill Creek levees. DEP held a flood protection workshop in April 2012 in Johnstown, PA. The next flood protection workshop will be held in the Spring of 2014.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-1d. Support legislation to expand the definition of flood protection by amending the Flood Control Act and Stream Clearance and Rectification Act to include other mitigation methods such as "non-structural;" e.g., acquisition/ demolition, elevations, non-residential flood proofing, etc.	Flood	DCED; DEP; PEMA	Staff time; Legislative liaisons; Legislative Officials	December 2013	Gain support from at least two legislators to sponsor a bill to expand the definition of flood protection projects to give DEP the authority to implement non-structural alternatives by September 2011.	Change. House Bills 1954 and 1955 of 2009 were drafted and approved by the Environmental/Energy Committee but were never passed. Many legislators were not willing to support this because of funding issues. The primary sponsor had retired so this effort isn't likely to move forward at this time.
Action 1-1e. Create and implement criteria to prioritize communities with severe repetitive and repetitive loss properties for available mitigation grant funding.	Flood	Counties; PEMA	Staff time	December 2013	Develop criteria to prioritize communities with repetitive loss and severe repetitive loss properties by August 2011.	Continue and update MOS. Projects and communities with RL and SRL properties are prioritized in the grant review process. Criteria are outlined in the State and Administration Plans.
Action 1-1f. Target SRL and RL properties for mitigation including demolition, acquisition and elevation, through HMA funding through prioritization during annual HMA project review and prioritization process.	Flood	PEMA; Counties	FEMA Hazard Mitigation Assistance Programs; Staff time	December 2011	Mitigate five to six SRL properties per year.	Continue. More than 30 SRL properties were mitigated.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-1g. Incorporate prioritizing of SRL and RL property mitigation into the PEMA-HM strategy and the Administrative Plan post-flood-related disaster.	Flood	PEMA; FEMA	Staff time	1 year after a flood-related disaster	Support the development of five to six SRL properties mitigation applications per flood-related-disaster.	Continue. Projects and communities with RL and SRL properties are prioritized in the grant review process. Criteria are outlined in the State and Administration Plans.
Action 1-1h. Include the targeting of SRL and RL structures for mitigation in the mitigation strategies section of multi-jurisdictional or county §322 plan with SRL or RL properties.	Flood	PEMA	Staff time	June 30, 2011	Ensure that each multi-jurisdictional or county planning committee is aware and is implementing this requirement for all RL/SRL properties by March 31, 2011.	Continue. All county HMP's completed since 2010 include information on local RL and SRL properties in the vulnerability section and mitigation strategy.
*Action 1-2a.*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	February 2012	Identify all of the exact databases, and owners of those databases, to be evaluated by February 2011.	Continue and update MOS. Critical facility GIS data updated and incorporated in 2013 update. An in progress activity is Dr. Thomas Mueller from PENNHAZUS and California University of Pennsylvania and Cynthia McCoy of FEMA Region III collaborating on a survey which will assess the current status of GIS data in each County. The results will provide understanding of what data is available for future risk assessments and the overall geospatial capabilities of the State. The results which are due in November 2013 will be shared with PEMA for situational awareness and to improve future risk assessments in the Commonwealth.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-2b. 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.	Flood, All Natural Hazards	PEMA; Local jurisdictions	FEMA Hazard Mitigation Assistance Programs; USACE	December 2013	Identify at least 100 structures to be acquired/ demolished/ elevated/ relocated with FEMA HMA grant support by January 2011.	Continue. USACE/SJ initiated discussions with PEMA about potentially using SJ partners to help with Technical Assistance for SSAHMP project proposals. USACE may be able to use Flood Plain Management Services funding for this effort, or PEMA could request Technical Assistance funds from FEMA to engage other partners. 556 homes have been identified for acquirement and have in progress projects.
Action 1-3a. Define "critical facilities" in terms of mitigation.	All Hazards	PEMA; KEMA	Staff time	January 2013	Update Standard Operating Guidance with statewide critical facilities definition information.	Continue and update MOS. All County HMP's completed since 2010 define critical facilities and provide flood hazard vulnerability maps with critical facilities located. GOHS maintains a list of State critical facilities. KEMA will work to define standard critical facility types for counties.
Action 1-3b. Review state executive order for floodplain management to consider appropriate opportunities to address multiple hazards and to encourage mitigation of state-owned or regulated facilities through a similar mechanism.	All Hazards	Department of General Services (DGS); Office of Administration (OA	Staff time	December 2013	Gain support from at least two members of the Emergency Management Council, Keystone Emergency Management Association (KEMA), and the code enforcement agency to re-evaluate the state executive order for floodplain management by November 2011.	Change. DGS will not build in floodplain. Gained support from multiple EMC members and KEMA.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-3c. Encourage mitigation of private sector infrastructure through technical assistance, education, demonstrations, etc.	All Hazards	PEMA; DL&I; DCED; OHS; DHS; PSP; State Police	Staff time; Agency Operating Budget; State Police	January 2013	Identify largest private sector owners of critical infrastructure and hold one meeting with each to discuss implementing mitigation projects within their business plans and protocols by January 2013.	Continue and update MOS. Private sector critical infrastructure owners identified through Southeastern PA through the Critical Infrastructure Protection Work Group. Worked with County COCs to identify private sector owners.
Action 1-3d. Leverage support of the nine Regional Task forces to support critical infrastructure mitigation.	All Hazards	PEMA; Regional Tasks Forces	80% of State Homeland Security Grant Program Mitigation Recovery Areas associated with HS Program	January 2013	Attend one meeting for each regional task force to discuss opportunities to leverage support and summarize spending and mitigation capacity in the 2013 Plan Update.	Continue and update MOS. No progress to date. Funding not available.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action1-3e. Continue to use and improve GIS capability to prioritize hazard/critical infrastructure for mitigation.	All Hazards	PEMA	Staff time	December 2013	Assign mitigation priorities to critical infrastructure by June 2011.	Continue. DGS is in the progress of collecting location, risk, and protective measures information for all state owned and leased facilities, which will help prioritize which critical infrastructure and facilities is most in need of mitigation. PENNHAZUS is working with FEMA to understand what local-level GIS capabilities are to assist in a state-level roll up of local critical infrastructure. Julie Yu and Steve Kiouttis are working with FEMA Region III on using HAZUS to assist in prioritization and risk identification for PEMA. There are also now GIS and HAZUS capabilities in the SEOC. The Governor's Office of Homeland Security is working to collect a more robust state-level critical infrastructure list that leverages local GIS data for state prioritization Current data was used as described in Section 4.1.3.
Action 1-3f. Continue to support LiDAR data development initiative.	Flood	PEMA; Department of Conservation and Natural Resources (DCNR)	Emergency Management Performance Grants (EMPG); National Preparedness Funds	July 2013	Finish remaining five counties' LiDAR data collection by 2012.	Completed. Update MOS.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-3g. Identify insurable state leased flood-prone buildings and appropriate mitigation methods if located in the special flood hazard area (SFHA).	Flood	DGS; DCED; DCNR	FEMA Hazard Mitigation Assistance Programs; USACE	December 2013	Continue to coordinate with DGS to see progress of DGS database for use in HMP work.	Continue. DGS has secured funding to collect the location of all state owned and leased facilities vis-à-vis the floodplain. They are collecting information for all state entities, not just those under the purview of the governor. This information should be ready for inclusion in the 2016 plan. See Section 4.1 for more details. Additionally, the number of counties with new/updated DFIRM data has increased since 2010; no counties have Q3 as the best available data, thus increasing the robustness of SFHA identification statewide.
Action 1-3h. Evaluate state-owned structures for mitigation options for non-flood related high-priority hazards.	All Hazards	PEMA; Identified state agencies	Homeland Security Grant Programs 20% Portion	December 2013	Identify all state-owned structures vulnerable to high priority hazards by March 2011.	Continue. DGS will be collecting information on other protective measures like generators, sprinkler systems, fire alarms, etc. They are also collecting information on construction type. sewage type and water supply. This information will be especially helpful in addressing winter storms, where construction type is a vulnerability factor, and utility interruptions. DGS is collecting information for all state entities, not just those under the purview of the governor. See Section 4.1 for more details.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-3i. Encourage cross-agency education and coordination for the adoption of DGS's hazard-specific siting and design criteria for state owned, operated, and leased facilities	All Hazards	DGS; OA; PEMA	Staff time	December 2013	Identify and include documentation of new procedures in the 2013 Plan Update. Work toward a more complete version of DGS's existing database of state facilities, especially in identifying facility features that impact risk and loss estimates, for the 2016 Plan Update.	Complete. DGS does not build in floodplain. Action 1-3b continues/combines this action to address other hazards.
Action 1-4a. Support the creation of a Commonwealth fusion center.	Terrorism, Civil Disturbance	PEMA; Pennsylvania State Police; OA	Department of Homeland Security (DHS) Grant Funding	December 2013	Identify the resources that would need to be acquired to develop and operate a fusion center by January 2012.	Continue and update MOS. The Delaware Valley Intelligence Agency (DVIC) opened in June 2013. Pennsylvania Criminal Intelligence Center (PCIC) established through State Police. Allentown Criminal Center established. Southwestern PA Region 13 Fusion Center; Pittsburgh, PA.
Action 1-4b. Promote reverse notification systems in high-hazard areas.	All 1-9a Hazards	Counties	DHS Grant Funding; Act 78 Funding	June 2013	Identify and catalog success stories of jurisdictions utilizing reverse notification system and develop promotional materials to distribute to local jurisdictions by June 2012.	No progress.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-4c. Increase participation in PA Alert.	All Hazards	OA; PennDOT	DHS Grant Funding	June 2011	Increase participation by 10%.	Complete but ongoing. PA Alert participation increased from 6,403 in 2010 to 57,510 as of July 2013 (89% increase). The increase has been steady at approximately 10,000 per year.
Action 1-5a. Re-examine impacts of federal levee guidance and impacts and identify necessary actions.	Flood; Levee Failure	DEP; DCNR; USACE	Staff time	December 2013	Continue to work with the USACE to implement the National Levee Safety Program and refine an inventory of all levees in the Commonwealth.	Continue. Delineate between proper and spoiler levees.
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; USACE	Staff time	December 2016	By 2013, DEP has performed outreach activities with 50% of levee owners.	Continue. Due to limited DEP staff resources and currently unavailability of the flood protection line item this was not completed.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-5c. Conduct an assessment to identify number of structures located within levee protected areas. This data can be included on FEMA's Mid-term levee inventory along with DEP's levee condition ratings (i.e. unacceptable, minimally acceptable, acceptable).	Flood; Levee Failure	DEP; FEMA; PEMA	Staff time	July 2013	Identify and prioritize based on analysis by July 2013.	Change. In order to identify the number of structures within levee protected areas, inundation maps would need to be available. Levee inundation maps are not currently available. DEP is in the process of developing emergency action plan guidelines for flood protection projects to assist project sponsors with developing project specific EAPs including inundation maps. Guidelines should be finalized by December 2013.
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; USACE	Staff time, DEP Flood Protection Line Item (currently unavailable), capital budget, H20 PA Grant Program, local government	July 2013, Ongoing	Conduct annual levee inspections and secure funding for project improvements by July 2013.	Continue and update MOS. Due to limited DEP staff resources and currently unavailability of the flood protection line item this was not completed.
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; DEP Flood Protection Grant	December 2010	Obtain Emergency Action Plans for 65% of state levee systems by December 2012.	Continue. DEP is in the process of developing emergency action plan guidelines for flood protection projects to assist project sponsors with developing project specific EAPs including inundation maps. Guidelines should be finalized by December 2013.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-6a. Create partnership between PEMA and DL&I to develop and deliver a workshop on building code implementation.	All Hazards	PEMA; DCED	HMGP 5% Initiative	December 2012	Provide six workshops statewide by December 2011.	Change. Implemented through the PA Construction Codes Academy (DCED).
Action 1-6b. Provide briefings to code association and county officials on damage assessment expectations following a disaster.	All Hazards	PEMA; DCED	EMPG	Ongoing	Provide 3 statewide briefings annually.	Continue and update MOS. Code officials were briefed following disasters Irene and Lee.
Action 1-6c. Request the Pennsylvania Association of Building Code Officials and Pennsylvania Association of Code Officials along with various county agencies previously identified (as well as Council of Government organizations (COG) where they exist) in areas to attend outreach meetings related to building resiliency and mitigation of structures.	All Hazards	PEMA; DL&I	Organizational funding	December 31, 2013	Conduct building code related Silver Jackets meeting and present at one building code related meeting or conference by December 2013.	Continue and update MOS. Implemented through the PA Construction Codes Academy. Code officials were briefed following disasters Irene and Lee with an emphasis on substantial damage estimator (SDE) tool.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-7a. Build on Silver Jackets initiative and 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	Staff time; National Dam Safety Program grant; USACE Silver Jackets, Dam Owner	December 2012	Host meeting by May 2011. Ensure that 95% of high hazard dams have completed a dam break analysis in order to develop a digital inundation map by December 2012.	Continue. 93 percent of high hazard dams currently have approved emergency action plans including inundation maps. The digital maps of inundation areas are in the process of quality assurance and quality control; this process includes quality control reviews at the county level.
Action 1-7b. Identify and implement mitigation actions based on Silver Jacket meeting results.	Flood, Dam Failure	PEMA; DEP; USACE	Staff Time	December 2013	Conduct capability assessment of departments and agencies that can assist with mitigation implementation by December 2013.	Continue. High hazard dams are inspected annually by DEP to ensure proper operation and maintenance in accordance with the rules and regulations of Chapter 105. Non-compliant dams are subject to enforcement action by DEP. DEP does not regulate locks or hydro-electric dams. High hazard dams are monitored during flood events
Action 1-7c. Evaluate and enforce appropriate remediation of dams.	Flood, Dam Failure	DEP	Staff time; PENNVEST loan and grant program, H20 PA Grant Program; Growing Greener, capital budget, dam owner	December 2013; Ongoing	Identify applicable dams and enforce and assist with remediation.	Continue. High hazard dams are inspected annually by DEP to ensure proper operation and maintenance in accordance with the rules and regulations of Chapter 105. Non-compliant dams are subject to enforcement action by DEP. DEP does not regulate locks or hydro-electric dams. High hazard dams are monitored during flood events

