City of Philadelphia

Managing Director's
Office of Emergency Management

Natural Hazard Mitigation Plan

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1. Introduction

1.1 Background

The term hazard mitigation, as defined by the Federal Emergency Management Agency (FEMA), describes sustained actions taken to prevent or minimize long-term risks to life and property from hazards and their effects.[1] Hazard mitigation is a process in which hazards are identified and profiled, people and facilities at risk are analyzed, and mitigation actions are developed. Mitigation actions are taken in advance of a hazard event and are essential to breaking the disaster cycle of preparedness, response, and recovery. According to a 2005 study by the National Institute of Building Sciences, for every one dollar spent on mitigation, four dollars in post-storm cleanup and rebuilding is saved.[2] Examples of mitigation include:

- Promoting sound land use planning based on known community hazards
- Adopting and enforcing building codes and standards
- Using fire-retardant materials in new construction
- Buying flood insurance to protect personal property and belongings
- Elevating structures above the floodplain
- Elevating critical equipment (i.e. computer servers, generators, water heaters, above the base flood elevation)
- Retrofitting highway overpasses to withstand earthquakes

The City and County of Philadelphia (hereinafter referred to as Philadelphia or the City) has developed this Hazard Mitigation Plan (hereinafter referred to as the HMP) to assess risks posed by natural hazards and to develop mitigation strategies for reducing the risks of these hazards. The City has prepared the HMP in accordance with the requirements of the Disaster Mitigation Act of 2000 (DMA 2000). The Managing Director's Office of Emergency Management (MDO-OEM) has coordinated the preparations of the HMP in cooperation with other City agencies and departments, as well as private agency representatives.

1.2 Purpose and Scope

1.2.1 Premise

As a condition of receiving federal disaster mitigation funds, Section 322 of the DMA 2000 requires that local governments have a mitigation plan. The HMP describes the process for identifying hazards, creating a risk assessment and vulnerability analysis, identifying and prioritizing mitigation strategies, and developing an implementation schedule.

[1] Federal Emergency Management Agency (FEMA). Emergency Management Institute Independent Study: IS-393.a Introduction to Hazard Mitigation. Retrieved 6 February 2012.
[2] Multi-hazard Mitigation Council: National Institute of Building Sciences. Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities. Retrieved 6 February 2012.

In order to satisfy this requirement MDO-OEM has prepared the HMP with the following objectives in mind:

- Provide a blueprint for reducing property damage and saving lives from the effects of natural disasters within Philadelphia County;
- Qualify Philadelphia for applicable pre-disaster and post-disaster grant funding;
- Comply with state and federal legislative requirements related to local hazard mitigation planning;
- Demonstrate a firm local commitment to hazard mitigation principles; and
- Improve community resiliency following a disaster event.

1.2.1.1 Grant Programs with Mitigation Plan Requirements

Hazard Mitigation Grant Program (HMGP)

The HMGP provides grants to state, local, and tribal entities to implement long-term hazard mitigation measures after declaration of a major disaster. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Projects must provide a long-term solution to a problem (for example, elevation of a home to reduce the risk of flood damage rather than buying sandbags and pumps to fight the flood). Also, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. Under the program, the federal government may provide a state or tribe with up to 20 percent of the total disaster grants awarded by FEMA; and may provide up to 75 percent of the cost of projects approved under the program.[3]

Pre-Disaster Mitigation (PDM) Program

The PDM Program provides funds to state, local, and tribal entities for hazard mitigation planning and the implementation of mitigation projects before a disaster event. PDM grants are awarded on a nationally competitive basis. Like HMGP funding, the potential savings of a PDM project must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The total amount of PDM funding available is appropriated by Congress on an annual basis. The federal government provides up to 75 percent of the cost of projects approved under the program.[4]

Flood Mitigation Assistance (FMA) Grant Program

[3] Federal Emergency Management Agency (FEMA). Hazard Mitigation Assistance Programs: Hazard Mitigation Grant Program. Retrieved 6 February 2012.

[4] Federal Emergency Management Agency (FEMA). Hazard Mitigation Assistance Programs: Pre-Disaster Mitigation Program. Retrieved 6 February 2012.

The goal of the FMA Grant Program is to reduce or eliminate flood insurance claims under the National Flood Insurance Program (NFIP). This program places particular emphasis on mitigating repetitive loss (RL) properties. The primary source of funding for this program is the National Flood Insurance Fund. Grant funding is available for three types of grants: Planning, Project, and Technical Assistance. Project grants, which use the majority of the program's total funding, are awarded to local entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP. The cost-share for this grant is 75 percent federal/25 percent nonfederal. However, a cost-share of 90 percent federal/10 percent nonfederal is available in certain situations to mitigate severe repetitive loss (SRL) properties.[5]

Repetitive Flood Claims (RFC) Program
The RFC Program provides funding to reduce or eliminate the long-term risk of flood damage to residential and non-residential structures insured under the NFIP. Structures considered for mitigation must have had one or more claim payments for flood damages. All RFC grants are eligible for up to100 percent federal assistance.[6]

Severe Repetitive Loss (SRL) Program
The SRL Program provides funding to reduce or eliminate the long-term risk of flood damage to residential structures insured under the NFIP. Structures considered for mitigation must have had at least four NFIP claim payments over $5,000 each, when at least two such claims have occurred within any 10-year period, and the cumulative amount of such claim payments exceeds $20,000; or for which at least two separate claims payments have been made with the cumulative amount of the building portion of such claims exceeding the value of the property, when two such claims have occurred within any 10- year period. The cost-share for this grant is 75 percent federal/25 percent nonfederal. However, a cost-share of 90 percent federal/10 percent nonfederal is available to mitigate SRL properties when the state or tribal plan addresses ways to mitigate existing and future SRL properties.[7]

1.2.2 Purpose of the Plan

The Philadelphia HMP represents the City's approach to mitigate the adverse impacts of natural disasters. The 2012 HMP is organized into the following sections:

Section I: Introduction
The Introduction provides a brief overview of the background and purpose, the legal authority for the plan, as well as the grant programs available to Philadelphia once the plan has been adopted.

[5] Federal Emergency Management Agency (FEMA). Hazard Mitigation Assistance Programs: Flood Mitigation Assistance Grant Program. Retrieved 6 February 2012.
[6] Federal Emergency Management Agency (FEMA). Hazard Mitigation Assistance Programs: Repetitive Flood Claims Program. Retrieved 6 February 2012.
[7] Federal Emergency Management Agency (FEMA). Hazard Mitigation Assistance Programs: Severe Repetitive Loss Program. Retrieved 6 February 2012.

Section II: Community Profile: Philadelphia
The Community Profile provides a general overview of Philadelphia by summarizing demographics, economic characteristics, the City's natural environment including its climate and waterways, growth trends, land use and more. To accomplish these goals, the profile is divided into three components:

- Physical Environment – the physical setting of Philadelphia, including: geography, hydrography and hydrology, topography and geology, and climate information
- Social Environment – includes the City of Philadelphia's history, social characteristics, demographic estimates, economic characteristics, and housing characteristics
- Built Environment – land use and infrastructure within Philadelphia's boundaries

Section III: Planning Process
This section outlines the process in which Philadelphia developed the HMP. It identifies the 19 Philadelphia, Commonwealth, federal, and private organizations that were involved in planning process. The section also details the strategies employed to obtain public feedback.

Section IV: Risk Assessment
The Risk Assessment provides an analysis of the hazards and risks facing Philadelphia. It contains detailed profiles of each natural hazard addressed in the plan, and estimates losses in Philadelphia in a realistic worst case scenario for each hazard.

Section V: Mitigation Strategy
The Mitigation Strategy section describes how Philadelphia intends to reduce losses identified in the Risk Assessment. The section contains a prioritized list of cost-effective, environmentally sound, and technically feasible mitigation actions broken down by hazard, and by the agency(ies) who would be primarily responsible for implementing each strategy. It identifies current and potential sources of funding and other resources needed to implement mitigation actions. Finally it includes Philadelphia policies and programs that will assist in administering the identified mitigation actions.

Section VI: Plan Adoption
This section states how Philadelphia will formally adopt the Plan, ensuring a citywide commitment to mitigation planning, and to comprehensive mitigation planning citywide, to include program management.

Section VII: Plan Maintenance
The Plan Maintenance section describes how Philadelphia will monitor, evaluate and update its HMP. Philadelphia's HMP will be updated and maintained to address natural and human-caused hazards. Plan updates will take place following significant disasters, or at a minimum, every five years.

1.3 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 201 and 206.
- Disaster Mitigation Act of 2000, Public Law 106-390, as amended.
- National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 *et seq.*
- National Flood Insurance Reform Act of 1994, 42 U.S.C. 4101.

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 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 386-9: *Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects*. August 2008.
- FEMA *Local Multi-Hazard Mitigation Planning Guidance*. July 1, 2008.

The following FEMA grant programs and reference document were used to prepare this document:

- Hazard Mitigation Grant Program under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act 42 U.S.C., Section 322, as amended.
- Pre-Disaster Mitigation Grant Program under Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act 42 U.S.C. 5133.
- Flood Mitigation Assistance Program under the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101).
- Severe Repetitive Loss Program under section 1361A of the National Flood Insurance Act, as amended (NFIA), 42 U.S.C. 4102a.
- Repetitive Flood Claims Grant Program under Flood Insurance Reform Act of 2004 (P.L. 108–264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al).

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: *Draft Standard Operating Guide*. October 9, 2009.

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

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

2. Community Profile: Philadelphia

The Community Profile provides a general overview of Philadelphia by summarizing demographics, economic characteristics, the City's natural environment including its climate and waterways, growth trends, land use and more. To accomplish these goals, the profile is divided into three components:

- Physical Environment
- Social Environment
- Built Environment

2.1 Physical Environment

This section presents the physical setting of Philadelphia, including: geography, hydrography and hydrology, topography and geology, and climate.

2.1.1 Geography

Philadelphia covers 134.1 square miles of land and is located in the southeastern portion of the Commonwealth of Pennsylvania.[8] The City is bounded by Bucks County to its north, Montgomery County to its west, Delaware County to its south, and the state of New Jersey to its east (the Delaware River separates the City of Philadelphia from the State of New Jersey). Philadelphia is the largest city in Pennsylvania. The City of Philadelphia is coterminous to Philadelphia County, meaning the City and County of Philadelphia share the same boundaries.

Philadelphia is the fifth most populous city in the United States with a population as of the 2010 Census of 1,526,006. Philadelphia is divided into 63 neighborhoods, each of which fall within twenty-one police districts, which are further grouped geographically into six police divisions: Central, East, Northeast, Northwest, South, and Southwest. Figure 2.1.1-1 on the following page depicts the 63 Philadelphia neighborhoods by police division boundary.

Additionally, the U.S. Census Bureau places Philadelphia as the urban center of a four-state "Greater Philadelphia" region, otherwise known as the Delaware Valley, comprised of the 12 counties within the Metropolitan Statistical Areas (MSA) of Philadelphia-Camden-Wilmington. The Delaware Valley is home to approximately 6 million people, and is the country's fifth-largest metropolitan area.[9]

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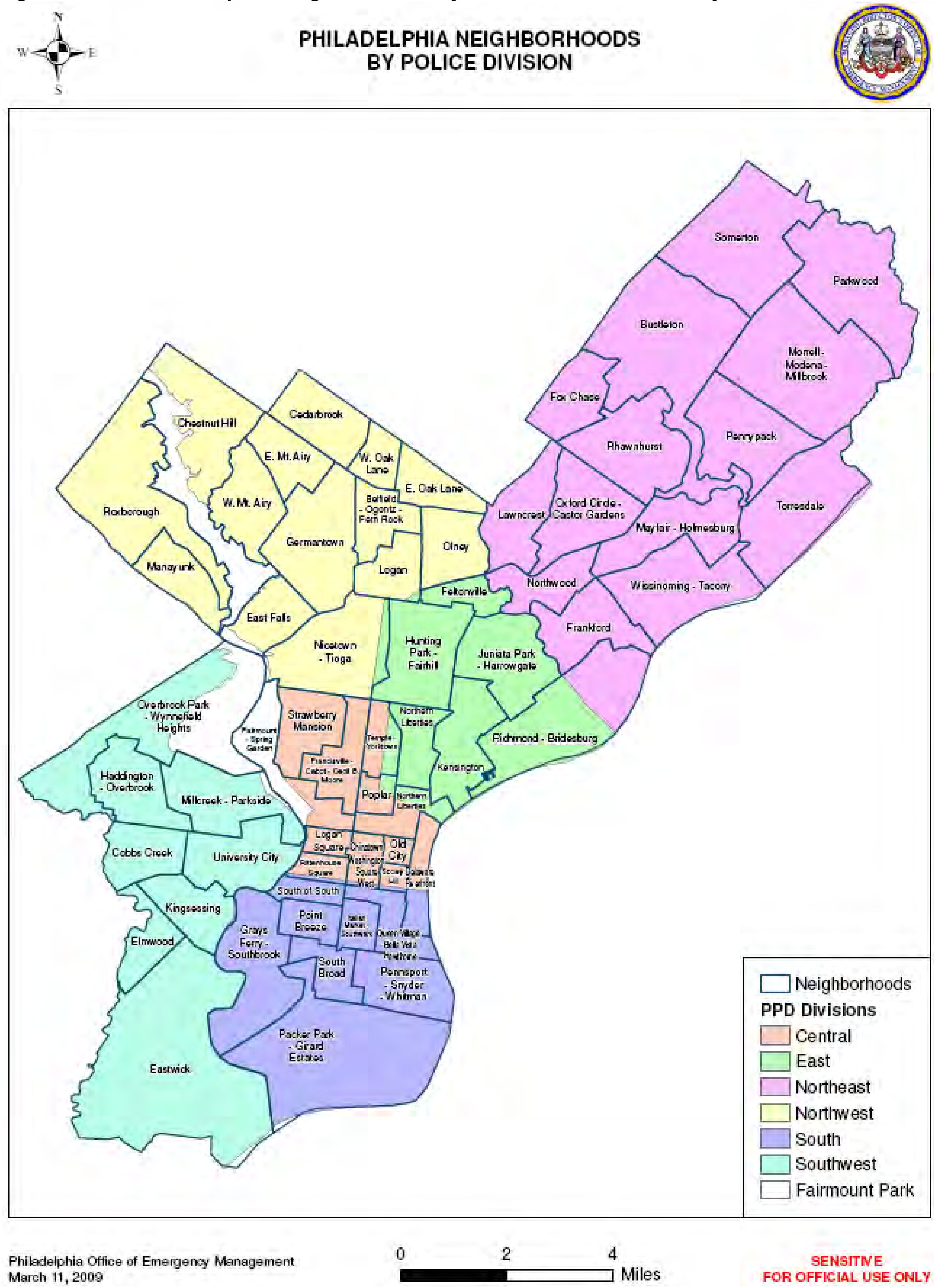
[8] United Census Bureau. 2010 Census: Philadelphia, Pennsylvania. Retrieved 3 November 2011.
[9] Ibid

Figure 2.1.1-1: Philadelphia Neighborhoods by Police Division Boundary

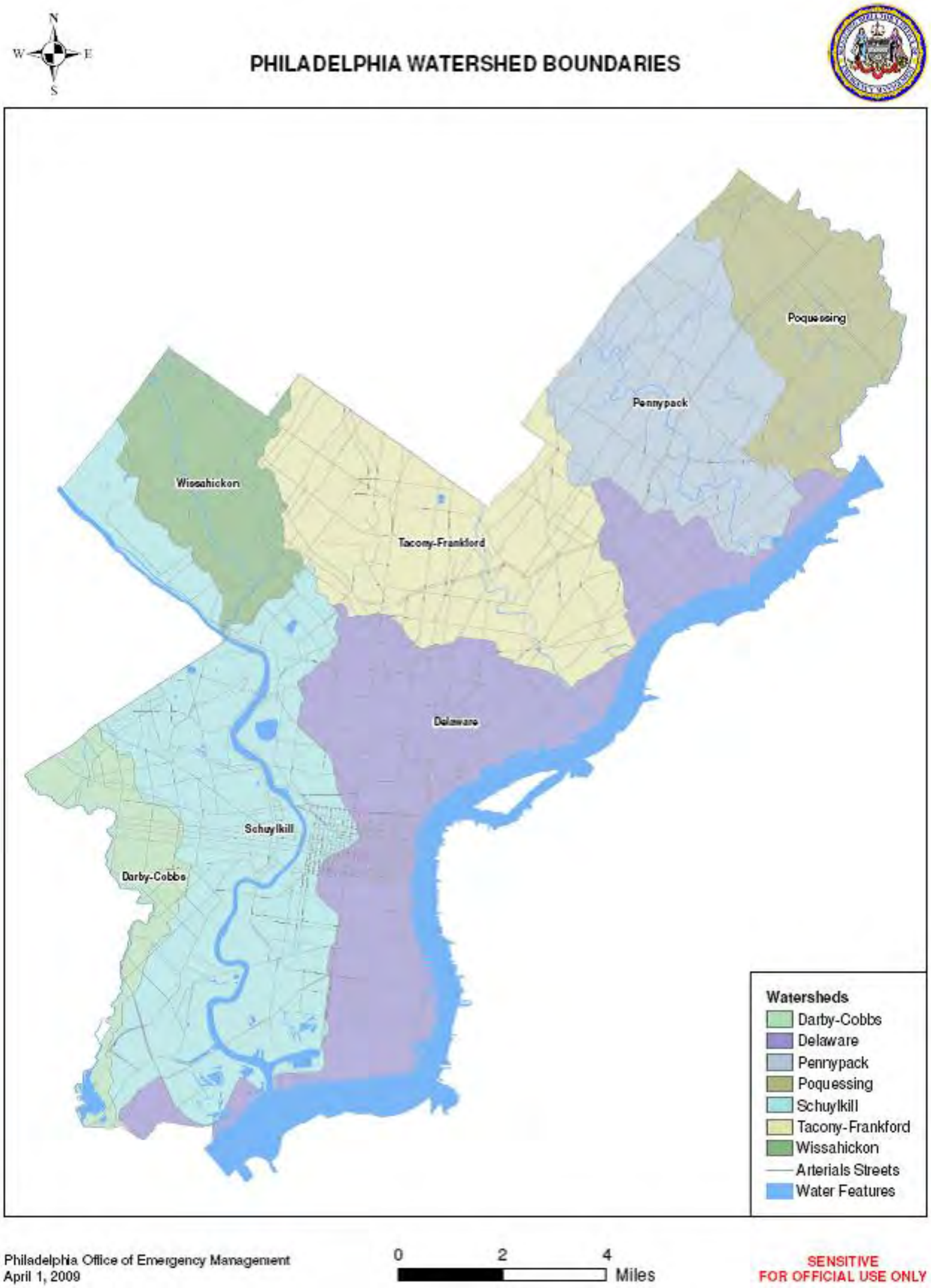


2.1.2 Hydrography and Hydrology

Numerous creeks and rivers make up the waterscape of Philadelphia. The major waterways within Philadelphia include: the Delaware River, the Schuylkill River, the Wissahickon Creek, the Pennypack Creek, the Frankford Creek, the Poquessing Creek and Cobbs Creek. The U.S. Environmental Protection Agency (EPA) defines a watershed as the area of land where all of the water that is under it or drains off of it goes into the same place. All of the major bodies of water within Philadelphia are part of seven primary and secondary watersheds. [10] (See Figure 2.1.2-1)

[10] Philadelphia Water Department – Office of Watersheds: Watershed Information Center. Retrieved 3 November 2011.

Figure 2.1.2-1: Philadelphia Watersheds



Source: Philadelphia Water Department – Department of Watersheds 2011

2.1.2.1 Primary Watersheds

The Delaware River Watershed

The Delaware River Watershed drains nearly 13,000 square miles, though Philadelphia's contribution is very small, approximately 40 square miles. The Delaware River Watershed includes territory from Point Mountain in the Catskills Range of Hancock (Schoharie County, New York) to the mouth of the Delaware Bay in Philadelphia, Pennsylvania. The Delaware River winds over 300 miles through four states on the eastern coast of the United States, encompassing 42 counties and 838 municipalities in the Mid-Atlantic region. The watershed contains 23,700 linear miles of streams, 21 of which are located within Philadelphia all within the Delaware River. An estimated 7.7 million people reside within the watershed, 530,652 of which live in Philadelphia.[11] The land use composition for this watershed is estimated at roughly 55% forest, 26% agriculture, and 15% developed. The area within Philadelphia is very densely developed and estimated to be 72% impervious surface and therefor highly susceptible to flash flooding.[12]

The Schuylkill River Watershed

The Schuylkill River Watershed is composed within portions of 11 counties, and encompasses approximately 2,000 square miles. The river travels approximately 130 linear miles from its headwaters at Tuscarora Springs in Schuylkill County, PA to its mouth at the Delaware River in Philadelphia. The Schuylkill River is the largest tributary to the Delaware River and is a major contributor to the Delaware Estuary. Approximately 1.5 million people reside within this watershed, 347,588 of which live in Philadelphia.[13] Within the watershed, 10% of the land is found to be impervious and therefore is susceptible to flash flooding.[14]

2.1.2.2 Secondary Watersheds

Wissahickon Creek Watershed

Wissahickon Creek begins in Montgomery Township, PA and flows for approximately 27 miles where it meets with the Schuylkill River at the end of Lincoln Drive in Philadelphia. The Wissahickon Creek Watershed drains nearly 64 square miles and contains 134 linear miles of streams. Nearly 160,000 residents live within this watershed, 48,441 of which live in Philadelphia.[15] Approximately 24% of the land is impervious and therefore susceptible to flash flooding.[16]

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[11] Philadelphia Water Department – Office of Watersheds: Watershed Information Center: Delaware Watershed. Retrieved 3 November 2011.

[12] Ibid

[13] Philadelphia Water Department – Office of Watersheds: Watershed Information Center: Schuylkill Watershed. Retrieved 3 November 2011.

[14] Ibid

[15] Philadelphia Water Department – Office of Watersheds: Watershed Information Center: Wissahickon Watershed. Retrieved 3 November 2011.

[16] Ibid

The Pennypack Creek Watershed

The Pennypack Creek Watershed encompasses areas of Montgomery, Philadelphia and Buck Counties. With approximately 56.3 square miles of area, 31.7 square miles (56%) is located in Montgomery County, 17.9 square miles (32%) in Philadelphia County, and 6.7 square miles (12%) in Bucks County. This watershed is home to 125 linear miles of streams and 230,000 residents, 137,010 of which live in Philadelphia.[17] Roughly 33% of the watershed is impervious and therefore susceptible to flash flooding.[18]

The Poquessing Creek Watershed

The Poquessing Creek rises from tributary streams in Lower Moreland and Lower Southampton Townships in Pennsylvania. The watershed encompasses approximately 22 square miles of drainage area in the areas of Philadelphia, Bucks and Montgomery counties. It contains 45 linear miles of streams and is home to 105,000 residents, 75,550 reside within Philadelphia.[19] The watershed has 38% impervious cover and therefore this land is susceptible to flash flooding.[20]

The Tookany/Tacony-Frankford Watershed

The Tookany/Tacony-Frankford Watershed drains 33 square miles, or about 20,000 acres, in Philadelphia and Montgomery Counties. The creek is referred to as the Tookany Creek until it enters Philadelphia at Cheltenham Avenue; then as the Tacony Creek from the Montgomery County border until the confluence with the historic Wingohocking Creek in Juniata Park; and finally the section of stream from Juniata Park to the Delaware River is referred to as the Frankford Creek. The Watershed contains 32 linear miles of streams and is home to 360,000 residents, 285,405 reside within Philadelphia.[21] The entire watershed is approximately 48% impervious, making almost half the watershed susceptible to flash flooding.[22]

The Darby-Cobbs Watershed

The Darby-Cobbs Watershed drains approximately 77 square miles, including portions of Chester, Delaware, Montgomery and Philadelphia counties. The watershed is often subdivided into the Cobbs Creek, Darby Creek, and Tinicum subwatersheds for planning purposes. The watershed as a whole is home to about 460,000 residents, with about 230,000 people, or half of the watershed's residents, living in the Cobbs Creek

[17] Philadelphia Water Department – Office of Watersheds: Watershed Information Center: Pennypack Watershed. Retrieved 3 November 2011.

[18] Ibid

[19] Philadelphia Water Department – Office of Watersheds: Watershed Information Center: Poquessing Watershed. Retrieved 3 November 2011.

[20] Ibid

[21] Philadelphia Water Department – Office of Watersheds: Watershed Information Center: Tookany-Tacony-Frankford Watershed. Retrieved 3 November 2011.

[22] Ibid

subwatershed, and 100,054 residents are within Philadelphia's boundaries.[23] The Darby-Cobbs Watershed contains 135 linear miles of streams, 33 miles of which are in the Cobbs Creek subwatershed and contains 44% impervious cover, which is susceptible to flash flooding. The Cobbs Creek subwatershed alone drains approximately 22 square miles, nearly 30% of the Darby-Cobbs watershed as a whole.[24]

2.1.3 Topography and Geology

A Physiographic Province is an area of land that is composed of a particular type(s) of rock as a result of having undergone environmental processes such as weathering and erosion, over a period of time. Each province is distinguishable by its physical landforms, unique rock formations and groundwater characteristics. According to the Commonwealth of Pennsylvania Department of Conservation and Natural Resources Bureau of Topographic and Geologic Survey, Philadelphia straddles two physiographic provinces, each with a distant suite of rocks: the Atlantic Coastal Plain and the Piedmont Upland Section (otherwise known as the Southern Piedmont Province.) Figure 2.1.3-1 depicts the physiographic provinces of Pennsylvania; and delineates the two physiographic provinces found within Philadelphia.

The Atlantic Coastal Plain is a narrow strip of sandy low-lying land immediately adjacent to the Delaware River in southeastern Philadelphia. The Southern Piedmont contains schist, metagraywacke, amphibolite and associated ultramafic rocks of the Wissahickon Formation overlain by unconsolidated Cretaceaous and tertiary sediments.[25]

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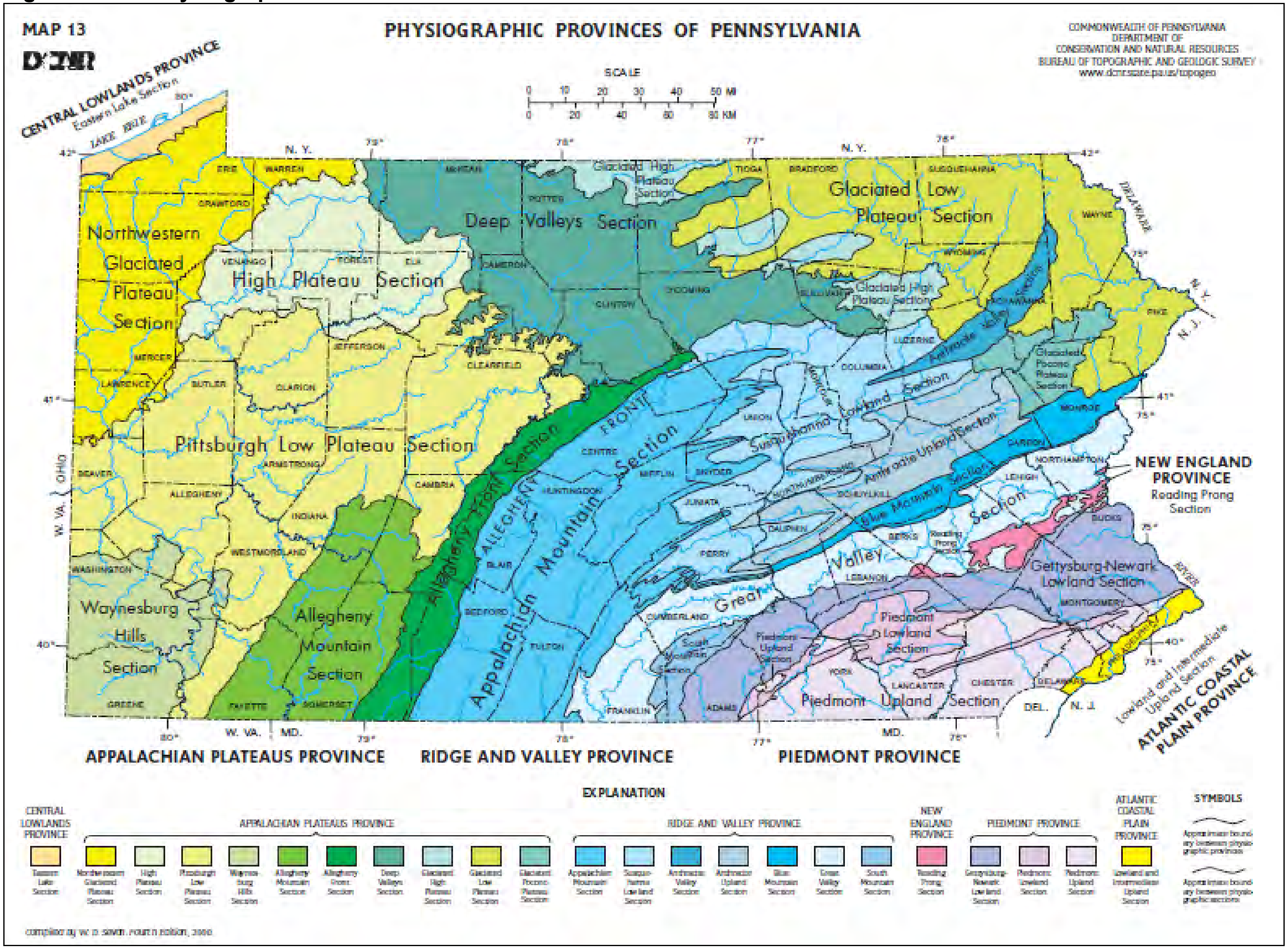
[23] Philadelphia Water Department – Office of Watersheds: Watershed Information Center: Darby-Cobbs Watershed. Retrieved 3 November 2011.

[24] Ibid

[25] Commonwealth of Pennsylvania Department of Conservation and Natural Resources. Lowland and Intermediate Upland Section, Atlantic Coastal Plain Province. Retrieved 3 November 2011.

Figure 2.1.3-1 Physiographic Provinces



Source: Commonwealth of Pennsylvania Department of Conservation and Natural Resources, 2011

2.1.4 Climate

The Delaware Valley lies about halfway between the equator and the North Pole. This midlatitude location puts the Philadelphia area about equidistant from the reservoirs of cold air to the north and warm air to the south, one of the primary reasons the region has diverse types of weather. In addition, the variability in Philadelphia's weather is increased by both the ample amount of moisture in the Atlantic Ocean just to the east, and the 3,000 miles of land to the west.

The following sections describe the characteristics of Philadelphia's temperature, precipitation amounts, and tendencies for severe weather. Data was obtained from several sources, including NOWDATA (NOAA online weather data), the National Climatic Data Center (NCDC) and The Philadelphia Area Weather Book. The normals, means and extremes listed below for Philadelphia's Climatological Data annuals are computed from observations taken primarily at the Philadelphia International Airport (PHL) from 1981-2010. Table 2.1.4-1 illustrates the annual temperature and precipitation averages for Philadelphia.

Table 2.1.4-1 Philadelphia Annual Temperature & Precipitation Averages
Average Annual Temperature: 55.8°F
Liquid Precipitation Average: 41.5 inches per year
Snowfall Average: 20.5 inches per year

Sources: NOAA, 2010; NCDC, 2011

2.1.4.1 Temperature

The average annual temperature of Philadelphia is 55.8°F, with mean monthly temperatures varying from 32.9°F in January to 78.1°F in July. During the summer months, daily temperatures reach 90°F or above 27 days annually on average; readings of 100°F are more sporadic, occurring on average, less than once annually.

Climatologically speaking Philadelphia winters are mild. On average, less than 85 days a year have minimum temperatures drop to 32°F or below, and readings below 0°F are just as infrequent as the 100°F readings, occurring less than once annually.[26]

Still, due to the location of Philadelphia and its weather variability, big swings in temperatures can occur from year to year. The temperature difference between Philadelphia's hottest and coldest years is more than 8°F, a dramatic range for climatology. During the warmest years (1998,1931) the temperature fell below freezing

[26] The Philadelphia Weather Book. John Nese and Glen Schwartz. Retrieved 2 November 2011.

on only forty-one days (less than half of the average), while the temperature reached 90°F or higher on thirty-one days (as compared to 27 days in an average year). In contrast, within the coldest year (1875), the temperatures fell below 32°F on 105 days, and the temperatures reached 90°F or above on just eight days.[27]

Table 2.1.4-2 Philadelphia Temperature Statistics – Winter & Summer
Winter Average Temperature: 35.4°F
Record High Temperature: 74°F (set February 27, 1997; February 24, 1985; February 15, 1949)
Record Low Temperature: -11°F (set February 9, 1934)
Summer Average Temperature: 76°F
Record High Temperature: 106°F (set August 7, 1918)
Record Low Temperature: 44°F (set August 29, 1986; and seven other times)

Sources: NOAA, 2010; Nese, Schwartz, 2002, Franklin Institute, 2008

2.1.4.2 Precipitation

Precipitation is fairly evenly distributed throughout the year. The average annual liquid precipitation in Philadelphia is about 41.5 inches of rain and melted snow and ice. The greatest amounts of precipitation generally occur during the spring and summer months. Records show July to be the rainiest month, averaging 4.35 inches, while February is the driest, producing 2.64 inches of precipitation on average.