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-7d. Ensure that all high hazard dams to have an Emergency Action Plan as required.	Flood, Dam Failure	DEP, PEMA	Staff Time; Dam owner	December 2012	Obtain PEMA and DEP approved Emergency Action Plans for 95% of high hazard dams by December 2012.	High hazard dams are inspected annually by DEP to ensure proper operation and maintenance in accordance with the rules and regulations of Chapter 105. Non-compliant dams are subject to enforcement action by DEP. DEP does not regulate locks or hydro-electric dams. High hazard dams are monitored during flood events.
Action 1-8a. 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; DEP	Community Assistance Program – State Support Services Element (CAP-SSSE)	Continuous	Maintain or increase NFIP participation after DFIRM update ordinance reviews. Promote early review and submission of ordinances to DCED.	Continue. This information is recorded by DCED during the ordinance update/adoption process. It is noted on the review checklist which is completed on paper and filed. DEP does not allow gas wells or sewage systems in the floodplain.
Action 1-8b. Conduct effective outreach with municipalities to explain value of floodplain ordinances and adopting more restrictive requirements.	Flood, All Hazards	DCED; PEMA; DEP	Community Assistance Program – State Support Services Element (CAP-SSSE)	Continuous	Reach 200 municipalities annually with ordinance related materials.	Continue. More than 1000 PA communities have been invited to attend CCO meetings associated with the Risk MAP process. In 2010, 112 municipalities attended, in 2011, 217 attended, in 2012, 51 attended, and in 2013, 42 attended. Meetings typically have a FEMA and DCED representatives on hand to discuss flood mapping, insurance, and ordinance requirements.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-9a. Conduct formal statewide community risk assessment using RAMS database.	Wildfire	DCNR Bureau of Forestry; Office of State Fire Commissioner	Staff time	June 2011	Risk assessment disseminated to all communities by June 2011.	Continue. There has been no update of the 2008 municipal-level wildfire risk/hazard evaluation. Activities to conduct local risk assessments can be tracked moving forward.
Action 1-9b. Work with Firewise communities to complete grant applications for outreach and fuels reduction projects.	Wildfire	DCNR Bureau of Forestry; Office of State Fire Commissioner	Staff time	December 2013	The number of submitted grant applications increases by 10% by December 2013.	Continue and update MOS. 36 Firewise communities exist in Pennsylvania, but their progress in competing for grants has not been tracked to date. Firewise activities will be tracked moving forward.
Action 1-10a. Promote linkages between PEMA, DEP mine safety programs, and the DL&I's Mine Safety and Health Administration to encourage mitigation where surface mine and subsidence hazards exist by creating interagency working group.	Subside nce Sinkhole	PEMA; DEP – Mine Safety; Counties impacted by surface mine related hazards	State Funding	December 2011	Identify members of responsible agencies to participate in an interagency working group by December 2011.	Change. DEP participated in a work group after Tropical Storm Lee to discuss mine related flooding. The meeting was also attended by MSHA OOSM.
Action 1-10b. Fully characterize coal ash basin inundation zones, rank hazards, and develop mitigation actions.	Environ-mental Hazards	DCNR; DEP/Bureau of Mining and Reclamation/Bureau of Waterways Engineering; PEMA	State Funding; U.S. Environmental Protection Agency	September 2013	A detailed risk assessment including loss estimate regarding coal ash basin failure is included in the 2013 PEMA state hazard mitigation plan.	Continue and update MOS. Slurry ponds (coal ash basins) are included in the 2013 Environmental Hazards profile. Digital inundation maps are not available. Will work towards requiring inundation maps as part of emergency plans.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-11a. Fully identify impacts and consequences of Marcellus Shale natural gas extraction operations.	Environ-mental Hazards	DEP; Counties impacted by Marcellus Shale	Potentially state severance tax	March 2011	Schedule a roundtable discussion with State and/or national experts to discuss the consequences of Marcellus Shale natural gas extraction operations by January 2011.	Continue and update MOS. Multiple discussions and workshops have occurred on both a state and local level over the last 3 years. Through Act 9 an EOP annex template for an Unconventional Well Site Emergency Response Plan was developed by PEMA for counties. Additional Act 9 regulations pertaining to oil and gas incidents were put in place. Over $200M was raised from Act 13 impact fees and distributed to local and state programs Currently DEP is conduction TNORM, flowback and water impacts studies related to unconventional gas extraction.
Action 1-11b. Identify mitigation options for identified impacts and consequences.	Environ-mental Hazards	DEP; PEMA; Counties impacted by Marcellus Shale	Potentially state severance tax	December 2011	A preliminary list of actions will be identified by June 2011.	Continue. Drillers are no longer permitted to take frac water to water treatment plants.
Action 1-11c. Provide training that will enable counties to mitigate the negative impacts of Marcellus Shale extraction.	Environ-mental Hazards	DEP; Office of State Fire Commissioner; Partnerships with private sector; Counties impacted by Marcellus Shale	Potentially state severance tax; Act 13 Unconventional Wells (impact fees)	July 2012	Develop training by January 2012.	Continue. State Fire Commission conducted training exercises.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-12a. Maintain access to the National Flood Insurance Program (NFIP) BureauNet database of repetitive loss properties.	Flood	DCED; FEMA; PEMA	Staff time	Continuous (meet annual requirements)	Ensure identified PEMA and DCED program managers receive by BureauNet access by October 2010.	Continue. This action is ongoing and supported by FEMA JFO staff. Millie Hanks supported the RL and SRL data collection for the 2013 SSAHMP by proving exports of RL, SRL, and ICC data. Tom Hughes and Dan Fitzpatrick also maintain access to BureauNet.
Action 1-12b. Improve the accuracy of geo-locational data on RL and SRL properties by researching matches for properties with incomplete and/or out-of-date address based on rural road designations that have changed.	Flood	DCED; PEMA; Counties	Staff time and travel	Continuous	Work with county staff to identify efficient means of geocoding remaining ~4,000 properties June 2011.	Continue and update MOS. Obtained latitude/longitude for properties. A team worked with county officials in Columbia, Dauphin, Wyoming, and Luzerne Counties over a 3 week period to verify RL/SRL locations. BureauNET was updated.
Action 1-12c. Align RL and SRL property data with validated FEMA NFIP RL and SRL property data annually.	Flood	DCED; PEMA	Staff time	December 2012	Establish schedule for routinely extracting validated property information from BureauNet by April 1, 2011.	Continue. Performed annually via letter.
Action 1-12d. Use the Greatest Savings to the Fund (GSTF) data and methodology to promote the cost-effectiveness of SRL property mitigation for HMA grant applications.	Flood	PEMA	Staff time	June 2011	Use Greatest Savings to the Fund data in HMA grant applications, when applicable.	Continue. Used when applicable; GSTF data has not been updated since 2011.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-12e. Report the successes of flood-related projects in the annual update of the SSAHMP 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	Staff time	Continuous (annual requirement)	Submit annual reports on time; solicit support for SRL funding to compile data.	Continue. An annual report was (and will continue to be) drafted and submitted to the Governor's Office outlining mitigation success in the Commonwealth. Mitigation Success section drafted and included in 2013 update.
Action 1-12f. Examine the FEMA-PEMA SRL and RL data sets to seek properties that could potentially be mitigated through the FEMA RFC, SRL or other HMA funding programs or any other funding sources on an annual basis.	Flood	PEMA; Counties	Staff time	December 2015.	Improve prioritization criteria for project selection in both pre- and post-disaster modes.	Continue. RL/SRL projects are given prioritization under the current prioritization method.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-13a. Update annually the list of completed SRL and RL mitigated properties and use GIS or other methods to merge FEMA's SRL and RL database with Pennsylvania's mitigated properties database. Update the merged database when each HMA grant closes or whenever local data becomes available.	Flood	PEMA; Counties	FEMA Hazard Mitigation Assistance Programs (management costs)	Continuous	Include information in annual report (Action 1-12e);100% compliance needed.	Continue. SRL/RL data has been updated and cross referenced with ICC data. See Appendix F.
Action 1-13b. Complete FEMA Form AW-501 for each mitigated property and provide to FEMA through FEMA database or submittal to Region III upon project close-out.	Flood	Municipalities; PEMA	Staff Time and HMA Funding	Continuous (tri-annual requirement)	Tri-annual report accurately submitted on time.	Continue. PEMA has completed projects from the JFO to assist communities with these forms over the last 3 years, though AW-501 form completion remains a municipal responsibility.
Action 1-13c. Use GIS to merge the Increased Cost of Compliance SRL and RL database with Pennsylvania's mitigated properties database annually.	Flood	PEMA	Staff Time	Continuous (annual requirement)	Annual report accurately submitted on time.	Continue. Requirements continue to be met.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 1-13d. Ensure that the latitude and longitude of each property is confirmed during project close-out as well as during sponsoring community's three-year mitigation compliance inspection for completed properties. Update mitigated properties Excel workbooks to assure accurate status of mitigated RL and SRL properties.	Flood	Municipalities; PEMA	FEMA Hazard Mitigation Assistance Programs (management costs)	Continuous	Accurately submitted tri-annual reports and project close-outs.	Continue and update MOS. RL/SRL property information accuracy and documentation of mappable addresses increased significantly between 2010 and 2013. Information will continue to be improved in next plan implementation phase.
Action 1-13e. Contact counties with SRL properties to confirm the number and type of mitigated properties and source of funding, if known. This approach can be used to establish an ongoing process of verifying addresses by gathering latitude and longitude data and will ensure currency of the FEMA RL and SRL data sets.	Flood	PEMA; Counties; Municipalities	Staff time	Continuous	Contact half of the jurisdictions with known SRL properties by June 30, 2011. Contact the remaining half by June 30, 2012. Contact other counties that may not have RL or SRL properties which had unknown damage. Engage community staff in strategies consistent with local mitigation plans to address RL and SRL properties.	Continue and update MOS. RL/SRL property information accuracy and documentation of mappable addresses increased significantly between 2010 and 2013. Information will continue to be improved in next plan implementation phase. PEMA sends list regularly to counties and changed the MOS to focus on outreach to 2 counties per year starting with the locations with the highest number of RL and SRL properties.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 2-1a. Ensure all critical government facilities have COOP and COG plans and have begun implementing appropriate back-up systems.	All Hazards	OA with support from all State Agencies; Counties	State agency funding; DHS grants	December 2013	Identify and prioritize critical facilities and infrastructure that require additional back-up systems by June 30, 2011.	Complete. Change. State government agencies now have COOP/COG plans in place. The measure of success for this action will become an action in the 2013 plan update.
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 and COG plans (or Business Recovery Plans).	All Hazards	PEMA; OHS; DHS	Staff time	January 2013	Complete two outreach workshops by January 1, 2013.	Continue. DHS/OHS has performed outreach to various businesses through the DVIC I the greater Philadelphia and assisted with planning.
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; Municipalities	Staff time; Plans funded by Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Program (HMGP) funding	Continuous	Train local jurisdictions in using the Hazard Mitigation Planning Toolkit and promote its use for effective development of local HMPs in Pennsylvania.	Complete. Change. Local risk assessment information incorporated into 2013 SSAHMP update. Toolkit Workshops completed for county planners and emergency managers.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 2-2b. Silver Jackets work to identify current policies, plans, regulations, and laws that should include mitigation.	All Hazards	PEMA; Other State Agencies; Silver Jackets; PAFPM	Staff time	January 2012	Work with appropriate state agencies to educate them on the Silver Jacket Program. Identify and work to resolve statutory or regulatory conflicts for mitigation efforts. Work with other planning teams to ensure mitigation principles are addressed in other plans. Promote use of best management practices for land use and other regulations by local government.	Complete. Continue and update MOS. A virtual tool was developed by PA Silver Jackets to assist the public with navigating through available hazard mitigation programs. http://www.nab.usace.army.mil/Home/SilverJackets.aspx. In addition, the SJ Team just helped host flood proofing workshops in the State and is just now completing a flood inundation project for the Susquehanna River near Harrisburg (available now on SRBC SIMV: http://maps.srbc.net/simv/ and soon on NWS AHPS) The SJ did not complete a specific project to resolve statutory or regulatory conflicts for mitigation efforts. Moving forward it was decided that the MOS should change to include lessons learned and planning guidance for local officials in the SJ mitigation guide.
*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	Staff time	October 1, 2012	Prioritization of action items from local plans is consistently summarized in the 2013 plan update for all counties.	Continue. Highest priority actions could not be obtained as most local HMP's use PA STEEL for evaluation and prioritization and this method is primarily useful for qualifying feasibility. A mitigation action prioritization method was developed and implemented in the 2016 update. Local guidance will be updated accordingly.
Action 2-3a. Canvass decision makers (mayors & County EMAs) and determine what data they need.	All Hazards	PEMA	Staff time	December 2012	Develop a comprehensive list of types of data that decision-makers might need by December 2011.	Change. Local needs have been tracked through the county HMP process. This action will be re-structured to include identification and sharing in the 2013 update.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 2-3b. Build a network of data stewards.	All Hazards	PEMA; Municipalities	Staff time	July 2012	Create goals, objectives, and roles and responsibilities for the stewards by January 2011.	Continue and update MOS. PASDA is the PA Spatial Data Access clearinghouse which contains aerial photography, elevation/topos, and other statewide data. PennHAZUS user groups.
Action 2-3c. Develop data-sharing protocols.	All Hazards	PEMA; OA; OIC	Staff time	January 2012	Create and distribute a protocol that encourages local jurisdictions to coordinate with state when updating plans and best available data by January 1, 2012.	Continue. Currently underway.
Action 2-4a. Identify County Hazard Mitigation Officers and the lead agency team members (planning, emergency management, GIS/data management, and conservation districts) for hazard mitigation in each county.	All Hazards	PEMA and Area Offices; Counties	Staff time	Continuous	Review list of County Hazard Mitigation Team Members from planning emergency management and conservation districts and update annually.	Continue and update MOS. PEMA maintains HM list for email blasts/trainings/etc., which includes EMC, planning, GIS, and conservation district personnel.
Action 2-4b. Create State/Federal charter and bring county leads and planning champions together for regular meetings, knowledge exchanges, and trainings.	All Hazards	PEMA; Counties; DCED' KEMA	Staff time; Agency operating budget; FEMA-sponsored training	December 1, 2015	Provide three consolidated planning workshops/seminars throughout the state.	Continue and update MOS Held integrated planning workshop in Bucks County. Once a more comprehensive list of invitees is created, statewide workshops will be conducted.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
*Action 2-4*c. Involve appropriate county mitigation plan team members in hazard mitigation implementation activities.	All Hazards	PEMA; Counties	Staff time	Continuous	Offer training or meeting opportunities for county mitigation planning team members at PEMA Annual Conference.	Continue. No progress to date. To be completed in Fall 2014.
Action 2-4d. Identify and pursue 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	2013	Complete high priority mitigation actions.	Continue. Progress was made on all high priority mitigation actions.
Action 2-4e. Develop County Hazard Mitigation Suggested Curriculum.	All Hazards	PEMA; Counties	EMPG	January 1, 2013	Encourage at least one member of the local hazard mitigation team with a Certified Floodplain Manager (CFM) certification.	Continue and update MOS Will work to provide EL 213 and EL214 classes. Work with EMI for FPM, GIS, etc. to put together curriculum.
Action 2-5a. Ensure that mitigation, planning, preparedness, and response personnel are cross-trained in each others' areas of expertise.	All Hazards	PEMA; Counties; Municipalities	Emergency Management Institute (EMI) Training Assistance	July 1, 2012	Establish sample training schedule for all first responders by July 1, 2011.	Discontinue. EM are regularly cross trained. PEMA training program includes multiple areas and training has been updated. This action will be discontinued as it is a standard operation.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 2-5b. Improve cooperation/ coordination of agencies with real time data (gauge station data, program availability, etc.).	All Hazards	Local, county, and state public safety agencies with planning support agencies	Various	Continuous	Establish a data exchange platform to share real time data by July 1, 2011. Meetings held where different officials can learn about different types of data available. Document success stories for 2013 update.	Continue and update MOS No progress. This will likely be taken care of by EOC. This action will be revised in 2013 to include consolidating data.
Action 2-5c. Reach out to agencies that were invited but did not participate in 2010 planning process.	All Hazards	PEMA; Silver Jackets	Staff time; USACE	October 1, 2012	Participation in 2013 State Plan update builds on 2010 success and has more than 45 participating agencies/organizations/ county representatives.	Continue. Thirty-seven agencies participated in the 2013 udpate. Eleven of the participating agencies were new to the planning process and did not participate in 2010. APA, KEMA and PSATS participated.
Action 3-1a. Develop and maintain a comprehensive list of relevant regional agencies, including Councils of Government (COGs), River Basin Commissions, and Metropolitan Planning Organizations (MPOs).	All Hazards	PEMA	Staff time	January 1, 2012	Identify a champion of this activity to oversee its development by January 1, 2011.	Continue. PEMA maintains HM list for email blasts/trainings/etc., which includes HM and planning, conservation district personnel. Will add GIS contacts moving forward.
Action 3-1b. Require Local Hazard Mitigation Plans to list relevant regional agencies.	All Hazards	PEMA	Staff time	Continuous	Ensure communities address this requirement in local HMPs.	Continue. PA HMP local guidance ensures that relevant agencies and capabilities are listed in the Capability, Integration, and Planning Team sections for local HMPs.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 3-1c. Assess and identify locations where regional coordination between local HMPs would be beneficial to achieving efficiencies in mitigation efforts.	All Hazards	Counties; DCED; other State Agencies as applicable	Staff time	January 1, 2013	Have 2 joint county grant applications by June 2011.	Continue and update MOS. Individual county plans are encouraged. PEMA is not seeking joint applications. As per FEMA guidance, communities are required to attempt to include surrounding counties/jurisdictions, in the HMP process.
Action 3-1d. Continue to support Pennsylvania Department of Education (PDE) in its multi-hazard school planning efforts.	All Hazards	PDE	Agency Operating Budget	Continuous	PDE submits 5 plans per year and shares them with local county hazard mitigation team.	Continue and update MOS. This has not occurred. However, safe schools planning guidance was developed, school resource officers positions were funded, PASBO pamphlets were distributed, and PEMA will attend the PASBO conference and distribute relevant information.
Action 3-1e. Identify and encourage involvement of key business, industry, and infrastructure stakeholders and stakeholder associations in mitigation.	All Hazards	Local jurisdictions and Chamber of Commerce	Agency Operating Budgets	Continuous	Identify potential business/industry and infrastructure partners that should be involved in mitigation and invite them to planning meetings between October 2010 and December 31, 2013.	Continue and update MOS. Invited and included industry and infrastructure partners to non-structural workshops and to participate in the HMP process.
Action 3-2a. Maintain and improve Pennsylvania's Hazard Mitigation Planning and Project Toolkit and related training, including Standard Operating Guide, Plan Builder, Library and other tools.	All Hazards	PEMA	EMPG	September 2010	Encourage all counties complete update process using new HM Toolkit.	Continue. The PA Standard Operating Guide is being updated as part of the 2013 SSAHMP update and will include new guidance in accordance with FEMA local HMP guidance and new action ranking methodology.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
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	Increase non-disaster and disaster project grant applications by 20% by 2013. Improve the specificity of funding sources within the 2010 Mitigation Actions by October 2011.	Continue and update MOS. No NDG in 2011 or 2012. PEMA utilized DR-1898, 4025, 4030, and 4099. Silver Jackets 2011 guidance identifies multiple funding sources. Increased project grant applications by more than 20% with 40 community sub-applicants.
Action 3-2c. Facilitate hands-on trainings regarding planning, project tools, as well as FEMA *e*Grants trainings.	All hazards	PEMA	Staff time; FEMA support	December 31, 2013	Conduct FEMA *e*Grants training by November 30, 2011. Conduct timely trainings as a part of at least 2 quarterly trainings per year.	Change. Applicants were required to take IS-30 course prior to gaining access to eGrants. Conduct timely trainings as a part of the following: • April 2013, PEMA Super Quarterly Training • July 2011, Pre-Conference Day and 4 HM Sessions at 2011 Conference • Oct 2011, PEMA C/A Quarterly Training • Jan 2012, PEMA C/A Quarterly Training • Nov 2012, Provided briefings for counties and municipalities on grant application process for Disaster 4099

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
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	Continuous	Thirty university, business, or regional organization personnel participate in meeting, training, or site visits by 2013. Create and implement a policy on the role of DRU plans in the mitigation strategy of the Commonwealth in the future.	Change. PA State System of Higher Education (PASSHE) is participated in quarterly training and FEMA-318 and is facilitating the update of state university HMP's.
Action 3-2e. Promote Hazard mitigation project tours to students at Emergency Management Institute (EMI), FEMA Regional staff, and FEMA Headquarters staff.	Natural Hazards	PEMA	Staff time	Continuous	Ten EMI, FEMA Region III, or FEMA Headquarters staff attends project site tour by 2013 and two EMI classes use site visit to Pennsylvania as a benchmark.	Continue and update MOS. Silver Jackets organized two HM project bus tours. This action will be revised to focus on flood related projects.
Action 4-1a. Facilitate tours or visits to mitigation projects, or areas where mitigation efforts are needed to local and county officials and state legislators.	All Hazards	Counties; Local Jurisdictions; PEMA	Staff time	July 31, 2013	Send invitation to site tours to organizations that organize jurisdictions in Pennsylvania and have 20 legislators attend a site tour visit by July 31, 2013.	Continue and update MOS. Silver Jackets organized two HM project bus tours. Attended and participated in hearings as requested. DEP flood protection workshop included legislators.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 4-1b. Develop and disseminate relevant information on hazard mitigation programs.	All Hazards	Counties; PEMA; DEP; DCED; Silver Jackets	FEMA Hazard Mitigation Assistance Programs	December 31, 2011	Coordinate with FEMA and other agencies to obtain relevant mitigation information to disseminate to the public by July 31, 2011.	Continue. A virtual tool was developed by PA Silver Jackets to assist the public with navigating through available hazard mitigation programs. http://www.nab.usace.army.mil/Home/SilverJackets.aspx In addition, the SJ Team just helped host non-structural flood proofing workshops in the State and is just now completing a flood inundation project for the Susquehanna River near Harrisburg (available now on SRBC SIMV: http://maps.srbc.net/simv/ and soon on NWS AHPS)
Action 4-1c. Document and share in-state success stories and best practices.	All Hazards	PEMA; Counties	Staff time; conference fees; printing fees; and WebEX costs	Continuous	Create and disseminate a brochure that identifies success stories by December 31, 2011 and conduct one presentation on success stories each year by 2013. Add success stories to FEMA website.	Continue. An annual report was (and will continue to be) drafted and submitted to the Governor's Office outlining mitigation success in the Commonwealth.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 4-1d. Perform a "Losses Avoided" study on mitigated SRL or RL properties to communicate money saved in response and recovery so that decision makers, community officials and property owners will be interested in mitigating specific properties.	Flood	PEMA	State funding; CAP-SSSE; Risk Map funding via FEMA Region III; USACE	October 2013	SRL and RL "Losses Avoided" analysis results included in the 2013 Plan Update.	Continue. Losses avoided were estimated and summarized in the Flood hazard profile of the 2013 SSAHMP update.
Action 4-2a. Expand working relationship with professional organizations including: NEMA, IAEM, ASFPM, KEMA, PAFPM, APA, PSATS, PAB, CCAP, League of Citizens, and Code Enforcement Officers.	All Hazards	PEMA	Staff time; Agency operating budget	January 31, 2013	Attend at least 2 new organization conferences and invite 2 new organizations to state Emergency Management conference.	Continue. Attended and presented at the 2011 APA conference in Scranton. KEMA was invited to Super Training PSATS, Borough Association, League of Citizens, among others, attended Silver Jackets briefing.
Action 4-2b. Invite two PA-based professional organizations with emphasis on inviting PA Association of Floodplain Managers (PAFPM) participation to be involved in the Silver Jackets Program.	All Hazards	PEMA	Staff time; Agency operating budget	Continuous	One PAFPM member and one member of another professional organization regularly attend Silver Jackets meetings between 2010 and 2013.	Change. Representatives from KEMA, Susquehanna River Basin Commission, and Lycoming County Planning regularly attend Silver Jackets meetings.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 4-2c. Promote an increase in the number of CFMs.	Floods	PAFPM; PEMA; DCED	Staff time	Continuous	Increase number of CFMs in PA to 100 and assist PAFPM in becoming a full chapter by 2013.	Continue and update MOS. No progress to date. Ongoing.
Action 4-2d. Develop a working relationship with private insurance and financial sector companies.	All Hazards	Department of Banking; Department of Insurance; PEMA	Staff time	July 31, 2011	Invite Department of Banking and Department of Insurance to applicable Silver Jackets by July 31, 2011. PEMA; DCED, and Department of Insurance participate in annual FEMA Region III insurance update meeting.	Continue and update MOS FEMA's Rich Sabota briefed PEMA on NFIP. A Department of Insurance representative (EPLO, EO, and Silver Jackets) attended municipal briefings after recent disasters to discuss insurance.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 4-3a. Identify statutory, regulatory or other barriers that currently exist with respect to mitigation efforts and build consensus and support with decision makers to promote mitigation related projects. For example, promoting riparian buffers can create areas to carry flood waters, but standing water can encourage the growth of mosquitoes and the Increased incidences of West Nile virus. This action will address these kinds of conflicting goals.	All Hazards	PEMA; Office of General Counsel	Staff time	Continuous	Schedule joint or separate meetings between State Hazard Mitigation Officer, State Historic Preservation Officer, FEMA Region III environmental officer, and PEMA legislative liaison, and present at quarterly State Land Use meeting by March 31, 2012.	Continue and update MOS. Progress towards plan integration includes new section in SSAHMP, new section in SOG, SJ Initiative, Tom presented at Main Street Program presentation in Lewisburg. Met with President's Advisory Council on Historic Preservation (ACHP), FEMA HQ EHP, Pennsylvania Historical and Museum Commission (PHMC) key staff and DCNR greenway planning. It was recommended to change measure of success since State Land Use committee is less active then in 2010. Action explanation reduced since plan integration is addressed and explained in Capability Section of plan.
Action 4-4a. Consider tax incentives and bonds for mitigation.	All Hazards	Pennsylvania; PEMA; KEMA	State funding	December 31, 2011	Develop a list of potential mitigation actions that could be associated with tax incentives and bonds by March 31, 2011.	Continue. No progress. KEMA will become involved with this effort.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
*Action 5-1*a. Develop and provide presentations on hazard mitigation programs and sponsor conference booths (exhibits).	All Hazards	PEMA; State Planning Team members	State funding	December 31, 2013	Research local, regional, and State-level conferences that the Commonwealth should attend, and develop a conference schedule by June 30, 2011.	Completed. Continue. BORM drafted list and sent to State Training office to include in 5-year plan. SJ Team non-structural flood proofing workshops is a sample of success on this action.
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	December 2012	Draft agenda and materials for the workshops and sessions by January 30, 2012.	Continue. Addressed regularly with quarterly progress reports and webinars. It was recommended to change measure of success.
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	July 31, 2013	Meet at least annually with Citizen Corps program director to discuss how to integrate hazard mitigation and preparedness into Citizen Corps programs.	Continue. Progress includes NWS outreach, and PAReady outreach. ReadyPA/Pennsylvania Citizen Corps bookmarks have been distributed to about 2000 PA 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 which will was implemented in 2011 and translation for the web of ReadyPA materials into Russian, Korean, Chinese, and Vietnamese.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
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	Staff time; Media expenses	December 31, 2013	Create a media strategy/campaign plan by December 31, 2011.	Continue. Progress includes NWS outreach, press release, advertisement for SSAHMP in local PA newspapers, distribution of ReadyPA information at PA libraries, community banks, credit unions, and multilingual outreach materials.
Action 5-1e. Collaborate with the business community to implement hazard mitigation information and strategies.	All Hazards	PEMA; Chamber of Commerce; Regional Task Force Business and Labor Infrastructure Committees (or equivalent)	Staff time; Small Business Administration funds	July 31, 2013	Attend three Regional Task Force-based meetings that address Business and Labor Infrastructure Committees (or equivalent) by December 31, 2013.	Continue and update MOS. No progress. Current coordination suggest that Chamber of Commerce meetings will be a better method of implementing this action moving forward than Regional Task Force-based meetings that address Business and Labor Infrastructure Committees. It was recommended to change measure of success to attending three Chamber of Commerce events by December 31, 2016.
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	December 31, 2013	Establish a list of target organizations to collaborate with by June 30, 2011.	Continue and update MOS. Progress includes IA Officer is also VOAD Officer, PEMA and DCED working on Long Term Recovery Planning, and BORM attended Methodist Agape meeting. It was recommended to change measure of success.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 5-1g. Collaborate with higher education institutions to incorporate hazard mitigation into relevant curricula.	All Hazards	PDE; PA Commission for Community Colleges; PA Association of Colleges and Universities	Staff time	March 31, 2012	Research out to PA Commission for Community Colleges and PA Association of Colleges and Universities to identify candidate institutions with relevant programs by July 31, 2011.	Continue. Progress includes inviting groups to SPT meetings.
Action 5-1h. Prepare hazard mitigation information to disseminate to specific audiences (i.e. multi-lingual, special needs).	All Hazards	PEMA; Counties; FEMA Region III; organizations that organize jurisdictions	Staff time	December 31, 2015	Create a list of hazard mitigation topics and target audiences by July 31, 2012.	Continue. No progress.
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 III; organizations that organize jurisdictions	Staff time	December 31, 2015	Develop awareness materials by July 31, 2013.	Continue and update MOS. Materials have been created and are continuously updated. Progress includes NWS briefings and PEMA briefings available on website. It was recommended to change measure of success to conducting 4 sessions a year.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 5-1j. Work with county and municipal officials to educate property owners about grandfathering and revisions to the NFIP program.	Flood	DCED, FEMA Region III, PEMA	CAP-SSSE and Risk Map	Continuous	PEMA will collect appropriate LOMC outreach information from FEMA and direct people to the appropriate FEMA websites and/or distribute FEMA's information as needed. Provide municipalities with proper point of contact for DFIRM updates. Partner with the two FEMA outreach personnel to accomplish action.	Continue and update MOS. The measures of success for this action where accomplished by DCED, PEMA, and FEMA Region III, but not documented in detail. The Biggert-Waters Flood Insurance Reform Act of 2012 and related outreach will make this action a priority and evolve in the coming years. It was recommended to change measure of success to focus on Biggert-Waters outreach and to document successes.
Action 5-1k. Increase Pennsylvania participation in the CRS program through a State education strategy.	Flood	DCED; PEMA; DEP	Staff time	December 31, 2012	Develop a State Education Strategy by January 31, 2012.	Continue. No progress. Remove DEP from agency list since DEP is not involved with CRS.
Action 5-2a. Establish a Hazard Mitigation Strategic Communications Plan Steering Sub-Committee to ensure goals, objectives, and actions are met.	All Hazards	Local, state, and federal communications points of contact involved in Silver Jackets Program	Staff time	July 31, 2011	Sub-committee members meet by January 31, 2011 and draft plan by July 31, 2011.	Completed and Discontinued