Measurable precipitation (at least 0.01 inches of liquid) occurs an average of 118.3 days each year. Extremely wet days (one inch or more) occur about 10.6 days per year. Most rain in summer comes from thunderstorms, with an average of 27.2 storms each year.[28] Severe coastal storms and remnants of tropical systems can also account for the higher occurrence of precipitation in the summer. For example new precipitation records for Philadelphia were established in 2011 for the months of August and September due to coastal storms and tropical moisture. In 2011, Philadelphia experienced 29.58 inches of rainfall during August and September. The previous record for the same period was 18.49 inches set in 1882.[29]

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[27] The Franklin Institute: Philadelphia Weather Data. Retrieved 2 November 2011.
[28] Ibid
[29] National Climatic Data Center (NCDC). State of the Climate National Overview: September 2011. Retrieved 7 November 2011. (National Climatic Data Center 2011)

Table 2.1.4-3 Philadelphia Precipitation Statistics				
Most Amount of Liquid Precipitation			**Least Amount of Liquid Precipitation**	
Year	**Month**	**Day**	**Year**	**Month**
64.33 inches (set in 2011)	13.61 inches (set August 2011)	6.63 inches (set September 16, 1999)	29.31 inches (set in 1922)	0.09 inches (set in October 1924; October 1963)

Sources: NOAA, 2010; Nese, Schwartz, 2002

During the winter, precipitation runs the gamut from rain, to snow, to ice. Philadelphia averages 20.5 inches of snowfall annually, based on 60 years of data from NCDC.[30] Historically, seasonal totals range from just a trace during the 1972/1973 season to 78.7 inches during the 2009-2010 season. The biggest single snowfall event in Philadelphia produced 30.7 inches from January 6-8, 1996.[31] Measurable snowfall generally occurs between November 20 and March 15, although snow has been recorded as early as October and persisted into April.

Table 2.1.4-4 Philadelphia Snowstorm Statistics
Average Snow Accumulations: 20.5 inches per year
Record Accumulation in a Day: 27.6 inches (set January 7, 1996)
Record Snow Accumulation in a Month: 33.8 inches (set January 1996)
Record Snow Accumulation in a Year: 78.7 inches (set 2009 – 2010 season)

Sources: NOAA, 2010; Nese, Schwartz, 2002, NCDC, 2011

2.1.4.3 Severe Weather

Philadelphia's midlatitude location not only means great variability in temperature and precipitation, but also a variety of severe weather threats that span the seasons. Heavy snow, extreme cold, and ice storms are the main winter threats. Droughts, extreme heat and thunderstorms, which can bring damaging winds, flash flooding, hail and even tornadoes are the primary natural hazards in late spring and summer.

[30] National Climatic Data Center (NCDC). Snowfall Average Total in Inches (including ice pellets and sleet) Retrieved 8 November 2011.
[31] National Weather Service (NWS) Forecast Office Philadelphia/Mount Holly. NOWDATA – NOAA Online Weather Data. Retrieved 7 November 2011.

Table 2.1.4-5 Philadelphia Severe Weather Statistics
Annual Average Precipitation: 117 days
Annual Average Thunderstorms: 20 days[32]
Annual Average Severe Thunderstorms: 2.3 days[33]
Annual Average Hail: 1 day
Tornadoes Reported (1960 – 2012): 8

Sources: NOAA, 2010; SPC, 2010, Oklahoma Climatological Survey

2.2 Social Environment

This section presents the social environment of the County, including: history, social characteristics, demographic estimates, economic characteristics, and housing characteristics.

2.2.1 History

Long before the area currently known as Philadelphia was settled by Europeans, it was inhabited by Native American tribes. The earliest people, called Paleo-Indians settled in the vicinity of Philadelphia over 10,000 years ago. When the Swedish settlers arrived in the Delaware Valley in 1638, they referred to the area as Lenapehocking or the Land of the Lenape after the members of the Lenni-Lenape tribe that inhabited the region. The English later renamed the river surrounding the area and the tribe, "Delaware" after Lord del la Warr, the governor of the Jamestown colony. William Penn came to the region in 1682, dreaming to build a city on the land between the Schuylkill and Delaware Rivers. Penn made numerous treaties with the Delaware Indians compensating them for the acquisition of the land. [34] The future city was named Philadelphia from the Greek words "philos" and 'adelphos'. Philos meaning loving and adelphos meaning brother, together Philadelphia became the City of Brotherly Love.[35]

Philadelphia's current ability to grow stems from Penn's early city design plan. Long, straight streets running east-west and north-south were surveyed over the landscape creating a grid of the land between the Delaware and Schuylkill Rivers.[36] The grid was an efficient way of selling real estate and thereby growing the population of

[32] Thunderstorms are considered when they contain thunder and lightning.
[33] Severe Thunderstorms are defined as storms reporting both hail and wind damage. Average is taken over a 54 year period. (1950-2004)
[34] Lenni-Lenape (Delaware) Indians' History, Culture and Food. Retrieved 8 November 2011.
[35] Online Etymology Dictionary. Douglas Harper. Retrieved 24 February 2012.
[36] Philadelphia City Planning Commission (PCPC). Philadelphia 2035: A Comprehensive Plan. Retrieved 12 February 2012.

Philadelphia. During its first two decades Philadelphia grew rapidly, from a few hundred inhabitants in 1683 to over 2000 in 1700.[37] Immigration of the Germans and the Scots-Irish and the growth of the port turned Philadelphia into a major city by the 1750s. During the 1770s Philadelphia quickly grew into an important colonial city, hosting the First and Second Continental Congresses and the Constitutional Convention. Following the Revolution War, Philadelphia was selected to be the temporary capital of the United States. On December 6, 1790, the United States Capital officially moved from New York City to Philadelphia. The capital remained in Philadelphia until 1800 when it permanently settled in Washington, D.C.[38]

Manufacturing in the United States increased in the late 18th century and early 19th century. As a result, manufacturing plants and foundries were built and Philadelphia became an important center of textiles, paper-related industries, and leather industries. Coal and iron mines, along with the construction of new infrastructure and transportation systems helped Philadelphia's manufacturing power grow. From 1800 to 1897 Philadelphia was the leading manufacturing city in the United States.[39] To work within the factories, immigrants mostly from Germany and Ireland streamed into Philadelphia, increasing the population from 41,220 in 1800 to 565,529 by 1860.[40] The city's growth continued until the early 1950's when Philadelphia's population peaked. As in many cities of the Northeast, decades-long period of de-industrialization resulted in closed factories, population loss, vacant land and urban decay over the next few decades. However by 2010, reinvestment and economic diversification stabilized and reversed the decline of population (increasing by 0.6% from 2000 to 2010).

Philadelphia is home to many of the country's significant national historical markers, including Independence Hall, the Liberty Bell, Franklin Court, Betsy Ross House, Declaration House, and many others. Several nationally and internationally known museums are also located within Philadelphia, including the Philadelphia Museum of Art and the Franklin Institute. More information on the iconic landmarks within Philadelphia is located in section 2.3.10.

2.2.2 Social Characteristics

The Social Characteristics section contains information on the population, geographic mobility, ethnicity, nativity and language, individuals with disabilities, and education levels for Philadelphians. The information in this section was based upon the "best available data" taken from the 2010 U.S. Census Bureau, and the 2005-2009 or 2006-2010 American Community Survey (ACS). The ACS produces population, demographic and housing unit intercensal estimates over a five year period. These estimates have been utilized when the official 2010 Census data was not available.

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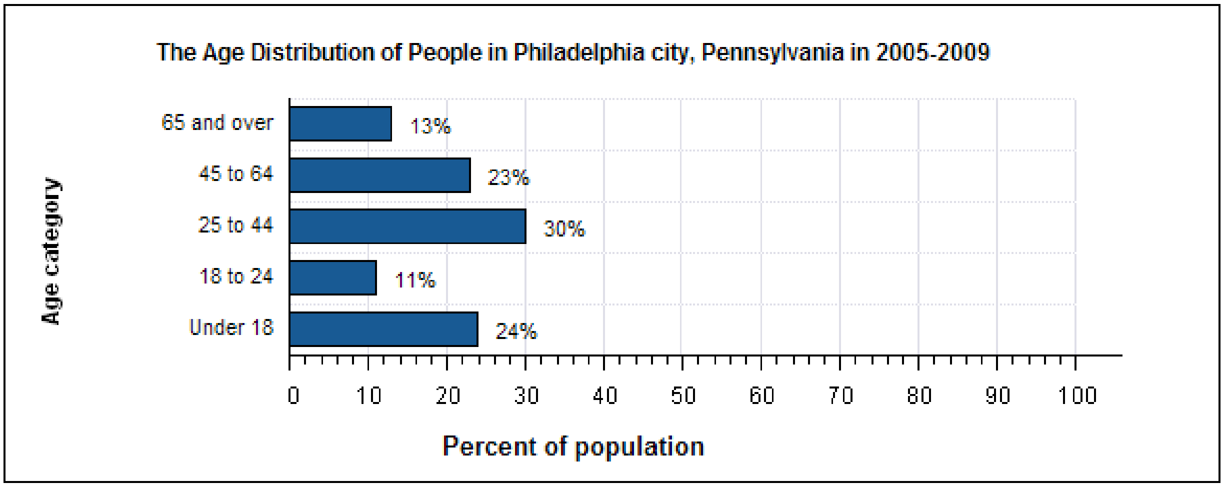
[37] Philadelphia 300 Years of History. Russell Weigley, Edwin Wolf. Retrieved 12 February 2012.
[38] Miller Center, University of Virginia. American President: A Reference Resource. Retrieved 12 February 2012.
[39] Manufacturing in Philadelphia, 1683-1912. John James Macfarlane. Retrieved 12 November 2011.
[40] United States Census Bureau. Population of the 100 Largest Cities and Other Urban Places in the United States: 1790 to 1990. Retrieved 12 February 2012.

2.2.2.1 Population

As of the 2010 Census, there were 1,526,006 people living within the Philadelphia, a population increase of approximately 0.6 percent since the 2000 Census (population 1,517,542 people). Approximately 53 percent of the population (815,307) are female and 47 percent are male (715,805). The median age is 34.2 years. Twenty-four percent of the population is under 18 years; 13 percent is 65 years and older.

Table 2.2.2-1

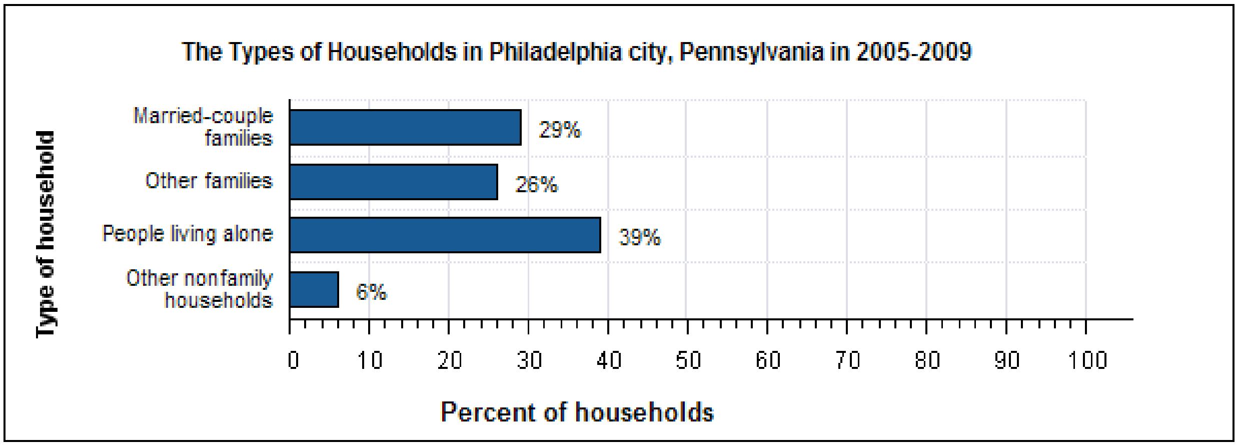


Source: American Community Survey, 2005-2009

As of the 2010 U.S. Census, there were 599,736 households in Philadelphia, with an average household size of 2.45 people. Families composed 56.8% of households in Philadelphia. The summation includes both married-couple families (28.3 percent) and other families (28.5 percent). Nonfamily households made up 43.2 percent of all households in Philadelphia. Most nonfamily households are composed of people living alone, however some are composed of people living in households in which no one was related to the householder.[41]

[41] The householder refers to the person (or one of the people) in whose name the housing unit is owned or rented (maintained) or, if there is no such person, any adult member, excluding roomers, boarders, or paid employees. If the house is owned or rented jointly by a married couple, the householder may be either the husband or the wife. The person designated as the householder is the "reference person" to whom the relationship of all other household members, if any, is recorded.

Table 2.2.2-2

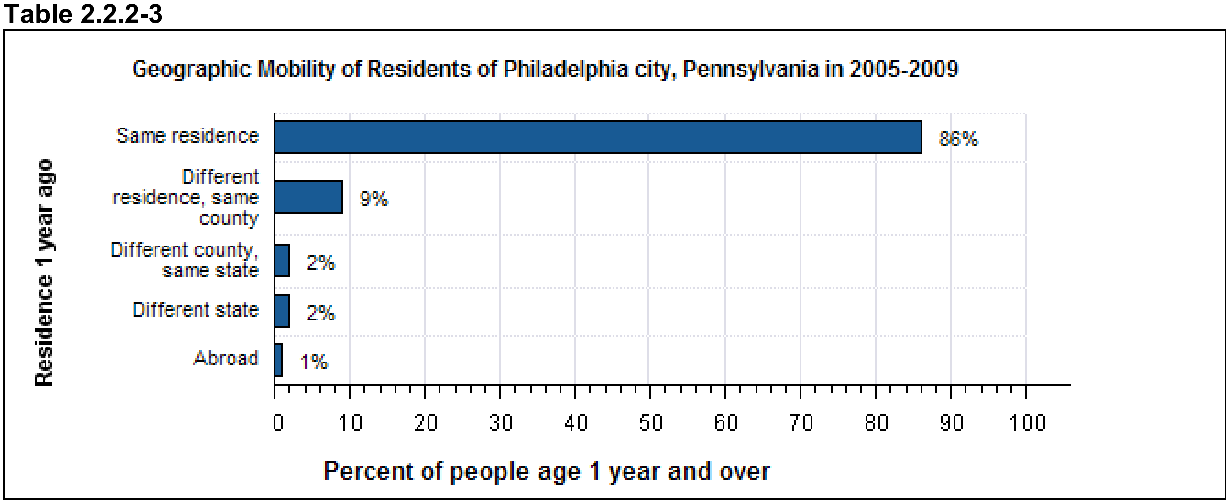


Source: American Community Survey, 2005-2009

2.2.2.2 Geographic Mobility

Eighty-six percent of the people one year or older residing in Philadelphia were living in the same residence one year earlier according to the 2005-2009 ACS; 9 percent had moved during the past year from another residence within Philadelphia, two percent moved to Philadelphia from another county in Pennsylvania, 2 percent moved from another state, and one percent moved from abroad.

Table 2.2.2-3



Source: American Community Survey, 2005-2009

2.2.2.3 Ethnicity

According to the 2010 Census, 97 percent of people living in Philadelphia reported being one race alone, 41 percent reported being White; 43 percent reported being Black or African American; less than 0.5 percent reported American Indian and Alaska Native; 6 percent reported Asian; less than 0.5 percent reported Native Hawaiian and Other Pacific Islander and 6 percent were some other race.

Three percent of Philadelphia residents reported they were two or more races. Thirty-seven percent of Philadelphians identified themselves as White, non-Hispanic.[42] Twelve percent of Philadelphians identified themselves as ethnically Hispanic in origin.

2.2.2.4 Nativity and Language

Nativity

Eleven percent of the people living in Philadelphia were foreign born. Eighty-nine percent were U.S. Born, and of this 70 percent were born in Pennsylvania.

Language

As of 2010, 6.4 percent of the households in Philadelphia are linguistically isolated, meaning all adults in a household have some limitation in communicating English. If there are children under the age of 14 who speak English, they too would be considered linguistically isolated.

Table 2.2.2-4	Linguistic Isolation in Philadelphia	
	Linguistically Isolated	**Margin of Error**
All households	6.4%	+/-0.3
Households speaking --		
Spanish	24.8%	+/-1.9
Other Indo-European languages	29.2%	+/-2.2
Asian and Pacific Island languages	43.2%	+/-3.1
Other languages	20.1%	+/-4.9

Source ACS, 2006-2010

Limitation of the Linguistic Isolation Data

There have been some concerns about the validity of the definition of "linguistic isolation." The U.S. Census Bureau defines as a "linguistically isolated" household as a household in which no member 14 years old or over: a) speaks only English, or b) speaks a non-English language and speaks English "very well." In other words, all individuals that are 14 years or over in a linguistically isolated household have at least some difficulty with speaking or understanding English.

Limitations within this data include households being classified as linguistically isolated where no household member 14 years or older speaks English "very well" but someone younger than 14 years in the household speaks English "very well". Also there are numerous linguistically isolated households unaccounted for, due to respondents not

[42] People of Hispanic origin may be of any race.

residing in Philadelphia at the time of enumeration. Also some households could be reluctant to be enumerated because of fears of deportation because they are undocumented immigrants.

2.2.2.5 People with Disabilities

There are six disability types reflected in the most recent version of the ACS; hearing, vision, cognitive, ambulatory, self-care, and independent living disability. The U.S. Census Bureau defines disability as "a long-lasting sensory, physical, mental, or emotional condition or conditions that make it difficult for a person to do functional or participatory activities such as seeing, hearing, walking, climbing stairs, and learning". Table 2.2.2-5 below identifies the population within Philadelphia that meet one (or more) of the characteristics of an individual with a disability.

Table 2.2.2-5 People with Disabilities in Philadelphia

Disability	Total # of Disabilities in People Age 18 & Older	% of Total Population with Disabilities Age 18 & Older
Hearing difficulty	41,264	3.6%
Vision difficulty	46,578	4.0%
Cognitive difficulty	83,020	7.2%
Ambulatory difficulty	131,907	11.5%
Self-care difficulty	46,690	4.1%
Independent living difficulty	96,306	8.4%

Source: American Community Survey, 2006-2010

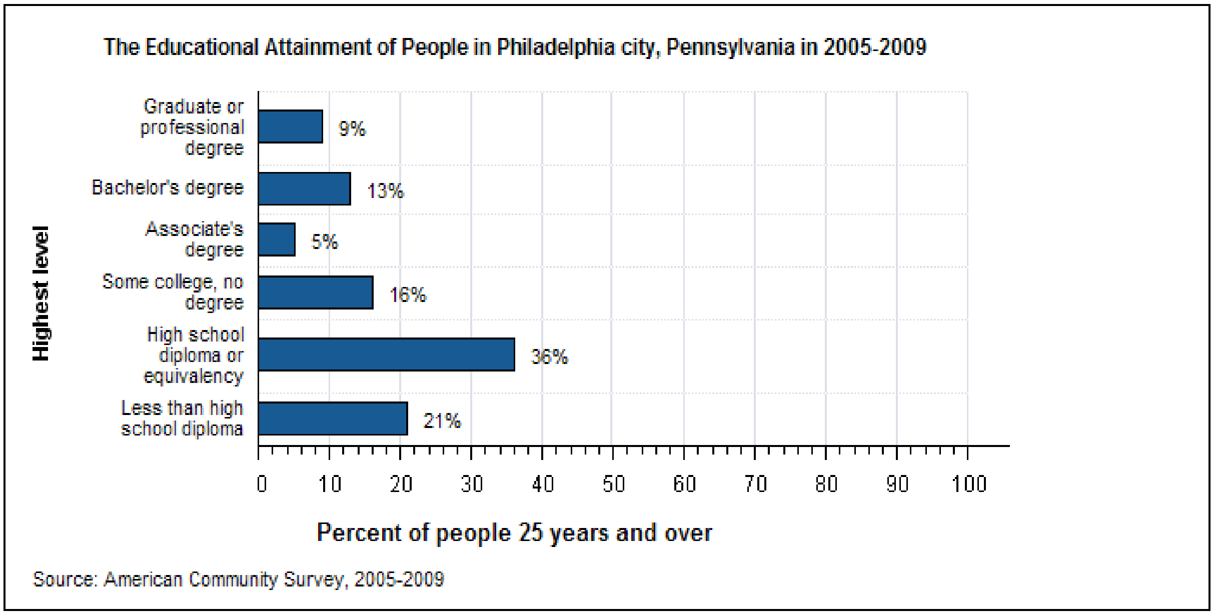
2.2.2.6 Education

Seventy-nine percent of people 25 years and over in Philadelphia had at least graduated from high school and 22 percent had a bachelor's degree or higher according to the 2006-2010 ACS. Twenty-one percent did not complete high school and were not currently re-enrolled in school or obtained a General Education Development degree (GED).

The 2005-2009 ACS identified total school enrollment in Philadelphia for the population 3 years and over as 422,271; nursery school, pre-school and kindergarten enrollment was 41,934, elementary through high school enrollment was 235,362, and college/graduate[43] school enrollment was 144,975 students.

[43] Includes associates, bachelors, graduate and professional degrees.

Table 2.2.2-6



2.2.3 Economic Characteristics

2.2.3.1 Industries

Like many urban areas in the East and Midwest of the United States, Philadelphia's economy has undergone a major transition in recent decades. Roughly half a century ago, manufacturing dominated the economy providing almost half of Philadelphia's jobs. As manufacturing employment declined knowledge-based industries gained prominence with life sciences, information technology, professional services and chemicals ranking among Philadelphia's top industries. Sectors such as education and health services, professional and business services, financial activities and information technology have emerged strongly as principal drivers of the economy.[44]

For the employed population 16 years and older, the leading industries in Philadelphia were educational services, and health care, and social assistance (28 percent), and professional, scientific, and management, and administrative and waste management services (11 percent).[45]

[44] Delaware Valley Regional Planning Commission (DVRPC). Economic Development Framework. Retrieved 29 November 2011.
[45] U.S. Census Bureau, American Community Survey, 2005-2009.

Table 2.2.3-2

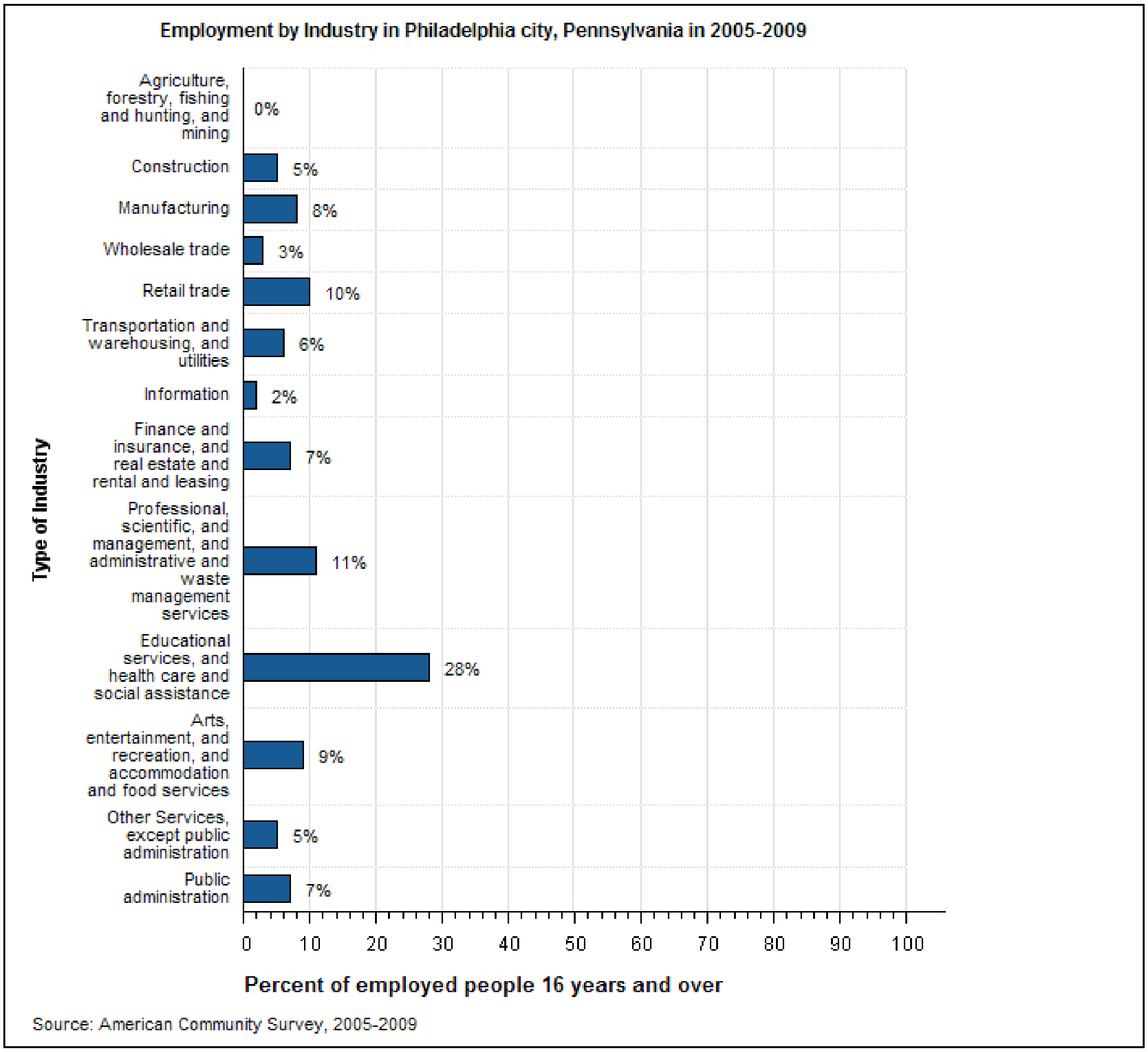


Table 2.2.2-9 identifies the top twenty private sector employers in Philadelphia as of 2010:

Table 2.2.3-1	**Largest Private Sector Employers**	
Company	**Industry**	**Employees #**
University of Pennsylvania	Colleges and Universities	21,000
University of Pennsylvania Health System	Health Care	11,908
Wachovia Bank	Financial Services - Banking	8,306
Temple University Health System	Health Care	8,000

The Children's Hospital of Philadelphia	Health Care – Pediatric	7,800
Albert Einstein Healthcare Network (Jefferson Health System)	Health Care	6,482
Thomas Jefferson University Hospital	Health Care	6,150
Tenet Health System	Health Care	6,021
PNC Bank, N.A.	Financial Services - Banking	5,749
Drexel University	Colleges & Universities	5,418
Temple University	Colleges & Universities	5,227
Comcast/Spectacor	Sports & Entertainment	3,500
Independence Blue Cross	Health Insurance	3,000
United Parcel Service	Parcel Services	3,000
Rohm & Hass	Chemicals	2,050
Cigna	Insurance	1,700
Sunoco	Oil Refinery	1,200
Urban Outfitters	Retail Location	1,031
Tasty Baking Company	Food Processing	900
Cardone Industries	Manufacturing	700
GlaxoSmithKline	Chemicals	250

Source: Greater Philadelphia Chamber of Commerce, 2010

According to the U.S. Department of Commerce's Bureau of Economic Analysis, the Real Gross Domestic Product (GDP) for the Philadelphia MSA grew by 2.3% in 2010 and ranks 7th nationally in total GDP at approximately $347 million. Table 2.2.2-7 depicts the GDP for the Philadelphian Metropolitan Area from 2001-2010.

Table 2.2.3-3	Philadelphia MSA - GDP	
Year	**GDP (in millions)**	**Rank**
2010	346,932	7th
2009	335,638	8th
2008	333,047	7th

2007	325,868	----
2006	309,498	----
2005	266,386	----
2004	262,149	----
2003	256,366	----
2002	247,902	----
2001	241,831	----

Source: U.S. Department of Commerce's Bureau of Economic Analysis, 2010

The city is home to the Philadelphia Stock Exchange and several Fortune 500 companies. Fortune 500 is well represented in Greater Philadelphia with over 100 Fortune 500 companies located within a 200-mile radius of Center City Philadelphia. Table 2.2.2-8 illustrates Fortune 1000 companies located within City limits.

Table 2.2.3-4 Fortune 1000 Companies in Philadelphia

Company Name	Rank	Revenues in Millions
Comcast	59	35,756
Sunoco	78	29,630
Cigna	129	18,414
Aramark	189	12,297
Crown Holdings	289	7,938
FMC	667	2,826
Urban Outfitters	852	1,937
PepBoys – Manny. Moe & Jack	860	1,910

Source: Fortune Magazine, 2010

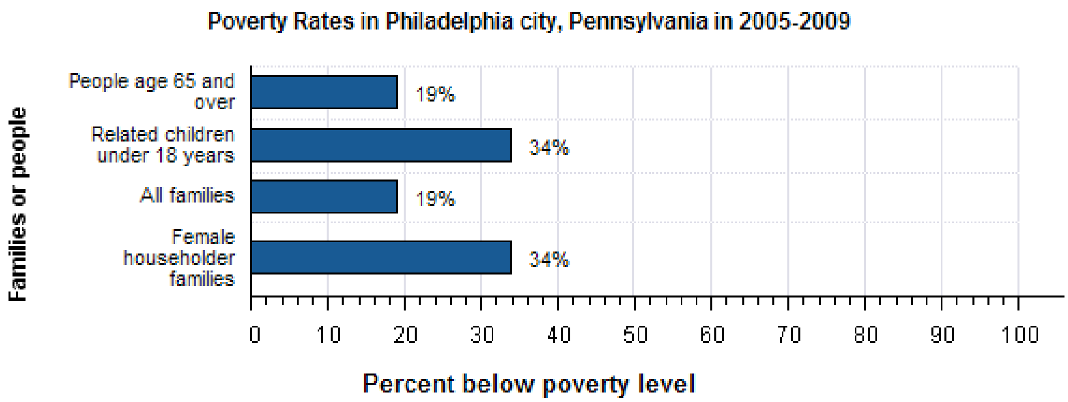
2.2.3.2 Income

As of the 2006-2010 ACS, the median income of Philadelphia households was $36,669. Seventy-three percent of Philadelphia households received their income through earnings from employment, 27 percent received Social Security (with an average Social Security income of $13,102), and 16 percent received retirement income other than Social Security. These income sources are not mutually exclusive, that is, some households received income from more than one source.

Poverty and Participating in Government Programs

The Census Bureau defines poverty as the total income for a family or unrelated individual falls below the relevant poverty threshold, asset by the U.S. Office of Management and Budget's (OMB's) Directive 14. As of the 2005-2009 ACS, 24 percent of all Philadelphians were living below the poverty level. Thirty-four percent of children under 18 were living in poverty, as were 19 percent of people 65 years old and over. Nineteen percent of all families, and 34 percent of families with a female householder (and no husband present) had incomes below the poverty level.