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 5-2b. Ensure that the Strategic Communications Plan goals and objectives are in agreement with the Governor's Office of Communications.	All Hazards	PEMA Press Office	Staff time	January 30, 2011	Press Office reviews Strategic Communications Plan by September 2011 and submits it to the Governor by December 2011.	Completed and Discontinued
Action 5-3a. Conduct one meeting annually in each region of the state targeting RL and SRL community officials who serve as HMA grant sponsors.	Flood	PEMA	EMPG	June 30, 2011	Establish a timeline of meeting dates and an agenda of the meetings by January 30, 2011.	Continue and update MOS. Meetings were provided by community requests, particularly as part of DR briefings for recent disasters.
Action 5-3b. Hold a town hall meeting forum with local governments and home and business owners of SRL properties to educate them about grant programs and their benefits.	Flood	PEMA	Staff time	December 31, 2015	Establish and finalize a timeline of meeting dates for at least 50% of the local jurisdictions by December 31, 2012.	Discontinued. Progress was made with meetings in Bloomsburg, Middletown, Shickshinny, and West Pittston. However new HMA guidance has more of a 'all-grants' focus so action folded into 5-3a.
Action 5-3c. Assist municipalities with direct mailings to SRL property owners.	Flood	Municipalities; PEMA	Staff time	December 31, 2013	Reach out to all municipalities and offer assistance by December 31, 2012.	Continue and update MOS. This action is currently partially addressed; FEMA sends annual letters to SRL property owners who then call PEMA who then sends residents to local officials. This process could be improved through coordination focused at 2 counties per year by PEMA in coordination with counties and FEMA.

Table 6.2.4-1 Evaluation of 2010 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS (MOS)	EVALUATION
Action 5-3d. Use the RL/SRL marketing and implementation program successes in PA communities (e.g., Bucks, Lycoming Counties) as a platform for outreach efforts to other RL/SRL communities.	Flood	PEMA; Counties	HMGP when under a disaster declaration	December 31, 2012	Document success stories by December 31, 2011.	Continue and update MOS. Success stories documented and included in plan. The next step remains for PEMA to submit stories to FEMA website.
Action 5-3e. Provide an update on SRL and RL mitigation strategies and accomplishments at the annual Commonwealth of Pennsylvania Emergency Management Conference.	Flood	PEMA	Staff time	September 30, 2011	Ensure slot on agenda by March 31, 2011.	Continue. Conferenced cancelled in 2012 due to Hurricane Sandy and one is not planned for 2013. Will address at 2014 conference

The new mitigation action prioritization ranking system was used to assign a high, medium, or low priority to each action based on the scoring system described in Section 6.2.2. Mitigation action plans were developed for all actions identified by the SPT in 2013. Each action plan includes:

- A general description of the mitigation action;
- The hazard it is designed to mitigate (the primary hazard is denoted in bold);
- Potential funding sources, if applicable;
- The agency assigned responsibility for carrying out the strategy (the primary agency is the first listed);
- A target completion date; and
- Measure of success.

Also, as stated previously, actions addressing Severe Repetitive Losses and Repetitive Losses from the SRL Strategy were incorporated into the 2013 Action Plan. Such actions that were included in the SRL Strategy are, for example:

- Goal 1, Objective 1-1, Actions 1-1e-h;
- Goal 1, Objective 1-12, Actions 1-12a-f;
- Goal 1, Objective 1-13, Actions 1-13a-e;
- Goal 4, Objective 4-1, Action 4-1d, and
- Goal 5, Objective 5-3, Actions 5-3a-e.

This Action Plan's information is intended to assist the SPT and the Commonwealth in accomplishing each action identified during the planning process. They are arranged by goal and objective. For actions in which counties are identified as a key agency, the individual counties involved will be identified and engaged based on the county's risk, vulnerability, and loss estimates.

Table 6.2.4-2 Summary of 2013 mitigation 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 RL and SRL properties.						
Objective 1-1: By 2016, reduce flood-related losses (with an emphasis on reducing repetitive loss and severe repetitive loss properties by 5%) through promotion of the Commonwealth's flood protection program through county, state, and federal partners.						
Action 1-1a. Support new state-funded flood protection and prevention projects.	Flood	Pennsylvania Emergency Management Agency (PEMA); Department of Environmental Protection (DEP); Department of General Services (DGS)	Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance Programs; US Army Corp of Engineers (USACE); US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS); DGS; DEP; PennDOT	July 2016	Secure funding for at least four new state-funded flood protection/prevention projects, one of which should focus on flood fighting supplies and training.	Medium
Action 1-1b. Support the maintenance of existing flood protection projects and construction.	Flood	DEP; Department Of Community And Economic Development (DCED); DGS; USACE; USDA; NRCS; Local Communities	H20 PA Grant Program; Flood Mitigation Grant Program (DCED) Capital Budget, Clean Water Fund, USACE, USDA NRCS, DGS	July 2016; Ongoing	Ensure existing flood protection projects are being operated and maintained to ensure a state of readiness. Provide annual workshops for Project Sponsors to discuss maintenance tips and latest technology.	Low
Action 1-1c. Provide non-federal match to project sponsors for FEMA Hazard Mitigation Assistance, NRCS, USACE and other federal funding sources.	Flood	Governor's Office	Agency Operating Budget, Capital Budget, DEP	July 2016	Allocate FY 2014 funds for the non-federal match for the projects listed in Action 1-1a.	Low

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-1d. Participate in discussions about potential solutions/policy changes regarding farm land flooding due to stream impediments.	Flood	DCED; PEMA; USDA; PDA	Staff time; Legislative liaisons; Legislative Officials	December 2016	Determine feasibility of developing supporting legislation.	Medium
Action 1-1e. Support criteria to prioritize communities with severe repetitive and repetitive loss properties for available mitigation grant funding.	Flood	Counties; PEMA; DCED	Staff time	December 2016	Document project ranking and prioritization criteria including RL and SRL prioritization criteria and by December 2013.	Medium
Action 1-1f. Target SRL and RL properties for mitigation including demolition, acquisition and elevation, through HMA funding through prioritization during annual HMA project review and prioritization process.	Flood	PEMA; Counties; DCED	FEMA Hazard Mitigation Assistance Programs; Staff time	December 2014	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.	Medium ***Super Priority During DR***
Action 1-1g. Incorporate prioritizing of SRL and RL property mitigation into the PEMA-HM strategy and the Administrative Plan post-flood-related disaster.	Flood	PEMA; FEMA; DCED	Staff time	1 year after a flood-related disaster	Support the development of five or more SRL properties mitigation applications per flood-related-disaster.	Medium ***Super Priority During DR***

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-1h. Include the targeting of SRL and RL structures for mitigation in the mitigation strategies section of multi-jurisdictional or county §322 plan with SRL or RL properties.	Flood	PEMA; DCED	Staff time	June 30, 2014	Ensure that each multi-jurisdictional or county planning committee is aware and is implementing this requirement for all RL/SRL properties by March 31, 2014.	Medium
Objective 1-2: Increase by 5% the number of projects implemented by the Commonwealth that will mitigate the most vulnerable structures against hazards by 2016.						
*Action 1-2a.*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	Annually	Identify all of the exact databases, and owners of those databases, to be evaluated by February of each year. Use the results of the survey by PENNHAZUS/ FEMA Region III to determine improvements to risk assessment based on County GIS capability.	Medium
Action 1-2b. 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.	Flood, All Natural Hazards	PEMA; Local jurisdictions	FEMA Hazard Mitigation Assistance Programs; USACE	December 2016	Identify at least 100 structures to be acquired/ demolished/ elevated/ relocated with FEMA HMA grant support by January 2015.	Medium ***Super Priority During DR***

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Objective 1-3: Identify and work toward implementation of 5 feasible and cost-effective projects related to the mitigation of critical buildings, state facilities, and infrastructure.						
Action 1-3a. Define "critical facilities" in terms of mitigation.	All Hazards	PEMA, OHS	Staff time	January 2016	Update Standard Operating Guidance with statewide critical facilities definition information.	Medium
Action 1-3b. Review state practices for floodplain management and consider appropriate opportunities to address multiple hazards and to encourage mitigation of state-owned or regulated facilities through a similar mechanism.	All Hazards	DGS; Office of Administration (OA)	Staff time	December 2016	Build on DGS policy to not build in floodplain, by promoting opportunities to address 2 more hazards in a state-wide policy by 2016.	Low
Action 1-3c. Encourage mitigation of private sector infrastructure through technical assistance, education, demonstrations, etc.	All Hazards	PEMA; DL&I; DCED; OHS; DHS; PSP; State Police; COC's	Staff time; Agency Operating Budget; State Police	January 2016	Coordinate with five local COC's to bridge information.	Medium
Action 1-3d. Leverage support of the nine Regional Task forces to support critical infrastructure mitigation.	All Hazards	PEMA; Regional Tasks Forces	DHS Hardening/Protection related Funding as available	January 2016	Complete 1 project through each task force before the 2016 plan update.	Low

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action1-3e. Continue to use and improve GIS capability to prioritize hazard/critical infrastructure for mitigation.	All Hazards	PEMA; GOHS/PSP; DGS (CC note: GOHS/PSP are in charge of the critical infrastructure list. DGS is in charge of any state facilities that are also CI. May want to add as other agencies	Staff time	December 2016	Assign mitigation priorities to critical infrastructure by December 2016.	Medium
Action 1-3f. Continue to support LiDAR data development initiative.	Flood	PEMA; Department of Conservation and Natural Resources (DCNR)	Emergency Management Performance Grants (EMPG); National Preparedness Funds	December 2016	Determine if any of the counties that underwent LiDAR data development will go through the RiskMAP process and if other counties should be prioritized for LiDAR development moving forward.	Medium
Action 1-3g. Identify insurable state owned flood-prone buildings and appropriate mitigation methods if located in the special flood hazard area (SFHA).	Flood	DGS; DCED	FEMA Hazard Mitigation Assistance Programs; USACE	December 2016	Continue to coordinate with DGS to see progress of DGS database for use in SSAHMP work.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-3h. Evaluate state-owned structures for mitigation options for non-flood related high-priority hazards.	All Hazards	PEMA; Identified state agencies	Homeland Security Grant Programs 20% Portion	December 2016	Identify all state-owned structures vulnerable to high priority hazards by December 2016.	Low
Action 1-3i. Provide emergency electrical backup generation to key state, county, and municipal critical facilities.	All Hazards	PEMA, FEMA	FEMA Hazard Mitigation Assistance Programs; HMGP 5% initiative	July 2016; Ongoing	Identify and prioritize key facilities including critical gas stations by December 2013. Submit 5 relative projects by 2014.	High
Action 1-3j. Add internet interruption to the list of reportable incidences in PIERS and Knowledge Center.	Utility interruption	PEMA, counties	Staff time	Fall 2014	Data tracking in place for utility interruption incidences that can be used for HM planning.	Medium
Objective 1-4: Identify projects related to advanced warning within the Commonwealth by 2016.						
Action 1-4a. Support the sustainment and enhancement of Commonwealth fusion centers.	Terrorism, Civil Disturbance	PEMA; Pennsylvania State Police; OHS	Department of Homeland Security (DHS) Grant Funding	December 2016	Identify the resources that would need to be acquired to sustain fusion centers by January 2014.	Medium
Action 1-4b. Promote reverse notification systems in high-hazard areas.	All Hazards	Counties	DHS Grant Funding; Act 78 Funding	June 2016	Identify and catalog success stories of jurisdictions utilizing reverse notification system by June 2014.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-4c. Increase participation in PA Alert.	All Hazards	OA	DHS Grant Funding	June 2016	Increase participation by 50% between 2013 and 2016.	Medium
*Action 1-4d. E*stablish Water Monitoring Council Action to improve stream gauge coordination in Commonwealth.	Flooding	USGS; River Basin Commissions; PEMA; DEP; NWS; USACE; Water Authorities; Municipalities; FEMA	USGS; USACE; PA DEP; Water Authorities; Municipalities	July 2016	Council established and met by 2016.	Medium
Action 1-4e. Complete flood inundation mapping, like completed for Harrisburg, for additional high risk and high population centers.	Flooding	SJ Initiative including USGS; USACE; NWS; PEMA; River Basin Commissions; FEMA	USGS; USACE	July 2016	Complete one flood inundation mapping project and related outreach per year based on funding availability.	Medium
Objective 1-5: By 2020, minimize risk to communities posed by levee structures by increasing compliance of all levees with National Levee Safety Program standard, focusing on planning and certification.						
Action 1-5a. Re-examine impacts of federal levee guidance and identify necessary actions.	Flood; Levee Failure	DEP; DCNR; USACE; FEMA	Staff time	Continuous	Continue to work with the USACE to implement the National Levee Safety Program and refine an inventory of all levees in the Commonwealth.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
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	USACE; FEMA	Staff time	December 2016	By 2013, USACE has performed outreach activities with 50% of levee owners.	Low
Action 1-5c. Develop emergency action plan guidelines for flood protection projects to assist project sponsors with developing project specific EAPs including inundation maps.	Flood; Levee Failure	DEP; USACE; PEMA; levee owners; County EMAs	Staff time	December 2014	Scheduled for completion in December 2014.	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.	Flood; Levee Failure	DEP; DCED; USACE	Staff time, capital budget, H20 PA Grant Program, local government; DCED Act 13 Flood Mitigation Grant Program	July 2016, Ongoing	Explore funding opportunities to provide support levee project improvements.	Medium
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	December 2013	Obtain Emergency Action Plans for 50% of state levee systems by December 2015.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Objective 1-6: By 2016, provide outreach and training opportunities for local building code enforcers by 500 individuals within the Commonwealth.						
Action 1-6a. Develop and deliver a workshop on building code implementation.	All Hazards	DCED; FEMA Region III	HMGP 5% Initiative	December 2015	Provide six workshops statewide by December 2016.	Low
Action 1-6b. Provide briefings to code association and county officials on damage assessment expectations following a disaster.	All Hazards	PEMA; DCED; FEMA Region III	EMPG; HMGP	Ongoing	Determine code officials "plug-in" and existing training opportunities.	Medium
*Action 1-6*c. Invite the following groups to outreach meetings related to building resiliency and mitigation of structures: PA Association of Building Code Officials, PA Association of Code Officials and Council of Government organizations (COG)	All Hazards	PEMA; DCED	Organizational funding	December 31, 2016	Bridge the Silver Jackets with Codes Academy.	Medium
Objective 1-7: Increase coordination, prioritization, and funding availability to address community needs for dam hazards with special emphasis on inundation zone evaluation by 2016.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-7a. Build on Silver Jackets initiative and 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	Staff time; National Dam Safety Program grant; USACE Silver Jackets, Dam Owner	December 2015	Host meeting by May 2014. Ensure that 95% of high hazard dams have completed a dam break analysis in order to develop a digital inundation map by December 2015.	High
Action 1-7b. Identify and implement mitigation actions based on Silver Jacket meeting results.	Flood, Dam Failure	PEMA; DEP; USACE	Staff Time	December 2016	Conduct capability assessment of departments and agencies that can assist with mitigation implementation by December 2016.	Medium
Action 1-7c. Evaluate and enforce appropriate remediation of dams.	Flood, Dam Failure	DEP	Staff time; PENNVEST loan and grant program, H20 PA Grant Program; Growing Greener, capital budget, dam owner	December 2016; Ongoing	Identify applicable dams and enforce and assist with remediation.	Medium
Action 1-7d. Ensure that all high hazard dams to have an Emergency Action Plan as required.	Flood, Dam Failure	DEP, PEMA	Staff Time; Dam owner	December 2016	Obtain PEMA and DEP approved Emergency Action Plans for 95% of high hazard dams by December 2015.	High
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.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
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 III	Community Assistance Program – State Support Services Element (CAP-SSSE)	Continuous	Maintain or increase NFIP participation after DFIRM update ordinance reviews. Promote early review and submission of ordinances to DCED.	Medium
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 III	Community Assistance Program – State Support Services Element (CAP-SSSE)	Continuous	Reach 200 municipalities annually with ordinance related materials.	Medium
Action 1-8c. Explore the possibility of providing legal support for floodplain management ordinance enforcement to municipalities.	Flooding, All Hazards	DCED; FEMA Region III; State legal counsel	Staff time	July 2014	Coordinate with DCED and meet with state legal counsel.	Low
Objective 1-9: Promote increased implementation of urban-wild land interface (wildfire) mitigation projects by local communities by 2016.						
Action 1-9a. Conduct formal statewide community risk assessment using Risk Assessment Mitigation Strategies database.	Wildfire	DCNR Bureau of Forestry; Office of State Fire Commissioner	Staff time	June 2014	Risk assessment disseminated to all communities by June 2014.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-9b. Work with FIREWISE communities to complete grant applications for outreach and fuels reduction projects.	Wildfire	DCNR Bureau of Forestry; Office of State Fire Commissioner	Staff time	December 2016	Identify any support available to DCNR through the HMP process.	Medium
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 – Mine Safety; Counties impacted by surface mine related hazards	State Funding	December 2014	Disseminate mapping and insurance information to jurisdictions once complete.	High
Action 1-10b. Fully characterize coal ash basin inundation zones, rank hazards, and develop mitigation actions.	Environ-mental Hazards	DEP/Bureau of Mining and Reclamation/Bureau of Waterways Engineering; PEMA	State Funding; U.S. Environmental Protection Agency	September 2016	Continue to implement Chapter 8 and work towards zero flowback.	Medium
Objective 1-11: Enable the Department of Environmental Protection to fully characterize hazard issues from Marcellus Shale natural gas extraction operations and explore mitigation options by 2016.						
Action 1-11a. Identify impacts and consequences of Marcellus Shale natural gas extraction operations.	Environ-mental Hazards	DEP; Counties impacted by Marcellus Shale	Act 13 impact fee	March 2014	Complete TNORM study by 2016.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-11b. Identify mitigation options for identified impacts and consequences.	Environ-mental Hazards	DEP; PEMA; Counties impacted by Marcellus Shale; PUC; PennDOT	Act 13 impact fee	December 2014	A preliminary list of actions will be identified by June 2014. Through Act 9, PEMA developed an Unconventional Well Site Emergency Response Plan template which was distributed to Counties. Over $200M was raised from Act 13 impact fees and distributed to local and state programs.	Medium
Action 1-11c. Provide training that will enable counties to mitigate the negative impacts of Marcellus Shale extraction.	Environ-mental Hazards	DEP; Office of State Fire Commissioner and Academy; Partnerships with private sector; Counties impacted by Marcellus Shale; Universities	Act 13 impact fee	July 2015	Develop training by January 2015. Promote US Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety (US DOT PHMSA OPS) training webinars as appropriate.	Medium
Objective 1-12: Manage all Repetitive Loss and Severe Repetitive Loss databases, providing updates to FEMA at least annually in order to more efficiently identify properties to be mitigated.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-12a. Maintain access to the National Flood Insurance Program (NFIP) BureauNet database of repetitive loss properties.	Flood	DCED; FEMA; PEMA	Staff time	Continuous (meet annual requirements)	Ensure identified PEMA and DCED program managers receive by BureauNet access by October 2010.	High
Action 1-12b. Improve the accuracy of geo-locational data on RL and SRL properties by researching matches for properties with incomplete and/or out-of-date address based on rural road designations that have changed.	Flood	DCED; PEMA; Counties; FEMA Region III	Staff time and travel	Continuous	Continue to verify and update as additional properties are added.	Medium
Action 1-12c. Align RL and SRL property data with validated FEMA NFIP RL and SRL property data annually.	Flood	DCED; PEMA; County EMAs and Planning Departments	Staff time	December 2012	Continue to routinely extract validated property information as needed from BureauNet.	Medium
Action 1-12d. Use the Greatest Savings to the Fund (GSTF) data and methodology to promote the cost-effectiveness of SRL property mitigation for HMA grant applications.	Flood	PEMA; DCED	Staff time	June 2011	Use Greatest Savings to the Fund data in HMA grant applications, when applicable.	Low