Table 2.2.3-5



Source: American Community Survey, 2005-2009

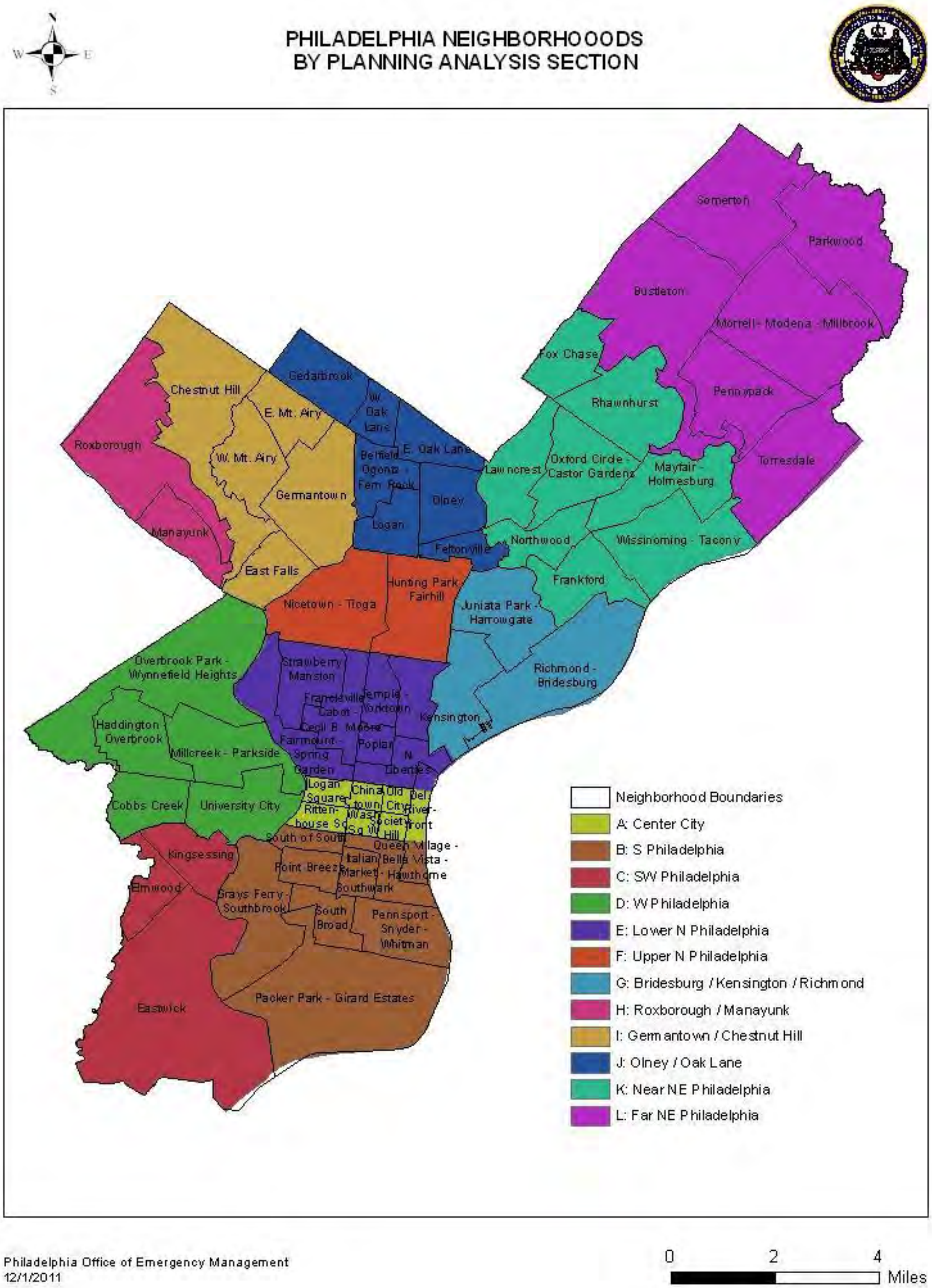
2.3 The Built Environment

This section presents information on the built environment of the County, including: land use and infrastructure.

2.3.1 Neighborhoods and Planning Districts

The 63 neighborhoods in Philadelphia are further aggregated into 12 planning analysis sections by Philadelphia City Planning Commission (PCPC) (Figure 2.3.1-1).

Figure 2.3.1-1: Philadelphia Neighborhoods by Planning Analysis Section



2.3.2 Land Use

This section includes 2010 PCPC land use data, identified by planning analysis sections within Philadelphia. For the purposes of this community profile, four land use categories constituting the built environment are identified in Table 2.3.2-1: residential (includes single-family detached residential, multi-family residential, residential row homes and mobile homes); commercial; industrial; and recreational and community services.

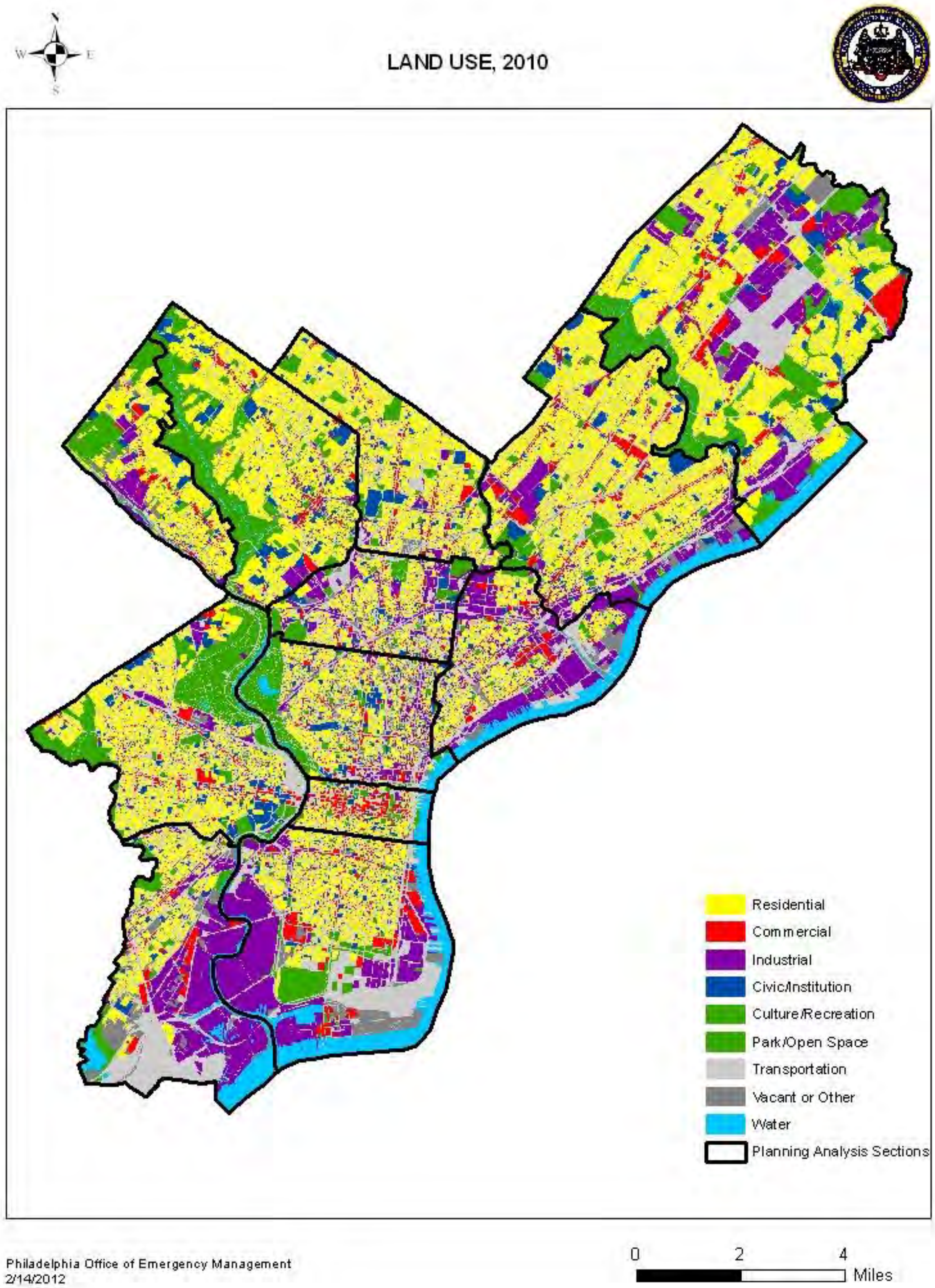
Table 2.3.2-1	**2010 Philadelphia Land Use (by acres)**			
Planning Analysis Section	**Residential**	**Commercial**	**Industrial**	**Recreation & Community Services**
Center City	316	233	33	182
S Philadelphia	1,446	593	2,246	521
SW Philadelphia	1,005	284	1,957	236
W Philadelphia	2,661	400	257	1,172
Lower N Philadelphia	1,237	233	334	513
Upper N Philadelphia	846	146	561	303
Bridesburg/ Kensington/ Richmond	932	274	1,433	184
Roxborough/ Manayunk	1,480	149	338	287
Germantown/ Chestnut Hill	3,464	239	182	1,024
Olney/ Oak Lane	2,396	240	189	481
Near NE Philadelphia	4,540	620	1,029	811
Far NE Philadelphia	5,482	960	2,156	1,465
Total	25,922	4,370	10,774	7,642

Source: PCPC, 2010

Additional land uses exist in Philadelphia, but do not constitute the built environment, including: open space; transportation; vacant; and water.

All land uses are identified in Figure 2.3.2-2 below.

Figure 2.3.2-2: Philadelphia Land Use, 2010



2.3.3 Housing

Table 2.3.3-1 below includes data concerning the total number of housing units in Philadelphia, including the number of vacant and occupied housing units. Housing data is primarily from the 2010 U.S. Census; data on structure age was obtained from the 2010 American Community Survey.

Table 2.3.3-1 Philadelphia Selected Housing Characteristics

Selected Housing Characteristics: 2010	Count
HOUSING OCCUPANCY	
Total housing units	670,171
Occupied housing units	599,736
Vacant housing units	70,435
YEAR STRUCTURE BUILT	
Built 2005 or later	9,741
Built 2000 to 2004	10,176
Built 1990 to 1999	16,307
Built 1980 to 1989	24,047
Built 1970 to 1979	43,993
Built 1960 to 1969	68,372
Built 1950 to 1959	116,216
Built 1940 to 1949	110,620
Built 1939 or earlier	270,397
HOUSING TENURE	
Owner-occupied	324,536
Renter-occupied	275,200
MORTGAGE STATUS	
Mortgage, contract to purchase or similar debt	188,884
▪ Either a second mortgage or home equity loan, but not both	35,883
• Second mortgage only	9,249
• Home equity loan only	26,634
▪ Both second mortgage and home equity loan	1,506
▪ No second mortgage and no home equity loan	151,495
Without a mortgage	124,554

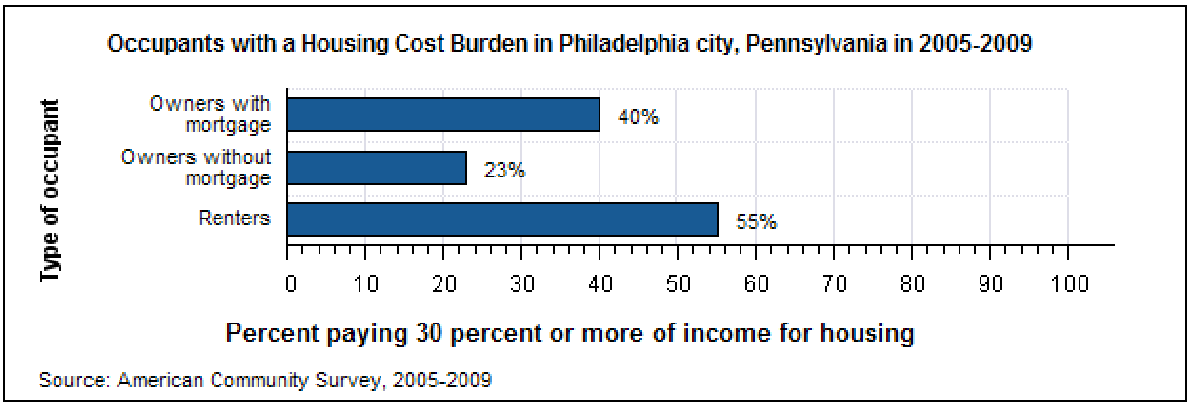
Source: U.S. Census Bureau, Census 2010 and American Community Survey, 2008-2010.

2.3.3.1 Housing Costs and Housing Cost Burden

As of the 2005-2009 ACS, the median monthly housing costs for mortgaged home owners was $1,172, nonmortgage home owners $413, and renters $801.

When households spend more than 30 percent of their income on housing, housing is considered to be a cost burden on that household. As of the 2005-2009 American Community Survey, 40% of home owners with mortgages, 23% of owners without mortgages, and 55% of renters in Philadelphia County experienced a housing cost burden in Philadelphia.

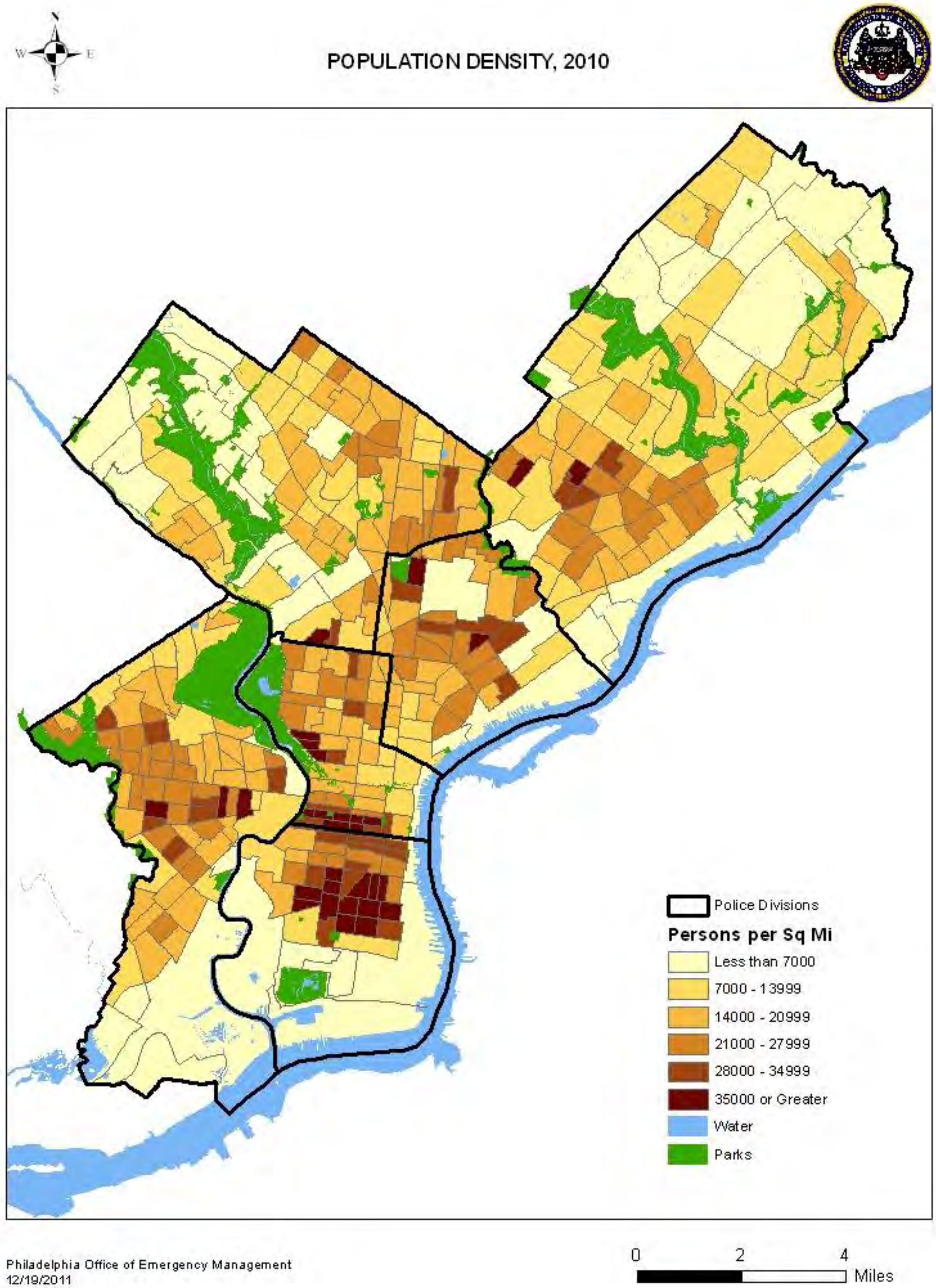
Table 2.3.3-2



2.3.4 Population Density

Figure 2.3.4-1 on the following page depicts Philadelphia's population density per square mile in 2010, indicating the highest population concentrations geographically. The highest density areas are in Center City, South Philadelphia, and portions of West Philadelphia.

Figure 2.3.4-1: Philadelphia Population Density by Police Division



2.3.5 Population Change

From its founding through the early 19th century, Philadelphia's boundaries encompassed the area between the Delaware and Schuylkill Rivers between Vine and South Streets. The City and County of Philadelphia were consolidated in 1854, significantly enlarging the boundaries and creating Philadelphia's current border.[46] This resulted in a large population increase, evident in the 1860 census. Philadelphia experienced steady growth between 1860 and 1950, except for a brief lull in 1930, which was in part due to the Great Depression. The City's population peaked in the 1950s and was on a steady decline until 2010. Table 2.3.5-2 depicts Philadelphia's population from 1790-2010.

Table 2.2.2-7		Historical Populations			
Year	**Population**	**%+-**	**Year**	**Population**	**%+-**
2010	1,526,006	0.6%	1890	1,046,964	23.6%
2000	1,517,550	-4.3%	1880	847,170	25.7%
1990	1,585,577	-6.1%	1870	674,022	19.2%
1980	1,688,210	-13.4%	1860	565,529	365.9%
1970	1,948,609	-2.7%	1850	121,376	29.6%
1960	2,002,512	-3.3%	1840	93,665	16.4%
1950	2,071,605	7.3%	1830	80,462	26.1%
1940	1,931,334	-1.0%	1820	63,802	18.8%
1930	1,950,961	7.0%	1810	53,722	30.3%
1920	1,823,779	17.7%	1800	41,220	44.5%
1910	1,549,008	19.7%	1790	28,522	----
1900	1,293,697	23.6%			

Source: U.S. Census Bureau, 2010

Philadelphia added 8,456 residents between 2000 and 2010. This was the first decade where Philadelphia experienced population growth since 1940-1950. The fastest growing areas from 2000 to 2010 include Center City and near Northeast Philadelphia.

[46] Ibid

The Olney/Oak Lane section saw the steepest declines on both a numerical and percentage basis.

Table 2.3.5-1	Population Change, 2000-2010			
Police Division	**2000 Population**	**2010 Population**	**Numerical Change, 2000-2010**	**Percent Change, 2000-2010**
Central	144,259	157,124	12,865	8.9%
East	187,537	190,319	2,782	1.5%
Northeast	406,174	425,022	18,848	4.6%
Northwest	334,605	314,892	-19,713	-5.9%
South	160,130	165,812	5,682	3.5%
Southwest	284,845	272,837	-12,008	-4.2%
Total	1,517,550	1,526,006	8,456	0.6%

Source: U.S. Census Bureau, 2010

2.3.6 Infrastructure

2.3.6.1 Streets, Highways and Bridges

Streets and Highways
The Philadelphia Streets Department (Streets), the Philadelphia Department of Parks and Recreation, and the Pennsylvania Department of Transportation (PENNDOT) manage roadway travel in Philadelphia. The streets system in Philadelphia totals 2,575 miles: 2,180 miles of city streets, 35 miles of Fairmount Park roads, and 360 miles of state highways.

Many major highways and roadways serve Philadelphia. Interstate 95 (I-95) is an interstate highway which runs from Miami, Florida to Houlton, Maine. The highway provides northern and southern access to the United States' eastern seaboard. In Philadelphia, the route is commonly known as the Delaware Expressway. It runs for approximately 19.89 miles along the eastern boundary of Philadelphia parallel the Delaware River. An estimated 169,000 motorists utilize the highway daily within Philadelphia.[47] Interstate 76 (I-76) is an interstate highway running 435 miles from Akron, Ohio to Camden, New Jersey. The stretch of I-76 close to Philadelphia is more commonly known as the Schuylkill Expressway. The Schuylkill is 25 miles in length, extending from the Pennsylvania Turnpike at Valley Forge, through Center City Philadelphia, to the Walt Whitman Bridge. The highway runs 10.33 miles through Philadelphia, and is located along the southwest shore of the Schuylkill River.

[47] "Interstate 95 - Annual Average Daily Traffic @ Interstate-Guide.com". Retrieved 13 February 2012.

Interstate 675 (I-676) or the Vine Street Expressway also serves as an essential part of Philadelphia's highway system. Completed in 1991, I-676 runs 7 miles between I-76 and I-95, crossing the Ben Franklin Bridge into Camden, New Jersey. U.S.-1 (also known as the Roosevelt Expressway/Roosevelt Boulevard) runs from Florida to Maine along the east coast. The portion in Philadelphia was completed in 1961, after three years of construction. In Philadelphia, U.S.-1 is an 18.43 mile stretch of road, connecting northeast Philadelphia with Center City.

Other major roadways in Philadelphia include Woodhaven Road (PA Route 63), and Cottman Avenue (PA Route 73) located in northeast Philadelphia, which connects I-95 and U.S.-1. The Fort Washington Expressway (PA Route 309) is a 10.2 mile long road, connecting the northern section of Philadelphia with Bucks and Montgomery Counties. U.S. Route 30, also known as Lancaster Avenue, connects Philadelphia to Lancaster County and Main Line suburbs.

Figure 2.3.6-1 Major Highways and State Roadways

Bridges

The Philadelphia Streets Department (Bridge Section), PennDOT and the Delaware River Port Authority (DRPA) manage the bridges within Philadelphia. Bridges are vital, providing transit for vehicles and pedestrians, into and out of Philadelphia. In total, Philadelphia has over 350 bridges. The DRPA manages most of the transportation between Philadelphia and New Jersey, including four bridges. The Streets Department maintains an additional 240 bridge structures within the City and PennDOT manages all state or federally owned bridges.

There are four interstate bridges linking Philadelphia to neighboring New Jersey over the Delaware River: the Benjamin Franklin Bridge, Betsey Ross Bridge, Walt Whitman Bridge, and Tacony-Palmyra. The Franklin, Ross, and Whitman are maintained and own by the DRPA; the Tacony-Palmyra is owned and operated by the Burlington County (New Jersey) Bridge Commission.

The first of these to be constructed was the Ben Franklin Bridge, originally named the Delaware River Bridge. After four and a half years of construction, the Benjamin Franklin Bridge was open to traffic on July 1, 1926. Today the Benjamin Franklin Bridge, whose main suspension span is the 34th longest in the world, carries an average of 100,000 vehicles, and more than 40,000 rail commuters on PATCO across the Delaware River each day.[48]

The Betsy Ross Bridge is a continuous truss bridge spanning the Delaware River from the Bridesburg section of Philadelphia to Pennsauken, New Jersey. Construction of the bridge began on June 12, 1969. After almost seven years of construction, the Bridge was opened to commuters on April 30, 1976. According to the New Jersey Department of Transportation (NJDOT), the Betsy Ross Bridge carries approximately 45,000 vehicles across the Delaware River each day.[49]

The Walt Whitman Bridge began construction in August 1953 and was opened to the public on May 16, 1957. The Bridge begins in South Philadelphia on I-76 and crosses the Delaware River into Gloucester, New Jersey. The Walt Whitman Bridge, whose main suspension span is the 27th longest in the world, currently carries approximately 120,000 vehicles across the Delaware River each day. On summer weekends, the bridge carries as many as 150,000 vehicles per day.[50]

The Tacony-Palmyra Bridge is a combination steel arch, double-leaf bascule bridge across the Delaware River, connecting New Jersey Route 73 in Palmyra, New Jersey

[48] Delaware River Port Authority (DRPA). Bridge Information & Resources: Benjamin Franklin Bridge. Retrieved 13 February 2012.
[49] Philly Roads. Betsey Ross Bridge: Historic Overview. Retrieved 13 February 2012.
[50] Delaware River Port Authority (DRPA). Bridge Information & Resources: Walt Whitman Bridge. Retrieved 13 February 2012.

and Pennsylvania Route 73 in the Tacony section of Philadelphia. The bridge serves approximately 50,000 vehicles per day.[51]

2.3.6.3 Freight and Passenger Rail

Philadelphia has served as a hub for major railroad transportation, including both freight, and passenger rail, since the early 19th Century, and has been home to both the Pennsylvania Railroad and the Reading Railroad companies. Figure 2.3.6-2 depicts the general railroads lines, the active railways and the inactive railways in Philadelphia.

Freight

Since the mid-1800s, rail transportation has been the centerpiece of industrial production and energy generation, and rail continues to be central to these industries. The Reading Railroad began in 1833 and was originally named the Philadelphia and Reading Railroad. In 1842, the Railroad connected markets in Philadelphia to the coal mining areas of Pennsylvania, but over time expanded business to incorporate coal mining and canal and ocean transport operations.[52] The Reading Railroad fell under bankruptcy in 1971, and the federal government transmitted its assets to the Consolidated Rail Corporation (Conrail).

The Pennsylvania Railroad was the largest railroad by traffic and revenue in the United States for the first half of the 20th century. In 1968 the railroad merged with its rival, New York Central Railroad, to form the Penn Central Transportation Company. Like many other railroads, Penn Central filed bankruptcy in 1970 and its assets were transmitted to Conrail. In 1997, Norfolk Southern Corporation and CSX Corporation agreed to acquire Conrail through a joint stock purchase.[53]

Today Norfolk Southern, Canadian Pacific (CP) Rail, and CSX continue to distinguish Philadelphia as one of few U.S. ports served by three class-one railroads. Philadelphia's core, or strategic, rail lines carry some of the highest volume in the nation. For example, the former Pennsylvania Railroad main line—now Norfolk Southern—connects Philadelphia, Harrisburg and Pittsburgh and extends to Chicago. This line carries more than 120 million gross tons (MGT) annually. Other very high-traffic rail lines include the I-95 corridor in southeastern Pennsylvania, this line contains the CSX mainline and parallels I-95 at Chester north through Philadelphia to the New Jersey/Pennsylvania border at Yardley, PA. Another important trunk line is Amtrak's Northeast Corridor, a portion of which passes through Philadelphia. Some freight is moved on this predominantly passenger rail corridor.[54] Although Conrail no longer handles commercial matters for customers, they continue to play a critical role in serving shippers and

[51] Philly Roads. Tacony-Palmyra Bridge: Historic Overview. Retrieved 13 February 2012.
[52] Reading Company Technical & Historical Society. RDG Co. – A Brief History. Retrieved 13 February 2012.
[53] Conrail Historical Society. Conrail Company History. Retrieved 13 February 2012.
[54] American Society of Civil Engineers (ASCE): 2010 Report Card for Pennsylvania's Infrastructure. Retrieved 13 February 2012.

receivers as an agent for their owners. Conrail operates about 372 miles of track in the Philadelphia/southern New Jersey area.[55]

Passenger
The first passenger railroad in Philadelphia was the Philadelphia, Germantown and Norristown Railroad, which opened in 1832. Many other rail lines were established in the years following. Amtrak was created by Congress in 1970 to take over the passenger rail services previously required to be operated by private freight railroad companies in the United States.[56]

In modern day railroad history, Amtrak is the major semi-national railroad company that serves Philadelphia at 30th Street Station. In 2010 Philadelphia's 30th Street Station was the 3rd busiest station for Amtrak in the United States. Table 2.3.6-1 illustrates the top 10 busiest rail stations as of 2010.

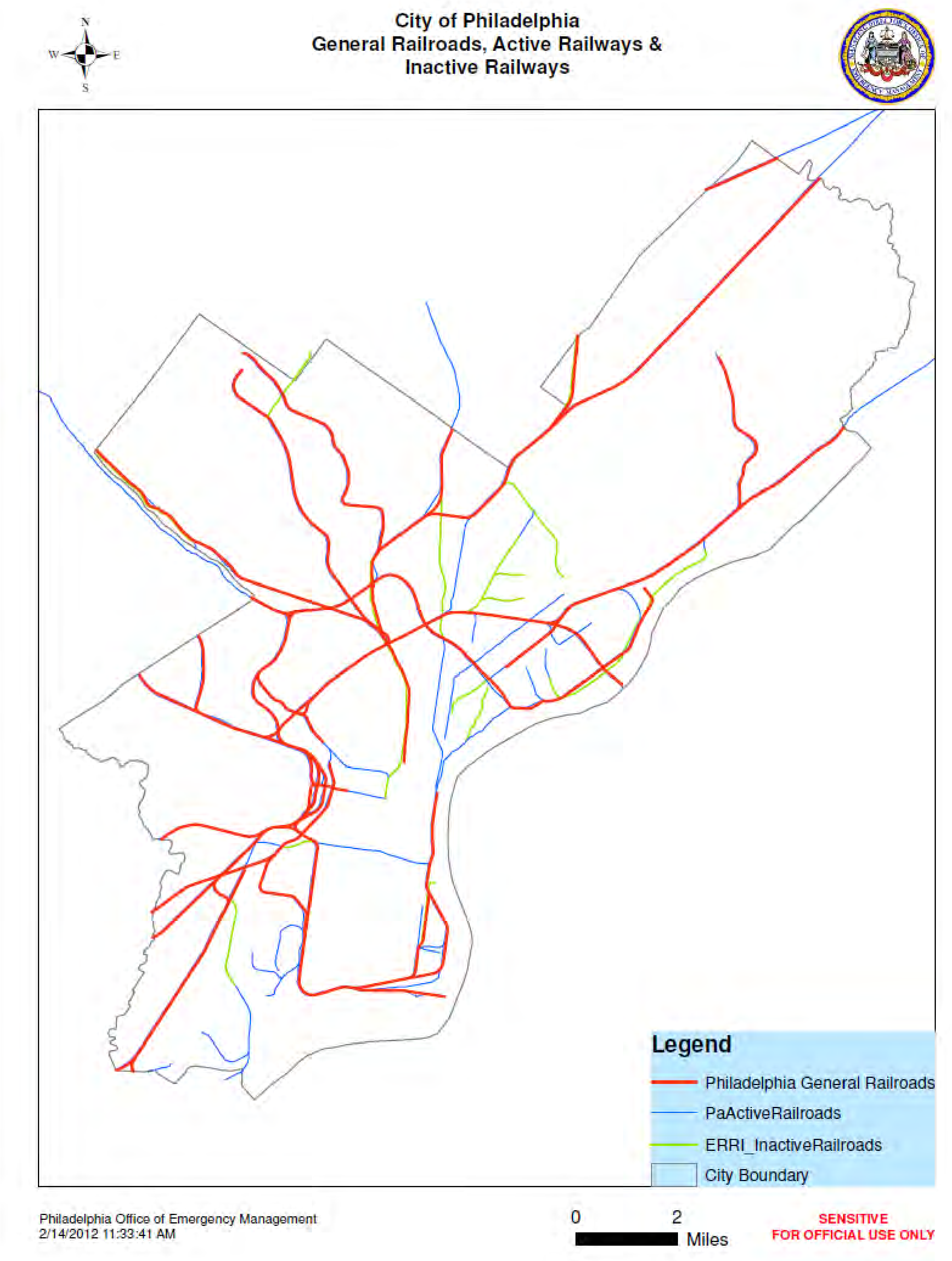
Table 2.3.6-1 10 Busiest Rail Stations in the U.S.

Station	Tickets From	Tickets To	Total Ridership
New York	4,207,590	4,170,354	8,377,944
Washington, DC	2,295,449	2,277,429	4,572,878
Philadelphia, PA	**1,889,161**	**1,898,170**	**3,787,331**
Chicago, IL	1,647,764	1,640,290	3,288,054
Los Angeles, CA	757,233	760,109	1,517,342
Boston South Station, MA	657,176	654,029	1,311,205
Sacramento, CA	557,132	550,088	1,107,220
Baltimore, MD	461,146	465,099	926,245
Albany-Rensselaer, NY	367,767	369,492	737,259
New Haven, CT	360,139	363,148	723,287

Source: Amtrak, 2010

55 Conrail. Freight Service. Retrieved 13 February 2012.
56 Amtrak. Historical Background on Amtrak. Retrieved 13 February 2012.