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-12e. Report the successes of flood-related projects in the annual update of the SSAHMP 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	Continuous (annual requirement)	Submit annual reports on time; solicit support for RL/SRL funding to compile data.	Medium
Action 1-12f. Examine the FEMA-PEMA SRL and RL data sets to seek properties that could potentially be mitigated through the FEMA RFC, SRL or other HMA funding programs or any other funding sources on an annual basis.	Flood	PEMA; Counties; DCED	Staff time	December 2014	Improve prioritization criteria for project selection in both pre- and post-disaster modes.	Medium
Objective 1-13: Compare properties within the Commonwealth that are known to have been mitigated with the FEMA-provided data sets for SRL and RL properties on an annual basis, and complete FEMA Form AW-501 to support update of the FEMA SRL and RL property databases.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-13a. Update annually the list of completed SRL and RL mitigated properties and use GIS or other methods to merge FEMA's SRL and RL database with Pennsylvania's mitigated properties database. Update the merged database when each HMA grant closes or whenever local data becomes available.	Flood	PEMA; Counties; DCED	FEMA Hazard Mitigation Assistance Programs (management costs)	Continuous	Include information in annual report (Action 1-12e);100% compliance needed.	Medium
Action 1-13b. Complete FEMA Form AW-501 for each mitigated property and provide to FEMA through FEMA database or submittal to Region III upon project close-out.	Flood	Municipalities; PEMA	Staff Time and HMA Funding	Continuous (tri-annual requirement)	Tri-annual report accurately submitted on time.	Medium
Action 1-13c. Use GIS to merge the Increased Cost of Compliance SRL and RL database with Pennsylvania's mitigated properties database annually.	Flood	PEMA; DCED	Staff Time	Continuous (annual requirement)	Annual report accurately submitted on time.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 1-13d. Ensure that the latitude and longitude of each property is confirmed during project close-out as well as during sponsoring community's three-year mitigation compliance inspection for completed properties. Update mitigated properties Excel workbooks to assure accurate status of mitigated RL and SRL properties.	Flood	Municipalities; PEMA; DCED	FEMA Hazard Mitigation Assistance Programs (management costs)	Continuous	Accurately submitted tri-annual reports and project close-outs.	Medium
Action 1-13e. Contact counties with SRL properties to confirm the number and type of mitigated properties and source of funding, if known. This approach can be used to establish an ongoing process of verifying addresses by gathering latitude and longitude data and will ensure currency of the FEMA RL and SRL data sets.	Flood	PEMA in coordination with Counties and Counties in coordination with municipalities; DCED	Staff time	Continuous	Reach out to 2 counties per year starting with locations with highest number of RL and SRL properties.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Objective 1-14: Promote Natural System Protection mitigation in the Commonwealth between 2013 and 2016.						
Action 1-14a. Identify cooperative funding opportunities with DEP for natural system protection projects	Flooding	PEMA; DEP; NRCS	FEMA Hazard Mitigation Assistance Programs; Growing Greener	July 2016	Obtain hazard mitigation funds for a stream corridor restoration or wetland restoration project associated with flooding by July 2016.	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	December 2016	Collect lat/long data for identified critical facilities. Request USACE Power team review of generator sizing.	Medium
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 Services	Staff time	January 2016	Complete two outreach workshops by January 1, 2016. Gather information on complementary workshops from DHS/GOHS for next SSAHMP update.	Low
Objective 2-2: Promote integration of mitigation goals, objectives, and actions where appropriate in other federal, state and local planning initiatives by 2016.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
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; 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.	Medium
Action 2-2b. Silver Jackets work to identify current policies, plans, regulations, and laws that should include mitigation.	All Hazards	PEMA; Other State Agencies; Silver Jackets; PAFPM	Staff time	January 2015	As part of the update to the SJ mitigation guide, include lessons learned and planning guidance for local officials.	Medium
*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 2016 SSAHMP update.	Medium
Objective 2-3: Support Pennsylvania Emergency Management Agency in developing mitigation data strategies for decision-makers by 2015.						
Action 2-3a. Develop a comprehensive list of types of data that decision-makers might need by December 2015.	All Hazards	PEMA	Staff time	December 2015	Share the list of identified data with stakeholders.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 2-3b. Build a network of data stewards.	All Hazards	PEMA; Other State Agencies; Municipalities; FEMA Region III	Staff time	July 2015	Survey counties for available data and consolidate with agency GIS.	Medium
Action 2-3c. Develop data-sharing protocols.	PEMA; OA; OIC	PEMA; OA IT; FEMA Region III	Staff time	January 2015	Create and distribute a protocol that encourages local jurisdictions to coordinate with state when updating plans and best available data by January 1, 2015.	Medium
Action 2-3d. Develop Pennsylvania-specific earthquake soil site classification data for use in HAZUS earthquake modeling.	Earthquake	DCNR; PEMA	PDM; Staff time	March 2016	Completed, HAZUS-ready GIS geodatabase with site classifications assigned statewide	Low

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 2-3e. Improve electronic data sharing between municipalities, BHP and PEMA to ensure statewide data remains current on historic properties and may be used for risk analysis.	All Hazards	Bureau for Historic Preservation (BHP) of PHMC; PEMA; FEMA	National Parks Service	June, 2016	Determine the status of historic resource surveys by municipality and identify under-surveyed areas. Encourage communities with local survey information to share their survey data with BHP and provide communities that have not completed survey with existing BHP survey tools to inventory locally important cultural and historic resources. Include historic properties risk analysis for high hazards in next SSAHMP update.	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 2013 and 2016.						
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; DEP; Counties	Staff time	Continuous	Expand contact lists to include conservation districts.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 2-4b. Create State/Federal charter and bring county leads and planning champions together for regular meetings, knowledge exchanges, and trainings.	All Hazards	PEMA; DCED' KEMA; FEMA Region III	Staff time; Agency operating budget; FEMA-sponsored training	December 1, 2015	Provide three integrated planning workshops/ seminars throughout the state (building on Bucks County pilot) by 2016	Medium
*Action 2-4*c. Involve appropriate county mitigation plan team members in hazard mitigation implementation activities.	All Hazards	PEMA; Counties	Staff time	Continuous	Offer training or meeting opportunities for county mitigation planning team members at PEMA Annual Conference.	High
Action 2-4d. Identify and pursue 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	May 2016	Complete high priority mitigation actions by May 2016	High
Action 2-4e. Develop County Hazard Mitigation Suggested Curriculum.	All Hazards	PEMA; Counties	EMPG	January 1, 2016	Encourage at least one member of the local hazard mitigation team with a 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.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 2-5a. Improve cooperation/ coordination of agencies with real time data (gauge station data, program availability, etc.).	All Hazards	Local, county, and state public safety agencies with planning support agencies	Various	Continuous	Combine data moving forward into the next generation EOC.	High
Action 2-5b. Reach out to agencies that were invited but did not participate in 2013 planning process.	All Hazards	PEMA; Silver Jackets	Staff time; USACE	October 1, 2014	Participation in 2016 State Plan update builds on 2013 success and has more than 45 participating agencies/organizations/ county representatives.	High
Action 2-5c. Identify strategic locations to deploy USACE Power Teams after a disaster.	All Hazards	PEMA; Silver Jackets; USACE	Staff time	January 2014	Establish contact with USACE Pittsburgh and Philadelphia Districts to determine POC for Power Team organization.	Medium
Goal 3 - Provide a framework for active hazard mitigation planning and implementation.						
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).	All Hazards	PEMA	Staff time	Continuous	Identify a champion of this activity to oversee its development by January 1, 2014.	High
Action 3-1b. Require Local Hazard Mitigation Plans to list relevant regional agencies.	All Hazards	PEMA	Staff time	Continuous	Ensure communities address this requirement in local HMPs.	High

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 3-1c. Assess and identify locations where regional coordination between local HMPs would be beneficial to achieving efficiencies in mitigation efforts.	All Hazards	Counties; DCED; other State Agencies as applicable	Staff time	January 1, 2013	Encourage counties to utilize university capabilities (i.e. engineering, planning, etc.) during the HM planning and implementation process.	Medium
Action 3-1d. Continue to support Pennsylvania Department of Education (PDE) in its multi-hazard school planning efforts.	All Hazards	PDE; PEMA; Safe Schools Imitative; PSP; FEMA Region III	Agency Operating Budget	Continuous	Perform outreach for safe school planning guide. Customize and update outreach material based on events.	High
Action 3-1e. Identify and encourage involvement of key business, industry, and infrastructure stakeholders and stakeholder associations in mitigation.	All Hazards	Local jurisdictions and Chamber of Commerce	Agency Operating Budgets	Continuous	Continue to invite a broad range of stakeholder to participate in the HM planning process.	High
Action 3-1f. Coordinate with USDA on the mass food contamination analysis phase.	Mass food contaminati on	PEMA; Dept. of Agriculture; Conservation dis	Staff time	January 2014	Identify point of contact at Department of Agriculture and discuss integration.	Low
Objective 3-2: Enable the Pennsylvania Emergency Management Agency to encourage each participating jurisdiction to secure funding and initiate one mitigation action by 2016.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 3-2a. Maintain and improve Pennsylvania's Hazard Mitigation Planning and Project Toolkit and related training, including Standard Operating Guide, Plan Builder, Library and other tools.	All Hazards	PEMA	EMPG	Continuous	Encourage all counties to complete update process using new HM Toolkit.	Medium
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.	Medium
Action 3-2c. Update training courses regarding planning, project tools, as well as FEMA *e*Grants trainings.	All hazards	PEMA	Staff time; FEMA support	December 31, 2016	Continue to require courses for access to eGrants. Conduct timely eGrants trainings as a part of at least 2 quarterly trainings per year. Track training and technical assistance location, date, and attendance for next SSAHMP update.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
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	Continuous	Create and implement a policy on the role of DRU plans in the mitigation strategy of the Commonwealth in 2016 SSAHMP update.	High
Action 3-2e. Promote Hazard mitigation project tours to showcase successful flood mitigation projects.	Natural Hazards	PEMA	Staff time	Continuous	Provide at least 2 bus tours through Silver Jackets.	High
Action 3-2f. Explore funding for county EMAP compliance	All	KEMA; PEMA	Staff time and EMPG	July, 2015	Disseminate information to counties pertaining to the incorporation of EMAP compliance into HM planning.	Low
Goal 4 - Build legislative support and secure funding for mitigation efforts.						
Objective 4-1: Provide opportunities for education of all State, county and local government officials and legislators about hazard risk and mitigation by Pennsylvania Emergency Management Agency and County Emergency Management Agencies by 2016.						
Action 4-1a. Facilitate tours or visits to mitigation projects, or areas where mitigation efforts are needed to local and county officials and state legislators.	All Hazards	Counties; Local Jurisdictions; PEMA	Staff time	July 31, 2016	Send invitation to site tours to organizations that organize jurisdictions in Pennsylvania and ask 20 legislators to attend a site tour visit by July 31, 2016.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 4-1b. Develop and disseminate relevant information on hazard mitigation programs.	All Hazards	Counties; PEMA; DEP; DCED; Silver Jackets	FEMA Hazard Mitigation Assistance Programs	Ongoing	Coordinate with FEMA and other agencies to obtain relevant mitigation information to disseminate to the public by July 31, 2014.	High
Action 4-1c. Document and share in-state success stories and best practices.	All Hazards	PEMA; Counties	Staff time; conference fees; printing fees; and WebEX costs	Continuous	Create and disseminate a brochure that identifies success stories by December 31, 2014 and conduct one presentation on success stories each year by 2016. Add success stories to FEMA website.	High
Action 4-1d. Perform a "Losses Avoided" study on mitigated SRL or RL properties to communicate money saved in response and recovery so that decision makers, community officials and property owners will be interested in mitigating specific properties.	Flood	PEMA; DCED	State funding; CAP-SSSE; Risk Map funding via FEMA Region III; USACE	June 2016	New SRL and RL "Losses Avoided" analysis results included in the 2016 Plan Update.	High
Action 4-1e. Press for Act 166 and 167 funding to be allocated.	Flood	KEMA; PEMA; DEP	Staff time	July 2014	Coordinate with DEP to determine statistics and figures needed to present a case for Act 167 funding from a HM perspective.	High

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
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 KEMA as part of this effort.	Medium
Objective 4-2: By 2013, 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: NEMA, IAEM, ASFPM, KEMA, PAFPM, APA, PSATS, PAB, CCAP, League of Citizens, and Code Enforcement Officers.	All Hazards	PEMA	Staff time; Agency operating budget	January 31, 2016	Attend at least 2 new organization conferences and invite 2 new organizations to state Emergency Management conference.	Medium
Action 4-2b. Encourage PA-based professional organizations, with emphasis on inviting PA Association of Floodplain Managers (PAFPM) participation, to be involved in the Silver Jackets Program.	All Hazards	PEMA	Staff time; Agency operating budget	Continuous	APA, PAFPM and River Basin Commission representatives and one member of another professional organization regularly attend Silver Jackets meetings between 2013 and 2016.	High
Action 4-2c. Promote an increase in the number of CFMs.	Floods	PAFPM; PEMA; DCED; DEP	Staff time	Continuous	Identify steps to becoming a full ASFPM chaper.	Low

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 4-2d. Develop a working relationship with private insurance and financial sector companies.	All Hazards	Department of Banking and Securities; Department of Insurance; PEMA	Staff time	November 2013	Host Forum to discussion insurance issues that were identified during Lee and Sandy.	Medium
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 2016.						
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	Staff time	June, 2016	Continue to address and expand plan integration and eliminate barriers to mitigation through SJ Initiative and document successes. Build on Bucks County Initiative with seminars in other areas of state. 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	BHP of PHMC; PEMA; FEMA	Staff time	June, 2016	Identify at-risk communities for disasters and create hazard mitigation and/or emergency management plans for their historic resources.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Objective 4-4: Encourage inclusion of at least 5 relevant mitigation projects in the Commonwealth's Capital Improvement Program by the next plan revision.						
Action 4-4a. Consider tax incentives and bonds for mitigation.	All Hazards	Pennsylvania Department of Revenue; PEMA; KEMA	State funding	December 31, 2014	Promote and gain approval for a tax free mitigation day were people may purchase items like generators tax free.	Low
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 5-1*a. Develop and provide presentations on hazard mitigation programs and sponsor conference booths (exhibits).	All Hazards	PEMA; State Planning Team members	State funding	December 31, 2016	Attend and present at 1 conference per year.	Low
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	December 2015	Draft lessons learned for elevation and acquisition projects the workshops and sessions by January 30, 2015.	Medium
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	July 31, 2016	Meet at least annually with Citizen Corps program director to discuss how to integrate hazard mitigation and preparedness into Citizen Corps programs.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
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 III	Staff time; Media expenses	December 31, 2016	Create a media strategy/campaign plan by December 31, 2014. Build outreach related coordination for Long Term Recovery	Medium
Action 5-1e. Collaborate with the business community to implement hazard mitigation information and strategies.	All Hazards	PEMA; Chamber of Commerce; Regional Task Force Business and Labor Infrastructure Committees (or equivalent)	Staff time; Small Business Administration funds	July 31, 2016	Attend three Chamber of Commerce events by December 31, 2016.	Medium
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	December 31, 2016	Invite VOAD groups to next SJ outreach session.	Medium
Action 5-1g. Collaborate with higher education institutions to incorporate hazard mitigation into relevant curricula.	All Hazards	PDE; PA Commission for Community Colleges; PA Association of Colleges and Universities	Staff time	March 31, 2015	Research out to PA Commission for Community Colleges and PA Association of Colleges and Universities to identify candidate institutions with relevant programs by July 31, 2014.	Medium

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 5-1h. Prepare hazard mitigation information to disseminate to specific audiences (i.e. multi-lingual, special needs).	All Hazards	PEMA; Counties; FEMA Region III; organizations that organize jurisdictions; NGOs	Staff time	December 31, 2015	Create a list of hazard mitigation topics and target audiences by July 31, 2015.	Medium
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 III; organizations that organize jurisdictions	Staff time	December 31, 2015	Complete 4 sessions a year.	Medium
Action 5-1j. Work with county and municipal officials to educate property owners about grandfathering and revisions to the NFIP program.	Flood	DCED, FEMA Region III, PEMA	CAP-SSSE and Risk Map	Continuous	Support and document Biggert-Waters Flood Insurance Reform Act outreach.	Medium
Action 5-1k. Increase Pennsylvania participation in the CRS program through a State education strategy.	Flood	DCED; PEMA	Staff time	December 31, 2015	Develop a State outreach Strategy for CRS by January 31, 2015.	Low
Objective 5-2: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications between 2013 and 2016.						