Figure 2.3.6-2 General Railroads, Active Railways & Inactive Railways



2.3.6.4 Public Transit

Southeastern Pennsylvania Transportation Authority

Philadelphia's primary source of public transportation is the Southeastern Pennsylvania Transportation Authority (SEPTA). Within Philadelphia, SEPTA operates the public buses, trolleys, trackless trolleys, Broad Street Subway, and Market-Frankford Elevated subway. In addition, SEPTA operates regional rail lines and bus services throughout Philadelphia, Bucks, Montgomery, Chester, Delaware counties, as well as provides additional service to portions of southern New Jersey.[57]

SEPTA began in the early 1950's and consisted of the subway, trolleys and buses. At this time many of the bus and trolley routes were owned by private companies such as the Philadelphia Transportation Company, Philadelphia Suburban Transit Company, Pennsylvania Railroad, and Reading Company. The creation and popularity of the automobile began to significantly hurt these private companies. In 1961, the city of Philadelphia along with Bucks, Montgomery, and Chester counties signed to the Southeastern Pennsylvania Transportation Compact. This initial agreement gave SEPTA the function of coordinating government subsidies to the railroads and transit companies. On September 30, 1968, SEPTA took control of the Philadelphia Transportation Company which included all buses, trolleys, trackless trolley lines, the Broad Street Subway and the Market-Frankford Elevated.[58]

At the end of the 2011 fiscal year season (June 30, 2011), SEPTA's buses, subways, trolleys, and trains had approximately 334 million trips. This amount is an increase of four percent from the 2010 season, and is SEPTA's highest ridership since 1989 (345 million trips).[59] Figure 2.3.6-2 illustrates SEPTA's rail lines in Philadelphia.

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[57] SEPTA. Driven to Achieve: Fiscal Year 2010 Annual Report. Retrieved 15 November 2011.

[58] The Philadelphia Chapter of National Railway Historical Society. John Amelia, 2004. Retrieved 8 November 2011.

[59] Southeastern Pennsylvania Transit Authority. Revenue & Ridership Report. Retrieved 13 February 2012.

Figure 2.3.6-3 SEPTA's Rail Services

Source: SEPTA, 2006

Port Authority Transit Corporation

The Port Authority Transit Corporation (PATCO) Speedline first began in 1926 with the creation of the Delaware River Bridge Commission and the construction of the Benjamin Franklin Bridge. In 1931, the Delaware River Bridge Commission was given the authority to construct a high-speed transit line connecting Philadelphia and Camden, New Jersey. On June 7, 1936, the new bridge line completed its first run from Camden to Philadelphia. Speedline operations began on February 15, 1969, with the first trip from Lindenwold, New Jersey to Center City Philadelphia. Back then, the 14.2 mile line carried 21,200 people per day. Today, more than 38,000 people rely on the high speedline.[60] PATCO began service with eight stations in Camden County, NJ and four in Philadelphia. Today there are thirteen stations, extending from 15th-16th St. and Locust St. in Philadelphia to Lindenwold, NJ.

Figure 2.3.6-4 PATCO Service Area Map

Source: PATCO, 2011

New Jersey Transit

New Jersey Transit (NJ Transit), founded in 1979, is New Jersey's public transportation corporation. Covering a service area of 5,325 square miles, NJ Transit is the nation's third largest provider of bus, rail and light rail transit, linking major points in New Jersey, New York, and Philadelphia. The agency operates a fleet of 2,027 buses, 711 trains and 45 light rail vehicles.[61] In Philadelphia, NJ Transit provides a train line services from Philadelphia to Atlantic City, New Jersey.

Figure 2.3.6-5 NJ Transit Philadelphia Service Area Map

Source: NJ Transit, 2012

[60] PATCO: A History of Commitment. Retrieved 8 November 2011.
[61] NJ Transit: About Us. Retrieved 9 November 2011.

2.3.6.6 Airports

Philadelphia is the home of two airports; Philadelphia International Airport (PHL) and Northeast Philadelphia Airport (PNE). PHL operates under the jurisdiction of the 77th PPD district, a police district solely responsible for PHL. PNE operates under the 8th PPD district.

Philadelphia International Airport

Then called Philadelphia's "Municipal Aviation Landing Field," PHL originally opened in 1925 as a training space for aviators in the Pennsylvania National Guard. However, on October 22, 1927, pilot Charles A. Lindbergh touched down his Spirit of St. Louis plane in Philadelphia during his tour of the United States. As a result of this historical event, the training field's name changed to Philadelphia Municipal Airport.

In 1930, airport expansion was initiated with the county's purchase of Hog Island, a World War I shipbuilding yard, for $3 million from the federal government. Construction was delayed until 1936 due to the economic decline of the Great Depression. Philadelphia Municipal Airport was officially opened on June 20, 1940. In its first year of operation, Philadelphia Municipal Airport transported 40,000 passengers. In the 1940s American Overseas Airline launched transatlantic service, and the airport was renamed Philadelphia International Airport (PHL) to reflect the change.[62]

In the 1950's, PHL became accessible by all means of transportation including highways, waterways, and railways. The Overseas Terminal, which catered to international and charter flights, opened in April of 1973. Over $300 million was spent in the late 1970's for the development and transformation of the domestic terminal. In 1985, SEPTA created a rail line connecting Center City Philadelphia to the Airport.

In 2010, PHL accommodated 30.8 million passengers, including 4.2 million international passengers, and 460,779 aircraft takeoffs and landings. Twenty-nine airlines provide nearly 620 daily departures to 123 cities including more than 55 nonstop flights to 36 international cities. Nearly 441,000 tons of cargo and 22,000 tons mail are moved annually by commercial airlines and a half-dozen cargo carriers.[63] The airport contains more than 200 businesses which employ more than 141,000 workers. PHL has a $14.4 billion economic impact on the region, making it one of the largest economic engines in Pennsylvania. The airport encompasses 7 terminal buildings with 126 boarding gates and is situate on about 2,370 acres.[64]

Philadelphia Northeast Airport

Philadelphia Northeast Airport (PNE) originally opened in June 1945. By 1953, it was ranked 21st in the nation for airfreight tonnage handled. Originally operated by the City of Philadelphia, the Airport's traffic control tower was taken over in 1957 by the Civil

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[62] Philadelphia International Airport. History of Philadelphia International Airport. Retrieved 8 November 2011.
[63] Philadelphia International Airport. About Philadelphia International Airport. Retrieved 8 November 2011.
[64] Philadelphia International Airport Liaison - John Glass. Retrieved 14 February 2012

Aeronautics Administration (this later evolved into the Federal Aviation Administration, FAA). In the early 1980's, Augusta Aviation Corporation opened a Northeast Service Center at the Airport and a few years later moved its headquarters from Bucks County to PNE.

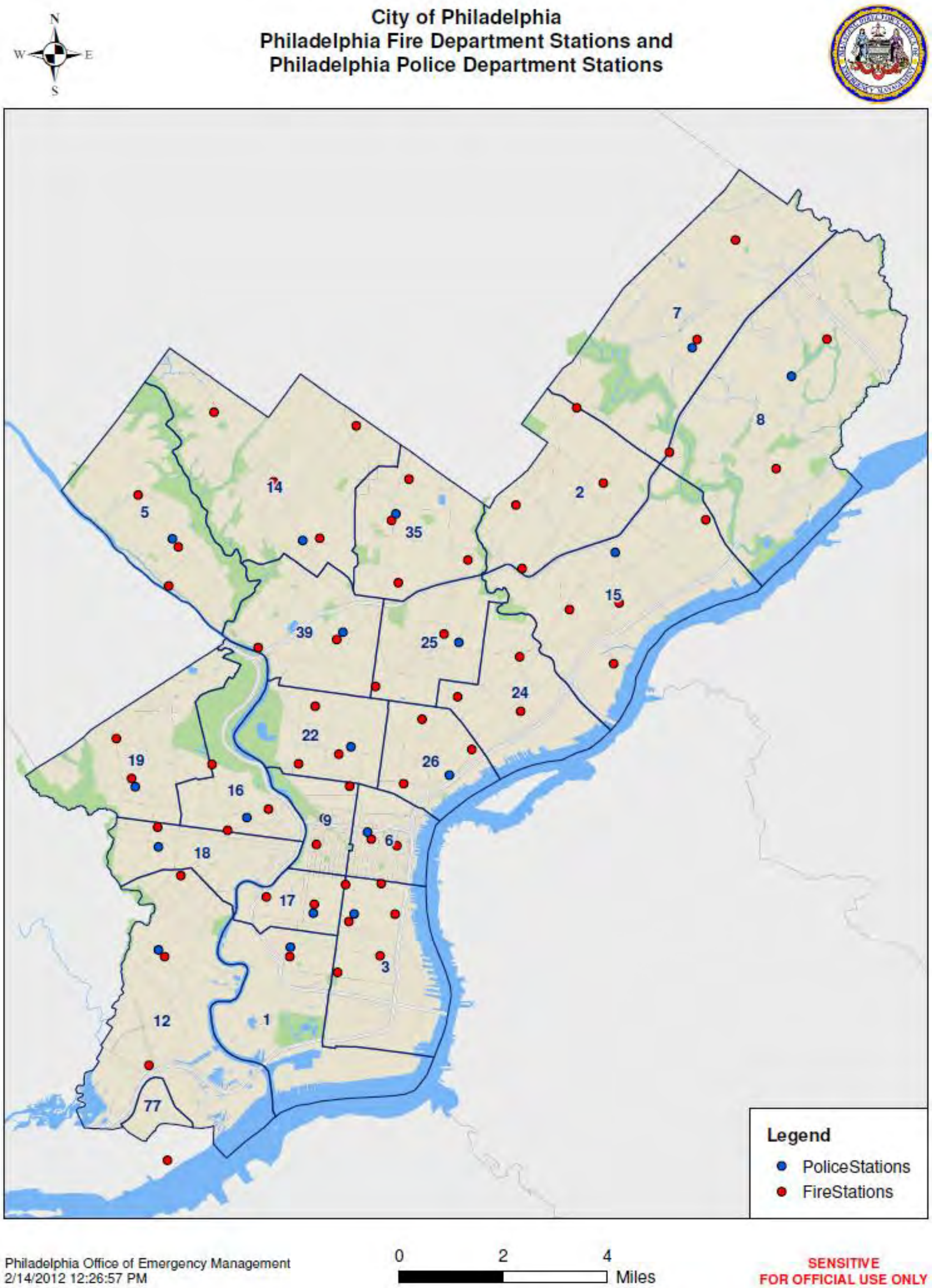
Today, PNE manages approximately 75,000 airport flight operations annually. A new taxiway was installed at PNE called Taxiway C in 2006, which gives Runway 15-33 full length on the east side of the landing strip.[65]

2.3.7 Emergency Services

Philadelphia's emergency services include the Fire Department (PFD), the Fire Department Emergency Medical Services (PFD-EMS), the Police Department (PPD), and hospitals. A number of other City agencies, including MDO-OEM, the Philadelphia Department of Public Health (PDPH), the Department of Behavioral Health and Intellectual disability Services (DBHIDS), and the Department of Licenses and Inspections (L&I) also have emergency response functions. Figure 2.3.7-1 identifies the locations of PPD and PFD stations within Philadelphia.

[65] Ibid

Figure 2.3.7-1 Philadelphia Fire and Police Stations



2.3.8 Hospitals and Healthcare Facilities

Philadelphia is one of the United States' leading major metropolitan areas in healthcare. The City is home to thirty hospitals dedicated to high-quality patient care and service.

Table 2.3.8-1	Philadelphia Hospitals			
Hospital Name	**Emergency Department**	**Trauma Center**	**Burn Center**	**Pediatric**
Angela Jane Pavilion Rehabilitation Hospital				
Aria Health – Frankford Campus	X			
Aria Health – Torresdale Campus	X	Level 2		
Cancer Treatment Centers of America - Eastern Region Medical Center				
Chestnut Hill Hospital	X			
Children's Hospital of Philadelphia	X	Level 1		X
Einstein Medical Center	X	Level 1		
Fox Chase Cancer Center				
Germantown Community Health Services				
Girard Medical Center				
Hahnemann University Hospital	X	Level 1		
Hospital of the University of Pennsylvania	X	Level 1		
Jeanes Hospital	X			
Kindred Hospital of Philadelphia				
Magee Rehabilitation Hospital				

Mercy Philadelphia Hospital	X			
Methodist Hospital	X			
Moss Rehab				
Nazareth Hospital	X			
Penn Medicine at Rittenhouse				
Penn Presbyterian Medical Center	X			
Pennsylvania Hospital	X			
Roxborough Memorial Hospital	X			
Shriner's Hospital for Children – Philadelphia				X
St. Christopher's Hospital for Children	X	Level 1	X	X
St. Joseph's Hospital	X			
Temple University Hospital	X	Level 1	X	
Temple University Hospital – Episcopal Campus	X			
Thomas Jefferson University Hospital	X	Level 1		
Philadelphia VA Medical Center	X			

2.3.9 Higher Educational Facilities
Philadelphia is home to numerous higher learning facilities. Table 2.3.9-1 lists the colleges, universities and institutes located within Philadelphia.

Table 2.3.9-1	Higher Educational Facilities
Colleges, Universities and Institutes	
• Academy of Vocal Arts • Chestnut Hill College • Community College of Philadelphia • Drexel University • Frankford Hospital School of Nursing • Hussian School of Art • Jna Institute of Culinary Arts • La Salle University • Lincoln Technical Institute • Lutheran Theological Seminary at Philadelphia • Metropolitan Career Center Computer Technology Institute • Moore College of Art & Design • Northeastern Hospital School of Nursing • Pierce College • Pennsylvania Academy of Fine Arts	• Philadelphia College of Osteopathic Medicine • Philadelphia University • Roxborough Memorial Hospital School of Nursing • Saint Joseph's University • Talmudical Yeshiva of Philadelphia • Temple University • The Art Institute of Philadelphia • The Curtis Institute of Music • The Restaurant School at Walnut • Hill college • The University of the Arts • Thomas Jefferson University • University of Pennsylvania • University of Phoenix • University of the Sciences in Philadelphia

2.3.10 Cultural Facilities

Philadelphia has one of the greatest concentrations of cultural institutions in the world. Table 2.3.10-1 displays some of Philadelphia's most visited museums, stadiums, iconic sites, zoos, theaters and concert halls.

Table 2.3.10-1	Cultural Facilities
Museums	
• Philadelphia Museum of Art • The Franklin Institute • Academy of Natural Sciences • Please Touch Museum • Penn Museum • Rodin Museum • National Museum of American Jewish History • Mutter Museum • African American Museum • Independence Seaport Museum	• Polish American Cultural Center Museum • Historical Society of Pennsylvania • National Liberty Museum • Fabric Workshop and Museum • Civil War Library and Museum • Wagner Free Institute of Science • Mummers Museum • Franklin Court

<table>
<tr><td>Simeone Foundation Museum
Rosenbach Museum and Library</td><td>Fireman's Hall
USS Becuna</td></tr>
<tr><th colspan="2">Iconic Sites</th></tr>
<tr><td>Independence Hall
Masonic Temple
Independence National Historical Visitors Center
Eastern State Penitentiary
National Constitution Center
City Hall
U.S. Mint
Liberty Bell Center
Todd House
Christ Church
Independence Mall
Congress Hall
Betsy Ross House</td><td>Bishop White House
Second Bank of the U.S.
Cathedral Basilica of SS. Peter and Paul
Pennsylvania Convention Center
Gloria dei Church
Boathouse Row
Love Park
Rittenhouse Square
Washington Square
Reading Terminal Market
Italian Market</td></tr>
<tr><th colspan="2">Theaters/Concert Halls</th></tr>
<tr><td>Kimmel Center for the Performing Arts
Arden Theatre Company
Wilma Theater
Walnut Street Theatre</td><td>Painted Bride Art Center
Academy of Music
Curtis Institute of Music
Mann Center for the Performing Arts</td></tr>
<tr><th colspan="2">Stadiums/Arenas</th></tr>
<tr><td>Citizens Bank Park
Lincoln Financial Field
Wells Fargo Center
Franklin Field</td><td>Palestra
Liacouras Center
Tom Gola Arena</td></tr>
<tr><th colspan="2">Zoos/Nature Centers</th></tr>
<tr><td>Philadelphia Zoo
Morris Arboretum
Fairmount Park
John Heinz Wildlife Refuge</td><td>Shofuso Japanese House and Garden
Bartram's Garden</td></tr>
</table>

2.4 Data Limitations

It should be noted that the analysis presented here is based upon "best available data". Data used in updates to this Hazard Mitigation Plan should be reassessed upon each review period to incorporate new or more accurate data if/when possible.

3. Planning Process

This section includes a description of the planning process used to develop the HMP, including how it was prepared, who was involved in the plan development, and how the public was engaged. To ensure the HMP met the requirements of the DMA 2000, an approach to the planning process and plan documentation was developed to achieve the following goals:

- The plan will consider the prominent natural hazards facing Philadelphia, thereby satisfying the natural hazards mitigation planning requirements specified in DMA 2000.
- The plan will be developed following the process outlined by DMA 2000, FEMA requirements and FEMA and PEMA guidance.

3.1 Planning Process and Participation Summary

Philadelphia applied for, and was awarded, funding under the Pre-Disaster Mitigation (PDM) Competitive Grant Program to assist in the development of an HMP. A Hazard Mitigation Planning Coordinator was hired under MDO-OEM to oversee the development of the plan. In November 2011 MDO-OEM began the development of Philadelphia's first HMP. By December 2011 Philadelphia had identified and profiled the natural hazards of concern, as well as had addressed the vulnerabilities associated with each hazard. In the same month, a Hazard Mitigation Planning Committee was assembled to support the plan development and compile an implementation-strategy action plan in order to mitigate potential losses. The HMP planning process concluded in February 2012 with the finalized HMP being sent to PEMA and FEMA for approval.

The Philadelphia HMP was written using the best available information obtained from a wide variety of sources. Throughout the plan development, an effort was made to solicit information from individuals with specific knowledge of certain natural hazards and their past impacts to Philadelphia.

3.2 Planning Committee

The Hazard Mitigation Planning Committee is a core group of nineteen agencies that manage, operate, and/or plan for some of the City's largest infrastructure networks. The planning committee provides subject-matter expertise in the following areas: emergency management, public safety, land use planning, building codes, transportation, infrastructure development, maintenance, and protection, and natural resource protection. This committee combines skills, expertise, and experience to achieve a common goal of natural hazard mitigation for Philadelphia.

The planning committee helps develop, manage and implement Philadelphia's HMP. The following list summarizes the planning committee's responsibilities:

- Support plan development
- Attend HMP Planning Committee meetings
- Provide subject matter expertise

- Assist in ranking hazards of concern
- Develop mitigation actions pertinent to their agency
- Assist in evaluating and prioritizing mitigation actions
- Review and comment on draft HMP sections provided by MDO-OEM
- Assist with plan maintenance

MDO-OEM served as the coordinating agency for the development of the HMP. MDO-OEM facilitated the overall plan development to ensure the HMP met the requirements of DMA 2000. As the HMP coordinator, MDO-OEM had many responsibilities including administration, content organization, and text development. The following list summarizes MDO-OEM's responsibilities:

- Organize and guide all meetings with the planning committee
- Provide support for all participants in the hazard mitigation planning process
- Coordinate with planning committee to identify relevant material for HMP
- Develop and implement the community involvement process
- Guide plan development to adhere to DMA 2000 requirements
- Manage identification, collection and analysis of capabilities submitted by the Planning Committee
- Guide hazard ranking process
- Manage identification, collection and analysis of mitigation actions submitted by the planning committee

3.2.1 Participants and Agency Descriptions

Planning committee agency participants include:

3.2.1-1 Participants in the Philadelphia HMP Planning Committee	
Agency	**Participants**
Managing Director's Office of Emergency Management (MDO-OEM)	• April Geruso • Caitlin Kelly • Joan Przybylowicz
Philadelphia Water Department (PWD)	• Jim Golembeski
The Streets Department of Philadelphia (Streets)	• Kevin Koch • Thomas O'Farrell • Michael Zaccagni
Philadelphia Parks and Recreation (PPR)	• Charles Dougherty • James Mako
Philadelphia Fire Department (PFD)	• Chief Richard Bossert • Lieutenant Arthur Myers

Philadelphia Department of Public Health (PDPH)	• Steve Alles, MD • Benjamin Whitfield
Philadelphia Gas Works (PGW)	• Mark Lee
Philadelphia Office of Innovation and Technology (OIT)	• Angelique O'Donnell
Philadelphia City Planning Commission (PCPC)	• Paula Brumbelow
Philadelphia Department of Licenses and Inspections (L&I)	• Steve Gallagher
Philadelphia International Airport (PHL)	• John Glass
Pennsylvania Department of Transportation (PENNDOT)	• Rodney Smith
Veolia Energy (Veolia)	• Patrick Davin
PECO Energy (PECO)	• Sharon Lownes
Southeast Pennsylvania Transportation Authority (SEPTA)	• John Power
Delaware River Port Authority (DRPA)	• Robert Only
National Park Service (NPS)	• Patrick Suddath
Pennsylvania Emergency Management Agency (PEMA)	• Tom Hughes • Kelsey Walko
Federal Emergency Management Agency (FEMA)	• Matt McCullough

3.3 Planning Committee Meetings and Documentation

The following planning committee meetings were held during the planning process. Agendas and sign-in sheets are included in Appendix I.

December 8, 2011 – Hazard Mitigation Kickoff Meeting held at the Fire Administration Building.

The meeting introduced all planning committee participants to the mitigation planning process, discussed timelines for implementation, reviewed initial sections of the HMP, including the community profile and three hazard profiles, drought, earthquake and extreme temperature, and described specific expectations and roles of planning committee members. A brief summary was given on what hazard mitigation planning entails and why Philadelphia needs a Hazards Mitigation Plan.

December 20, 2011 – Hazard Mitigation 2nd Planning Meeting held at the Fire Administration Building and via teleconference.

Due to the topics discussed, selected members of the planning committee were invited to attend the 2nd hazard mitigation planning meeting in person. All planning members were invited to attend via teleconference. The meeting reviewed three additional hazard profiles: Flooding, Tropical Cyclones, and Windstorms/Tornadoes. Information was also collected on the local planning, regulatory, administrative, technical, fiscal and political capabilities within Philadelphia.

January 5, 2012 - Hazard Mitigation 3rd Planning Meeting held at the Fire Administration Building.

The 3rd planning meeting determined the ranking for the seven hazards profiled within the HMP. The final hazard rankings were determined by a group census after the planning committee established the level of concern for the population, built environment and economy of Philadelphia based on the proposed hazard. The rankings were determined as high, moderate or low. Extreme temperature, floods, and winter weather were determined as high risk; tropical cyclone and windstorms/tornado were determines as moderate risk; and earthquake and drought as low risk. A brief introduction into the development of the mitigation strategies was also provided.

February 2, 2012 – Hazard Mitigation 4th Planning Meeting held at the Fire Administration Building.

A brief summary was provided on the risk assessment results and what language was developed for the plan. The meeting also reviewed the preliminary mitigation strategies developed for Philadelphia, how to prioritize these strategies using the PASTEEL method, and grants available to fund such strategies.

February 16, 2012 – Hazard Mitigation Final Planning Meeting held at the Fire Administration Building.

The planning committee reviewed the finalized draft version of the HMP, provided comments and suggestions and/or approved the information. A brief introduction to Phase II of the HMP was provided by MDO-OEM, explaining the inclusion of human-made disasters during this subsequent phase.

Throughout the planning process MDO-OEM's Hazard Mitigation Planning Coordinator was available to provide additional HMP information and clarification to the participating agencies. Individual meetings were conducted to further explain what hazard mitigation entails, and potential mitigation actions for Philadelphia.

3.4 Public Meetings

In compliance with hazard mitigation planning requirements, extensive public participation was sought and encouraged throughout the development of the HMP. To engage the community in the hazard mitigation planning process, MDO-OEM developed a comprehensive community involvement strategy. MDO-OEM first held a series of meetings designed to garner support and comments from numerous Philadelphia residents.

3.4.1 Meeting Logistics

Media releases and advertisements on MDO-OEM social media sites were posted to invite Philadelphia residents to five public meetings. Appendix C and E includes the press releases and agendas for each of the five public meetings. Several articles were also published in local newspapers providing information on the public meetings; these articles can be found in Appendix D of this plan. In addition, the public meeting dates and agendas were available on the MDO-OEM's website homepage, and the meeting announcements were provided to all planning committee members. The list of public meetings is presented in table 3.4.1-1 below.

3.4.1-1	**Philadelphia Hazard Mitigation Public Meetings**
Date	**Location**
Thursday, December 15, 5:30 p.m. – 7:30 p.m.	The Salvation Army Corps Roxborough Community Center 6730 Ridge Avenue
Saturday, January 7, 2012, 10:00 a.m. - 12:00 p.m.	Federation Housing Inc., Rieder House 10102 Jamison Avenue
Tuesday, January 24, 6:00 p.m. - 8:00p.m.	Mercy Eastwick Wellness Center 2821 Island Avenue
Wednesday, February 8, 6:00 p.m. - 8:00 p.m.	Free Library of Philadelphia – Central Branch Skyline Room, 4th Floor 1901 Vine Street
Thursday, February 16, 6:00 p.m. - 8:00 p.m.	Salvation Army Tabernacle Corps 3150 North Mascher Street

3.4.2 Meeting Materials

The hazard mitigation public meetings provided members of the planning committee an opportunity to present on the Hazard Mitigation planning process, present and discuss the hazards of concern and related hazard profiles and vulnerability assessments. A presentation was developed which outlined the entire planning process. At each subsequent meeting, opportunity was given to provide information on the status of the draft plan, and to provide feedback on the plan.

In addition, a natural hazards questionnaire was developed to gauge the citizens' level of knowledge and perception to natural hazards within Philadelphia. The questionnaire asked 14 quantifiable questions about citizen perception of risk, knowledge of mitigation actions available, and household emergency preparedness. The questionnaire also asked several demographic questions to help analyze trends. The questionnaire was available on the MDO-OEM website for residents to complete in electronic format and was distributed during Hazard Mitigation Public Meetings, Emergency Preparedness Workshops, and the Global Citizen MLK Day of Service Health & Wellness Fair & Civic Engagement Expo. All questionnaires were completed online, collected at meetings or returned to MDO-OEM through pre-paid envelopes and all results were compiled. Appendix A provides a summary of the questionnaire and the questionnaire findings.

3.4.3 Hazard Mitigation Plan Website

A public website (www. http://oem.readyphiladelphia/hazardmitigation.org) was launched on March 2, 2012 to inform Philadelphia residents of the project. The website contains the draft version of the Hazard Mitigation Plan, information on the hazards profiled within the plan, information on family and personal preparedness, links to personal mitigation measures, a link to the natural hazards questionnaire, and answers to frequently asked questions regarding hazard mitigation.

4. Risk Assessment

According to the FEMA Guidance 386-2, "risk assessment is the process of measuring the potential loss of life, personal injury, economic injury and property damage resulting from natural hazards by assessing the vulnerability of people, buildings and infrastructure to natural hazards." Philadelphia's risk assessment is organized into three sections. Section 4.1 identifies the natural hazards of concern for further profiling and evaluation. Section 4.2 profiles those natural hazards, describing their range of magnitude, probability of occurrence and their impact on population, property (general building stock including critical facilities), and the economy. Section 4.3 then provides a summary for the vulnerability assessment, and describes the methodology and tools used to support the risk assessment process.

4.1 Hazard Identification

4.1.1 Table of Disaster Declarations

Since 1955, declarations have been issued for numerous natural hazard events in Philadelphia, including hurricanes, tornadoes, severe winter storms, flooding events, and droughts. Understanding the disaster history of Philadelphia helps provide direction on the identification of the primary natural hazards and their significance.

4.1.1.1 Federal Declarations

Presidential Major Disaster Declaration
A Presidential Major Disaster Declaration (hereon referred as a 'Presidential Disaster Declaration') is defined by FEMA as "any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under [The Stafford] Act to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby."

All requests for a declaration by the President that a major disaster exists shall be made by the Governor of the affected state. Such a request shall be based on a finding that the disaster is of such severity and magnitude that effective response is beyond the capabilities of the state and the affected local governments and that federal assistance is necessary. As part of such request, and as a prerequisite to major disaster assistance, the Governor shall take appropriate response action under state law and direct execution of the state's emergency plan. Based on the request of a Governor, the President may declare under this chapter that a major disaster or emergency exists.[66] A Presidential Disaster Declaration puts into motion long-term federal recovery programs designed to aid disaster victims, businesses and public entities. The following is a list of eligible major assistance programs that may be available with a Presidential Disaster Declaration under the Stafford Act:[67]

- Public Assistance Program
- Individual Assistance Program
- Small Business Administration (SBA) Physical and Economic Injury Disaster Loans (EIDL)
- Tax Refunds
- National Flood Insurance Program (NFIP)
- The U.S. Department of Housing and Urban Development (HUD) Disaster Recovery Assistance
- Hazard Mitigation Assistance (HMA)
- Debris Removal/Public Facility Restoration through the Department of Defense (DOD)
- Flood Protection and Recovery through the U.S. Army Corps of Engineers (USACE)
- The Federal Highway Administration (FHWA) Emergency Relief Funds

Emergency Declaration

An Emergency Declaration is defined by FEMA as "any occasion or instance for which, in the determination of the President, federal assistance is needed to supplement state and local efforts and capabilities to save lives and the protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States." An Emergency Declaration is more limited in scope and without long-term federal recovery programs of a Presidential Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring.

Table 4.1.1-1 identifies Presidential Disaster and Emergency Declarations issued between 1955 through 2011 for Philadelphia. These dates indicate the declaration date and not the date of the disaster.

Table 4.1.1-1 Presidential Disaster (PD) and Emergency Declarations (ED)

Date	PD or ED	Event	Actions	Disaster Number

[66] 44 C.F.R. § 206.36 sets out the requirements to be fulfilled by the Governor or Acting Governor in his or her absence in requesting a Presidential major disaster declaration: § 5191. Procedure for declaration § 206.36 Requests for major disaster declarations.

[67] This list represents a selection of the programs that may be available after a disaster. For a complete listing of Federal Disaster Assistance programs, please refer to DisasterAssistance.gov.

September, 2011	PD	Tropical Storm Lee	Emergency Measures Declaration for Public Assistance and Hazard Mitigation	EM-4030
September, 2011	PD	Hurricane Irene	Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation	DR-4025
April, 2010	PD	Severe Winter Storms & Snowstorms	Major Disaster for Public Assistance	DR-1898
June, 2006	PD	Proclamation of Emergency - Flooding	Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation	DR-1649
September, 2005	ED	Proclamation of Emergency – Hurricane Katrina	Presidential Declaration of Emergency for Public Assistance	EM-3235
September, 2004	PD	Tropical Depression Ivan	Major Disaster for Individual Assistance	DR-1557
August, 2004	PD	Severe Storms & Flooding	Major Disaster for Individual Assistance and Hazard Mitigation	DR-1538
February, 2003	ED	Severe Winter Storm	Governor's Proclamation of Disaster Emergency	EM-3180
September, 1999	PD	Hurricane Floyd	Major Disaster for Individual Assistance and Public Assistance	DR-1294
January, 1996	PD	Flooding	Governor's Proclamation; President's Declaration of Major Disaster	DR-1093
January, 1996	PD	Severe Winter Storms	Major Disaster for Individual Assistance and Public Assistance	DR-1085

January, 1994	PD	Winter Storm/Severe Storm	Governor's Proclamation; President's Declaration of Major Disaster	DR-1015
March, 1993	ED	Blizzard	Governor's Proclamation; President's Declaration of Major Disaster	EM-3105
June, 1972	PD	Tropical Storm Agnes	Governor's Proclamation; President's Declaration of Major Disaster	DR-340
September, 1971	PD	Floods	Governor's Proclamation; President's Declaration of Major Disaster	DR-312
August, 1965	PD	Water Shortage	Governor's Proclamation; President's Declaration of Major Disaster	DR-206

Small Business Administration Disaster Declaration
Philadelphia has also historically received numerous SBA Disaster Declarations. A SBA declaration can activate the Physical Loan and/or EIDL programs, which make disaster assistance available to affected homeowners, renters, and businesses in the form of low-interest loans. Table 4.1.1-2 illustrates SBA Disaster Declarations issued for Philadelphia between 1992 and 2010.

4.1.1-2 Small Business Administration Disaster Declarations in Philadelphia		
DATE	**EVENT**	**Actions**
September, 2011	Tropical Storm Lee	SBA - Physical Damage and Economic Injury
September, 2011	Hurricane Irene	SBA - Physical Damage and Economic Injury
February, 2010	Fire	SBA - Physical Damage and Economic Injury
August, 2009	Storms and Flooding	SBA - Physical Damage and Economic Injury
September, 2008	Fire	SBA - Physical Damage and Economic Injury

August, 2008	Fire	SBA - Physical Damage and Economic Injury
April, 2007	Severe Storms and Flooding	SBA - Economic Injury Disaster Loan
June, 2006	Proclamation of Emergency - Flooding	SBA - Physical Damage and Economic Injury
September, 2004	Tropical Depression Ivan	Information Not Available (NA)
August, 2004	Severe Storms & Flooding	NA
February, 2003	Severe Winter Storm	NA
October, 2001	Fire	SBA - Economic Injury Disaster Loan
May, 2001	Fire	SBA - Physical Damage and Economic Injury
March, 2001	Fire	SBA - Economic Injury Disaster Loan
September, 1999	Hurricane Floyd	NA
June, 1998	Severe Storms/Tornadoes	NA
January, 1998	Fire	SBA - Physical Disaster Loans & Economic Injury Disaster Loan
January, 1996	Severe Winter Storm	NA
January, 1996	Flooding	NA
January, 1994	Severe Winter Storm	NA
July, 1994	Flooding	SBA - Physical Disaster Loans & Economic Injury Disaster Loan
March, 1993	Blizzard	NA
March, 1993	Fire	SBA - Physical Disaster Loans & Economic Injury Disaster Loan
July, 1992	Fire	SBA - Physical Disaster Loans & Economic Injury Disaster Loan

4.1.1.2 Commonwealth Declarations

Gubernatorial State of Emergency

In addition to the presidentially declared events, the Governor of Pennsylvania is authorized under state law to declare a Gubernatorial State of Emergency (also referred to as a Gubernatorial Disaster Proclamation) upon the occurrence of a natural or man-made disaster. The law gives the Governor broad authorities to implement emergency measures to ensure the safety and health of the residents of the Commonwealth, take appropriate steps to mobilize state assets, and conduct other emergency business for the protection of the Commonwealth. A Gubernatorial State of Emergency is initiated when it becomes necessary for the Governor to assume command for the efficient utilization of the total resources of the Commonwealth, in order to mitigate the effects on people and property of a large-scale threat, emergency or disaster.

Table 4.1.1-3 outlines the Gubernatorial Disaster Proclamations that have been issued for Philadelphia between 1955 and 2010. Several other natural hazard events received Gubernatorial Disaster Proclamations, including all events listed under the Presidential Disaster and Emergency Declaration table. Table 4.1.1-3 only lists the events that exhausted local resources and were able to be handled by state resources.

Table 4.1.1-3 Pennsylvania Gubernatorial Disaster Proclamations for Philadelphia

Date	Event	Actions
April, 2007	Severe Winter Storm	Statewide – to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
February, 2007	Severe Winter Storm	Statewide – to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
February, 2007	Severe Winter Storm	Statewide – waive the regulation regarding hours of service limitations for divers of commercial vehicles
September, 2006	Tropical Depression Ernesto	Statewide - utilize all available resources and personnel as deemed necessary to cope with the magnitude and severity of the emergency situation
April, 2006	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	Hurricane Katrina	Statewide - regarding waiving enforcement of applicable state laws & regulations that govern transport of oversized loads
February, 2002	Drought & Water Shortage	NA

July, 1999	Drought	Statewide - Governor's Proclamation, Individual Assistance, Hazard Mitigation Grant Program
June, 1998	Severe Storms/Tornadoes	Philadelphia, Chester, Delaware, Lancaster, Montgomery – Governor's Proclamation
March, 1996	Highway Bridge (I-95) Destruction	Philadelphia – Governor's Proclamation
September, 1995	Drought	Philadelphia – Governor's Proclamation
November, 1980	Drought Emergency	Philadelphia – Governor's Proclamation
January, 1978	Heavy Snow	Statewide – Governor's Proclamation
December, 1972	Steam Heat Problem	Philadelphia – Governor's Proclamation
January, 1966	Heavy Snow	Statewide – Governor's Proclamation
February, 1958	Heavy Snow	Southeast & South Central PA – Governor's Proclamation
September, 1955	Drought	Eastern & Central PA – Governor's Proclamation

4.1.1.3 Philadelphia Declarations

Mayoral State of Emergency
Chapter 75, Section 7501 of the Pennsylvania Emergency Management Services Code authorizes both cities and counties to issue local state of emergency declarations. Such declarations activate local plans, mutual aid, and local ordinances authorizing certain restrictions, prohibitions, and other measures taken to protect public health, safety and welfare during the period of disaster declaration.[68]

Philadelphia operates under a Home Rule Charter, where the mayor may declare the disaster unilaterally. The effects of a declaration are to activate the response and recovery aspects of the Philadelphia Emergency Operations Plan and to authorize furnishing aid and assistance. The period of the declaration cannot continue or be renewed for a period in excess of seven days without formal renewal. Any declaration

[68] Commonwealth of Pennsylvania Emergency Management Handbook for Elected Officials. Retrieved 21 February 2012.

must be given prompt and general publicity and filed with the Pennsylvania Emergency Management Agency (PEMA).

Table 4.1.1-3 outlines the Mayoral State of Emergencies that have been issued for Philadelphia between 1985 and 2011.

Table 4.1.1-3 Mayoral State of Emergency for Philadelphia

Date	Event	Actions
August, 2011	Hurricane Irene	• Citywide • National Guard • Additional police powers • Code Grey issued • Curfew
December 1985	Racial Violence	• Southwest Philadelphia • Banned gatherings in groups of 4 or more • Created early curfew

4.1.2 Summary of Hazards

The "Pennsylvania Standard List of Hazards" profiles sixteen natural hazards the Commonwealth as a whole is susceptible to, and details the likeliness of each hazard to occur in Pennsylvania.[69] Using this list, as well as previous historical occurrences of disaster declarations and input from the Philadelphia Hazard Mitigation Planning Committee, seven natural hazards were selected to be profiled in more depth within this Plan, as they are the most likely to occur in future within Philadelphia. These natural hazards include (alphabetically):

- Drought
- Earthquake
- Extreme Temperature
- Floods
- Tropical Cyclone: Hurricane, Tropical Storm
- Windstorm, Tornado
- Winter Storm

A brief description for each of these natural hazards developed in the Pennsylvania Standard List of Hazards is provided in Table 4.1.2-1.

Additional natural hazards do pose a threat to Philadelphia, though their expected occurrence will not be as frequent as those mentioned within this HMP. As mentioned

[69] Pennsylvania 2010 Hazard Mitigation Plan. Retrieved November 3, 2011.

previously, man-made hazards and natural hazards of a lesser priority will be profiled in later iterations of this Plan.

Table 4.1.2-1 Profiled Natural Hazards
Philadelphia Hazard Mitigation Plan

Natural Hazard	Description
Drought	Drought is a natural climatic condition which occurs in virtually all climates, the consequence of a natural reduction in the amount of precipitation experienced over a long period of time, usually a season or more in length. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. This hazard is of particular concern in Pennsylvania due to the presence of farms as well as water-dependent industries and recreation areas across the Commonwealth. A prolonged drought could severely impact these sectors of the local economy, as well as residents who depend on wells for drinking water and other personal uses. (National Drought Mitigation Center, 2006).
Earthquake	An earthquake is the motion or trembling of the ground produced by sudden displacement of rock usually within the upper 10-20 miles of the Earth's crust. Earthquakes result from crustal strain, volcanism, landslides, or the collapse of underground caverns. Earthquakes can affect hundreds of thousands of square miles, cause damage to property measured in the tens of billions of dollars, result in loss of life and injury to hundreds of thousands of persons, and disrupt the social and economic functioning of the affected area. Most property damage and earthquake-related deaths are caused by the failure and collapse of structures due to ground shaking which is dependent upon amplitude and duration of the earthquake. (FEMA, 1997).
Extreme Temperature	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 2010 HMP, 2004).

Floods	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).
Tropical Cyclone: Hurricane, Tropical Storm	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).

Windstorm, Tornado	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).
Winter Storm	Winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. A winter storm can range from a moderate snowfall or ice event over a period of a few hours to blizzard conditions with wind-driven snow that lasts for several days. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely impair visibility and disrupt transportation. The Commonwealth of Pennsylvania has a long history of severe winter weather. (NOAA, 2009).

Source: PAHMP, 2010

4.2 Hazard Profiles and Vulnerability Assessment

The following sections profile and assess vulnerability for each of the seven natural hazards identified in section 4.2 of this document. For each hazard, the profile includes a brief description; identifies what section of Philadelphia is affected; the range of magnitude or the possible extent of that hazard; previous occurrences and losses; and the probability of future events. The vulnerability assessment for each hazard includes: an overview of vulnerability; the impact on life, health and safety; impact on the natural environment; impact on the built environment; and the impact on the economy.

4.2.1 Drought

4.2.1.1 Description

A drought is defined as "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area."[70] In simplest terms, a drought is a period of unusually persistent dry weather that persists long enough to cause serious problems such as crop damage and/or water supply shortages. The severity of the drought depends upon the degree of moisture deficiency, the duration, and the size of the affected area.

The National Drought Mitigation Center (NDMC) categorizes drought in terms of four basic approaches:[71]

- Meteorological - Meteorological drought is defined in terms of the departure from a normal precipitation pattern and the duration of the drought hazard. Definitions of meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.
- Agricultural - Agricultural drought refers to a situation where the amount of moisture in the soil no longer meets the needs of a particular crop. It links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, and so forth.
- Hydrological - Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although climate is a primary contributor, other factors such as changes in land use, land degradation, and the construction of dams all affect the hydrological characteristics of the basin. Hydrological droughts often lag behind meteorological and agricultural droughts.

[70] Glossary of Meteorology. Drought. Retrieved 23 January 2012.
[71] National Drought Mitigation Center (NDMC). Types of Drought. Retrieved 23 January 2012.

- Socioeconomic - Socioeconomic droughts occur when physical water shortage begins to affect the population, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good.

4.2.1.2 Location

Droughts are regional climatic events, so like all other counties in Pennsylvania, Philadelphia is subject to periodic droughts that would impact the ability to meet the city's water needs. Droughts can have varying effects, depending upon their timing, severity, duration and location. In most Pennsylvania counties, droughts have their greatest impact on agriculture and water supply. For Philadelphia droughts primarily impact water supply for water use activities such as recreation, as opposed to consumption. The agricultural land in Philadelphia is not immune to the effects of a drought, however the percentage of agricultural land use is so small in Philadelphia, approximately 60 acres, and it is not a primary concern.[72]

4.2.1.3 Range of Magnitude

Droughts are a normal meteorological occurrence in all of the climates within the United States, resulting from the natural reduction in the amount of precipitation experience over a period of time, usually a season or more in length. Most droughts cause direct impacts to aquatic resources. High temperatures, prolonged winds and low relative humidity may exacerbate the severity of a drought.

The two types of drought most common to southeastern Pennsylvania and of concern to emergency management are hydrological drought and socioeconomic drought. Hydrological 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, water quality, soil moisture, conditions conducive to wildfire events and water for navigation and recreation. Water management drought events exist when water management practices or facilities fail to bridge normal or abnormal dry periods. This is not necessarily a reduction in supply, but rather a disparity in supply and demand.

Monitoring and managing the Commonwealth's water resources during droughts is the responsibility of the Pennsylvania Emergency Management Agency (PEMA), with direct support from the Pennsylvania Department of Environmental Protection (PADEP).

4.2.1.4 Drought Phases

PADEP and PEMA manage droughts using the drought phase conditions *watch*, *warning*, and *emergency*. These indicators are used to identify, generally on a county basis, the overall water supply conditions. While some of the indicators could be used to help identify meteorological or agricultural or other types of droughts as well, the

[72] Vitiello, D, Nairn, M.; Community Gardening in Philadelphia, 2008 Harvest Report. October 2009

primary objective is to identify and manage hydrological droughts. They are listed in order of increasing severity:[73]

Drought Watch: A drought watch is a period to alert government agencies, public water suppliers, water users and the public regarding the potential for future drought-related problems. 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. On the Palmer Drought Severity Index, explained later within this section, a drought watch would be classified as a 'moderate' drought.

Drought Warning: A drought warning 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 ask for more stringent conservation actions. On the Palmer Drought Severity Index, a drought warning would be classified as a 'severe' drought.

Drought Emergency: A drought emergency 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 15 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. On the Palmer Drought Severity Index, a drought emergency would be classified as an 'extreme' drought.

4.2.1.5 Response Techniques

Local Water Rationing: 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

[73] Pennsylvania Department of Environmental Protection. Managing Drought in Pennsylvania. Retrieved 2 November 2011.

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.[74]

Philadelphia Water Department Drought Emergency Restrictions

In the event a drought emergency occurs in Philadelphia, the Philadelphia Water Department (PWD) has developed mandatory water use restrictions to conserve water resources. Throughout a drought emergency, it is illegal to:[75]

- Use water to clean personal, leased or rented vehicles, trailers, and boats by any means other than by bucket.
- Use water to clean sidewalks, streets or gutters, unless determined to be necessary for public health and safety.
- Use water for ornamental purposes, like fountains, waterfalls, and reflecting pools.
- Water gardens, trees, shrubs, except between 5 p.m. and 9 a.m. and then only by a bucket, can, or hand-held hose equipped with an automatic shutoff nozzle.
- Water lawns at all, except newly seeded or sodded lawns, which may be watered between 5 p.m. and 9 a.m. by bucket, can, or hand-held hose equipped with an automatic shutoff nozzle; sprinklers are strictly prohibited.
- Fill residential swimming pools; (NOTE: The state has permitted water providers, depending on their supplies, to allow residential swimming pools to be filled.)
- Fill swimming pools serving at least 25 dwelling units such as hotels, motels, and apartment complexes, unless they have filtration equipment to allow for continued use and recycling of water over the swimming season.
- Fill swimming pools unless they are operated by health care facilities used in relation to patient care and rehabilitation.
- Serve water in restaurants, clubs or eating places, unless requested by an individual.

4.2.1.6 Assessing Drought Conditions

The Commonwealth of Pennsylvania uses five parameters to assess drought conditions:

Precipitation Deficits

Precipitation deficits are the earliest indicators of a potential drought, because it is rainfall that provides the basis for both ground and surface water resources. The National Weather Service (NWS) records 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.

[74] Ibid
[75] The Philadelphia Water Department. Philadelphia Water Department Outlines Drought Emergency Restrictions. Retrieved 7 November 2011.

Each month, the total cumulative precipitation values in each county, for periods ranging from three to twelve 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 4.2.1-1 lists the drought conditions indicated by various precipitation deficit percentages.[76]

Table 4.2.1-1 Precipitation Deficit Drought Indicators

Duration of Deficit Accumulation (months)	Drought Watch (%)	Drought Warning (%)	Drought Emergency (%)
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

Source: PADEP, 2007

Stream Flows

Stream flows typically lag one to two months behind precipitation in signaling a drought. The U.S. Geological Survey (USGS) maintains a network of stream gages across the state. In Philadelphia the USGS has eleven streamflow gages (see Table 4.2.1-2). PADEP uses a set of these gages, equipped with satellite communication transmitters, as its drought monitoring network.[77]

[76] Ibid
[77] Ibid

Table 4.2.1-2	USGS Streamflow Gages for Philadelphia	
Station	**Location**	**Drainage Area**
Poquessing Creek at Grant Ave	Latitude 40`03'25", Longitude 74`59'08", Hydrologic Unit 02040202, on right bank 600 ft. upstream from Interstate Highway 95, 3,000 ft. upstream from mouth, and in northeast Philadelphia.	**21.4 miles²**
Pennypack Creek at Pine Rd	Latitude 40`05'23", Longitude 75`04'10 Hydrologic Unit 02040202, on right bank 20 ft. below Pine Road, 300 ft. upstream from Stream "A" at north city limits of Philadelphia.	**N/A**
Pennypack Creek at Lower Rhawn St	Latitude 40`03'00", Longitude 75`01'59 Hydrologic Unit 02040202, on left bank at downstream side of footbridge pier, 400 ft. downstream from Lower Rhawn Street bridge, and 0.8 mi upstream from Wooden Bridge Run in Philadelphia.	**49.8 miles²**
Tacony Creek at Adams Avenue	Latitude 40`02'47", Longitude 75`06'40" Hydrologic Unit 02040202.	**16.6 miles²**
Frankford Creek at Castor Ave	Latitude 40`00'57", Longitude 75`05'50 Hydrologic Unit 02040203, on left bank at upstream side of Castor Avenue bridge, and 2.8 mi upstream from mouth in northeast Philadelphia.	**30.4 miles²**
Delaware River at Ben Franklin Bridge	Latitude 39`57'14", Longitude 75`08'16 Hydrologic Unit 02040202, on right bank at river end of pier 12, 150 ft. upstream from Ben Franklin bridge, and at Philadelphia.	**7,993 miles²**

Wissahickon Creek at Mouth	Latitude 40`00'54", Longitude 75`12'24 Hydrologic Unit 02040203, on left bank 100 ft. upstream from dam at Ridge Avenue, 750 ft. upstream from mouth, and 1,000 ft. northwest of Gustine Lake in Philadelphia.	**64.0 miles²**
Schuylkill River at Philadelphia	Latitude 39`58'04", Longitude 75`11'20 Hydrologic Unit 02040203, on right bank 150 ft. upstream from Fairmount Dam, 1,500 ft. upstream from bridge on Spring Garden Street in Philadelphia, and 8.7 mi upstream from mouth.	**1,893 miles²**
Delaware River at Fort Mifflin	Latitude 39`52'45", Longitude 75`12'11 Hydrologic Unit 02040202, on right bank at outer end of L-shaped pier at Fort Mifflin, 0.4 mi downstream from mouth of Schuylkill River, and at Philadelphia.	**9,971 miles²**
Cobbs Creek at U.S. Highway No. 1	Latitude 39`58'29", Longitude 75`16'49 Hydrologic Unit 02040202, on left bank 30 ft. downstream from bridge on U.S. Highway No. 1 and 50 ft. upstream from unnamed tributary at west city limits of Philadelphia.	**4.78 miles²**
Cobbs Creek at Mt. Moriah Cemetery	Latitude 39`55'58", Longitude 75`14'15" Hydrologic Unit 02040202	**19.9 miles²**

Source: USGS, 2011

Every day gage records are utilized to compute an average flow of the last 30 days preceding that day (called the "30-day moving average daily flow"), that serves as a stream flow indicator. The stream flow indicators are then compared with statistical flow values known as "percentiles" derived from historic stream gage records. A flow percentile is a value on a scale from 0 to 100 that indicates the percent of the time on that given date throughout the gage period of record that flow has been equal to or below that value.

The following percentile ranges are used as indicators for drought watch, warning, and emergency:[78]

Table 4.2.1-3 Drought Watch, Warning, and Emergency Indicators

Flow Percentile Range	Drought Status
25 to 100	None
10 to 25	Watch
5 to 10	Warning
0 to 5	Emergency

Reservoir Storage Levels
Depending on the total quantity of storage and the length of the refill period for various raw water supply reservoirs, PADEP uses varying percentages of storage drawdown to indicate the three drought phases for each of the raw water supply reservoirs. There are no raw water supply reservoirs in Philadelphia; however, PWD monitors finished water storage reservoirs.[79]

The difference between the two types of reservoirs lies with the basin make-up and the amount of water it holds. Raw water supply reservoirs typically consist of a large surface water impoundment, such as a dammed river, and store thousands to millions of acre-feet of untreated raw water. Whereas, finished water reservoirs are typically much smaller in volume and vary considerably with regard to design function, materials of construction, and capacity. A small system may have an elevated steel storage tank that stores several hundred gallons of finished water, while a large system may have a concrete-walled basin that stores on the order of 150 acre-feet (50-million gallons) of water for distribution.[80]

Groundwater levels
Groundwater levels typically lag two to three months behind precipitation, largely due to the storage effect. 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.[81]

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[78] Ibid
[79] Ibid
[80] Environmental Protection Agency (EPA). Uncovered Finished Water Reservoirs Guidance Manual. Retrieved 18 January 2012.
[81] Ibid

Groundwater levels are used to indicate drought status in a manner similar to stream flows. Every day, groundwater levels in USGS observation wells are used to compute the "30-day moving average groundwater level" that serves as a ground water indicator. The groundwater indicators are then compared with statistical groundwater level values known as "percentiles" derived from historic observation-well records. A percentile is a value on a scale from 0 to 100 that indicates the percent of the time on that given date throughout the observation well period of record that water levels have been equal to or below that value.

PADEP has defined that groundwater percentile range of 10 to 25, 5 to 10, and 0 to 5 to represent entry into drought watch, warning, and emergency phases, respectively.[82] Suitable observation wells with adequate periods of record do not exist in Philadelphia. Instead, surrogate wells located in Delaware County are used for the USGS ground water and composite drought monitoring maps in Philadelphia.[83]

Soil Moisture - The Palmer Drought Severity Index
Soil moisture information is provided by the National Oceanic and Atmospheric Administration (NOAA) in the form of the "Palmer Drought Severity Index," (PSDI). The Palmer Index is a computed value, based on a number of meteorological and hydrological factors; it is compiled weekly by the Climate Prediction Center (CPC) of the NWS. The table below outlines the drought statuses caused by various PSDI values.[84]

Table 4.2.1-4 Palmer Drought Severity Index (PSDI)

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

[82] Pennsylvania Department of Environmental Protection (PA DEP). Drought Management in Pennsylvania. Retrieved 30 November 2011.
[83] Ibid
[84] Ibid

Extreme Drought	-4.0 or less	Emergency

Source: NDMC, 2009

According to the NDMC, no single index works for determining the magnitude of a drought. Therefore, NDMC developed the National Drought Monitor, a synthesis of multiple indices and impacts that represents a consensus of federal and academic scientists. The drought monitor combines numeric measures of drought and experts' best judgment into a weekly map. It is produced by the NDMC, the U.S. Department of Agriculture and NOAA and incorporates review from 300 climatologists, extension agents and others across the nation. The accompanying drought severity classification (Table 4.2.1-5) depicts the five drought indicators utilized to determine an areas drought severity.[85]

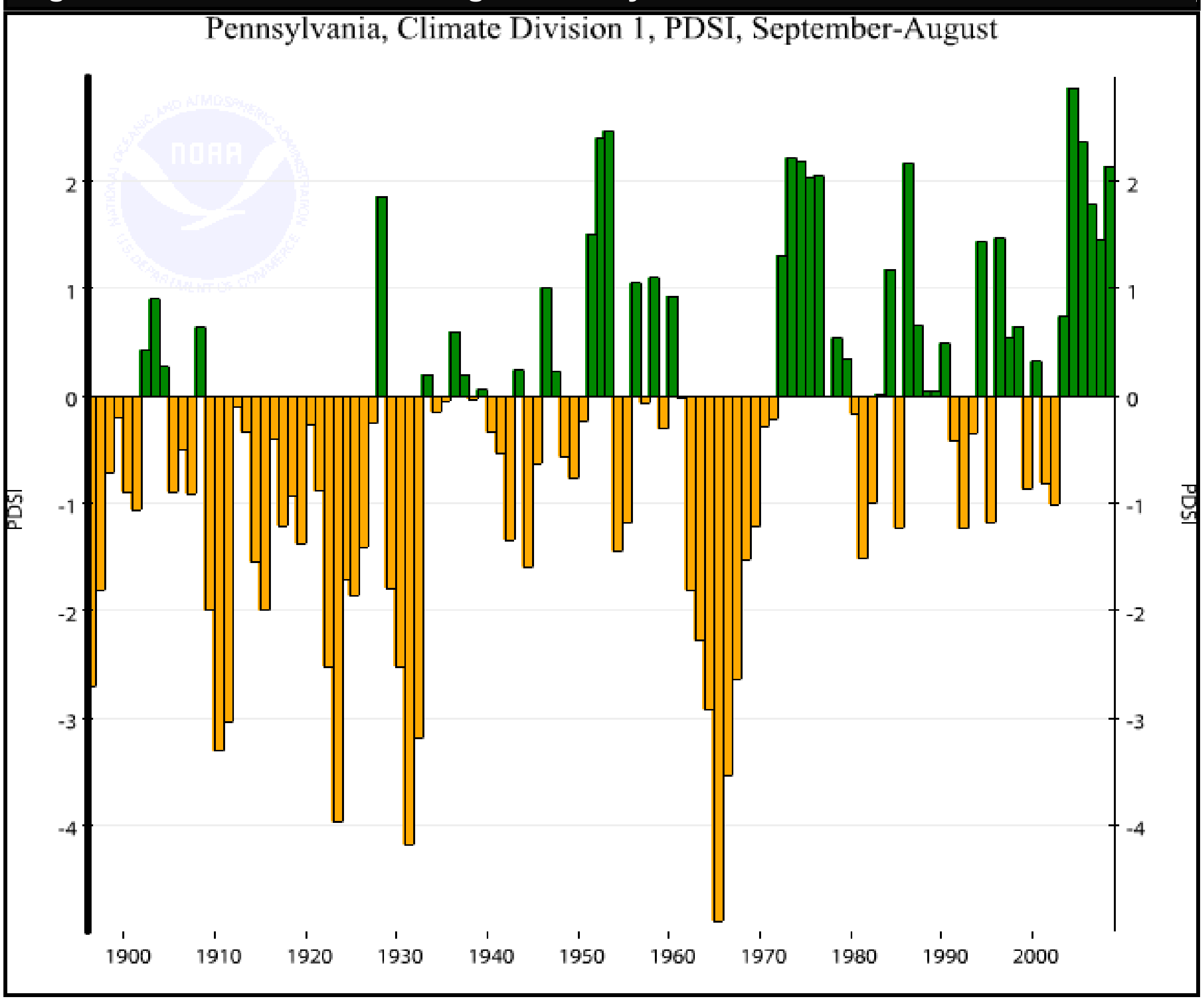
[85] National Drought Monitoring Center. Drought Severity Classification. Retrieved 30 November 2011.

Table 4.2.1-5		Drought Severity Classification					
		Ranges					
Category	**Description**	**Possible Impacts**	**Palmer Drought Index**	**CPC Soil Moisture Model (Percentiles)**	**USGS Weekly Streamflow (Percentiles)**	**Standardized Precipitation Index (SPI)**	**Objective Short and Long-term Drought Indicator Blends (Percentiles)**
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	21-30
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	11-20
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	6-10
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	3-5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	0-2

4.2.1.7 Past Occurrences

The earliest mention of drought in Philadelphia dates back to the Colonial times in 1762. Philadelphia's driest year, 1922, was at the center of a three-year drought from 1921 to 1923. Several months of extreme drought occurred between July 1929 and September 1932, which included the lowest PDSI value ever recorded in the Philadelphia area in January 1931. This drought coincided with the earlier years of the infamous Dust Bowl in Kansas, Oklahoma and Texas. Figure 4.2.1-6 depicts the PDSI for southeastern Pennsylvania from 1895 to 2011. Positive values of the PSDI indicate a moisture surplus; negative values indicate a moisture deficit. A PSDI value of -3 indicates severe drought, while +3 indicates a moisture spell.

Figure 4.2.1-6 Palmer Drought Severity Index from 1895-2011



Source: NCDC, 2011

A summary of declared drought statuses for Philadelphia between November, 1980 and September, 2011 is provided in Table 4.2.1-7. One Presidential and five Gubernatorial Declarations have been issued as a result of the drought emergencies identified below.

Table 4.2.1-7 Summary of Declared Drought Status from 1980-2011

Drought Phase	Date
Drought Watch	August 2011 – September 2011
	October 2007 – January 2008
	April 2006 – June 2006
	November 2001 – December 2001
	September 1999 – February 2000
	March 1999 – June 1999
	December 1998
	September 1992 – January 1993
	July 1988 – December 1988
Drought Warning	September 2010 – November 2010
	November 2002 – December 2002
	December 2001 – February 2002
	June 1999 – July 1999
	October 1997 – January 1998
	November 1995 – December 1995
	September 1995
	September 1991 – September 1992
	March 1989 – May 1989
	January 1985 – April 1985
	November 1982 – March 1983
Drought Emergency	September 2002 – November 2002
	February 2002 – June 2002
	July 1999 – September 1999
	September 1995 – November 1995
	April 1985 – December 1985
	November 1980 – April 1982

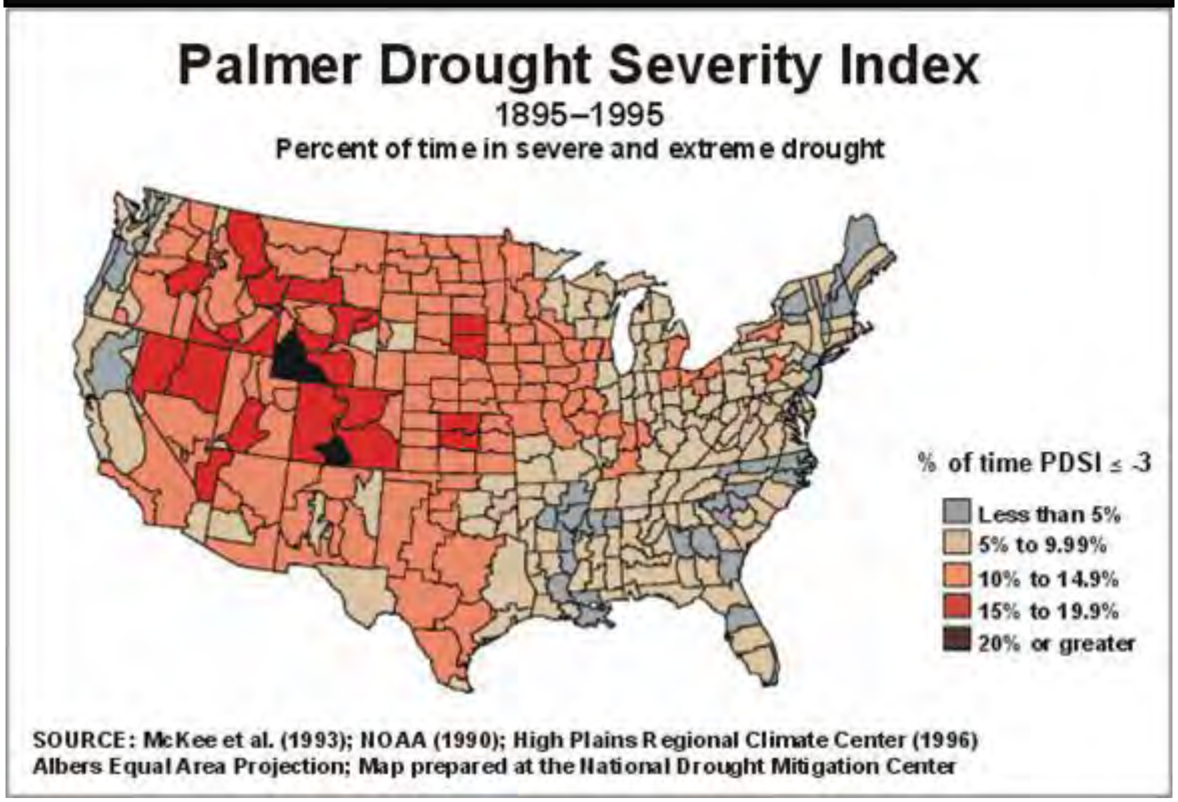
Totals	Total Drought Watches	Total Drought Warnings	Total Drought Emergencies
	9	**12**	**6**

Source: PADEP, 2011

4.2.1.8 Future Occurrences

It is difficult to forecast the severity and frequency of future drought events in Philadelphia. Occasional drought is a normal occurrence in virtually every climate in the United States. Based on national data from 1895 to 1995, Philadelphia experienced severe or extreme drought (equivalent to a PDSI value less than or equal to -3.0) approximately five to ten percent of the time over the hundred year span. Therefore, the future occurrence of drought in Philadelphia should be considered possible.

Figure 4.2.1-8 Percent of time in severe and extreme drought



Source: NDMC, 1996

4.2.1.9 Vulnerability Assessment

Impact to Philadelphia

The impact of a drought depends not only on its severity, duration, and spatial extent, but also on ever-changing social conditions. A wide-range of factors, both physical and social, determines vulnerability to drought.

Understanding both direct and indirect impacts is one of the most significant challenges in preparing for drought. Direct impacts of drought on Philadelphia include loss of revenue from businesses reliant on water, such as car washes, landscapers, and manufacturers. In a drought, water use restrictions may force businesses to suspend all or a portion of their activities. The indirect impacts associated with drought may be far-reaching, including increase in food prices, loss to recreational and tourism industry, and air quality affects. Table 4.2.1-9 indicates a more robust list of impacts associated with drought. Each one can directly or indirectly impact Philadelphia's economy, environment, and people.