Table 6.2.4-2 Summary of 2013 mitigation actions.

ACTION DESCRIPTION	HAZARD	LEAD/SUPPORT AGENCY	FUNDING SOURCE	TARGET COMPLETION DATE	MEASURE OF SUCCESS	PRIORITY
Action 5-2a. 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	June 30, 2016	Document meeting dates and outreach for HMA in detail for 2016 SSAHMP.	Low ***Super Priority During DR***
Action 5-2b. Assist municipalities with direct mailings to SRL property owners.	Flood	PEMA in coordination with Counties and Counties in coordination with municipalities; DCED	Staff time	December 31, 2016	Reach out to 2 counties per year starting with locations with highest number of RL and SRL properties.	Low
Action 5-2c. Use the RL/SRL marketing and implementation program successes in PA communities (e.g., Bucks, Lycoming Counties) as a platform for outreach efforts to other RL/SRL communities.	Flood	PEMA; Counties; DCED	HMGP when under a disaster declaration	December 31, 2016	Submit 1 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.	Flood	PEMA; DCED	Staff time	September 30, 2014	Ensure slot on agenda by March 31, 2014.	Medium

6.3. Local Mitigation Strategy

6.3.1. Local Mitigation Planning Assistance

6.3.1.1. Support of Local Hazard Mitigation Planning

The Commonwealth is committed to providing strong support to local hazard mitigation planning efforts. Since the 2010 SSAHMP update PEMA has updated the HM Toolkit consisting of an SOG and the PA Tool.

These tools were developed to standardize and simplify the planning process and to aid counties in hazard mitigation plan development as well as project identification, tracking and implementation. In addition, thirty-three Pennsylvania counties received HMP development support provided by PEMA via a private consulting firm funded through EMPG.

Key Standards

The development of the HM Toolkit gave rise to several hazard mitigation standards, four of which can be considered primary or key standards that contribute to the Commonwealth's goal of supporting local hazard mitigation planning. These standards will allow county and other local hazard mitigation plans to be compared and easily incorporated into the Commonwealth Mitigation Plan.

Model Plan Outline (MPO): An appendix to the SOG, this document provides a standard plan format which ensures that plans are uniform and contain the same type of information.

Standard List of Hazards: Enables local entities and the Commonwealth to compare "apples to apples" by providing a standard list of hazards and hazard descriptions.

Risk Factor (RF) Methodology: Uses five weighted Risk Categories: probability, impact, spatial extent, warning time and duration, to calculate a RF between 0 and 4. Moving forward, comparisons can be made between counties and jurisdictions as to the level of risk associated with like hazards.

Mitigation Action Prioritization Methodology: A method for prioritizing mitigation actions in the Commonwealth. Actions are prioritized as high, medium, or low based cumulative scores according to five criteria: effectiveness, efficiency, multi-hazard mitigation, addressing a high risk hazard, and addressing critical communications/infrastructure.

PA STEEL: This is a method for evaluating the feasibility of mitigation actions and projects. The methodology prompts planning entities to evaluate actions based on political, administrative, social, technical, economic, environmental and legal considerations.

Together PA STEEL and mitigation action prioritization will change the way hazard mitigation planning is done in Pennsylvania. As HM Toolkit utilization by local planning entities and the Commonwealth increases, the ability to obtain, extract, combine and evaluate large volumes of data and information pertaining to hazards, risk, vulnerability and capabilities with increase significantly.

Standard Operating Guide

In an effort to standardize mitigation planning and streamline the process of integrating local plans into the SSAHMP, PEMA funded the development of the SOG, which captures FEMA requirements, clarifies and combines existing guidance (particularly FEMA 386), and allows communities a greater opportunity to excel in the preparation of HMP's. The SOG is the next generation of the Commonwealth's *Planning Made Easy!* document; the step-by-step "how-to" guidance provided in the SOG makes the HMP development process seem 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. A more detailed discussion of local hazard mitigation project support can be found in Section 6.3.1.3.

The plan review process has also been simplified as a result of the development of key standards and the MPO in the SOG, allowing PEMA to conduct a more thorough and detailed HMP review in less time.

PA Tool

The PA Tool is an online tool consisting of following three primary components:

1. Plan Builder
2. Project Catalog
3. Library

The PA Tool allows entities to create or update and export their HMP online with the Plan Builder component which follows the standard operating procedures and the MPO described in the SOG. The Project Catalog allows users to track mitigation projects in a way that gives communities the ability to more easily apply for project funding through eGrants. The PA Tool Library holds applicable documents and files that can be shared among planners in the within the same jurisdiction or planning area.

One of the most important aspects of the PA Tool is that it makes it possible to efficiently roll-up information from local mitigation plans into the SSAHMP. Because plan and project information is entered into a database via the PA Tool, data pertaining to locally identified hazards, assessed risk, assessed capabilities, and proposed actions and projects can easily be sorted and integrated into the SSAHMP. This capability provides for a more comprehensive and informed Commonwealth Plan moving forward.

HM Toolkit Training

PEMA provided HM Toolkit Training workshops in May and June of 2010 for State and local officials in order to familiarize users with the new hazard mitigation tools. Representatives received instruction and information on the new key standards in hazard mitigation planning, the SOG, and functionality and capabilities of the PA Tool. This training will ensure a smooth transition to the new streamlined hazard mitigation planning process developed for the Commonwealth. Table 6.3.1-1 shows county attendance at 2010 HM Toolkit Training workshops.

Table 6.3.1-1 County Participation in HM Toolkit Training Workshops.

COUNTY	ATTENDED	COUNTY	ATTENDED
Adams	No	Lackawanna	No
Allegheny	Yes	Lancaster	Yes
Armstrong	Yes	Lawrence	No
Beaver	Yes	Lebanon	No
Bedford	No	Lehigh	Yes
Berks	Yes	Luzerne	Yes
Blair	Yes	Lycoming	Yes
Bradford	No	McKean	No
Bucks	No	Mercer	Yes
Butler	Yes	Mifflin	Yes
Cambria	Yes	Monroe	Yes
Cameron	No	Montgomery	Yes
Carbon	No	Montour	Yes
Centre	No	Northampton	Yes
Chester	Yes	Northumberland	Yes
Clarion	No	Perry	No
Clearfield	Yes	Philadelphia	Yes
Clinton	No	Pike	Yes
Columbia	Yes	Potter	No
Crawford	Yes	Schuylkill	Yes
Cumberland	No	Snyder	Yes
Dauphin	No	Somerset	No
Delaware	Yes	Sullivan	Yes
Elk	No	Susquehanna	Yes
Erie	Yes	Tioga	Yes
Fayette	Yes	Union	Yes
Forest	No	Venango	No
Franklin	Yes	Warren	Yes
Fulton	No	Washington	Yes
Greene	Yes	Wayne	No
Huntingdon	Yes	Westmoreland	Yes
Indiana	Yes	Wyoming	No
Jefferson	Yes	York	No
Juniata	Yes		

As of 2013, all county HMP's have been entered into the PA Tool and can be exported as a Microsoft Word document.

Local Hazard Mitigation Plan Development

PEMA contracted with a private firm to assist 33 counties with the update or development of their HMPs between 2009 and 2011 using EMPG funds. Counties received comprehensive

services from this contractor including community outreach assistance, data collection, risk analysis, meeting and workshop set-up and facilitation, and mitigation strategy and plan development. The following counties received planning services and were chosen because of the expiration date of their existing plan or the lack of an existing plan: Adams, Allegheny, Beaver, Bedford, Bucks, Butler, Cambria, Cameron, Carbon, Centre, Clearfield, Clinton, Columbia, Crawford, Cumberland, Delaware, Elk, Erie, Fayette, Fulton, Greene, Indiana, Jefferson, Lawrence, Lycoming, McKean, Mercer, Monroe, Pike, Somerset, Tioga, Venango, and Warren

All plans have been completed and have received FEMA approval. These 33 plans were developed or updated using the new standards set forth in the HM Toolkit

In addition, 24 counties will receive or have received funding support for hazard mitigation planning as follows:

L-PDM: Lehigh and Northampton Counties;

PDM: Dauphin, Lancaster, Lackawanna, Luzerne, Northumberland, Philadelphia, Potter and Union Counties; and

HMGP: Berks, Clarion, Franklin, Juniata, Lebanon, Mifflin, Montgomery, Montour, Schuylkill, Snyder, Susquehanna, Perry, Wyoming, and York Counties.

PDM funding has also been granted to the State System of Higher Education for the completion of the fourteen Disaster-Resistant University plans. Additional information on these university plans and the status of local hazard mitigation plans can be found in Section 5.3.1.

Additional Support

PEMA supports all 67 counties as required under Commonwealth statute. The State's support is based on the inherent needs dependent upon the level of the counties' planning cadre, expertise and need. PEMA prioritizes support for counties whose capabilities are less than others and/or greater risk and vulnerability by comparison. Pennsylvania jurisdictions have many obligations and demands on existing resources (PEMA 2007).

PEMA's BORM staff review and approve local hazard mitigation plans prior to submitting the plans to FEMA. Hazard Mitigation Planning entities are to provide a complete paper copy of the draft HMP and completed review crosswalk, and two CD's with a PDF file of the draft HMP and a file of the review crosswalk to PEMA for review.

BORM staff will review the draft HMP and ensure that it meets all PEMA requirements and that all elements of the review crosswalk have been satisfied. Should the HMP be missing plan components the plan will be returned to the planning entity with comments for plan improvement and editing. PEMA encourages that multi-jurisdictional plans follow the HM Toolkit including the MPO and Risk Factor methodology, and that all plans are entered into the PA Tool.

6.3.1.2. Support of Local Hazard Mitigation Projects

Mitigation projects identified in local hazard mitigation plans, once approved, are included in the Commonwealth's Mitigation Project Inventory. The Mitigation Project Inventory contains all mitigation projects from local hazard mitigation plans in the Commonwealth. State agencies,

through the Hazard Mitigation Planning Team, will review this inventory to determine if they have funding or are cognizant of upcoming or external funding programs that could be applicable to any of these projects. If a funding source is a likely match to a project, the agency which identified the potential funding is responsible for contacting the municipality, county, or other entity and assisting completion of funding applications. PEMA uses the Letter of Intent for HMGP projects and Letter of Interest for other HMA projects to get leads on hazard mitigation projects; if the projects described in the letters fit the eligibility guidelines, the HMPO form is completed. For more information on the elevation guidelines for HMA grant funded projects, please see *Appendix K – HMA Elevation Guidelines*.

Throughout Commonwealth government, hazard mitigation projects are solicited throughout the year and are identified through the local hazard mitigation planning process. These projects, along with those identified in the post-disaster environment are maintained in the Commonwealth's Hazard Mitigation Project Inventory until eligible funding sources are identified. At that time, 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 6.3.1.3 Prioritizing Local Assistance.

PEMA supports local hazard mitigation projects by providing technical assistance and trainings. These trainings are described in more detail in Section 5.2.1. PEMA also uses its website to provide guidance on mitigation grant programs and supply forms and documents. Two important forms for mitigation projects include the HMPO form and Questionnaire. The Questionnaire can be used by communities to review hazards and identify projects that would reduce or eliminate the effects of hazards identified in their hazard mitigation plans. Completed local HMPO Forms are required to be submitted as an integral part of the FEMA-approved county hazard mitigation plans. These forms will include identification of potential non-federal sources to assist in meeting the local match requirement of Federal funding programs.

PEMA is working to build a more robust database for the Commonwealth to track local hazard mitigation projects. PEMA currently tracks local hazard mitigation projects for which FEMA HMA Grant Funds are pending, approved, or obligated. Table 6.3.1-2 summarizes local hazard mitigation projects that have FEMA HMA Grant Funds pending, approved or obligated from 1999-2013. There are 353 projects and they are listed in more detail in *Appendix L – Mitigation Projects List*.

Table 6.3.1-2 Number of Local Hazard Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2013 (PEMA).

COUNTY	MITIGATION TECHNIQUE						TOTAL PROJECTS*
	ACQUISITION	ELEVATION	FLOODPROOFING	RELOCATION	PLANNING	OTHER/ UNKNOWN	
Adams	0	0	0	0	0	0	***0***
Allegheny	11	0	1	0	0	2	***14***
Armstrong	1	0	0	1	1	1	***4***
Beaver	4	0	0	0	0	0	***4***
Bedford	2	0	0	0	0	0	***2***
Berks	2	0	0	0	1	0	***3***
Blair	7	0	0	0	1	0	***8***
Bradford	3	0	0	0	1	0	***4***
Bucks	8	9	1	0	0	3	***21***
Butler	3	0	0	0	0	0	***3***
Cambria	1	0	0	0	0	0	***1***
Cameron	0	0	0	0	0	1	***1***
Carbon	0	0	0	0	0	0	***0***
Centre	1	0	0	0	0	0	***1***
Chester	1	0	0	0	1	1	***3***
Clarion	0	0	0	0	1	0	***1***
Clearfield	2	0	0	0	0	0	***2***
Clinton	0	0	0	0	0	0	***0***
Columbia	18	0	0	0	0	2	***20***
Crawford	1	0	0	0	1	0	***2***
Cumberland	0	0	0	0	0	0	***0***
Dauphin	23	1	0	0	0	2	***26***
Delaware	8	0	0	0	0	0	***8***
Elk	0	0	0	0	0	0	***0***

Table 6.3.1-2 Number of Local Hazard Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2013 (PEMA).

COUNTY	MITIGATION TECHNIQUE						TOTAL PROJECTS*
	ACQUISITION	ELEVATION	FLOODPROOFING	RELOCATION	PLANNING	OTHER/ UNKNOWN	
Erie	0	0	0	0	0	0	***0***
Fayette	0	0	0	0	0	0	***0***
Forest	0	0	0	0	1	0	***1***
Franklin	1	0	0	0	1	0	***2***
Fulton	0	0	0	0	0	0	***0***
Greene	0	0	0	0	0	0	***0***
Huntingdon	2	1	0	0	1	1	***5***
Indiana	1	0	0	0	0	0	***1***
Jefferson	4	0	0	0	0	0	***4***
Juniata	2	0	0	0	1	0	***3***
Lackawanna	6	0	0	0	1	0	***7***
Lancaster	2	0	0	0	1	0	***3***
Lawrence	0	0	0	0	1	0	***1***
Lebanon	13	0	0	0	1	1	***15***
Lehigh	1	0	0	0	0	2	***3***
Luzerne	36	0	0	0	1	1	***38***
Lycoming	30	0	0	0	0	7	***37***
McKean	0	0	0	0	0	0	***0***
Mercer	0	0	0	0	0	0	***0***
Mifflin	0	0	0	0	1	0	***1***
Monroe	0	0	0	0	0	0	***0***
Montgomery	16	1	0	0	1	6	***24***
Montour	0	0	0	0	1	0	***1***
Northampton	0	0	0	0	0	9	***9***
Northumberland	4	0	0	0	1	1	***6***

Table 6.3.1-2 Number of Local Hazard Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2013 (PEMA).

COUNTY	MITIGATION TECHNIQUE						TOTAL PROJECTS*
	ACQUISITION	ELEVATION	FLOODPROOFING	RELOCATION	PLANNING	OTHER/ UNKNOWN	
Perry	0	0	0	0	1	0	***1***
Philadelphia	2	0	0	0	1	1	***4***
Pike	0	1	0	0	0	0	***1***
Potter	0	0	0	0	1	0	***1***
Schuylkill	2	0	0	0	1	0	***3***
Snyder	0	1	0	0	1	0	***2***
Somerset	1	0	0	0	0	2	***3***
Sullivan	1	0	0	0	1	0	***2***
Susquehanna	7	0	0	0	1	0	***8***
Tioga	3	0	0	0	0	0	***3***
Union	5	1	0	0	1	0	***7***
Venango	0	0	0	0	1	2	***3***
Warren	0	0	0	0	1	0	***1***
Washington	0	0	0	0	1	0	***1***
Wayne	0	0	0	1	1	1	***3***
Westmoreland	0	0	0	0	1	0	***1***
Wyoming	12	0	0	0	1	0	***13***
York	3	0	0	0	0	0	***3***
TOTAL	***250***	***15***	***2***	***2***	***34***	***45***	***353***

***Please note that many projects have multiple properties associated.**

Table 6.3.1-3 depicts local mitigation projects for which FEMA HMA grants have been obligated, approved, or are pending since approval of the previous Commonwealth 2010 SSAHMP. There are 201 projects and a total of 2,239 properties (not including projects pending approval). One project has been funded in Pennsylvania under the FMA program since 2010. Additionally, nineteen projects have been funded under PDM/LPDM since 2010, eleven under SRL, and one project has been funded since 2010 under the RFC program.

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Benton Township - Maple Grove Acquisition	Columbia	Benton Township	1898	$99,525.00	1
Berks County HM Plan Update	Berks	Berks County Dept of Emergency Services	1898	$48,075.00	0
City of Oil City - Ice Boom Project	Venango	City of Oil City	1898	$450,000.00	0
Clarion County HM Plan Update	Clarion	Clarion County	1898	$52,500.00	0
Franklin County HM Plan Update	Franklin	Franklin County	1898	$34,875.00	0
Franklin Township McKim Way Acquisition	Beaver	Franklin Township	1898	$550,425.00	19
Huntingdon County - Shavers Creek Mitigation Project	Huntingdon	Huntingdon County	1898	$292,761.00	4
Lebanon County HM Plan Update	Lebanon	Lebanon County	1898	$43,987.50	0
Lewisburg Borough - Acquisition Project	Union	Lewisburg Borough	1898	$1,037,941.50	5
Lycoming County - Carr Acquisition	Lycoming	Lycoming County	1898	$109,200.00	1
Lycoming County Combined Acquisition	Lycoming	Lycoming County	1898	$267,510.00	3
Montgomery County HM Plan Update	Montgomery	Montgomery County Planning Commission	1898	$37,500.00	0
Oakland Twp - Riverside Drive Acquisition	Susquehanna	Oakland Township	1898	$207,986.25	1
Plymouth Township - Acquisition Project	Luzerne	Plymouth Township	1898	$575,550.00	7
Redevelopment Authority of Allegheny County	Allegheny	Redevelopment Authority of Allegheny County	1898	$64,875.00	1
Schuylkill County HM Plan Update	Schuylkill	Schuylkill County EMA	1898	$47,250.00	0

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Shickshinny Borough - Acquisition and Demolition	Luzerne	Shickshinny Borough	1898	$1,592,868.00	24
Snyder County HM Plan Update	Snyder	Snyder County Commissioners	1898	$18,637.50	0
Susquehanna County HM Plan Update	Susquehanna	Susquehanna County	1898	$45,000.00	0
Swatara Twp II - 9060 Bridge Rd Acquisition	Dauphin	Swatara Township	1898	$137,625.00	3
Swatara Twp Spring Creek Acquisition	Dauphin	Swatara Township	1898	$525,885.75	7
Wilkins Twp - Acquisition and Demolition	Allegheny	Wilkins Twp	1898	$219,483.00	6
Wyoming County - Hazard Mitigation Plan Update	Wyoming	Wyoming County	1898	$37,500.00	0
Juniata County Hazard Mitigation Plan Update	Juniata	Juniata County	4003	$29,250.00	0
Lower Macungie Twp, Lehigh County Phase Two Acquisition BCA	Lehigh	Lower Macungie Township	4003	Pending Approval	-
Mifflin County HM Plan Update	Mifflin	Mifflin County	4003	$29,250.00	0
Perry County Hazard Mitigation Plan Update	Perry	Perry County	4003	$29,250.00	0
Philadelphia GIS Floodplain Analysis	Philadelphia	City of Philadelphia	4003	Pending Approval	0
Whitemarsh Township Mathers Lane Acquisition	Montgomery	Whitemarsh Township	4003	$673,500.00	1
Allegheny County Generators for communication sites	Allegheny	Allegheny County	4025	Pending Approval	0
Annville Township Substantially Damaged Acquisition Project 1	Lebanon	Annville Township	4025	$906,982.50	4
Annville Township Substantially Damaged Acquisition Project 2	Lebanon	Annville Township	4025	$688,335.00	5
Cherry Township Substanially Damaged Acquisition	Sullivan	Cherry Township	4025	$61,327.50	1
Chester County backup EOC and alternate 911 center generator	Chester	Chester County	4025	Pending Approval	-
Conyngham Twp Substantially Damaged Acquisition Project 2	Luzerne	Conyngham Township	4025	$472,725.00	8
East Hanover Township Substantially Damaged Acquisition Project 1	Lebanon	East Hanover Township	4025	$207,082.50	2

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Fishing Creek Twp Substantially Damaged Acquisition Project 1	Columbia	Fishing Creek Township	4025	Pending Approval	-
Hatboro Woodwinds Condos Bldgs 1 through 5	Montgomery	Hatboro	4025	Pending Approval	-
Hunlock Township Substantially Damaged Acquisition	Luzerne	Hunlock Township	4025	$100,350.00	1
Jenkins Township Substantial Damage Acquisition Project 3	Luzerne	Jenkins Township	4025	$622,950.00	8
Manheim Borough Substantially Damaged Acquisition	Lancaster	Manheim Borough	4025	Pending Approval	-
Middletown Boro Substantially Damaged Acquisition No-6 Few Ave	Dauphin	Middletown Borough	4025	$107,532.75	1
Middletown Borough Substantially Damaged Acquisition Project 2	Dauphin	Middletown Borough	4025	$1,265,575.50	8
Middletown Borough Substantially Damaged Acquisiton Project 3	Dauphin	Middletown Borough	4025	$207,537.00	1
Montour Township Substantially Damaged Acquisition Project 3	Columbia	Montour Township	4025	Pending Approval	-
Mount Pleasant Twp Substantially Damaged Acquisition	Columbia	Mount Pleasant Township	4025	$93,511.50	1
Nanticoke Substantially Damaged Acquisition	Luzerne	City of Nanticoke	4025	$225,000.00	3
Orange Township Substantially Damaged Acquisition	Columbia	Orange Township	4025	$546,855.00	5
PEMA-Bucks County Generator Project	State Agency/Dept	Various	4025	Pending Approval	-
Pine Grove Borough Substantiallly Damaged Acquisition Project 1	Schuylkill	Pine Grove Borough	4025	$1,055,426.25	482
Plymouth Township Poplar St Canal St Acquisition	Luzerne	Plymouth Township	4025	Pending Approval	-
Plymouth Township West Nanticoke, Luzerne County Acquisition	Luzerne	Plymouth Township	4025	Pending Approval	-
Point Township Northumberland County Acqusition Sub Damaged	Northumberland	Point Township	4025	Pending Approval	-
Scott Township Substantially Damaged Acquisition Project 1	Columbia	Scott Township	4025	$1,244,341.50	10

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
South Centre Twp Substantially Damaged Acquisition	Columbia	South Centre Township	4025	$147,645.75	1
Susquehanna County - Viaduct St Acquisition	Susquehanna	Lanesboro Borough	4025	Pending Approval	-
Swatara Twp Dauphin Co Substantially Damaged Acquisition Project 1	Dauphin	Swatara Township	4025	$398,128.50	4
Swatara Twp Lebanon Co Substantially Damaged Acquisition Project 1	Lebanon	Swatara Township	4025	$128,375.25	1
Swatara Twp Lebanon Co Substantially Damaged Acquisition Project 3	Lebanon	Swatara Township	4025	$391,756.50	4
Upper Providence Township, Montgomery County, Acquisition, BCA	Montgomery	Upper Providence Township	4025	$455,100.00	3
Armstrong County Hazard Mitigation Plan Update	Armstrong	Armstrong	4030	$29,092.50	0
Athens Township Substantially Damaged Acquisition	Bradford	Athens Township	4030	$948,562.50	7
Benton Township Substantially Damaged Acquisition	Columbia	Benton Township	4030	$636,354.75	5
Blair County HMGP Planning Application	Blair	Blair County	4030	$18,712.50	0
Bloomsburg Substantially Damaged Acquisition Project 1	Columbia	Town of Bloomsburg	4030	$1,524,033.75	11
Bradford County HM Planning Grant	Bradford	Bradford	4030	$35,250.00	7
Cameron County Stevenson Dam Siren System	Cameron	Cameron County EMA	4030	Pending Approval	-
Catawissa Borough Substantially Damaged Acquisition Phase Two Project 1	Columbia	Catawissa Borough	4030	$1,015,242.00	13
Catawissa Borough Substantially Damaged Acquisition Phase Two Project 2	Cambria	Catawissa Borough	4030	$163,683.75	2
Catawissa Borough, Columbia County Project 4	Columbia	Catawissa Borough	4030	Pending Approval	-
Cheltenham Township Substantially Damaged Acquisition	Montgomery	Cheltenham Township	4030	Pending Approval	-
Chester County Hazard Mitigation Plan Update	Chester	Chester County	4030	$56,250.00	-

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Chester Township Toby Farms Acquisiton	Delaware	Chester Township	4030	$557,230.50	1
Conyngham Township Substantially Damaged Acquisition Project 1	Luzerne	Conyngham Township	4030	$642,600.00	9
Conyngham Township-4, Luzerne, Acquisition Project	Luzerne	Conyngham Township	4030	$90,600.00	1
Conyngham Twp 5 Primary Residential Sub Damage Acquisition	Luzerne	Conyngham	4030	Pending Approval	-
Conyngham Twp 6 Secondary Residential Sub Damage Acquisition	Luzerne	Conyngham	4030	Pending Approval	-
Crawford County HM planning grant	Crawford	Crawford County	4030	Pending Approval	-
Derry Township Substantially Damaged Acquisition	Dauphin	Derry Township	4030	$100,620.00	1
DMVA Fort Indiantoen Gap Bldg. 10-104 POD Generator	State Agency/Dept	Annville	4030	Pending Approval	-
DMVA Fort Indiantown Gap Area 19 Emergency Generator	State Agency/Dept	Annville	4030	Pending Approval	-
Etna Borough Building Floodproofing	Allegheny	Etna Borough	4030	$147,116.25	1
Exeter Township Acquisition Project	Luzerne	Exeter Township	4030	$423,600.00	6
Fairview Township Acquisition	York	Fairview Township	4030	Pending Approval	-
Fairview Twp Acquisition Sub. Damaged	York	Fairview Township	4030	$98,103.75	1
Fishing Creek Township	Columbia	Fishing Creek Township	4030	$78,315.00	1
Forest County HMGP Planning Application	Forest	Forest County	4030	$22,500.00	0
Hatboro Borough, Montgomery County, BCA	Montgomery	Hatboro Borough	4030	Pending Approval	-
Hemlock Township Substantially Damaged Acquisition Project 1	Columbia	Hemlock Township	4030	$2,045,444.25	21
Hummelstown Borough Substantially Damaged Acquisition	Dauphin	Hummelstown Borough	4030	$785,625.00	2
Huntingdon County Hazard Mitigation Plan Update	Huntingdon	Huntingdon	4030	$37,417.50	0

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Jenkins Township 4 Acquisition Project	Luzerne	Jenkins Township	4030	Pending Approval	-
Jenkins Township Substantially Damaged Acquisition Project 1	Luzerne	Jenkins Township	4030	$587,400.00	4
Jenkins Township Substantially Damaged Acquisition Project 2	Luzerne	Jenkins Township	4030	$805,275.00	15
Jenkins Township Substantially Damaged Acquisition Project 5	Luzerne	Jenkins Township	4030	$576,225.00	7
Jenkins Township Substantially Damaged Acquisition Project 6	Luzerne	Jenkins Township	4030	$493,425.00	8
Jenkins Twp - Commercial Substantial Damage Acquisition	Luzerne	Jenkins Twp	4030	Pending Approval	-
Jonestown Borough Substantially Damaged Acqusition	Lebanon	Jonestown Borough	4030	$174,290.25	1
Lackawanna County HM planning grant	Lackawanna	Lackawanna	4030	$39,750.00	0
Lawrence County HM plan	Lawrence	Lawrence	4030	Pending Approval	-
Lewisburg Borough, Union County, phase 2 elevation	Union	Lewisburg Borough	4030	Pending Approval	-
Londonderry Substantially Damaged Acquisition Project 1	Dauphin	Londonderry Township	4030	$1,374,450.00	10
Lower Swatara Township Substantially Damaged Acquisition Project 1	Dauphin	Lower Swatara Township	4030	$1,446,671.25	13
Lower Swatara Twp Substantially Damaged Acquisition Project 2	Dauphin	Lower Swatara Township	4030	$284,790.75	1
Luzerne County Hazard Mitigation Plan Update grant application	Luzerne	Luzerne County	4030	$45,000.00	0
Lycoming County Lower Multi-Municipal Acquisition	Lycoming	Lycoming County	4030	Pending Approval	-
Lycoming County Substantially Damaged Acquisition Project 1	Lycoming	Lycoming County	4030	$452,962.50	484
Lycoming County Substantially Damaged Acquisition Project 2	Lycoming	Lycoming County	4030	$1,528,162.50	486
Lycoming County Substantially Damaged Acquisition Project 5	Lycoming	Lycoming County	4030	$653,700.00	5
Middletown Acquisition 9	Dauphin	Middletown Borough	4030	Pending Approval	-

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Middletown Boro Project 9	Dauphin	Middletown	4030	Pending Approval	-
Middletown Borough Acquisitions Project 7	Dauphin	Middletown Borough	4030	Pending Approval	-
Middletown Borough Substantially Damage Acquisition Project 1	Dauphin	Middletown Borough	4030	$2,313,150.75	11
Middletown Borough Substantially Damaged Acquisition Project 5	Dauphin	Middletown Borough	4030	$257,135.25	5
Montour County HMGP Planning Application	Montour	Montour County	4030	$28,506.00	0
Montour Township Substantially Damaged Acquisition Project 1	Columbia	Montour Township	4030	$714,702.00	8
Montour Township Substantially Damaged Acquisition Project 2	Columbia	Montour Township	4030	$513,141.75	5
Muncy Creek Twp Substantially Damaged Acquisition	Lycoming	Muncy Creek Township	4030	$120,788.25	1
Nescopeck Borough Substantially Damaged Acquisition Project 1	Luzerne	Nescopeck Borough	4030	$270,225.00	2
Nescopeck Township Acquisition	Luzerne	Nescopeck Township	4030	$356,175.00	4
North Annville 4 Upper Glen Lane SubDamage Phase 2	Lebanon	North Anville 4	4030	$135,942.75	1
North Annville Township Substantially Damaged Acquisition Project 1	Lebanon	North Annville Township	4030	$680,911.50	8
North Annville Township Substantially Damaged Acquisition Project 2	Lebanon	North Annville Township	4030	$1,063,059.75	8
North Annville Twp - Towpath Rd, Lebanon County, Substantially Damaged, phase 2	Lebanon	North Annville	4030	$133,930.50	7
North Annville Twp Substantially Damaged Acquisition Project 3	Lebanon	North Annville Township	4030	$133,470.75	2
Northumberland Co. Jackson Township Phase Two Substantially Damaged Acquisition	Northumberland	Jackson Township	4030	$110,775.00	1
PEMA - Municipal Generator Purchase and Distribution	State Agency/Dept	Various	4030	Pending Approval	0

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
PEMA Back-up Generator SEOC	State Management Cost	NA	4030	Pending Approval	0
Pine Grove Township Substantially Damaged Acquisition	Schuylkill	Pine Grove Township	4030	$59,430.00	1
Plains Township Substantially Damaged Acquisition Project 1	Luzerne	Plains Township	4030	$803,475.00	10
Plains Township Substantially Damaged Acquisition Project 3	Luzerne	Plains Township	4030	$896,475.00	12
Plunketts Creek Twp. Lycoming County Sub-stanial Damaged Phase 2---Commercial	Lycoming	Plunketts Creek Twp.	4030	Pending Approval	-
Plymouth Borough Phase Two acquisition	Luzerne	Plymouth Borough	4030	Pending Approval	-
Plymouth Township CDBG, Luzerne County	Luzerne	Plymouth Township	4030	Pending Approval	-
Plymouth Township Substantially Damaged Acquisition	Luzerne	Plymouth Township	4030	$629,226.00	6
Scott Township Substantially Damaged Acquisition Project 2	Columbia	Scott Township	4030	$1,400,099.25	10
Selinsgrove Borough, Snyder County, phase 2, elevation	Snyder	Selinsgrove Borough	4030	Pending Approval	-
Shamokin Sustantially Damaged Acquisition	Northumberland	Shamokin City	4030	$152,340.00	7
Shickshinny Boro Acquisition 5	Luzerne	Shickshinny	4030	Pending Approval	-
Shickshinny Borough Substantially Damaged Acquisition Project 1	Luzerne	Shickshinny Borough	4030	$1,073,925.00	14
Shickshinny Borough Substantially Damaged Acquisition Project 2	Luzerne	Shickshinny Borough	4030	$518,850.00	6
South Hanover Substantially Damaged Acquisition Project 2	Dauphin	South Hanover Township	4030	$259,770.00	2
South Hanover Township 1 Substantially Damaged Acquisition	Dauphin	South Hanover Township	4030	$1,263,367.50	8
South Lebanon Substantially Damaged Acquisition	Lebanon	South Lebanon Township	4030	$724,112.25	4
Springfield Twp - Carolton Way Acquisition	Montgomery	Springfield Twp	4030	Pending Approval	-

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Springfield Twp, Montgomery County Phase Two Acquisition BCA	Montgomery	Springfield Township	4030	$3,214,927.50	205
Sugarloaf Township Substantially Damaged Acquisition	Columbia	Sugarloaf Township	4030	$149,611.50	1
Sullivan County HMGP Planning Grant Application	Sullivan	Sullivan County	4030	$24,750.00	0
Susquehanna County Substantially Damaged Acquisition Project 2	Susquehanna	Susquehanna County	4030	$362,250.00	3
Susquehanna County Susbstantially Damaged Acquisition Project 1	Susquehanna	Susquehanna County	4030	$35,199.00	1
Swatara Township Substantially Damaged Acqusition Project 2	Lebanon	Swatara Township	4030	$150,203.25	2
Swatara Township, Dauphin County, phase 2	Dauphin	Swatara	4030	Pending Approval	-
Venango County HM Plan update	Venango	Venango	4030	Pending Approval	-
Warren County HM Plan update grant	Warren	Warren County	4030	Pending Approval	-
Washington County HM Plan Update	Washington	Washington County	4030	Pending Approval	-
Wayne County HMGP Planning Application	Wayne	Wayne County	4030	$41,190.60	0
West Pittston Borough 7 Acquisition Project	Luzerne	West Pittston Borough	4030	$706,350.00	5
West Pittston Borough Acquisition Project	Luzerne	West Pittston Borough	4030	$695,925.00	4
West Pittston Substantial Damage Acquisition 8	Luzerne	West Pittston Boro	4030	Pending Approval	-
West Whiteland Twp. BCR 1.47	Chester	West Whiteland Township	4030	$205,600.50	1
Westmoreland County HM Plan Update	Westmoreland	Westmorland	4030	$50,250.00	0
Whitemarsh Twp 4030 Acquisition	Montgomery	Whitemarsh Township	4030	$871,500.00	2
Wyoming County 6 - Forkston Twp Substantially Damaged Acquisition	Wyoming	Wyoming County	4030	$299,700.00	1
Wyoming County Substantially Damaged Acquisition Project 1	Wyoming	Wyoming County	4030	$1,396,950.00	12

Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
Wyoming County Substantially Damaged Acquisition Project 2	Wyoming	Wyoming County	4030	$1,213,950.00	9
Wyoming County Substantially Damaged Acquisition Project 3	Wyoming	Wyoming County	4030	$392,850.00	45
Wyoming County Substantially Damaged Acquisition Project 4	Wyoming	Wyoming County	4030	$1,679,325.00	12
Wyoming County Substantially Damaged Acquisition Project 5	Wyoming	Wyoming County	4030	$1,045,477.50	7
Lower Makefield Township Elevation	Bucks	Lower Makefield	FMA	$120,000.00	1
Presque Isle Road Elevation	PA DCNR	Presque Isle	LPDM	$999,382.50	0
911 Generator	Wayne	Wayne County	LPMD	$187,500.00	0
Catasaqua Boro	Northampton	Catasaqua Borough	LPMD	Pending Approval	-
Catasaqua Boro	Northampton	Catasaqua Borough	LPMD	Pending Approval	-
Forks Twp	Northampton	Forks Township	LPMD	Pending Approval	-
Hellertown Boro	Northampton	Hellertown Borough	LPMD	Pending Approval	-
Hellertown Boro	Northampton	Hellertown Borough	LPMD	Pending Approval	-
Lower Milford Twp	Northampton	Lower Milfor Township	LPMD	Pending Approval	-
Lower Saucon Authority	Northampton	Lower Saucon Township	LPMD	Pending Approval	-
Lower Saucon Twp	Northampton	Lower Saucon Township	LPMD	Pending Approval	-
Armstrong County Generators	Armstrong	Armstrong County	PDM	$392,572.00	-
Lancaster County Plan	Lancaster	Lancaster County	PDM	$49,350.00	0
Lehigh Generator	Lehigh	Lehigh County	PDM	$318,174.75	0
Lower Milford bank stabilization	Lehigh	Lower Milford	PDM	$70,140.00	0
Northampton Generator	Northampton	Northampton County	PDM	$399,738.00	0
Northumberland County Plan	Northumberland	Northumberland County	PDM	$70,083.00	0
Philadelphia County Plan	Philadelphia	Philadelphia	PDM	$113,250.00	0
Potter County Plan	Potter	Potter County	PDM	$40,387.50	0
Union County Plan	Union	Union County	PDM	$41,187.75	0

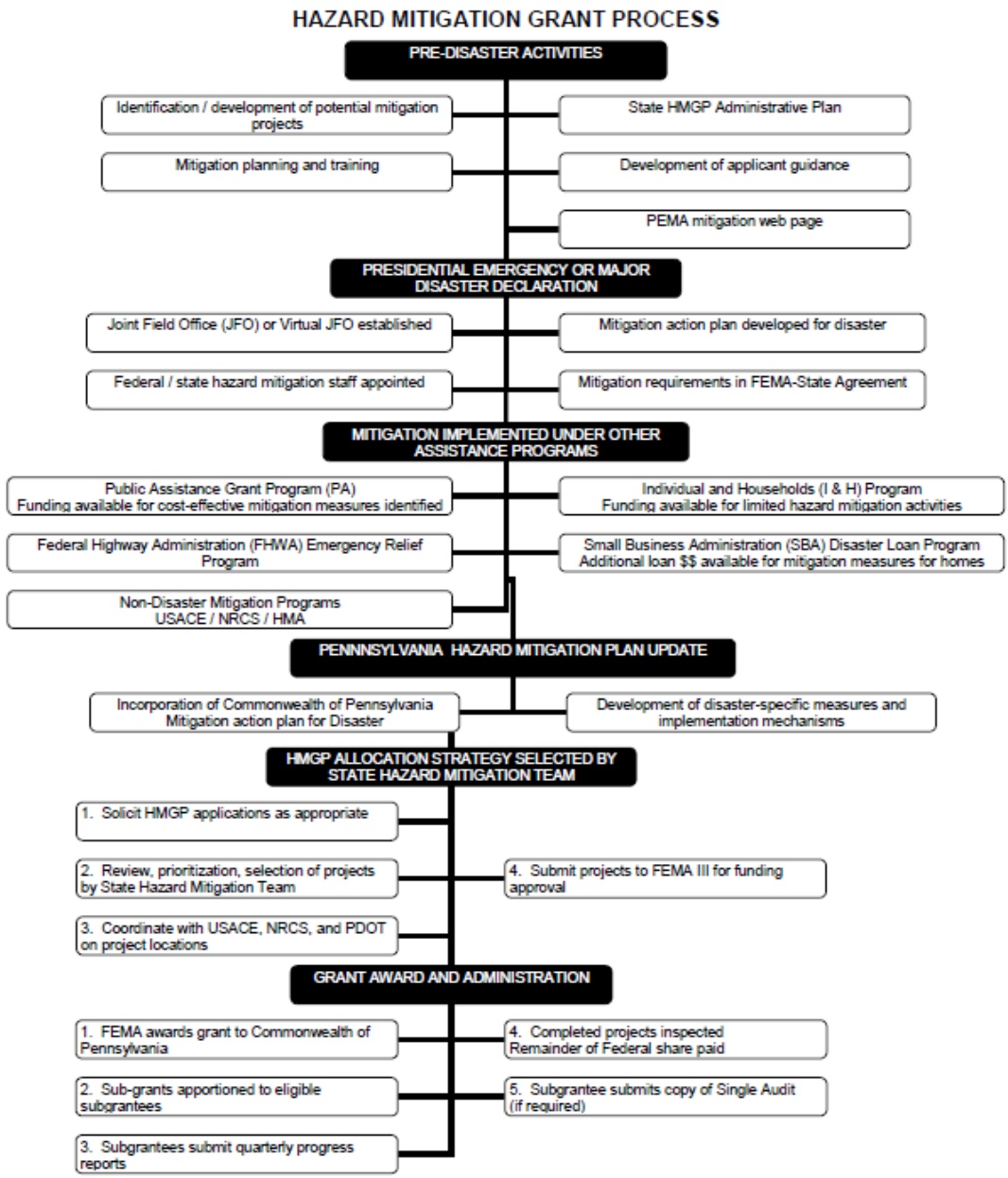
Table 6.3.1-3 Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010 (as of August 1, 2013).