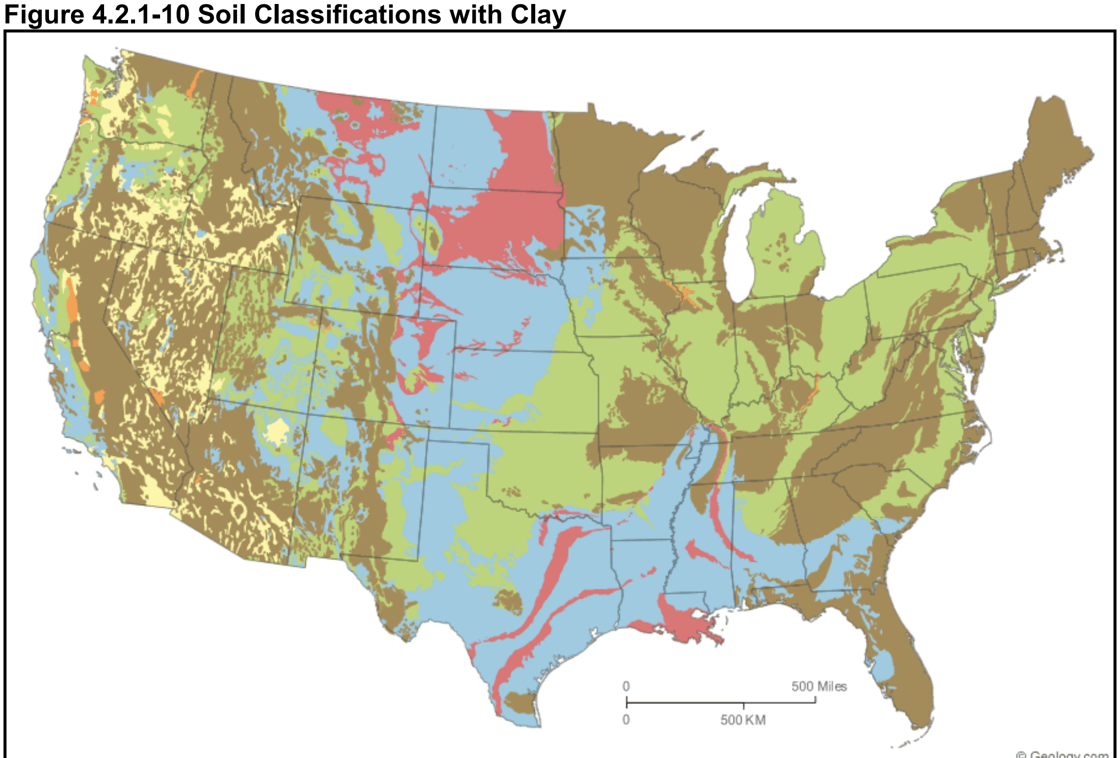
Table 4.2.1-9 Drought Impacts

Economy	Environment	People
• Damage to crops • Increase in food prices • Increase in transportation costs for food • Reduced dairy and livestock production • Increased fire hazard • Loss to recreational and tourism industry • Revenue loss to water-reliant businesses • Loss of hydro-electric power • Loss of navigability of rivers • Reduction of economic development	• Reduction and degradation of fish and wildlife habitat • Wind and water erosion of soils • Loss of wetlands • Increased number and severity of fires • Air quality effects • Damage to plant species, loss of biodiversity • Lower water in rivers, streams and reservoirs • Water quality effects (e.g.' salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)	• Food shortages • Public dissatisfaction with government • Loss in aesthetic values • Reduction or modification of recreational activities • Health issues related to use restrictions • Health issues related to lack of hygiene • Increased fire hazard • Mental and physical stress • Decrease in quality of life • Increased poverty • Population migrations

Drought has a varying effect on the quantity of drinking water in Philadelphia. The PWD has two drinking water treatment plants (Queen Lane and Belmont WTPs) on the Schuylkill River and one plant (Baxter WTP) on the Delaware River. The flow in the Delaware River is controlled during a drought by the Delaware River Basin Commission (DRBC). Releases from large reservoirs in the Delaware watershed keep the tidal flow and salt line from coming upstream to the Baxter plant's intake. While the quantity of water is protected, the quality of the water can have an impact on plant processes. The Schuylkill plants are less protected during a drought. While there are several reservoirs in the watershed, their releases are controlled by the Army Corps of Engineers. While Fairmont Dam protects the city's two water plants intakes from any tidal influence, deteriorating water quality due to low flow can become a serious enough issue to affect the quantity of water the plants can produce. For example, large algae blooms caused by low flow conditions can stress the processes at the plants and reduce finished water production. Also, sediment built up near Belmont WTP's raw water intake can limit flow into the plant during severe drought conditions. Fortunately the city's water conveyance system can partially redistribute the finished water in the city so that water quantity during a drought is less problematic. However, PWD is increasingly proactive in the watershed when the region suffers from drought.

Structural Vulnerability
In general, drought does not cause structural damage and does not affect infrastructure such as highways, bridges and buildings. A rare exception is severe soil shrinkage. Severe soil shrinkage compromises the foundation upon which the infrastructure stands. However as shown in Figure 4.2.1-10 below, Philadelphia is underlain by soils with little to no clays with high shrink/swelling potential; therefore, there is a very low risk of structural damage associated with drought.

Figure 4.2.1-10 Soil Classifications with Clay



	Over 50 percent of these areas are underlain by soils with abundant clays of high swelling potential.
	Less than 50 percent of these areas are underlain by soils with clays of high swelling potential.
	Over 50 percent of these areas are underlain by soils with abundant clays of slight to moderate swelling potential.

	Less than 50 percent of these areas are underlain by soils with abundant clays of slight to moderate swelling potential.
	These areas are underlain by soils with little to no clays with swelling potential.
	Data insufficient to indicate the clay content or the swelling potential of soils.
The map above is based upon "Swelling Clays Map of the Conterminous United States" by W. Olive, A. Chleborad, C. Frahme, J. Shlocker, R. Schneider and R. Schuster. It was published in 1989 as Map I-1940 in the USGS Miscellaneous Investigations Series.	

Loss Estimate
Although potential direct and indirect impacts are detailed above, accurate loss estimates for drought are not available. Reduced water levels and subsequent curtailment of water usage will have a direct economic impact on businesses and industries that are water-dependent. The indirect impacts associated with drought are far-reaching but so diffuse that financial estimates of potential damages are not feasible.

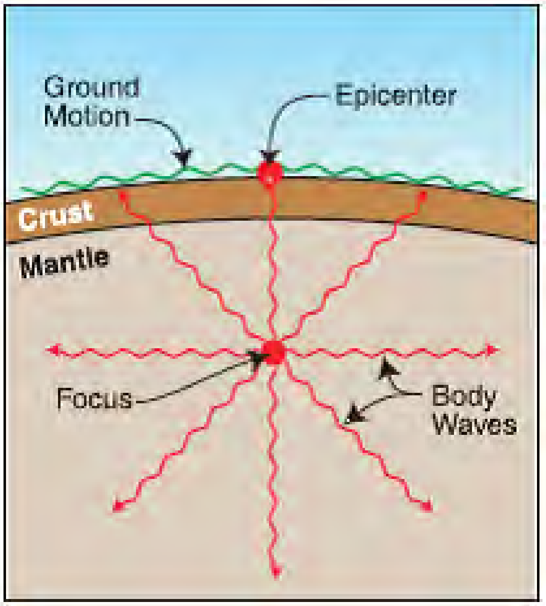
4.2.2 Earthquake

4.2.2.1 Description

An earthquake is defined as a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.[86] The severity of these effects is dependent on the amount of energy released from the fault or epicenter. Figure 4.2.2-1 is a definition sketch for an earthquake. In this sketch the focus is the point within the earth where an earthquake rupture starts; the epicenter is the point directly above the focus at the surface of the earth; and a body wave is a seismic wave that moves through the interior of the earth, as opposed to surface waves that travel near the earth's surface.[87]

[86] Federal Emergency Management Agency (FEMA). FEMA 386-2, Understanding Your Risks, Identifying Hazards and Estimating Losses. Retrieved 17 November 2011.
[87] United States Geological Survey (USGS). Earthquake Glossary. Retrieved 23 January 2012.

Figure 4.2.2-1: Earthquake Description



Source: FEMA, 2001

According to the USGS Earthquake Hazards Program, more than 90% of earthquakes occur at boundaries where the earth's tectonic plates converge, though it is possible for earthquakes to occur within plates. As plates continue to move and plate boundaries change over geologic time, weakened boundary regions become part of the interior of the plates. These zones of weakness within the continents cause earthquakes in response to stresses that originate at the edges of the plate or in the deeper crust.[88]

4.2.2.2 Location

Philadelphia is located within the North American plate, far from the plate boundary located approximately 2,000 miles east in the Atlantic Ocean. However, due to zones of weakness or deep fault lines, within the North American plate, earthquakes are a possible hazard within Philadelphia.

East of the Rocky Mountains earthquake faults do no break the ground surface. Their focuses are a few miles below the Earth's surface and their locations are determined by interpreting seismographic records. The closest fault to Philadelphia is the Ramapo Fault which is part of a system of north-east striking, southeast-dipping faults, which are mapped from southeastern New York to eastern Pennsylvania and beyond. These faults were active at different times during the evolution of the Appalachians approximately 200 million years ago.[89]

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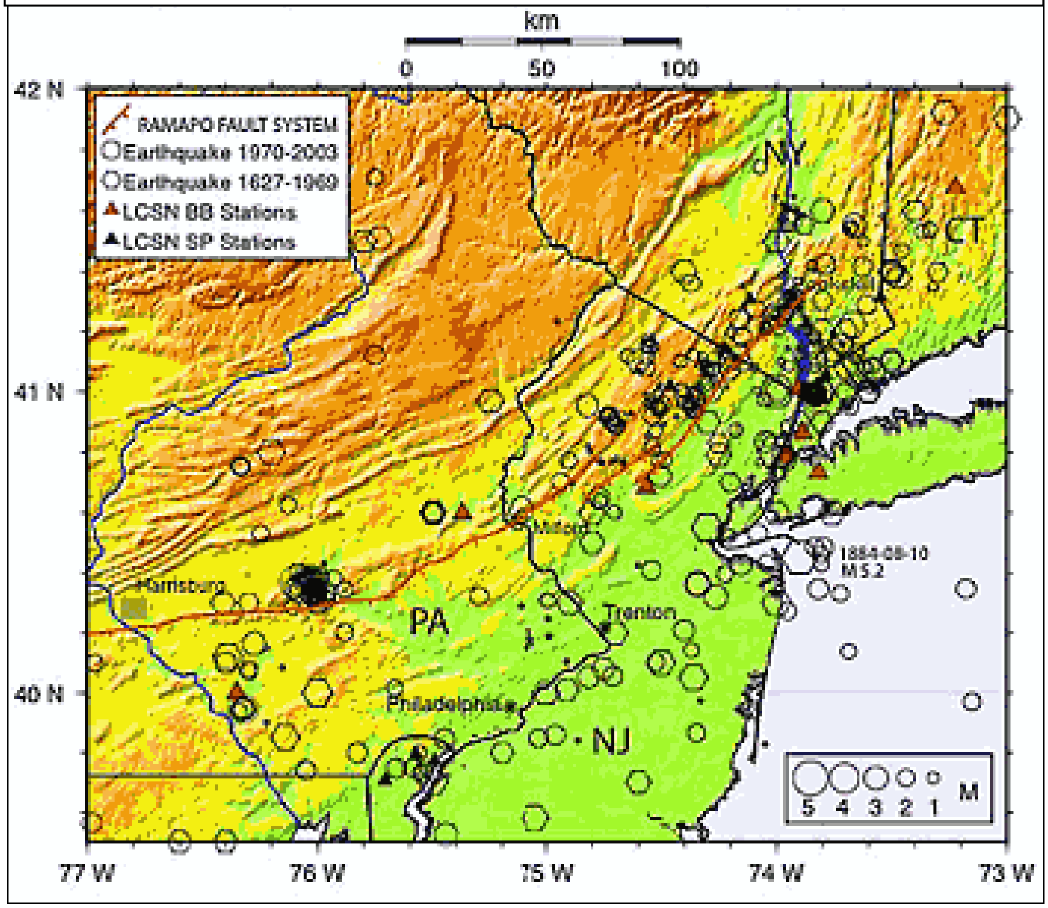
[88] United States Geological Survey (USGS). Earthquakes and Plate Tectonics. Retrieved 15 November 2011.
[89] Columbia University. Earthquakes and the Ramapo Fault System in Southeastern New York. Retrieved 21 February 2012.

Figure 4.2.2-2 depicts the epicenters of earthquakes occurring between 1627 and 2003 in New York, New Jersey and Pennsylvania. Historical earthquakes and other events prior to 1970 are plotted with "hexagons", whereas earthquakes that have occurred since 1970 – when systematic earthquake monitoring began in the region – are plotted with "circles". The symbol size is proportional to magnitude. The Ramapo Fault System is shown as a red line.

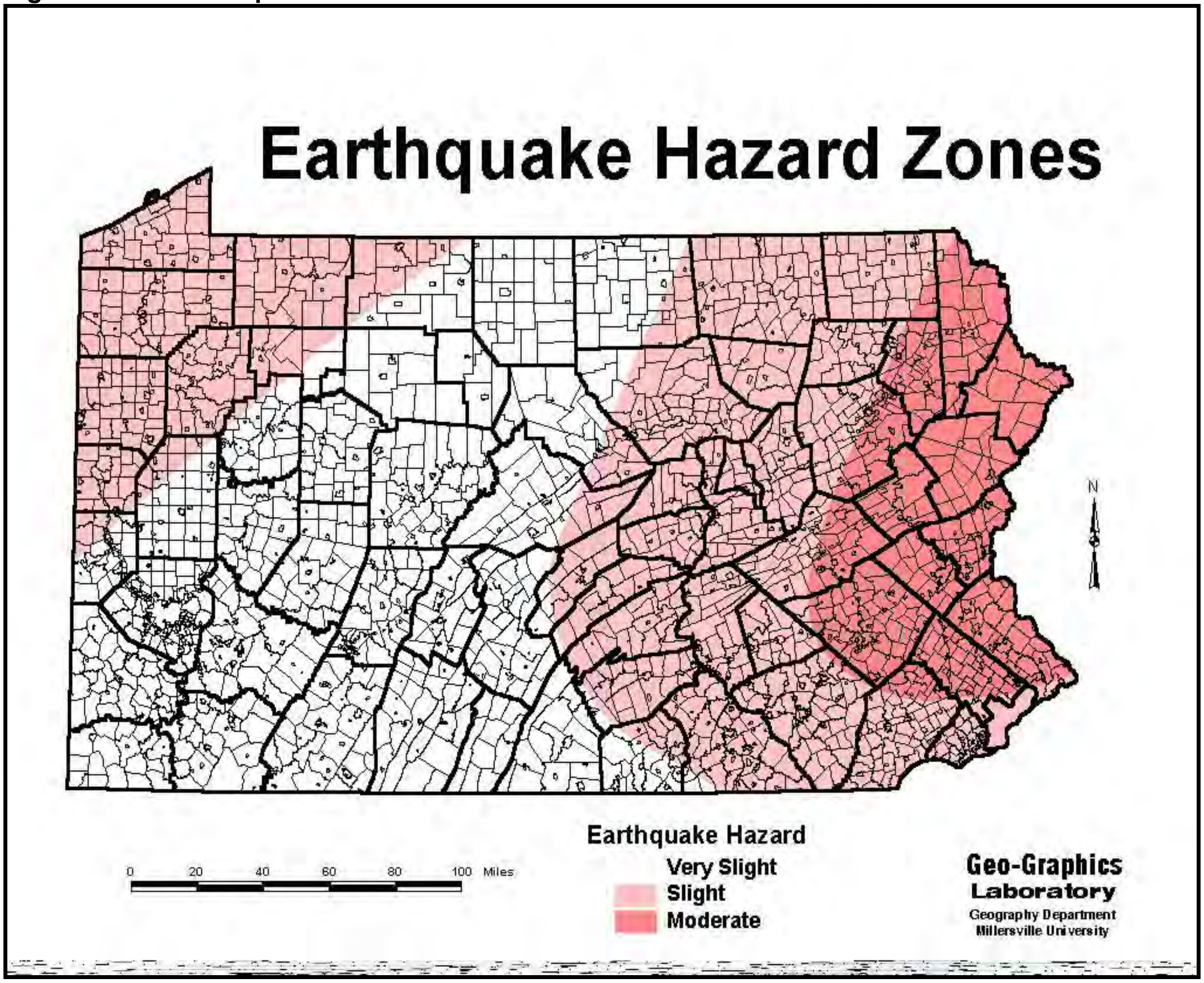
Figure 4.2.2-2: Ramapo Fault



Source: Columbia University, 2004

Figure 4.2.2-3 shows earthquake hazard zones in Pennsylvania. According to the Pennsylvania 2010 HMP, Philadelphia is located within a slight earthquake hazard zone.

Figure 4.2.2-3 Earthquake Hazard Zones



Source: Pennsylvania HMP, 2010

Soil type can have a great impact on the severity of an earthquake at a given location because some rocks types transmit seismic wave energy more readily. Seismic waves propagate out from the earthquake epicenter and travel outward through the bedrock up into the soil layers. A soil's firmness affects the wave speed and velocity. Generally, in a stiff or hard soil, the wave will travel at a higher velocity. With soft soils, the wave will slow, traveling at lower velocities. Slower waves modify the seismic energy, resulting in waves with greater amplitude, which results in greater earthquake damage. Some soils can also become liquefied when saturated.[90] When liquefaction[91] occurs, the strength of the soil decreases and, the ability of a soil to support structural foundations is reduced.

[90] The Encyclopedia of Earth. Earthquake. Retrieved 16 November 2011.

[91] The transformation of loose sediment or soil into a fluid state as a result of increasing the pressure of the fluid in between the grains due to strong ground shaking. Liquefaction typically occurs in poorly consolidated, water-saturated sediment. Liquefaction can cause significant earthquake-related damage because structures located on ground that liquefies can collapse or sink into the ground

The National Earthquake Hazard Reduction Program (NEHRP) Soil Classification System describes how soils affect seismic waves. The soil classification system ranges from A to E, where A represents hard rock that reduces ground motions from an earthquake and E represents soft soils that amplify and magnify ground shaking and increase building damage and losses.[92]

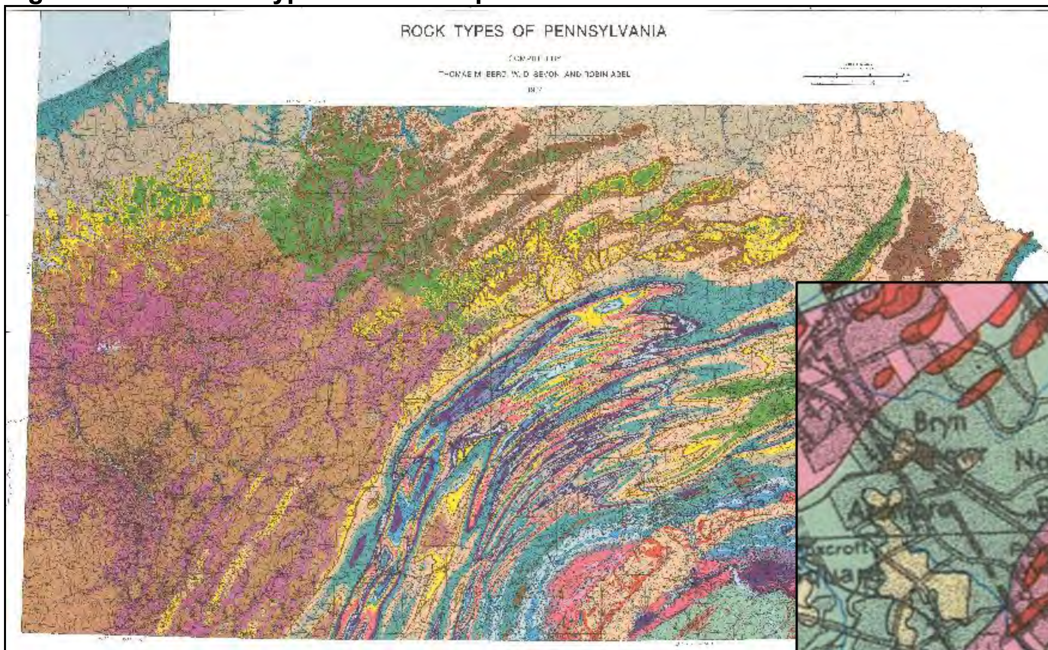
Table 4.2.2-4 NEHRP Soil Classifications

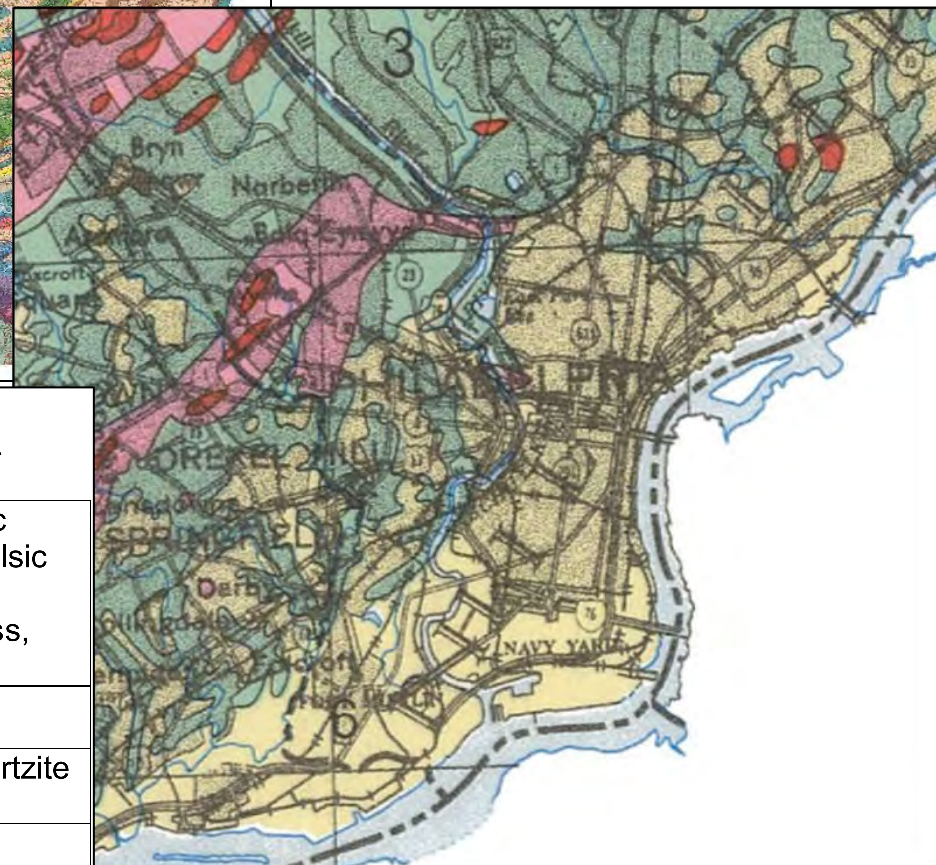
Soil Classification	Description
A	Very hard rock (e.g., granite, gneisses)
B	Sedimentary rock or firm ground
C	Stiff clay
D	Soft to medium clays or sands
E	Soft soil including fill, loose sand, waterfront, lake bed clays

As shown in Figure 4.2.2-5, depending on its geographic location Philadelphia has a variety of soil types, including siltstone, shale, sandstone, limestone, claystone, coal, granite, phyllite, etc. Most of Philadelphia is classified as Class D (soft to medium clays or sands), and Class B (sedimentary rock or firm ground), with small amounts of Class A (very hard rock), and Class E (Soft soils).

[92] Federal Emergency Management Agency. FEMA Region II Hazard Mitigation Plan Toolkit: Risk Assessment. Retrieved 12 November 2011.

Figure 4.2.2-5 Rock Types of Philadelphia





Rock Types of Philadelphia

(light red)	Light colored (acid) igneous and metamorphic rocks. Includes granite and granite gneiss, felsic gneiss, granodiorite and granodiorite gneiss, quartz monzonite and quartz monzonite gneiss, anorthosite and metarhyolite.
(dark red)	Quartzite
(green)	Schist, including minor amount of gneiss, quartzite and phyllite.
(tan)	Shale or siltstone and minor amounts of sandstone.
(yellow)	Unconsolidated sediments. Includes coastal-plain deposits, Delaware River gravel and sand.

4.2.2.3 Range of Magnitude

Though magnitude and intensity measure different characteristics of earthquakes, both describe the overall severity. Magnitude measures the energy released at the source of the earthquake and is determined by measurements on seismographs. Intensity measures the strength of shaking produced by the earthquake at a certain location.[93] Moreover, intensity takes into consideration the effects earthquakes have on people, human structures, and the natural environment. The severity of an earthquake depends on the amount of energy released at the epicenter, the distance from the epicenter, and the underlying soil type.

The Richter scale, an open-ended logarithmic scale, measures the magnitude of earthquakes. Since it is logarithmic, each higher number on the Richter scale represents a tenfold increase in the magnitude of the tremors, and a thirty-fold increase in the energy released. A two-point quake is barely noticeable, a five may cause minor damage, a seven is considered severe, and an eight is a violent quake. Table 4.2.2-6 summarizes the Richter scale magnitudes as they relate to spatial extent of impacted areas. The PA 2010 HMP states that based on historical data, earthquakes in Pennsylvania do not exceed magnitudes greater than 6.0.

Table 4.2.2-6 Richter Scale Magnitudes & Associated Effects

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally not felt, but recorded
3.5 - 5.4	Often felt, but rarely causes damage
5.5 - 6.0	At most, slight damage to well-designed buildings; can cause major damage to poorly constructed buildings over small regions
6.1 - 6.9	Can be destructive in areas where people live up to about 100 kilometers across
7.0 - 7.9	Major earthquake; can cause serious damage over large areas
8.0 or greater	Great earthquake; can cause serious damage in areas several hundred kilometers across

Source: PA 2010 HMP

Although it can be inferred that higher magnitude events cause more damage, the Richter scale does not give any real indication of the impact or damage of an earthquake. Instead, the impact of an earthquake event is measured in terms of

[93] United States Geological Survey (USGS). Earthquake Hazard Program: Earthquake Facts. Retrieved 15 November 2011.

earthquake intensity, usually measured using the Modified Mercalli Intensity (MMI) scale. Table 4.2.2-7 summarizes earthquake intensity as expressed by the MMI scale.

Table 4.2.2-7 Modified Mercalli Intensity (MMI) scale

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only seismographs	<4.2
II	Feeble	Some people feel it	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	<4.2
IV	Moderate	Felt by people walking	<4.2
V	Slightly Strong	Sleepers awake; church bells ring	<4.8
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves	<5.4
VII	Very Strong	Mild alarm, walls crack, plaster falls	<6.1
VIII	Destructive	Moving cars uncontrollable, masonry fractures, poorly constructed building damaged	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open	<6.9
X	Disastrous	Ground cracks profusely, many building destroyed, liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed, general triggering of other hazards	<8.1

XII	Catastrophic	Total destruction, trees fall, ground rises and falls in waves	>8.1

Source(s): Michigan Tech University, 2007; Nevada Seismological Laboratory, 1996

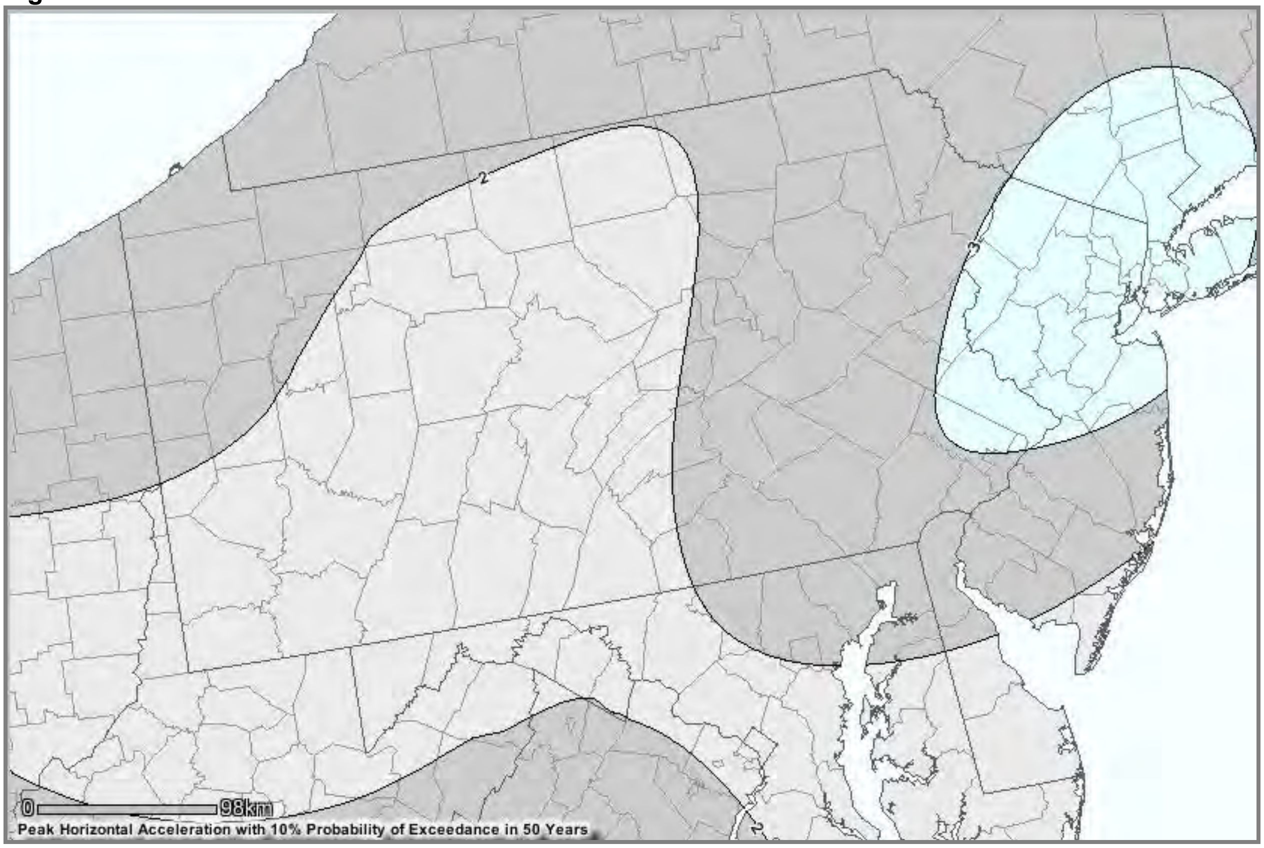
USGS expresses seismic hazards in terms of how much the ground shakes, or Peak Ground Acceleration (PGA), and what a building experiences, known as Spectral Acceleration (SA). Both PGA and SA can be measured in *g* (the acceleration of gravity) or expressed as a percent acceleration force of gravity (%*g*). [94]

PGA is a common earthquake measurement that identifies: the geographic area affected; the probability of an earthquake of each given level of severity; and the strength of ground movement (severity) expressed in terms of %*g*. In other words, PGA expresses the severity of an earthquake and is a measure of how hard the earth shakes or accelerates in a given geographic area.

Figure 4.2.2-8 illustrates a probabilistic hazard map. The map shows contours, which represent earthquake ground motions that have a one percent probability of being experienced over a 50-year period. PGA values ranging from two percent (identified in blue/gray) to four (identified in blue/gray) percent have the potential to occur within Philadelphia.

[94] United States Geological Survey. What do the ground-motion parameters on these maps mean? Retrieved 1 December 2011.

Figure 4.2.2-8 PGA



Source: USGS, 2011

Table 4.2.2-9 portrays an approximated relationship between MMI and PGA. In the example provided above, the 2 percent to 4 percent PGA predicted would result in an MMI intensity of IV (light perceived shaking and no damage) to V (a light to moderate shaking with very light damage).

Table 4.2.2-9	MMI and PGA Equivalents		
MMI	**Acceleration (%g) (PGA)**	**Perceived Shaking**	**Potential Damage**
I	<.17	Not Felt	None
II	.17-1.4	Weak	None
III	.17-1.4	Weak	None
IV	1.4-3.9	Light	None
V	3.9-9.2	Moderate	Very Light
VI	9.2-18	Strong	Light
VII	18-34	Very Strong	Moderate

VIII	34-65	Severe	Moderate to Heavy
IX	65-124	Violent	Heavy
X	>124	Extreme	Very Heavy
XI	>124	Extreme	Very Heavy
XII	>124	Extreme	Very Heavy

SA determines approximately what a building experiences during an earthquake, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building, and is a better indicator of damage for specific building types and heights than PGA.[95]

4.2.2.4 Past Occurrences

Based on seismic records, thousands of earthquakes have occurred in Pennsylvania over the past centuries. Table 4.2.2-10 shows past earthquakes with epicenters in or around Southeast Pennsylvania. It also includes the magnitude and intensity of each earthquake.