PROJECT	COUNTY	JURISDICTION OR SUB-APPLICANT	FUNDING SOURCE	FEDERAL SHARE ($)	NUMBER OF PROPERTIES
University HMP updates	PASSHE	PASSHE	PDM	$847,697.44	0
Lewisburg Union County Acquisition	Union	Lewisburg Borough	RFC	$1,102,800.00	8
East Hanover	Lebanon	East Hanover Township	SRL	$79,143.75	1
Lanesboro Acquisition	Susquehanna	Lanesoboro Acquisition	SRL	$125,746.67	1
Lower Makefield Acquisition Project	Bucks	Lower Makerfield	SRL	$315,244.50	1
Solebury Acquisition Project	Bucks	Solebury	SRL	$599,250.00	1
Solesbury Twp Elevation	Bucks	Solesbury	SRL	$353,980.20	1
SRL 2009 Lower Makefield Township	Bucks	Lower Makerfield	SRL	$166,950.00	1
SRL 2010 Lower Makefield Township	Bucks	Lower Makerfield	SRL	$120,000.00	2
West Norriton Elevation	Montgomery	West Norriton	SRL	$1,525,489.50	5
Westfall Township, Pike County Elevation	Pike	Westfall Township	SRL	$143,718.75	1
Yardley Borough Elevation 4	Bucks	Yardley	SRL	$750,751.50	3
Yardley Borough Elevation 3	Bucks	Yardley	SRL	$500,850.00	2
			TOTAL	***$71,085,586.65***	***2239***

6.3.1.3. Prioritizing Local Assistance

As described in Section 6.1, 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 will likely always 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 Administrative Plan to target counties with planning needs and prioritize them based on risk and capabilities. However, the general decision process used to make decisions on which projects provide the greatest benefit to the Commonwealth is summarized in Table 6.3.1-4.

Table 6.3.1-4 Summary of process used prioritize and select mitigation projects in Pennsylvania.



Selection of projects for funding through Hazard Mitigation Assistance grant programs is typically based on one of the following criteria depending on the scope of the disaster declaration:

1) For disaster declarations involving three or more coterminous counties the State Hazard Mitigation Team (i.e. Team of individuals requested by the PEMA Director from Commonwealth agencies with hazard mitigation responsibilities. Team members are designated by Cabinet Secretaries/Commissioners/Directors to assist with hazard

mitigation activities related to Sections 322, 404, and 406 of the Stafford Act.) is convened and tasked to review all eligible applications and develop a rank-order list for project funding;

2) For disaster declarations not involving three or more coterminous counties, PEMA and other state agencies are responsible for project application review and prioritization. They work with the affected County Emergency Management Agency and County Planning Commission and, if established, County Hazard Mitigation Team. At the conclusion of this process, the affected county Emergency Management Agency or County Hazard Mitigation Team forwards all applications along with a project priority order ranking list to the SHMO.

Regardless of the evaluation methodology employed, the process for project selection is in accordance with criteria in 44 CFR, Section 206.434(c) and 206.435(b) and (c) as follows:

1) Measures that best fit within an overall plan for development and/or all-hazard mitigation in the disaster area, community or Commonwealth;
2) Measures that, if not taken, will have a detrimental impact on the applicant, such as potential loss of life, loss of essential services, damage to critical facilities, or economic hardship on the community;
3) Measures that have the greatest potential impact on reducing future disaster losses;
4) Measures that are designed to accomplish multiple objectives including damage reduction, environmental enhancement and economic recovery, will not have an adverse impact on the environment if implemented and conform with historical and environmental laws and regulations;
5) Specific metric criteria will be developed prior to project evaluation and will be based on the disaster scope and magnitude as well as the Commonwealth's mitigation priorities. Weight will be given to certain criteria to reflect those priorities.
6) When developing the ranking, the State Hazard Mitigation Team will take into consideration the total amount of funding available from all sources, including overmatching of federal funds with non-federal funds.
7) The State Hazard Mitigation Team will also consider the level of interest and demonstrated degree of commitment of each applicant.
8) The project solves a problem independently or constitutes a functional portion of a solution and is suitable for funding under the HMGP rather than other funding programs.
9) The project is consistent with other Hazard Mitigation projects, initiatives, and Commonwealth priorities.
10) Applicants will be notified of the results of the project selection no later than 30 days after the process is completed.

In addition, the Commonwealth has obligated itself under the Pennsylvania State Emergency Operations Plan to perform reviews of local projects and statewide mitigation opportunities on a quarterly basis. This review is to be undertaken to determine if a funding source is currently available or may be upcoming such that the reviewing agency can assist in implementing the project. If a funding source is identified, that project is discussed by the state agency with the

identifier of the project or local government to determine eligibility and appropriateness of funding.

In addition to the criteria above, 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 technically feasibility. When PEMA receives project applications, it examines each to determine if it fits RFC or SRL program criteria; if so, appropriate actions are taken to ensure those projects are properly placed under the RFC or SRL funding program. RL or SRL property status is also taken in account for the funding streams that do not require a property to be RL or SRL. 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. Additionally, Action 1-1e of the 2013 Mitigation Action Plan states that the Commonwealth will create and implement criteria to prioritize communities with severe repetitive and repetitive loss properties for available mitigation grant funding.

Local assistance provided for the 33 local Hazard Mitigation Plan updates between 2009 and 2011 was prioritized based on plan expiration update needs. 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 funded assistance.

6.3.2. Integration of Local Mitigation Plans

In order to evaluate priority mitigation actions developed by local communities and link these actions with the 2013 SSAHMP, mitigation action strategies from the 67 county Hazard Mitigation Plans currently adopted were reviewed. The majority of top ranked actions from county plans pertained to Education and Awareness, and Plans and Regulations. This aligns with the breakdown of mitigation techniques used in the 2013 SSAHMP, having 55% and 35% of actions falling under Education and Awareness Programs, and Plans and Regulations respectively. A majority of top ranked actions from county plans pertained to flooding and particular focus on Act 167 plans, the NFIP, and Floodplain Management/Zoning ordinances was given. This also aligns with the 2013 SSAHMP as the majority of single hazard actions target flooding and associated levee and dam failure.

As described in Section 6.2.3, local communities are encouraged to use the PA STEEL method to evaluate and prioritize potential mitigation actions. The use of this method in all local Hazard Mitigation Plans as well as the 2010 Commonwealth SSAHMP facilitates consistency in how projects are prioritized and ranked. The 33 local Hazard Mitigation Plan updates completed between 2009 and 2011 use the PA STEEL method. However, other methods of ranking and prioritization have been used for some of the remaining plans across Pennsylvania. Therefore, there is some variation in how the importance of critical actions is measured.

SPT members involved in the 2013 SSAHMP update reviewed the Commonwealth goals, objectives, and actions identified in Section 6.2.4 throughout the planning process and during the Mitigation Strategy Meeting. Based comments from county officials and a review of County Hazard Mitigation Plan priority actions, local mitigation priorities appear to align with the Commonwealth's goals and objectives.

6.4. Pennsylvania Repetitive Loss and Severe Repetitive Loss Mitigation Strategy

6.4.1. Introduction

RL and SRL information are woven throughout this Pennsylvania Hazard Mitigation Plan. This section contains a *Repetitive Loss and Severe Repetitive Loss 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 SSAHMP 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 the 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.

6.4.2. Strategy Overview

The Commonwealth of Pennsylvania 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 will employ will compare the known mitigation project locations with the repetitive loss locations as identified by FEMA in Microsoft Excel workbooks contained in Appendix G. The Greatest Savings to the Fund (GSTF) data and methodology will be used promote the cost-effectiveness of SRL property mitigation for HMA grant applications (see Action 1-12d). GSTF is a FEMA approved methodology for Benefit-Cost Analysis for the SRL program.

- **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 the PEMA for grant

programs to mitigate flood-prone properties. Specifically, municipalities with repetitive and severe repetitive loss properties must include strategies to address these properties in their hazard mitigation plans.

- **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.

Figure 6.4.2-1 Sample RL and SRL outreach materials provided by PEMA to interested applicants.

As of July 2013, Pennsylvania had 8,180 repetitive loss properties (1,070 of which have been mitigated) and 475 severe repetitive loss properties (46 of which have been mitigated). This information is contained in the flood hazard profile in Section 4.3.5. This section summarizes Pennsylvania data on SRL and RL claims, properties, and mitigated structures by county and provides tables and maps of this information. Table 4.3.5-6 and Table 4.3.5-7 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 4.3.5-6 shows the location of RL and SRL properties in Pennsylvania.

In order for the Commonwealth to reduce the number of these repetitive loss and severe repetitive loss properties, the SPT reviewed the Mitigation Strategy of the 2010 Pennsylvania Hazard Mitigation Plan and developed 2013 mitigation goals, objectives and actions. This is detailed in the Mitigation Strategy in Section 6.2. of this Plan Update.

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 6.2.4, the following Objectives and Actions under Goal 1 specifically address RL and SRL mitigation:

Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including RL and SRL properties.
Objective 1-1: *By 2016, reduce flood-related losses (with an emphasis on reducing repetitive loss and severe repetitive loss properties by 5%) through promotion of the Commonwealth's flood protection program through county, state, and federal partners.*
Action 1-1e. Support criteria to prioritize communities with severe repetitive and repetitive loss properties for available mitigation grant funding.
Action 1-1f. Target SRL and RL properties for mitigation through HMA funding through prioritization during annual HMA project review and prioritization process.
Action 1-1g. Incorporate prioritizing of SRL and RL property mitigation into the PEMA-HM strategy and the Administrative Plan post-flood-related disaster.
Action 1-1h. Include the targeting of SRL and RL structures for mitigation in the mitigation strategies section of multi-jurisdictional or county §322 plan with SRL or RL properties.
Objective 1-12: *Manage all Repetitive Loss and Severe Repetitive Loss databases, providing updates to FEMA at least annually in order to more efficiently identify properties to be mitigated.*
Action 1-12a. Maintain access to the National Flood Insurance Program (NFIP) BureauNet database of repetitive loss properties.
Action 1-12b. Improve the accuracy of geo-locational data on RL and SRL properties by researching matches for properties with incomplete and/or out-of-date address based on rural road designations that have changed.
Action 1-12c. Align RL and SRL property data with validated FEMA NFIP RL and SRL property data annually.
Action 1-12d. Use the Greatest Savings to the Fund (GSTF) data and methodology to promote the cost-effectiveness of SRL property mitigation for HMA grant applications.
Action 1-12e. Report the successes of flood-related projects in the annual update of the SSAHMP 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 31th of the report year.
Action 1-12f. Examine the FEMA-PEMA SRL and RL data sets to seek properties that could potentially be mitigated through the FEMA RFC, SRL or other HMA funding programs or any other funding sources on an annual basis.
Objective 1-13: *Compare properties within the Commonwealth that are known to have been mitigated with the FEMA-provided data sets for SRL and RL properties on an annual basis, and complete FEMA Form AW-501 to support update of the FEMA SRL and RL property databases.*
Action 1-13a. Update annually the list of completed SRL and RL mitigated properties and use GIS or other methods to merge FEMA's SRL and RL database with Pennsylvania's mitigated properties database. Update the merged database when each HMA grant closes or whenever local data becomes available.
Action 1-13b. Complete FEMA Form AW-501 for each mitigated property and provide to FEMA through FEMA database or submittal to Region III upon project close-out.
Action 1-13c. Use GIS to merge the Increased Cost of Compliance SRL and RL database with Pennsylvania's mitigated properties database annually.
Action 1-13d. Ensure that the latitude and longitude of each property is confirmed during project close-out as well as during sponsoring community's three-year mitigation compliance inspection for completed properties. Update mitigated properties Excel workbooks to assure accurate status of mitigated RL and SRL properties.
Action 1-13e. Contact counties with SRL properties to confirm the number and type of mitigated properties and source of funding, if known. This approach can be used to establish an ongoing process of verifying addresses by gathering latitude and longitude data and will ensure currency of the FEMA RL and SRL data sets.

Although the four other goals identified in the Hazard Mitigation Plan Update and their respective objectives are broader-reaching and may address hazards other than flooding, the following goals and objectives have one or more associated actions that specifically address RL and SRL properties:

Goal 4: Build legislative support and secure funding for mitigation efforts.
Objective 4-1: *Provide opportunities for education of all State, county and local government officials and legislators about hazard risk and mitigation by Pennsylvania Emergency Management Agency and County Emergency Management Agencies by 2016.*
Action 4-1d. Perform a "Losses Avoided" study on mitigated SRL or RL properties to communicate money saved in response and recovery so that decision makers, community officials and property owners will be interested in mitigating specific properties.

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 2013 and 2016*.
Action 5-2a. Conduct one meeting annually in each region of the state targeting RL and SRL community officials who serve as HMA grant sponsors.
Action 5-2b. Assist municipalities with direct mailings to SRL property owners.
Action 5-2c. Use the RL/SRL marketing and implementation program successes in PA communities (e.g., Bucks, Lycoming Counties) as a platform for outreach efforts to other RL/SRL communities.
Action 5-2d. Provide an update on SRL and RL mitigation strategies and accomplishments at the annual Commonwealth of Pennsylvania Emergency Management Conference.

The Commonwealth of Pennsylvania seeks to reduce the number of RL and SRL properties through all of the above actions which each fall under one of the three categories: data, planning, and outreach. The actions under objective 1-1 contribute to the Commonwealth's SRL mitigation strategy category of "planning." The actions under objectives 1-12 and 1-13 address the Commonwealth's SRL mitigation strategy category of "data." The actions under objectives 4-1 and 5-2 address the Commonwealth's SRL mitigation strategy category of "outreach." A schedule for completion of each action is contained in Section 6.2.4. This section also identifies funding sources for each action and lead agencies.

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 6.3.1.3. 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 RL and SRL mitigation in Pennsylvania. Twenty-three of the 46 SRL mitigated properties are identified as having been mitigated per PEMA. The remaining 23 properties have been mitigated using ICC program funds. Additionally, 900 of the 1,070 mitigated RL properties have been mitigated using FEMA grant program funding, and 298 properties have been mitigated through the ICC. Furthermore, Section 6.3.1.2 discusses the Commonwealth's support of local hazard mitigation projects, including RL and SRL property mitigation, in more detail. Table 6.3.1-3 includes Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated since 2010. Local Hazard Mitigation Projects for which FEMA HMA Grant Funds are Pending/Approved/Obligated from 1999-2013 including RL/SRL projects are included in Appendix J.

The State and local capabilities to fund and mitigate RL and SRL properties are discussed in Sections 5.3. Pennsylvania will also continue to pursue ways to improve on RL mitigation as indicated by several of the above actions. In order to capture the true total number of properties mitigated in Pennsylvania and more effectively target RL and SRL properties for mitigation, additional database analysis is required. Database tracking and updates have improved greatly between 2010 and 2013, however there remains a need to continue to improve and update this information.

One database improvement includes adding the GSTF data to the PA RL and SRL Inventory in 2013. This addition shows that 57 of the 545 or 10% GSTF properties have been mitigated. This represents a $5,674,674 savings over 30 years.

Sections 5.3 and 6.3.1 of the Hazard Mitigation Plan describes the Commonwealth's process provide local mitigation planning assistance. In particular, Section 6.3.1.1 describes how the Commonwealth supports the development of local mitigation plans.

6.4.3. Review of Implementation Actions from 2010 SRL Strategy

The following represents a summary of actions identified in the 2010 SRL Strategy and progress related to these actions since 2010.