Table 4.2.2-10 Catalog of Earthquakes with Epicenters in or around Southeast Pennsylvania (Philadelphia epicenters indicated in bold)

Date	Location	Magnitude	Intensity
5/27/2011	**Philadelphia, PA**	**1.7**	**I**
7/27/1999	Warwick, PA	N/A	N/A
5/31/1999	Columbus, NJ	2.3	N/A
10/27/1998	Centerville, DE	1.5	II
3/25/1998	Salem, NJ	1.9	N/A
3/19/1998	Wilmington, DE	1.7	I-II
3/15/1998	Wilmington, DE	1.8	III
4/16/1997	Talleyville, DE	1.6	III-IV
3/11/1997	Pineville, PA	1.6	N/A
1/29/1997	Wilmington, DE	1.4	II
10/17/1996	Nottingham, PA	2.2	N/A
7/5/1996	Glen Mills, PA	2.6	N/A
6/23/1996	Wilmington, DE	1.7	I-II
6/14/1996	Wilmington, DE	2.1	II-III
12/20/1995	Wilmington, DE	1.4	I-II

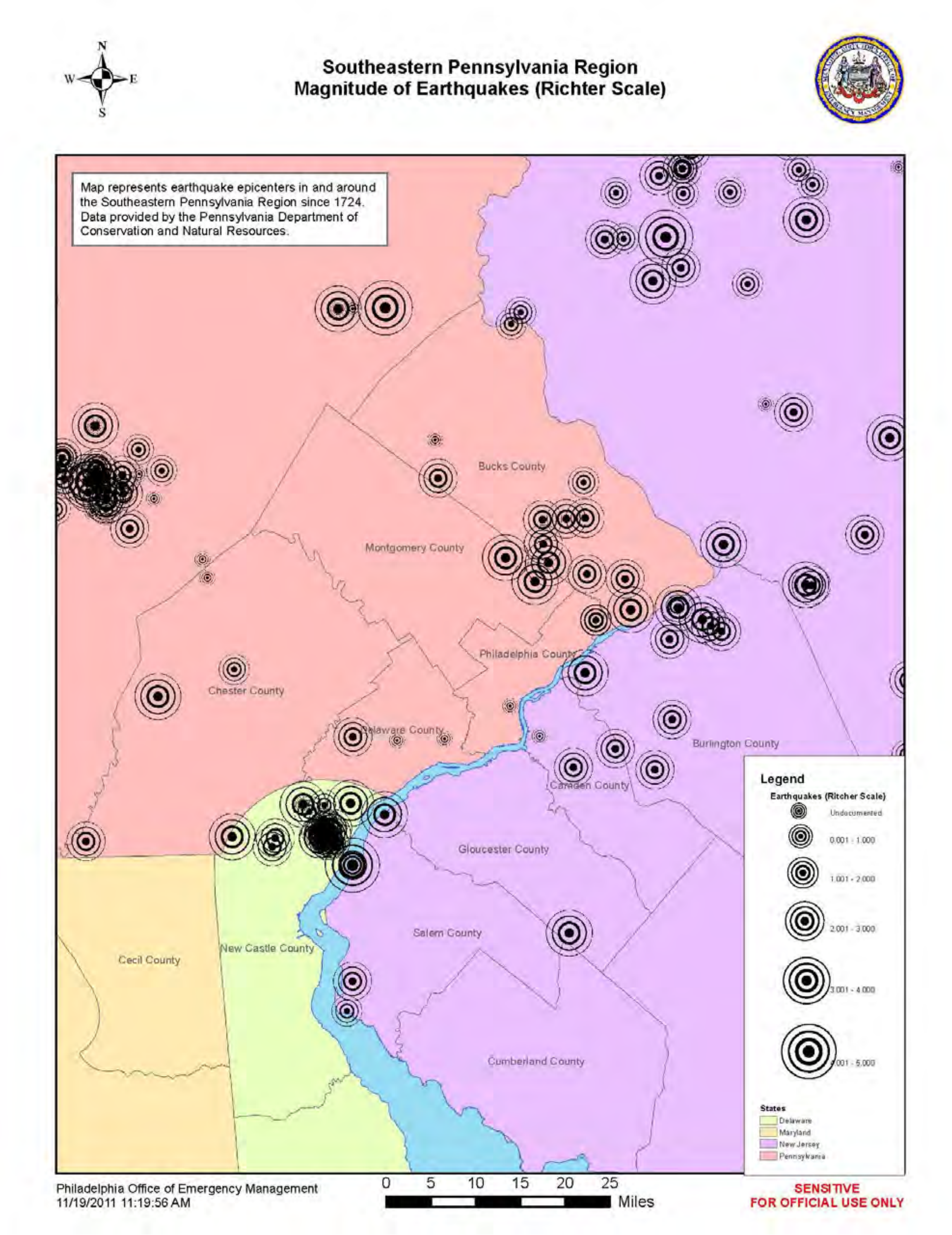
[95] Ibid

10/17/1995	Wilmington, DE	2	II
4/23/1994	Wilmington, DE	2	I-II
2/11/1994	Wilmington, DE	1.9	I
11/8/1993	Wilmington, DE	1.7	I-II
2/26/1993	Haddonfield, NJ	2.5	IV
5/15/1992	Milford, PA	1.6	N/A
9/29/1991	Magnolia, NJ	2.2	N/A
10/23/1990	Salem, NJ	2.9	V
3/30/1990	Downingtown, PA	1.8	N/A
2/2/1989	Perkasie, PA	N/A	N/A
12/6/1987	Columbus, NJ	2.1	N/A
9/15/1986	Roebling, NJ	1.9	N/A
5/2/1986	Wilmington, DE	2.5	N/A
10/20/1985	Wilmington, DE	1.7	III-IV
10/11/1985	Wilmington, DE	1.9	III-IV
10/20/1984	Wilmington, DE	1.7	III-IV
5/10/1984	Hatfield, PA	2.2	N/A
2/15/1984	Wilmington, DE	1.5	I-II
1/20/1984	Wilmington, DE	1.8	I-II
1/19/1984	Wilmington, DE	2.5	IV
12/12/1983	Wilmington, DE	2.4	IV
11/17/1983	Wilmington, DE	2.9	V
5/12/1982	Penndel, PA	2.4	II
4/12/1982	Burlington, NJ	2.8	V
8/30/1980	Medford, NJ	3	N/A
5/2/1980	Abington, PA	2.8	N/A
3/11/1980	Abington, PA	2.8	N/A
3/5/1980	Abington, PA	3.5	IV
3/2/1980	Abington, PA	2.8	N/A
2/10/1977	Wilmington, DE	2.6	VI
3/11/1975	Wilmington, DE	2	VI
4/28/1974	Centerville, DE	3.3	IV
7/10/1973	Newark, DE	3.3	IV
2/28/1973	Penns Grove, NJ	3.8	V-VI
11/29/1972	Wilmington, DE	N/A	III-IV
11/27/1972	Wilmington, DE	2.4	III-IV

11/26/1972	Wilmington, DE	2.4	III-IV
8/14/1972	Wilmington, DE	3.3	IV
2/11/1972	Wilmington, DE	3.2	V
1/23/1972	Wilmington, DE	2.4	IV
1/22/1972	Wilmington, DE	2.4	IV
1/7/1972	Wilmington, DE	2.4	IV
1/3/1972	Wilmington, DE	2.4	IV
1/2/1972	Wilmington, DE	2.4	IV
12/29/1971	Wilmington, DE	3.3	IV
7/14/1971	Wilmington, DE	3.3	IV
12/10/1968	Medford, NJ	3	V
12/27/1961	Croyden Heights, PA	3.3	V
1/8/1944	Bellefonte, DE	3.2	V
11/15/1939	Folsom, NJ	3.8	V
12/3/1937	Deepwater, NJ	2.8	IV-V
1/26/1926	Cinnaminson, NJ	3.5	N/A
1/26/1921	Cinnaminson, NJ	3.3	V
4/29/1900	Gloucester City, NJ	N/A	IV
11/20/1895	Centerville, DE	N/A	IV
9/10/1877	Roebling, NJ	3.2	IV
10/10/1871	Deepwater, NJ	N/A	IV
10/9/1871	Deepwater, NJ	4.1	VII
2/10/1857	Columbus, NJ	3.1	N/A
<1840	**Philadelphia, PA**	**N/A**	**I**
11/23/1777	Darby, PA	N/A	III
3/22/1763	Darby, PA	N/A	III
12/17/1752	Sadsburyville, PA	3.6	IV
12/8/1737	Media, PA	N/A	IV

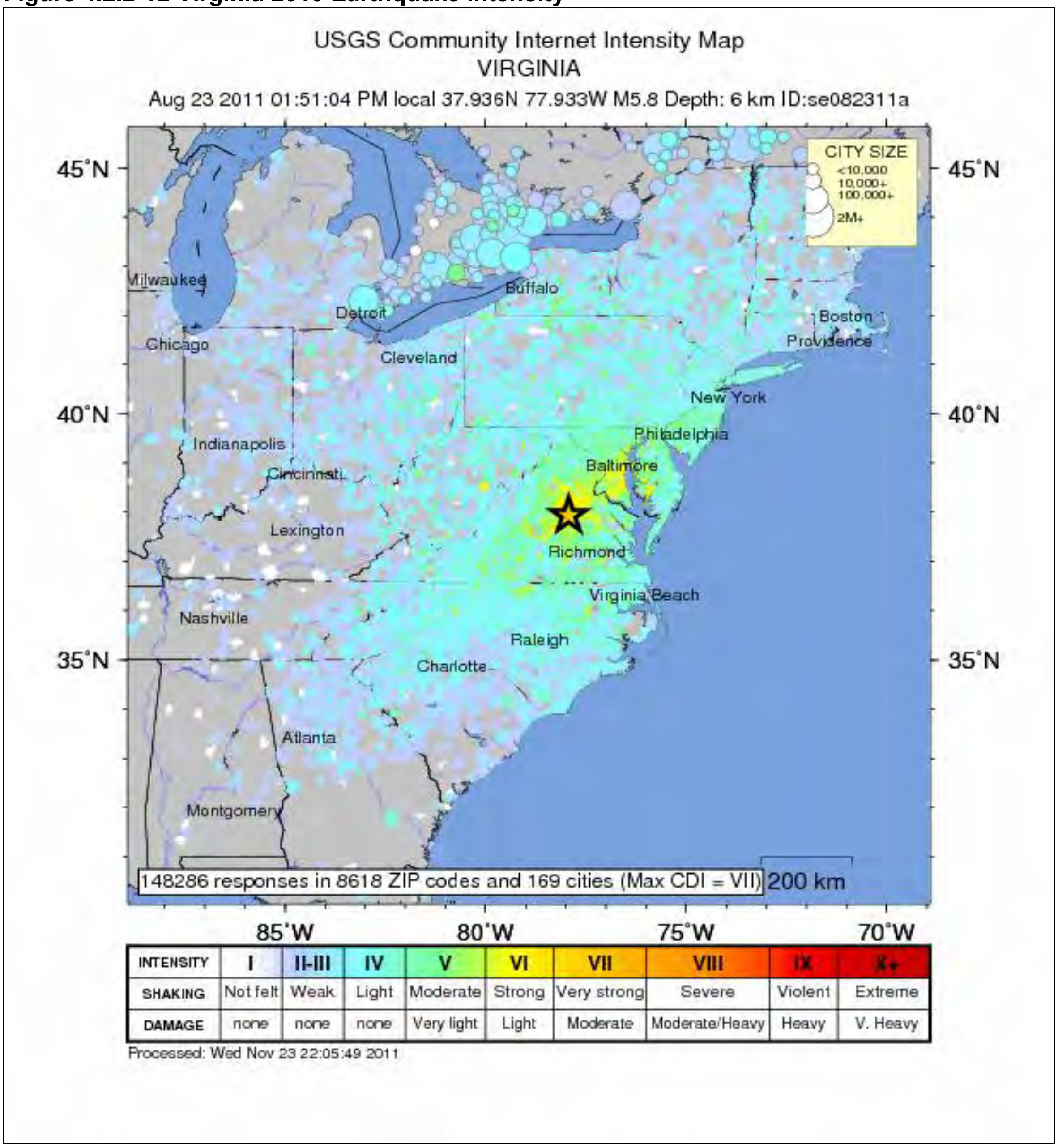
Source: Pennsylvania Bureau of Topographic and Geologic Survey, Department of Conservation and Natural Resources, 2011

Figure 4.2.2-11 Past Earthquakes



The epicenter of an earthquake does not need to be within a close distance of Philadelphia for the city to experience its effects. On August 23, 2011 a magnitude 5.8 earthquake centered northwest of Richmond, VA shook most of the East Coast, including Philadelphia. Numerous buildings in Center City Philadelphia were evacuated as a precaution (this is not the recommended course of action during an earthquake; see Appendix J for Earthquake Safety Tips) and many people around the region reported feeling structures shake. Figure 4.2.2-12 depicts the intensity of the August 23, 2011earthquake.

Figure 4.2.2-12 Virginia 2010 Earthquake Intensity



Source: USGS, 2011

4.2.2.5 Future Occurrences

Though the Eastern United States experiences far fewer moderate or large magnitude earthquakes than the Pacific Coast, which sits directly on an active tectonic plate boundary, this does not mean the area is immune to such a hazard. A few very large and very damaging earthquakes have occurred in stable continental regions like the one Philadelphia lies within. One of the most significant and destructive examples of this is the magnitude 7.3 earthquake which occurred in Charleston, South Carolina, in 1886. Therefore, it would be unwise to say that no earthquakes larger than the ones previously experienced could occur in Philadelphia. Table 4.2.2-13 illustrates probabilities associated with higher magnitude earthquakes in or around 50 km of Philadelphia.

Table 4.2.2-13 Earthquake Probability Within the Next 100yr
(50 km vicinity of Philadelphia)

Magnitude	Probability	Magnitude	Probability
5.0	2.957%	6.4	0.342%
5.1	2.402%	6.5	0.269%
5.2	2.402%	6.6	0.229%
5.3	1.954%	6.7	0.208%
5.4	1.592%	6.8	0.153%
5.5	1.301%	6.9	0.123%
5.6	1.209%	7.0	0.106%
5.7	0.992%	7.1	0.067%
5.8	0.877%	7.2	0.046%
5.9	0.725%	7.3	0.035%
6.0	0.677%	7.4	0.015%
6.1	0.545%	7.5	0.002%
6.2	0.472%	7.6	0.001%
6.3	0.373%		

Source: USGS, 2009

4.2.2.6 Vulnerability Assessment

Impact to Philadelphia

The infrequency of major earthquakes, coupled with relatively low magnitude events in the past, has led Philadelphia to be perceived as not being vulnerable to a damaging earthquake. However, as indicated within this hazard analysis, Philadelphia could be affected by a high magnitude earthquake, which would cause significant financial losses, casualties and disruptions in critical facilities and services within the City.

The following is a list of impacts, associated with a major earthquake event. Each one directly or indirectly affects Philadelphia's economy, environment and people if an earthquake were to occur locally.

Table 4.2.2-14	Earthquake Impacts	
Economy	**Environment**	**People**
• Damage/destruction of infrastructure • Disruption of transportation systems • Disruption of communication systems • Disruption of utility systems • Disruption of marketing systems • Loss of business • Loss of industrial output • Higher insurance premiums • Increased fire hazard • Loss to tourism industry • Reduction of economic development	• Induced flooding • Landslides/Mudslides • Poor water quality • Damage to vegetation • Breakage in sewage or toxic material containments • Breakage of gas mains • Breakage of water mains • Soil liquefaction • Increased fire hazard	• Loss of life, livelihoods, property • Loss of housing • Decrease in quality of life • Break down of social order • Disease • Lack of basic necessities • Increased fire hazard • Loss in aesthetic values • Increased poverty

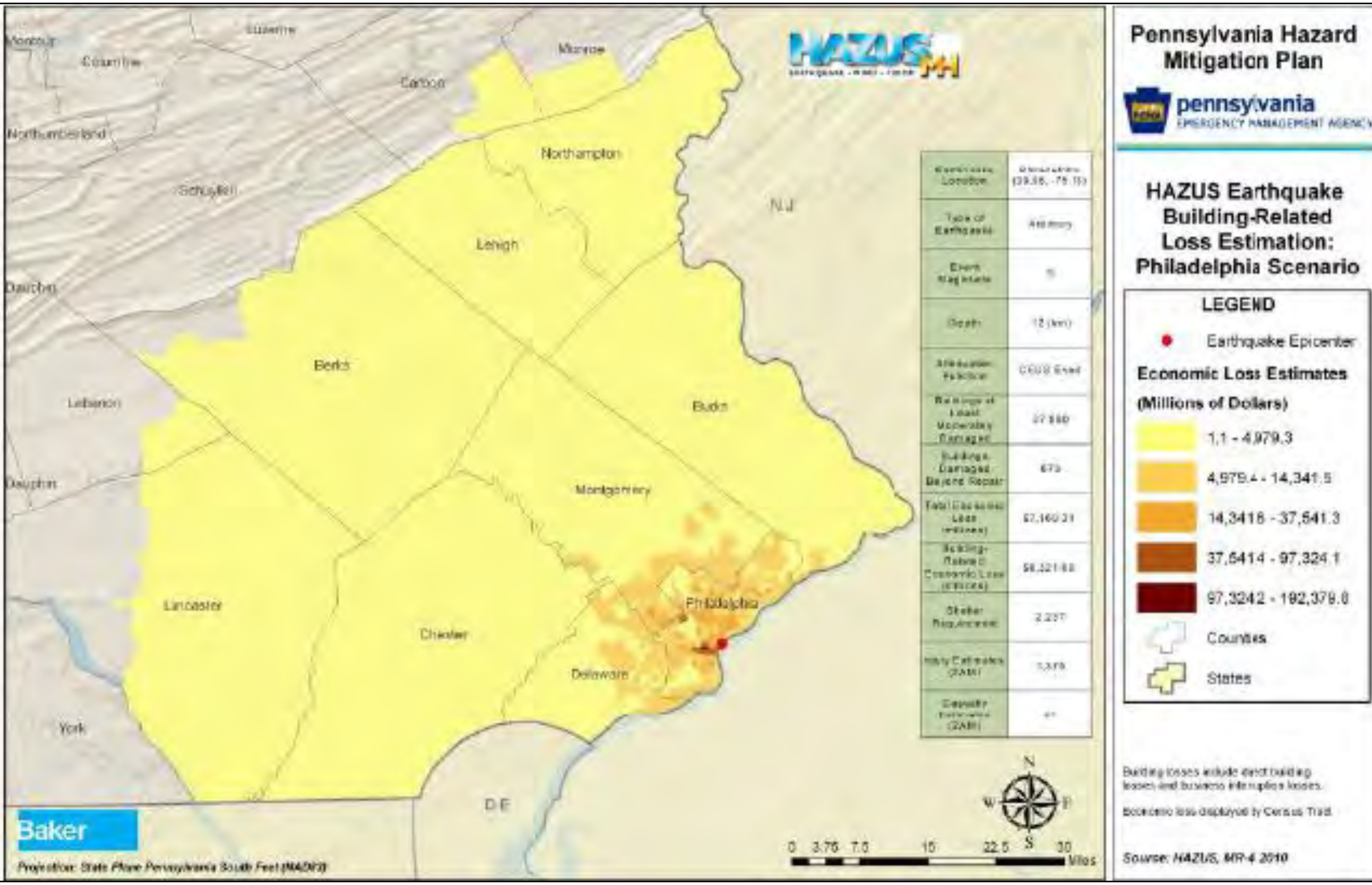
Data and Methodology
Table 4.2.2-14 summarizes earthquake losses for Philadelphia predicted by HAZUS as outlined in the PA 2010 HMP. (HAZUS is detailed further in Section 4.3.3.1 of this plan) The data depicts that an arbitrary earthquake event (Magnitude 5) would result in over $7 billion in economic loss and nearly 40,000 buildings experiencing at least moderate damage.

Table 4.2.2-15	Earthquake Impacts
Event Name	Philadelphia
Buildings at Least Moderately Damaged	37,980
Buildings Damaged Beyond Repair	873
Total Economic Loss (Millions)	$7,169.31
Building - Related to Economic Loss	$6,321.69

(Millions)	
Shelter Requirement	2,237
Injury Estimates (2AM)	1,375
Casualty Estimates (2AM)	41

Figure 4.2.2-16 shows the distribution of potential total economic losses for the HAZUS scenario. According to the HAZUS model, the densely populated area of Center City Philadelphia would incur the largest economic losses.

Figure 4.2.2-16: HAZUS Earthquake Building-Related Loss Estimation: Philadelphia Scenario



4.2.3 Extreme Temperatures

4.2.3.1 Hazard Description

Extreme temperatures, both cold and hot have a significant impact on human health and infrastructure. Weather conditions that represent extreme cold or heat are not uniform throughout the United States. These conditions vary depending on topography and climate. Sections 2.13-2.14 of the Community Profile provide more information for the climate and topography specific to Philadelphia.

Extreme Heat

As defined by the Center for Disease Control and Prevention (CDC), extreme heat is when summertime temperatures hover 10 degrees or more above the average high temperature for a region and last for several weeks. The NWS defines a heat wave as a period of at least three days when the temperature reaches 90 degrees or higher. A heat wave is applied both to routine weather variations and to extraordinary spells of heat, which may occur only once a century. Individuals exposed to extreme heat for a prolonged time may experience serious health problems including heat cramps, heat stroke, heat exhaustion, and death. Seniors, young children, and those who have respiratory problems, or are overweight are more likely to succumb to extreme heat than others.[96]

Extreme Cold

Extreme cold events are days where the mean daily temperature, the average between the high-recorded temperature and the low-recorded temperature over a 24-hour period, falls below 32°F. In Philadelphia, extremely cold temperatures typically accompany a winter storm, often bringing snow and ice. Prolonged exposure to cold temperatures, whether indoors or outside, can lead to serious or life-threatening health problems such as hypothermia, cold stress, frostbite or freezing of the exposed extremities such as fingers, toes, nose and ear lobes. Extreme cold can cause emergencies in susceptible populations, including those without shelter or who are stranded, or those who live in a home that is poorly insulated or without heat. Infants and the elderly are particular at risk, but anyone can be affected.[97]

4.2.3.2 Location

Located in such close proximity to the Atlantic Ocean, Philadelphia generally has warm summers and mild winters (for more information on Philadelphia's climate see Section 2.1.4). However, extreme temperature occurrences throughout the City are not uncommon. Philadelphia is subject to both extreme heat and extreme cold in the summer and winter months. Extreme cold artic air masses can move down from

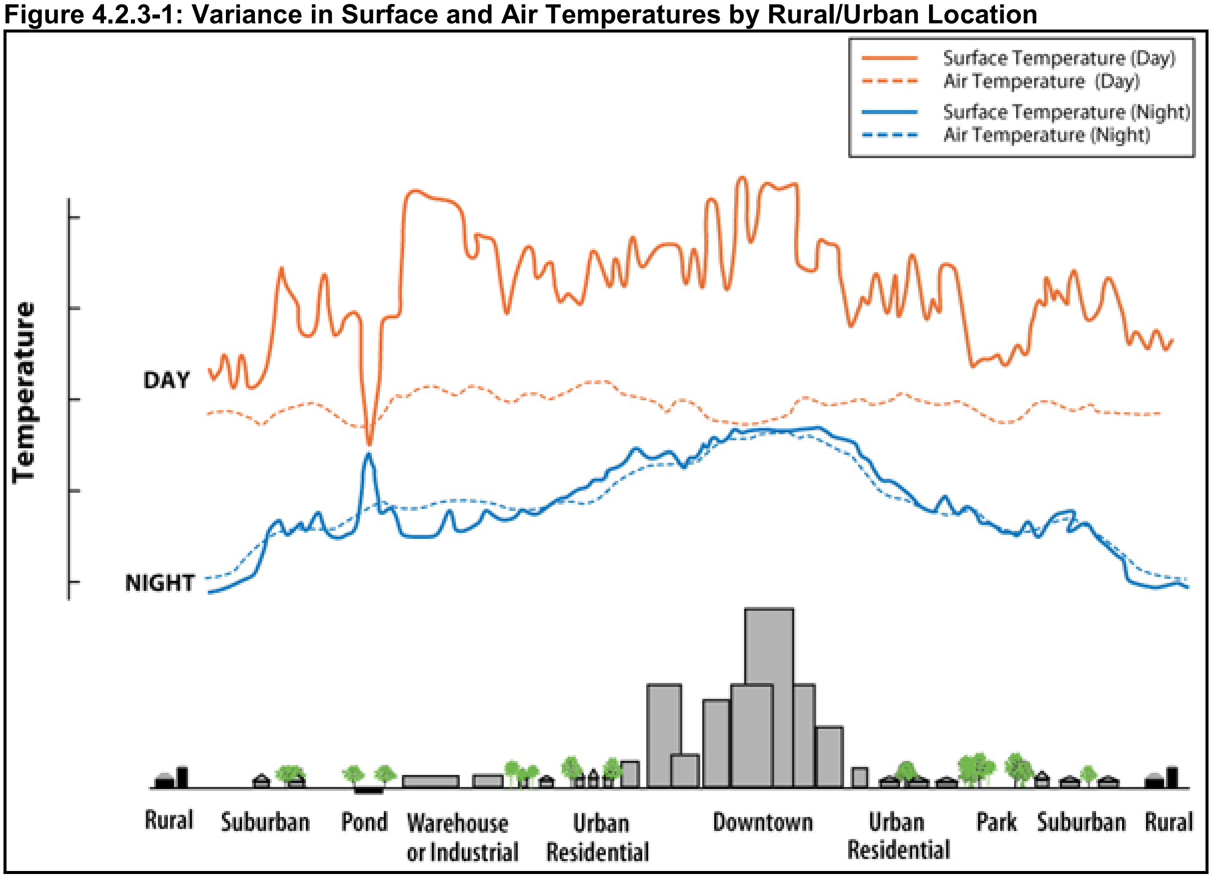
[96] Center for Disease Control and Prevention (CDC). Emergency Preparedness and Response Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety. Retrieved 7 December 2011.
[97] Center for Disease Control and Prevention (CDC). Emergency Preparedness and Response Extreme Cold: A Prevention Guide to Promote Your Personal Health and Safety. Retrieved 7 December 2011.

Canada during winter months bringing frigid temperatures to the region for an extended period of time. The same is true during the summer months when hazy, hot and humid conditions filter in from the Gulf of Mexico.

In addition, as a primarily urban environment, extreme heat in Philadelphia can be exacerbated into a phenomenon known as the urban heat-island effect. As urban areas develop, changes occur in their landscape. Buildings, roads, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist become impermeable and dry. Impervious surfaces such as asphalt may release heat hours after the sun is down. These changes cause urban regions to become warmer than their rural surroundings, forming an "island" of higher temperatures in the landscape. Other by-products, such as exhaust fumes, burning furnaces, heating units, and smokestacks contribute to the heat retention and entrapment.

Figure 4.2.3-1 below depicts the variance in surface and air temperatures for both night and day in a spectrum of urban and rural locations. Note how the air temperature above the “Downtown” (urban) region does not vary much between day and night. This leaves little opportunity for the region to cool and can affect a community’s environment and quality of life.

Figure 4.2.3-1: Variance in Surface and Air Temperatures by Rural/Urban Location



Source: EPA, 2011

4.2.3.3 Range of Magnitude

The severity or magnitude of extreme temperatures is generally measured through the Heat Index for extreme heat, and the Wind Chill Temperature Index for extreme cold.

Conditions that induce extreme temperature related illnesses include stagnant atmospheric conditions and poor air quality. Therefore, the air quality index and illnesses associated with extreme temperatures are discussed in this section.

Extreme Heat

As identified by the NWS and NOAA, the Heat Index is the temperature the body feels when heat and humidity are combined. Higher humidity plus higher temperatures often combine to make individuals feel a perceived temperature that is higher that the ambient air temperature. Figure 4.2.3-2 identifies the Heat Index that corresponds to the actual air temperature and relative humidity.

Figure 4.2.3-2: Heat Index Chart

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

Heat Index	Notes
80-90	Caution - fatigue is possible with prolonged exposure and activity
90-105	Extreme caution - sunstroke, heat cramps, and heat exhaustion are possible
105-130	Danger - sunstroke, heat cramps, and heat exhaustion are likely; heat stroke is possible
over 130	Extreme danger - heat stroke or sunstroke are likely with continued exposure

Source: NWS, 2008

Table 4.2.3-3 identifies the four NWS categories for heat hazards, as well as their associated heat index and health hazards.

Table 4.2.3-3	Health Hazards Associated with Heat Index Values	
Category	**Heat Index**	**Health Hazards**
Extreme Danger	130°F-Higher	Heat Stroke/Sunstroke is likely with continued exposure
Danger	105°F-129°F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity
Extreme Caution	90°F-105°F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity
Caution	80°F-90°F	Fatigue possible with prolonged exposure and/or physical activity

Source: NWS, 2008

NOAA's Heat Alert procedures are based mainly on heat index values. Research has shown that heat index thresholds do not always fully account for a variety of factors that could influence public health. Based on this research, NOAA/NWS has supported the implementation of a new Heat Health Watch/Warning System (HHWS) that is used to guide the production of daily warnings and forecast products and is tailored to each urban locale. This system is currently utilized in Philadelphia. The system considers not only heat and humidity, but also cloud cover, wind, and expected duration of the event.[98]

When conditions warrant, NWS issues the heat-related weather products described in Table 4.2.3-4 for Philadelphia.

Table 4.2.3-4	NWS Heat Products
Product	**Criteria**
Excessive Heat Outlook	An Excessive Heat Outlook is issued when the potential exists for an excessive heat event in the next 3-7 days. The purpose of issuing an Outlook is to provide information those who need considerable lead-time to prepare for and Excessive Heat Event, such as public health officials, emergency managers, and public utilities.

[98] National Weather Service (NWS). Heat Wave a Major Summer Killer. Accessed 5 December 2011.

Excessive Heat Watch	An Excessive Heat Watch is issued when conditions are favorable for an Excessive Heat Event in the next 12 to 48 hours. This is used when the risk of an Excessive Heat Event has increased but its occurrence and time frame is still uncertain. The purpose is to allow those who need to set plans in motion enough lead time to do so.
Excessive Heat Warning/Advisory	Either of these may be issued when an Excessive Heat Event is expected in the next 36 hours. These are issued when an event is occurring, is imminent, or has a very high probability of occurring. A Warning is used for conditions posing a threat to life or property. An Advisory is for less serious conditions that cause significant discomfort and if caution is not taken, could lead to a threat to life and/or property.

Source: NWS, 2008

The Unites States Environmental Protection Agency (EPA) created the Air Quality Index (AQI), a color-coded scale to exhibit pollution levels in the atmosphere. The AQI breaks air quality down into six categories: Good (green), Moderate (yellow), Unhealthy for Sensitive Populations (orange), Unhealthy for Everyone (red), Very Unhealthy (purple), and Hazardous (maroon). Each color relates to quantitative levels of air pollution and indicates the health risks associated with air quality conditions. The table below depicts the six AQI ranges, with each range assigned a descriptor and a color code.