Table 6.4.3-1 Progress Report of SRL Strategy

2010 SRL Strategy Actions	Progress to date
Goal 1: Protect lives, property, environmental quality, and resources of the Commonwealth, including RL and SRL properties.	
Objective 1-1: *By 2013, reduce flood-related losses (with an emphasis on reducing repetitive loss and severe repetitive loss properties by 5%) through promotion of the Commonwealth's flood protection program through county, state, and federal partners.*	
Action 1-1e. Create and implement criteria to prioritize communities with severe repetitive and repetitive loss properties for available mitigation grant funding.	*Continue and update MOS.* *Projects and communities with RL and SRL properties are prioritized in the grant review process.* *Criteria are outlined in the State and Administration Plans.*
Action 1-1f. Target SRL and RL properties for mitigation through HMA funding through prioritization during annual HMA project review and prioritization process.	*Continue.* *More than 30 SRL properties were mitigated.*
Action 1-1g. Incorporate prioritizing of SRL and RL property mitigation into the PEMA-HM strategy and the Administrative Plan post-flood-related disaster.	*Continue.* *Projects and communities with RL and SRL properties are prioritized in the grant review process.* *Criteria are outlined in the State and Administration Plans.*
Action 1-1h. Include the targeting of SRL and RL structures for mitigation in the mitigation strategies section of multi-jurisdictional or county §322 plan with SRL or RL properties.	*Continue.* *All county HMP's completed since 2010 include information on local RL and SRL properties in the vulnerability section and mitigation strategy.*
Objective 1-12: *Manage all Repetitive Loss and Severe Repetitive Loss databases, providing updates to FEMA at least annually in order to more efficiently identify properties to be mitigated.*	
Action 1-12a. Maintain access to the National Flood Insurance Program (NFIP) BureauNet database of repetitive loss properties.	*Continue.* *This is ongoing and supported by FEMA JFO staff.*
Action 1-12b. Improve the accuracy of geo-locational data on RL and SRL properties by researching matches for properties with incomplete and/or out-of-date address based on rural road designations that have changed.	*Continue and update MOS.* *Obtained latitude/longitude for properties.* *A team worked with county officials in Columbia, Dauphin, Wyoming, and Luzerne Counties over a 3 week period to verify RL/SRL locations. BureauNET was updated.*
Action 1-12c. Align RL and SRL property data with validated FEMA	*Continue.*

Table 6.4.3-1 Progress Report of SRL Strategy	
2010 SRL Strategy Actions	**Progress to date**
NFIP RL and SRL property data annually.	*Performed annually via letter.*
Action 1-12d. Use the Greatest Savings to the Fund (GSTF) data and methodology to promote the cost-effectiveness of SRL property mitigation for HMA grant applications.	*Continue.* *Used when applicable; GSTF data has not been updated since 2011.*
Action 1-12e. Report the successes of flood-related projects in the annual update of the SSAHMP 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 31th of the report year.	*Continue.* *An annual report was (and will continue to be) drafted and submitted to the Governor's Office outlining mitigation success in the Commonwealth.* *Mitigation Success section drafted and included in 2013 update.*
Action 1-12f. Examine the FEMA-PEMA SRL and RL data sets to seek properties that could potentially be mitigated through the FEMA RFC, SRL or other HMA funding programs or any other funding sources on an annual basis.	*Continue.* *RL/SRL projects are given prioritization under the current prioritization method.*
Objective 1-13: By 2013, compare properties within the Commonwealth that are known to have been mitigated with the FEMA-provided data sets for SRL and RL properties on an annual basis, and complete FEMA Form AW-501 to support update of FEMA SRL and RL property databases.	
*Action 13-1*a. Update annually the list of completed SRL and RL mitigated properties and use GIS or other methods to merge FEMA's SRL and RL database with Pennsylvania's mitigated properties database. Update the merged database when each HMA grant closes or whenever local data becomes available.	*Continue.* *SRL/RL data has been updated and cross referenced with ICC data. See Appendix G.*
*Action 13-1*b. Complete FEMA Form AW-501 for each mitigated property and provide to FEMA through FEMA database or submittal to Region III upon project close-out.	*Continue.* *PEMA and FEMA have continued to assist communities with these forms over the last 3 years.*
*Action 13-1*c. Use GIS to merge the Increased Cost of Compliance SRL and RL database with Pennsylvania's mitigated properties database annually.	*Continue.* *Requirements continue to be met.*
*Action 13-1*d. Ensure that the latitude and longitude of each property is confirmed during project close-out as well as during sponsoring community's three-year mitigation compliance inspection for completed properties. Update mitigated properties Excel workbooks to assure accurate status of mitigated RL and SRL properties.	*Continue and update MOS.* *RL/SRL property information accuracy and documentation of mappable addresses increased significantly between 2010 and 2013. Information will continue to be improved in next plan implementation phase.*
*Action 13-1*e. Contact counties with SRL properties to confirm the number and type of mitigated properties and source of funding, if	*Continue.*

Table 6.4.3-1 Progress Report of SRL Strategy	
2010 SRL Strategy Actions	**Progress to date**
known. This approach can be used to establish an ongoing process of verifying addresses by gathering latitude and longitude data and will ensure currency of the FEMA RL and SRL data sets.	*RL/SRL property information accuracy and documentation of mappable addresses increased significantly between 2010 and 2013. Information will continue to be improved in next plan implementation phase.*
Goal 4: Build legislative support and secure funding for mitigation efforts.	
Objective 4-1: *Provide opportunities for education of all State, county and local government officials and legislators about hazard risk and mitigation by Pennsylvania Emergency Management Agency and County Emergency Management Agencies by 2013.*	
Action 4-1d. Perform a "Losses Avoided" study on mitigated SRL or RL properties to communicate money saved in response and recovery so that decision makers, community officials and property owners will be interested in mitigating specific properties.	*Continue.* *Losses avoided were estimated and summarized in the Flood hazard profile of the 2013 SSAHMP update.*
Goal 5: Increase awareness, understanding, and preparedness across all sectors.	
Objective 5-3: Prioritize outreach efforts that will result in a 10% increase in RL and SRL related grant applications by 2013.	
Action 5-3a. Conduct one meeting annually in each region of the state targeting RL and SRL community officials who serve as HMA grant sponsors.	*Continue and update MOS.* *Action driven by community requests.*
Action 5-3b. Hold a town hall meeting forum with local governments and home and business owners of SRL properties to educate them about grant programs and their benefits.	*Discontinued.* *Progress was made with meetings in Bloomsburg, Middletown, Shickshinny, and West Pittston. However new HMA guidance has more of a 'all-grants' focus so action folded into 5-3a.*
Action 5-3c. Assist municipalities with direct mailings to SRL property owners.	*Continue and update MOS.* *This action is currently partially addressed; FEMA sends annual letters to SRL property owners who then call PEMA who then sends residents to local officials. This process could be improved through coordination focused at 2 counties per year by PEMA in coordination with counties and FEMA.*
Action 5-3d. Use the RL/SRL marketing and implementation program successes in PA communities (e.g., Bucks, Lycoming Counties) as a platform for outreach efforts to other RL/SRL communities.	*Continue and update MOS.* *Success stories documented and included in plan. The next step remains for PEMA to submit stories to FEMA website.*
Action 5-3e. Provide an update on SRL and RL mitigation strategies and accomplishments at the annual Commonwealth of Pennsylvania Emergency Management Conference.	*Continue.* *Conferenced cancelled in 2012 due to Hurricane Sandy and one is not planned for 2013. Will address at 2014 conference*

6.4.4. Partnerships

The SPT was integral in the development of the 2013 SRL strategy. Section 3.2. of this 2013 Hazard Mitigation Plan Update describes the composition and role of the SPT in the plan update process. Table 6.4.4-1 below depicts the membership of the 2013 SPT.

Table 6.4.4-1 2013 State Planning Team Member Agencies and Organizations

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

Achieving and working through this revised SRL strategy will require the Commonwealth to continue with the members of the SPT as well as reach out to other groups. In particular, the Commonwealth should seek partnerships with local governments. PEMA will continue to seek assistance to implement this SRL strategy through close cooperation with its public and private sector partners.

6.5. Mitigation Success

Mitigation success in the Commonwealth has been obtained by maintaining strong partnerships with a broad range of stakeholders and utilizing multiple funding sources. Not only does the Commonwealth have 201 projects funded through HMA which are pending, approved, or obligated (see Table 6.3.1-3) but PEMA along with its partners have made great strides through improved capabilities. A robust description of existing and improved capabilities is provided in Section 5.

The SRL/RFC Pilot Program was launched in 2007, and the first application administered by PEMA took place in 2008. Some of the projects have now been completed successfully, as detailed in the following section. Due to these successes, the SRL/RFC Pilot Program was adopted on a permanent basis.

As shown in Table 6.5- 1, a total of 761 AW-501's have been submitted for mitigation projects funded throughout the Commonwealth as of April 30, 2013.

Table 6.5-1 Mitigation Actions for which an AW-501 has been submitted and corresponding Source of Funding Summary for Pennsylvania Data from 01/01/2000 - 04/30/2013

SOURCE OF FUNDING	FLOOD PROTECTION	ACQUISITION OR RELOCATION	OTHER MITIGATION	GRAND TOTAL
HMGP	4	94	0	98
FMA	4	5	0	9
PDM	0	2	0	2
RFC	0	0	0	0
SRL	1	1	0	2
1362	0	0	0	0
Other FEMA	1	13	0	14
ICC	117	21	0	138
HUD/CDBG-DR	1	0	0	1
USACE/NRCS	14	14	0	28
Other Fed	1	2	0	3
State Program	26	10	0	36
Local Program	5	10	0	15
Owner	7	13	0	20
Natural Disaster	0	13	0	13
Unknown/Not Specified	2	13	367	382
Total	***183***	***211***	***367***	***761***

Some of these projects are ongoing, and some have been closed out. Three successfully completed structural projects are summarized in Table 6.5-2.

Table 6.5-2 PEMA Mitigation Success Stories	
Cox Avenue RL Acquisition Project	
Street Address: 995 Cox Avenue, Washington Crossing	**County:** Bucks
Total Cost: $441,815	**Funding:** SRL, 100% federal
Project: This was a substantially damaged RL property, which was acquired in order to demolish the existing dwelling and return the parcel to open space use.	**Outcome:** By removing an obstruction in the floodplain and returning the land to a pervious surface, this project will reduce future flood elevations in the area and eliminate potential paths of potable well and aquifer contamination. The end result is better protection of health and property as well as the potential reduction in insurance claims throughout the area.
Lower Makefield Township Elevation Project	
Street Address: 193 River Road, Washington Crossing & 1411 North River Road, Yardley	**County:** Bucks
Total Cost: $419,892	**Funding:** FMA, 75% federal / 25%local
Project: Certain areas within Lower Makefield Township have a history of frequent flooding due to high flows in the Delaware River, railroad embankments and culverts which act as dams during high flows, and storm sewer backups. This project involved the elevation of two properties.	**Outcome:** By elevating these two properties, future damages and insurance claims onsite will be reduced or eliminated. Also, by greatly decreasing the amount of floodplain obstruction on these two properties, future flood elevations will be lowered throughout the area.
Presque Isle Roadway Flood Project	
Street Address: Presque Isle State Park	**County:** Erie
Total Cost: $1,332,510.00	**Funding:** LPDM, 75% federal / 25%local
Project: High wind/storm events caused waves from Lake Erie to wash over the beach and breach dunes which resulted in flooding along the roadway, occasionally stranding visitors and personnel. The scope included relocation of the roadway and dune line establishment.	**Outcome:** By relocating Old Lake Road and establishing a high-drift back beach dune line recurring flooding has been alleviated. Additional sand and plantings were used for dune restoration.

In addition to structural projects, progress has been made through grant fun allocation, providing training, attending workshops, and developing guidance and outreach materials among other techniques. Mitigation success is detailed throughout the plan primarily in the Capability Assessment and Mitigation Strategy chapters. A list summarizing many of these key successes is included in Table 6.5-3 below.

Table 6.5-3 Key Mitigation Success since 2010.

SUCCESS TITLE	SUCCESS SUMMARY DESCRIPTION
DR 1898 funding	• 16 acquisitions and structural projects totaling over $17M.
DR 4003 funding	• 1 acquisition..
DR 4025 funding	• 20 acquisitions (91 properties). • Utilizing NFIP ICC and Section 407 to fund demolitions, and HUD CDBG as Global Match for local match.
DR 4030 funding	• 50 Phase I acquisition projects (361 substantially damaged homes). • 33 Phase II acquisition and structural projects . • 46 generator projects totaling over $4.5M. • Utilizing NFIP ICC and Section 407 to fund demolitions, and HUD CDBG as Global Match for local match. • Instrumental in paving way for other states to navigate “clear title” issues (Iron Ore, Coal Mineral Rights, and Gas Lease Surface and Sub-Surface issues). Measures taken in PA will appear in updated UHMA guidelines.
DR 4099 funding	• 10 acquisition/elevation projects (61 homes).
Emergency management grant funds disbursed (federal and state funds)	• 103.5M in FY 2010-11 • $63M in FY 2011-12 • $80M in FY 2012-13
County HMP’s	• 25 County HMP updates using new HM standards.
Training/Workshops	• Provided 3 FEMA/PEMA G-393 Hazard Mitigation for Emergency Manager courses. • Two L-273 Courses delivered by the PA Department of Community & Economic Development. • Brought in the Natural Hazard Mitigation Association’s “Legal Aspects for Hazard Mitigators” Course – Well attended/part of a pre-conference course for the FEMA SHMO/NFIP Workshop held at Harrisburg PA • Hosted the biannual FEMA SHMO/NFIP Workshop held at Harrisburg PA; made accommodations for FEMA Region III and FEMA HQ staff who could not travel due to sequestration. • Pennsylvania Hosted the 2012 National Silver Jackets Workshop in Harrisburg PA. • Assisted FEMA Region III in the delivery of Substantial Damage (SD) Substantial Damage Improvement (SDI), Substantial Damage Estimator (SDE) workshops. • PEMA Staff attended FEMA’s Advanced Concepts II & III, E-213 and E-214 courses at the Emergency Management Institute. • Silver Jackets – Have held 9 WEBEX sessions & 3 face-to-face meetings. • Approximately 2,500 state and local emergency preparedness and response personnel trained each year since 2010.
PEIRS	• Average of nearly 11,000 incidents reported since 2010. Total number of reported incidents increases annually.
Flood Risk Management Website	• The Pennsylvania Silver Jackets team has developed a website (http://www.nab.usace.army.mil/Home/SilverJackets.aspx) to provide Pennsylvania residents and business owners with the best resources for information related to flood preparedness and response. The site is divided into three sections: Before the Flood/General Information, During the Flood, and After the Flood. Each section contains some of the most frequently asked questions regarding floods and provides

Table 6.5-3 Key Mitigation Success since 2010.

SUCCESS TITLE	SUCCESS SUMMARY DESCRIPTION
	links to resources that can answer those questions.
BureauNet	• Updated BureauNet Data for SRL & RL identified homes in Columbia, Luzerne and Wyoming counties.
Other	• USACE PA Silver Jackets Team coordinator recognized at the Silver Jackets Team Coordinator of the Year; Team in running for team of the year. • PEMA SHMO on the National Silver Jackets Virtual Conference team to assist in the delivery of the Virtual Conference in August 2013.

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.

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 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. For a more complete discussion of the 2004-2007 triennial update, please see Section 3.1.

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.

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 SSAHMP. Separate meetings to review the SSAHMP 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 PA Tool, an online plan builder and project information management system aided in the plan maintenance process coordination between the local and state hazard mitigation plans.

The Silver Jackets was an effective method for maintenance on the SSAHMP and will be used moving forward to maintain and implement the 2013 SSAHMP update. Membership in the PA Silver jackets includes:

Federal

- USACE
- FEMA, Region III
- NOAA and NWS
- USGS
- HUD
- NRCS
- EDA

Commonwealth

- PennDOT
- PA Insurance Department
- PA Department of Agriculture
- PEMA
- DCED
- DEP
- DCNR

Regional

- Susquehanna River Basin Commission (SRBC)
- Delaware River Basin Commission (DRBC)
- Interstate Commission on the Potomac River Basin (ICPRB)

Professional

- PA Association of Floodplain Managers (PAFPM)
- Keystone Emergency Management Agency (KEMA)
- American Rivers Organization (ARO)

The following PA Silver Jackets meetings were held between the 2010 and 2013 update:

- May 7-9, 2013, Nonstructural Flood Proofing Workshops
- March 21, 2013, Webinar
- February 21, 2013, Webinar
- January 17, 2013, Quarterly Meeting
- December 20, 2012, Webinar
- November 15, 2012, Webinar
- October 18, 2012, Quarterly Meeting
- September 20, 2012, Webinar
- July 26,2012, Quarterly Meeting
- June 21, 2012, Webinar
- May 17, 2012, Webinar
- April 19, 2012, Quarterly Meeting
- February 16, 2012, Webinar
- January 19, 2012, Quarterly Meeting
- December 15, 2011, Webinar

- November 17, 2011, Webinar
- October 20, 2011, Quarterly Meeting
- September 24, 2011, PEMA Workshop
- August 25, 2011, Webinar
- July 14, 2011, Quarterly Meeting
- June 16, 2011, Webinar
- May 12, 2011, Quarterly Meeting
- March 17, 2011, Webinar
- February 17, 2011, Webinar
- January 13, 2011, Quarterly Meeting
- December 16, 2010, Webinar
- November 18, 2010, Webinar
- October 19, 2010, Quarterly Meeting
- September 23, 2010, PA SJ Webinar
- August 18, 2010, First PA SJ Working Meeting - Harrisburg, PA
- March - June 2010, Participation in HMP Update (meetings, reviews)
- March 22, 2010, Silver Jackets Introduction to PA Reps Mtg - Harrisburg, PA

Moving forward, annual SSAHMP review meetings will be planned for 2014 and 2015. The SPT and Silver Jackets will be invited to these meetings. In 2016, there will be another set of in depth meetings focused on the SSAHMP update. The Silver Jackets will be used moving forward to maintain and implement the 2013 SSAHMP mitigation strategy for flood, dam and levee actions.

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-BORM will take will take the lead in monitoring, evaluating, and conducting future updates. BORM will be assisted in this effort by the USACE Silver Jackets program, facilitated by PEMA's Area Offices, SHMO, Hazard Mitigation Planner, DEP Emergency Preparedness Liaison Officer, the DCED 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 2013 SPT and other interested parties will be encouraged to join and build the Silver Jackets.

The Commonwealth Hazard Mitigation Plan will be reviewed annually. 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, BORM 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. Findings will be appended to the existing plan. Goals, objectives, and actions will also be reviewed annually by the Governor and the State Legislature. Objectives pertinent to HMGP are also reviewed after each disaster and are formalized with the preparation of the Administrative Plan; 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 Triennial Updating of the State All- Hazards Mitigation Plan will be completed, FEMA Approved and State Adopted by the 2013 Anniversary date.

A key component of the bi-annual review of the Commonwealth Hazard Mitigation Plan 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 quarterly and other meetings related to the plan will be filed and saved so that they may be included in the Planning Process Appendix for the 2013 SSAHMP 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 SSAHMP 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 SSAHMP update and illustrates that their role in implementing the 2013 SSAHMP continues to be an excellent choice.

7.3. Continued Public Involvement

PEMA will involve the public during periodic evaluations of the SSAHMP by providing an opportunity to submit comments about the plan. The public will have access to the plan online and through the Bureau of Recovery and Mitigation. The public is encouraged to submit comment on the plan at any time. Relevant comments will be incorporated into the plan's next update.

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.state.pa.us). 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 2-way communication. Additionally, the Bureau of Recovery and Mitigation 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 Bureau of Recovery and Mitigation is responsible for the monitoring and tracking of the 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. PEMA will provide FEMA with the status of properties acquired, relocated, elevated, or retrofitted. The Bureau, through the Emergency Preparedness Liaison Officers, 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.

Projects will be divided for evaluation by the subject matter of each project and assigned to appropriate staff members. PEMA staff shall develop an evaluation document that addresses outcomes or the success of projects. The team will assess new information provided through research and disaster assessment reports to update the baseline data. The team will review the level of coordination among state agencies. This review is key to the success in implementing the plan.

The project reporting process will be more uniform and efficient with the advent of the PA Tool. With all projects in a digital inventory, it becomes easier to categorize potential projects. Once a project has a Letter of Intent or Interest, it becomes part of the PEMA Hazard Mitigation Fiscal and Project database. The PA Tool was an improvement over the 2007 project reporting because both fiscal and project officers have visibility on all projects worked. Increasing use of these database tools will assist in more efficient implementation, tracking, and management as the Commonwealth moves towards its goal of receiving Enhanced Plan Status. In the period between 2010 and 2013, HMGP funding was available for winter storm disaster (DR-1898), severe storms and flooding (DR-4003), Hurricane Irene (4025-DR), Tropical Storm Lee (4030-DR), and Hurricane Sandy (DR-4099). This led to funding for projects and related project reporting documented in Section 6.3.1.2 Support of Local Hazard Mitigation Projects. Many grant applications were eligible but did not receive funding; this provides PEMA with a list of 'shovel ready' projects to facilitate applications for future funding.

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 III 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 III
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 Closeout and full grants management process are outlined in PEMA's HMPO Handbook.

8. Plan Adoption

The Plan was submitted to the Pennsylvania State Hazard Mitigation Officer on July 16, 2013. It was forwarded to FEMA for final review and approval-pending-adoption on August 15, 2013. FEMA granted approval-pending-adoption on October 18, 2013. The Commonwealth of Pennsylvania adopted the plan on October 21, 2013. Full approval from FEMA was received on October 21, 2013.

This section of the plan includes a copy of the adoption resolution passed by PEMA. A completed Standard State Mitigation Plan Review Crosswalk can be found in *Appendix B – Standard Plan Crosswalk*.

Commonwealth of Pennsylvania
2013 Standard State All-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 (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 2013 State Standard All-Hazard Mitigation Plan Update has been developed through the efforts of the Pennsylvania Emergency Management, 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 2013 State Standard All-Hazard Mitigation Plan Update, and

WHEREAS, the Commonwealth of Pennsylvania 2013 State Standard All-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 44 CFR 13.11 and 13.11(d) 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 Standard State All-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 2013 State Standard All-Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this 21st day of October, 2013.

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Glenn M. Cannon, Esq.
Director, Pennsylvania Emergency Management Agency