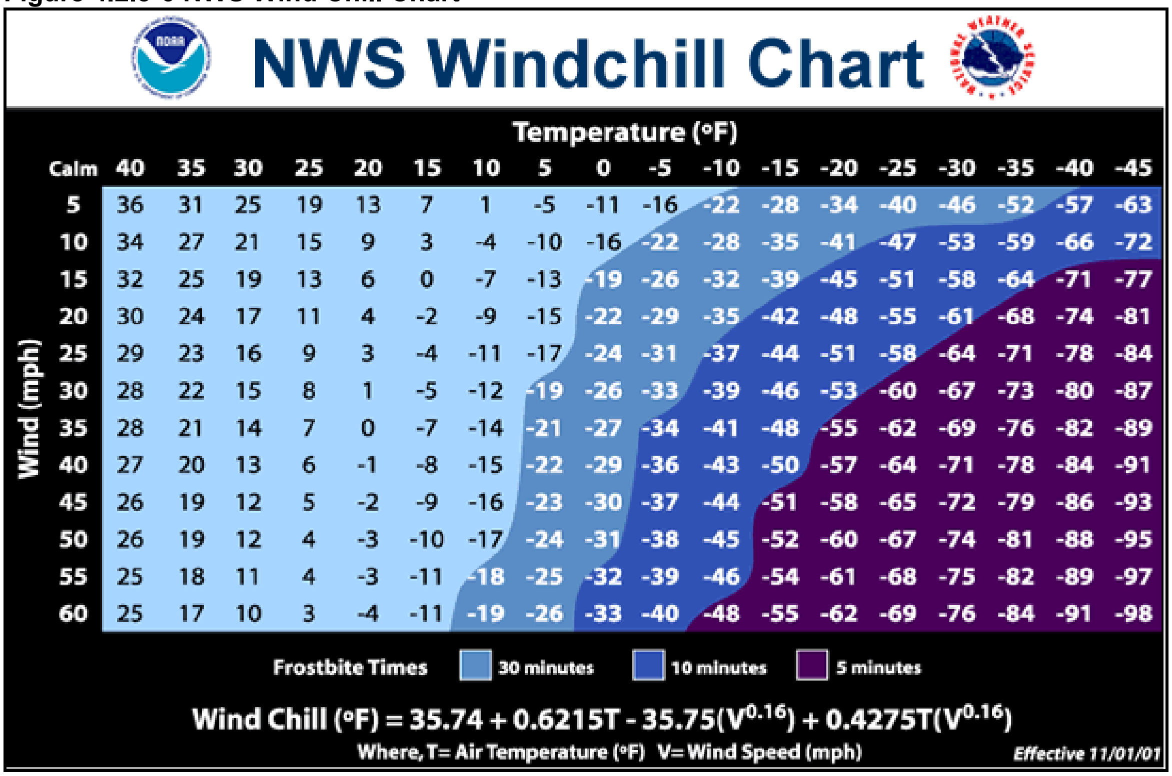
Table 4.2.3-5 Air Quality Index

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0-50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51-100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101-150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151-200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201-300	Health alert: everyone may experience more serious health effects.
Hazardous	> 300	Health warnings of emergency conditions. The entire population is more likely to be affected.

Source: EPA, 2011

Extreme Cold
Whenever temperatures drop well below normal and wind speed increases, heat leaves a body rapidly. NWS has developed a wind chill chart depicting apparent temperature felt on exposed skin due to the combination of air temperature and wind speed.

Figure 4.2.3-6 NWS Wind Chill Chart



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

Source: NWS, 2008

When conditions warrant, NWS issues wind chill products used in Philadelphia. Table 4.2.3-7 describes the criteria for these weather products.

Table 4.2.3-7	**NWS Wind Chill Products**
Product	**Description**
Wind Chill Watch	Issued by the NWS when there is a chance that wind temperatures will decrease to at least 20°F below zero during the next 24 to 48 hours
Wind Chill Advisory	Issued when the wind chill could be life threatening if action is not taken. The criteria for this advisory are expected wind chill readings of 10°F to 24°F degrees below zero.

Wind Chill Warning	Issued when wind chill readings are life threatening. Wind chill reading or 25°F below zero or lower are expected.

Source: NWS, 2008

Common Extreme Temperature Health Concerns
Table 4.2.3-8 through table 4.2.8-4 describes the heath related illness and health concerns associated with extreme temperatures.

Table 4.2.3-8	**Heat Related Illnesses/Health Concerns**
Illness/Health Concern	**Description**
Heat Stroke	Heat stroke occurs when the body is unable to regulate its temperature. If the body's temperature rises rapidly, the sweating mechanism fails and the body is unable to cool down. Body temperature may rise to 106 degrees F or higher within 10-15 minutes, which can cause death or permanent disability if emergency treatment is not provided.
Heat Cramps	Heat cramps are muscle pains or spasms-usually in the abdomen, arms or legs, that may occur in association with strenuous activity. If you have heart problems or are on a low sodium diet, get medical attention for heat cramps.
Sunburn	Sunburns render the skin red, painful and abnormally warm after prolonged sun exposure. Although the discomfort is usually minor and healing occurs in about a week, more severe sunburn may require medical attention.
Dehydration	Dehydration occurs when the level of water in the body has been reduced. Chemical substances in the body such as salt and potassium fall to an irregular level. The main symptoms include dizziness, lethargy and dry mouth. A loss of appetite may also occur.
Heat Rash	Heat rash is a skin irritation caused by excessive sweating during hot, humid weather. It can occur at any age but is most common in young children.
Death	

Table 4.2.3-9	Cold Related Illnesses/Health Concerns
Illness/Health Concern	**Description**
Frostbite	Frostbite is the most common injury caused by exposure to cold. Before the onset of frostbite, exposed skin may become slightly flushed, pink in color, then change to white or yellow as the condition develops. Pain sometimes occurs, followed by a feeling of intense cold and numbness. In cases of severe frostbite, large blisters appear on and beneath the skin. The affected area is hard, cold and without sensation.
Hypothermia	Hypothermia is the rapid and progressive physical and mental collapse that results from a loss of body heat. Hypothermia occurs from a combination of cold, exhaustion, wind chill and moisture. Hypothermia can occur in above freezing (32º F) temperatures, and symptoms include uncontrollable shivering, drowsiness or exhaustion, slurred speech, fumbling or staggering, and lack of concern for physical well-being.
Carbon Monoxide Poisoning	Carbon Monoxide is a colorless, odorless, tasteless, non-irritating, toxic gas that is undetectable without a monitoring device. Sources of carbon monoxide poisoning include heating systems and any appliance that burns fuel, such as poorly ventilated gas ranges and kerosene space heaters. Automobile exhaust fumes are another source of carbon monoxide. The risk of CO exposure increases in the winter because windows and doors are shut tight, trapping gases inside.
Exacerbation of Pre-Existing Respiratory Conditions	Cold air constricts soft tissue of the respiratory tract. Thus, individuals with a history of respiratory ailments, such as asthma, emphysema, chronic bronchitis are particularly susceptible to a worsening of their conditions.
Death	

4.2.3.4 Past Occurrences

Due to its location, extreme heat and extreme cold are frequent events in Philadelphia. Data from the NCDC reports that there have been 83 extreme temperature events (13 extreme cold, 70 extreme heat) in Philadelphia between 1994 and 2011; none of these events have resulted in a FEMA Presidential Disaster Declaration.

On average, the temperature reaches 90°F between 25 and 30 days a year in Philadelphia. The NWS measures summer heat by three different means: through identifying average temperature; identifying the longest stretches of days 90°F and above; and identifying summers that had the most days over 90°F and above. Each of these methods is depicted in the tables below, showing the variability of average summer temperature in Philadelphia since official records began in 1874.

Table 4.2.3-10 Hottest Summers by Average Temperature

Year	Average Temp (°F)	Year	Average Temp (°F)
2010	79.6	1991	77.9
1995	78.5	1900	77.1
1994	78.3	1973	77.1
1993	78.2	1988	77.1
2011	78.0	1999	77.1

Source: Nese, Swartz, 2002; Accuweather, 2011

Table 4.2.3-11 Hottest Summers by Longest Stretches of 90+ F Days

Dates	Length	Dates	Length
Jul 29- Aug 15, 1988	18 days	Jul 23- Aug 3, 1999	12 days
Jul 20- Aug 5, 1995	17 days	Jul 12- Jul 23, 1952	12 days
Aug 24- Sep 5, 1953	13 days	Jun 25- Jul 6, 1901	12 days

Source: Nese, Swartz, 2002; Accuweather, 2011

Table 4.2.3-12 Hottest Summers by Most 90+ F Days

Year	# of 90+ F days	Year	# of 90+ F days
2010	55	1943	42
1991	53	1983	41
1988	49	1993	41
1995	49		

Source: Nese, Swartz, 2002; Accuweather, 2011

Philadelphia's all-time record high temperature is 106 °F, set on August 7, 1918. The table below illustrates the nine hottest days on record in Philadelphia.

Table 4.2.3-13	Hottest Days on Record		
Date	**High Temperature (°F)**	**Date**	**High Temperature (°F)**
Aug 7, 1918	106	July 21, 1930	103
July 10, 1936	104	July 9, 1936	103
July 3, 1966	104	July 4, 1966	103
July 2, 1901	103	July 7, 2010	103
Aug 6, 1918	103	July 22, 2011	103

Source: Nese, Swartz, 2002; Accuweather, 2011

From 1874-2002 there have been 45 days on record when the temperature dropped below 0°F. More than half of these days were in the month of January, with the majority of the rest being in February. [99] The ten coldest days are listed in table 4.2.3-14.

Table 4.2.3-14	Coldest Days on Record		
Date	**Low Temperature (°F)**	**Date**	**Low Temperature (°F)**
Feb 9, 1934	-11	Jan 21, 1985	-6
Jan 17, 1982	-7	Jan 10, 1875	-5
Jan 22, 1984	-7	Dec 30, 1880	-5
Feb 10, 1899	-6	Jan 29, 1963	-5
Feb 11, 1899	-6	Jan 19, 1994	-5

Source: Nese, Swartz, 2002

Philadelphia has never experienced temperatures remaining below zero for a 24+ hour time period. However, since 1874, there have been nine different days when single-digit temperatures prevailed through a twenty-four hour period.[100]

The longest streak in Philadelphia's recorded history of temperatures remaining below freezing is fifteen days, occurring twice, both in January/February 1961, and in February 1979.[101]

[99] Ibid
[100] Ibid
[101] Ibid

4.2.3.5 Future Occurrences

Several extreme temperature events occur each year in Philadelphia, and that trend is projected to continue. These extreme events may in turn then induce secondary hazards such as snow, hail, ice, windstorms, thunderstorms, drought, human health impacts, utility failures and transportation accidents.

4.2.3.6 Vulnerability Assessment

Impact to Philadelphia

Though extreme temperatures generally occur over a short period of time, they can, in a short timeframe, cause a range of impacts to humans, animals, and infrastructure.

Often the most impacted populations in extreme temperatures include vulnerable populations with little or no access to adequate cooling or heating. According to the CDC, populations most at risk to extreme cold and heat events include the following:[102]

- the elderly, who are less able to withstand temperatures extremes due to their age, health conditions and limited mobility to access shelters;
- infants and children up to four years of age;
- individuals who are physically ill
- individuals who have pre-existing conditions (e.g., heart disease or high blood pressure)
- low-income persons that cannot afford proper heating and cooling; and
- those without living without adequate shelter
- individuals with limited access to healthcare
- the general public who may overexert during work or exercise during extreme heat events or experience hypothermia during extreme cold events

A significant portion of Philadelphians meet criteria which make them more susceptible to hazardous effects of extreme heat, such as seniors (13% of the population), infants/children up to 4 years of age (6.6%), and those living below the poverty line (24%). Please review the community profile section of this plan for more data on Philadelphia's demographics.

During periods of both extreme cold and extreme heat, inadequate protection from the harsh temperatures is extremely dangerous to individuals. Subsequently, Philadelphia's homeless population is especially vulnerable. Both the Philadelphia Heat and Winter Weather Emergency Plans include outreach strategies to the homeless population.

In addition, Philadelphia's susceptibility to the urban heat-island effect exacerbates hazardous conditions to individuals from extreme heat. Consequently, people living in Philadelphia are at greater risk from the effects of a heat wave than those living in rural or less urbanized areas.

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[102] Centers for Disease Control and Prevention (CDC). Emergency Preparedness and Response: Information for Specific Groups. Retrieved 7 December 2011.

Environmental Vulnerability

Temporary periods of extreme heat or cold events typically do not have a significant impact on the environment. However prolonged exposure to periods of hot temperatures may be associated with drought conditions. Environmental impacts associated with droughts are explained earlier in Section 4.1.2.8 of this plan. Additionally, prolonged exposure to extreme cold temperatures can kill crops, vegetation and wildlife, especially if it occurs later in fall or earlier in the spring months. Cold conditions are also associated with winter storms, which are profile in Section 4.2.7 of this plan.

Structural Vulnerability

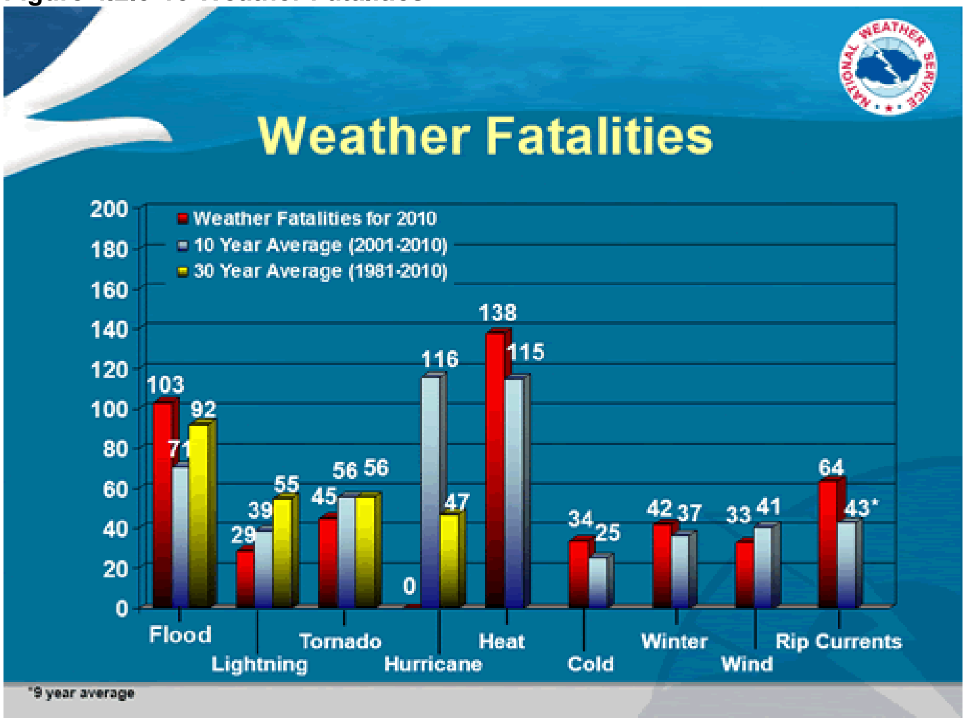
A portion of Philadelphia's utility infrastructure is susceptible to extreme temperatures. During the winter months, frozen pipes can create service interruptions in water, drainage and gas supply. There is a direct correlation in water main breaks and gas main breaks to air temperature. Generally surface breaks do not occur when the air temperature is at its minimum. Surface breaks do not appear until temperatures begin to rise and the water or gas expands. In addition, during extreme cold water intakes within Philadelphia tend to freeze, slowing operations. During extreme heat episodes roads and bridges can buckle due to expansion. To limit these effects, utility providers monitor conditions, perform routine maintenance and address problems as they arise.

In warmer months, a direct link exists between extreme heat and power disruptions. The demand for electricity rises during extreme heat events as air conditioners, fans and other devices are utilized to battle the heat. This increase in demand stresses the electrical generation, transmission and distribution infrastructure, which in turn increases the likelihood that sections or components of the electrical system will fail, causing power outages.

Potential Loss Estimate

Unlike other natural hazards, extreme temperatures have limited physical destructive force. Economic losses can be observed through the repairing of damaged infrastructure like roads and bridges, as well as through the disruption in transportation services, caused by the unreliability of equipment, such as rail switches and trolley lines. However, the primary concern associated with extreme temperatures is public health and safety. Fatalities caused by extreme temperatures ranks the highest in the United States, with 140 deaths on average the past ten years. Figure 4.2.3.6-1 illustrates weather fatalities based in the United States over the past 9 years.

Figure 4.2.3-15 Weather Fatalities



Source: NWS, 2010

According to the Philadelphia Department of Public Health Medical Examiner's Office (PDPH-MEO), Philadelphia generally begins to experience heat-related fatalities when an excessive heat event last 3 days or more, however; fatalities have occurred within vulnerable populations in shorter excessive heat events in Philadelphia. Heat-related deaths vary from year-to-year depending on the number, severity, and length of excessive heat events. Table 4.2.3-16 depicts heat-related deaths within Philadelphia by month from 2003-2011. Please note that "these data were supplied by the Philadelphia Department of Public Health (PDPH). PDPH specifically disclaims responsibility for any analyses, interpretations or conclusions."

Table 4.2.3-16 Number of Heat Related Deaths in Philadelphia, 2003-2011

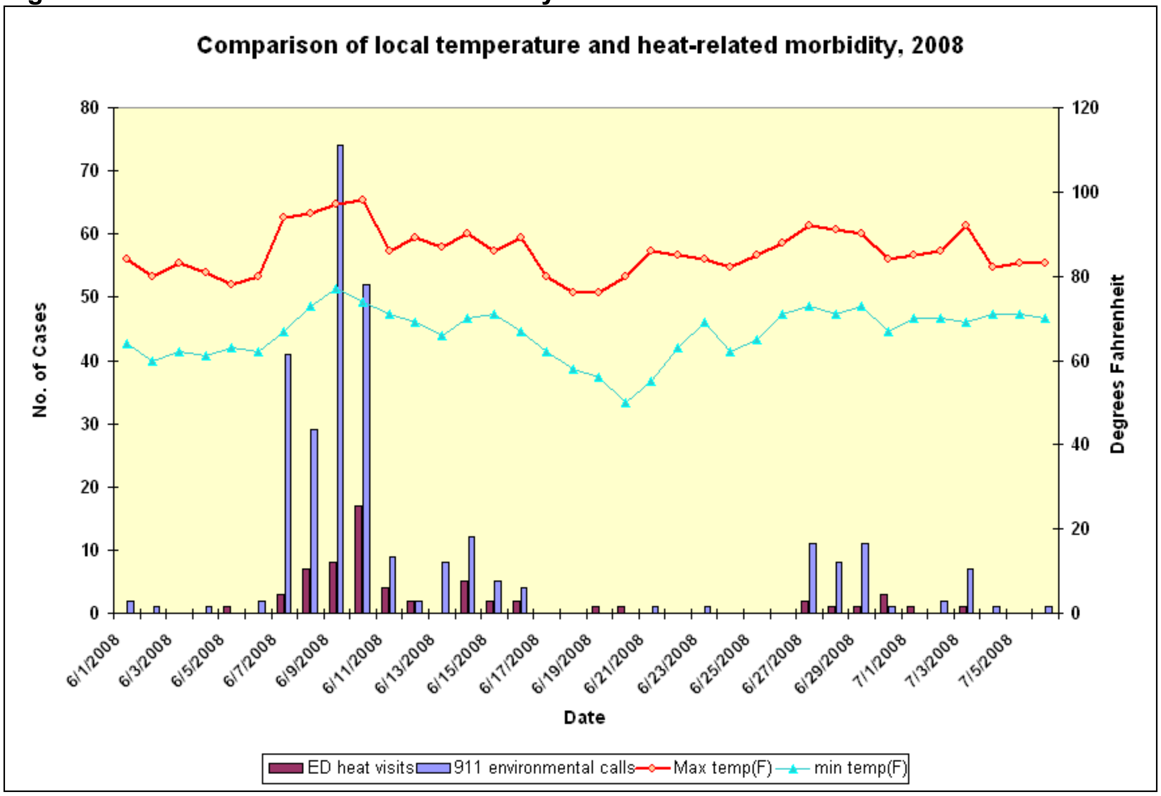
Year of Death	Month of Death						Total
	Apr	May	Jun	Jul	Aug	Sept	
2003	0	0	2	5	0	0	7
2004	1	0	1	0	0	0	2

2005	0	0	5	11	7	1	24
2006	0	0	1	4	24	0	29
2007	0	1	0	2	0	0	3
2008	0	0	18	7	0	0	25
2009	0	0	0	0	1	0	1
2010	0	0	4	11	0	0	15
2011	0	1	1	31	2	0	35
Total	1	2	32	71	34	1	141

The Philadelphia Department of Public Health Division of Disease Control (PDPH-DDC) receives de-identified emergency department chief complaint data on a daily basis as a part of an effort to conduct near-real time all hazards surveillance. PDPH-DDC also periodically requests data from 911 ambulance dispatches for heightened surveillance situations.

During a heat emergency, PDPH-DDC examines this data for visits that may be due to excessive heat (i.e. heat exhaustion syndrome), as well as 911 dispatch data that is related to environmental exposures. This provides a near real-time citywide view into the impact of the heat wave on health care utilization. Figure 4.2.3-17 depicts the correlation between the emergency department visits, 911 call and temperatures related deaths for June-July 2008.

Figure 4.2.3-17 Local Heat-related Morbidity



Source: PDPH, 2012

4.2.4 Floods

4.2.4.1 Description

Floods are one of the most common natural hazards in the United States. They can develop slowly over a period of days or develop quickly within hours resulting in disastrous effects that can be local (affecting a neighborhood or community) or regional (affecting entire river basins, multiple counties or states). Most communities in the U.S. have experienced some kind of flooding after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws. According to PA 2010 HMP, Pennsylvania is one of the most flood-prone states in the U.S., with the southeastern region (including Philadelphia) being the most susceptible.

A flood is any high flow, overflow, or inundation by water, which causes or threatens damage.[103] Floods are the result of a combination of meteorological and hydrological extremes as indicated in the table below. In most cases, flooding is compounded by human factors. While diverse, these human factors generally tend to aggravate flood hazards by accentuating flood heights.[104]

[103] NWS Glossary. Retrieved on 14 December 2011.
[104] World Meteorological Organization. Associated Programme on Flood Management. Urban Risk Management. Retrieved 14 December 2011.

Table 4.2.4-1	Factors contributing to flooding	
Meteorological Factors	**Hydrological Factors**	**Human Factors aggravating Natural Flood Hazards**
• Rainfall • Large-scale storms – hurricanes, tropical storms, mesoscale convective systems • Small-scale storms – severe thunderstorms, cloudbursts, • Temperature • Snowfall and snowmelt • Ice Jams on waterways	• Soil moisture level • Groundwater level prior to storm • Natural surface infiltration rate • Presence of impervious cover • Channel cross-sectional shape and roughness • Presence or absence of over bank flow, channel network • Synchronization of runoffs from various parts of watershed • High tide impeding drainage	• Land-use changes (e.g. surface sealing due to urbanization, deforestation) increase run-off and may be sedimentation • Occupation of the floodplain obstructing flows • Inefficiency or non-maintenance of infrastructure • Climate change affects magnitude and frequency of precipitations and floods • Urban microclimate may enforce precipitation events

As a result of the different combination of factors, including meteorological, hydrological, and human, floods can be divided into three categories for Philadelphia:[105]

- Local Floods
- Riverine Floods
- Flash Floods

Local Floods
Local floods are defined as increase volumes of water due to poor drainage capacity. Built environments like cities generate higher surface run-off that is in excess of local drainage capacity, thereby causing local floods. Local drainage capacity is primarily made up of local storm water drainage system composed of storm drainpipes, curb inlets, manholes, minor channels, roadside ditches and culverts. This system is intended to convey storm flows efficiently to the community's primary drainage system. However, rubbish and debris can clog the bottlenecks of drainage facilities, thus

[105] Federal Emergency Management Institute. Types of Floods and Floodplains. Retrieved 16 December 2011

reducing drainage capacity and leading to increased surface runoff and back up effects, causing local floods.

Riverine Floods
Riverine floods, also called river floods, occur when the river run-off volume exceeds local flow capacities. River floods are triggered by heavy rainfall or snow melt in upstream areas, or in the case of the Delaware River, tidal influence from downstream. Ground conditions such as soil, vegetation cover, and land use have a direct bearing on the amount of run-off generated. Flooding from large rivers usually results from large-scale weather systems that generate prolonged rainfall over wide areas. Small rivers, streams and creeks are susceptible to flooding from more localized weather systems that cause intense rainfall over small areas.

Flash Floods
Flash floods are characterized as a rapid and extreme flow of high water into a normally dry area, or rapid water level rise in a stream or creek above a predetermined flood level.[106] Flash floods occur as a result of the rapid accumulation and release of runoff waters, which are caused by heavy rainfall, cloudbursts, landslides, or the sudden break-up of an ice jam. Ongoing flooding can intensify into flash flooding in cases where intense rainfall results in a rapid surge of rising floodwaters. Densely populated areas have a high risk for flash floods, as the construction of buildings, highways, driveway and parking lots increases runoff by reducing the amount of rain absorbed by the ground.

4.2.4.2 Location

The most damaging floods in Philadelphia appear to occur within the designated floodplains. A floodplain is defined as the land adjoining the channel of a river, stream, ocean, lake or other watercourse or water body that becomes inundated with water during a flood. The size of the floodplain is described by the recurrence interval of a given flood. Note: a floodplain associated with a flood that has a 10 percent chance of occurring annually is smaller than the floodplain associated with a flood that has a 0.2 percent-annual-chance of occurring. In other words the higher the percentage of a flood occurring annually the smaller the area of the floodplain. Please see figure 4.2.4-2 for clarification.

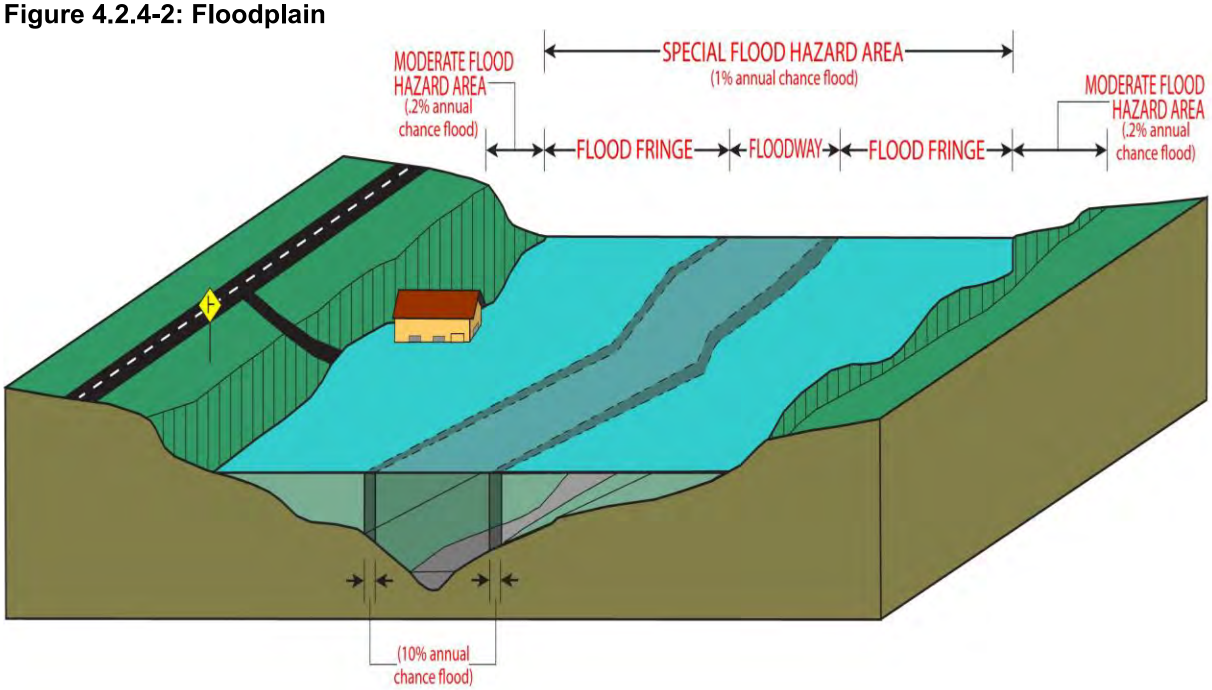
FEMA Flood Insurance Rate Maps (FIRMs) delineate special flood-hazard areas and the moderate flood areas in a community. Special flood-hazard areas identify locations that will be inundated by a flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also commonly referred to as the base flood or 100-year flood. Within this plan this area will be illustrated as the 1-percent annual chance area. Special flood-hazard areas are labeled as Zone A on FIRMS for Philadelphia. Moderate flood hazard areas, labeled Zone X

[106] Ibid

are also shown on the FIRM, and are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood.[107]

Figure 4.2.4-2 depicts the special flood hazard area or the 1-percent annual chance area of a floodplain, composed of both the flood fringe and the floodway areas, as well as the .2-percent annual chance area (or the moderate flood hazard area) and the 10-percent annual chance area.

Figure 4.2.4-2: Floodplain



Source: Adapted from NJDEP, Date Unknown

The Special Flood Hazard Area serves as the primary regulatory boundary used by FEMA and the Commonwealth of Pennsylvania. Digital FIRMs, paper FIRMs, 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 percent- and 0.2 percent-annual-chance event.

Within Philadelphia, 39 of 63 neighborhoods (based on the Philadelphia City Planning Commission's 2005 neighborhood designation) are located at least in part in the 1-percent annual chance area. The following table identifies the Philadelphia neighborhoods that intersect the 1-percent annual chance area and the percentage that falls within the boundaries of a floodplain. Figure 4.2.4-4 depicts the 1-percent annual chance areas within Philadelphia's 63 neighborhoods.

[107] Federal Emergency Management Agency. Flood Zones. Retrieved 19 January 2012.

Table 4.2.4-3 Percentage of Philadelphia Neighborhood Intersecting 1-percent Annual Chance Area

Neighborhood	% in Floodplain	Neighborhood	% in Floodplain
Delaware Riverfront	76.25%	University City	7.27%
Eastwick	55.97%	Overbrook Park - Wynnefield Heights	7.06%
Packer Park - Girard Estates	45.84%	Chestnut Hill	6.85%
Richmond - Bridesburg	39.89%	East Falls	6.81%
Pennsport - Snyder - Whitman	39.15%	Morrell - Modena - Millbrook	5.92%
Torresdale	25.06%	Millcreek - Parkside	5.77%
Wissinoming - Tacony	21.63%	Feltonville	5.73%
Grays Ferry - Southbrook	20.00%	Kensington	5.69%
Fairmount - Spring Garden	17.93%	Roxborough	4.17%
Logan Square	14.71%	Parkwood	3.93%
Queen Village - Bella Vista - Hawthorne	13.35%	Olney	3.08%
Manayunk	13.05%	Cobbs Creek	2.50%
Frankford	12.78%	Pennypack	2.36%
Rittenhouse Square	12.46%	Lawncrest	1.94%
Bustleton	10.75%	Juniata Park - Harrowgate	1.62%

Northern Liberties	10.61%	Somerton	1.38%
South of South	9.99%	Mayfair - Holmesburg	1.34%
Elmwood	8.43%	Nicetown - Tioga	1.26%
Kingsessing	8.18%	E. Oak Lane	0.87%
Northwood	7.38%		

As past flood events indicate, Philadelphia has several flood-prone areas. These areas include Cobbs Creek along the western City border, the marshlands in the southwest sector of the City; the Philadelphia Naval Base; Delaware Avenue underneath the Benjamin Franklin Bridge; Linden Avenue where it meets the Delaware River in the Northeast; River Road and areas along Main Street Manayunk; and areas along Kelly and Lincoln Drives. City streams most prone to flooding include the Pennypack, Poquessing and Cobbs Creeks, as well as Tacony, Frankford and Wissahickon Creeks. Figures 4.2.4-5 through 4.2.4-9 show the most common flood prone areas of Philadelphia, as well as identifies numerous critical facilities that fall within those flood prone areas.

Figure 4.2.4-4: 1-percent Annual Chance Area

Figure 4.2.4-5


COBBS CREEK
CITY AVE
LANSDOWNE AVE
CARDINGTON RD
N 63RD ST
W GIRARD AVE
HAVERFORD AVE
LANCASTER AVE
PPD DIST 19
PPD DIST 16
VINE ST
MARKET ST
CHESTNUT ST
WALNUT ST
SPRUCE ST
COBBS CREEK PKY
PPD DIST 18
BALTIMORE AVE
SPRINGFIELD AVE
WHITBY AVE
Delaware County
Cobbs Creek
S 65TH ST
WOODLAND AVE
LINDBERGH BLV
S 61ST ST
PPD DIST 12
S 63RD ST
W PASSYUNK AVE
S 67TH ST
NORWITCH DR
ESSINGTON AVE
ISLAND AVE
LINDBERGH BLV
Fire Stations
Police Offices
Dialysis Centers
Personal Care Homes
Schools
Daycare Centers
Hazmat Facilities
Hydrology
100-Year Floodplain
Fairmount Park
Police Districts
Philadelphia City Limits
Source: National Flood Hazard Layer
November 16, 2009
N
0
0.5
1
Miles

Figure 4.2.4-6

MAIN ST, MANAYUNK

Figure 4.2.4-7


PENNYPACK CREEK
PPD DIST 7
PPD DIST 8
PPD DIST 2
PPD DIST 15
Pennypack Creek
Delaware River
Fire Stations
Police Offices
Dialysis Centers
Personal Care Homes
Schools
Daycare Centers
Hazmat Facilities
Hydrology
100-Year Floodplain
Fairmount Park
Police Districts
Philadelphia City Limits
Source: National Flood Hazard Layer
November 16, 2009
N
0
0.5
1
Miles

Figure 4.2.4-8

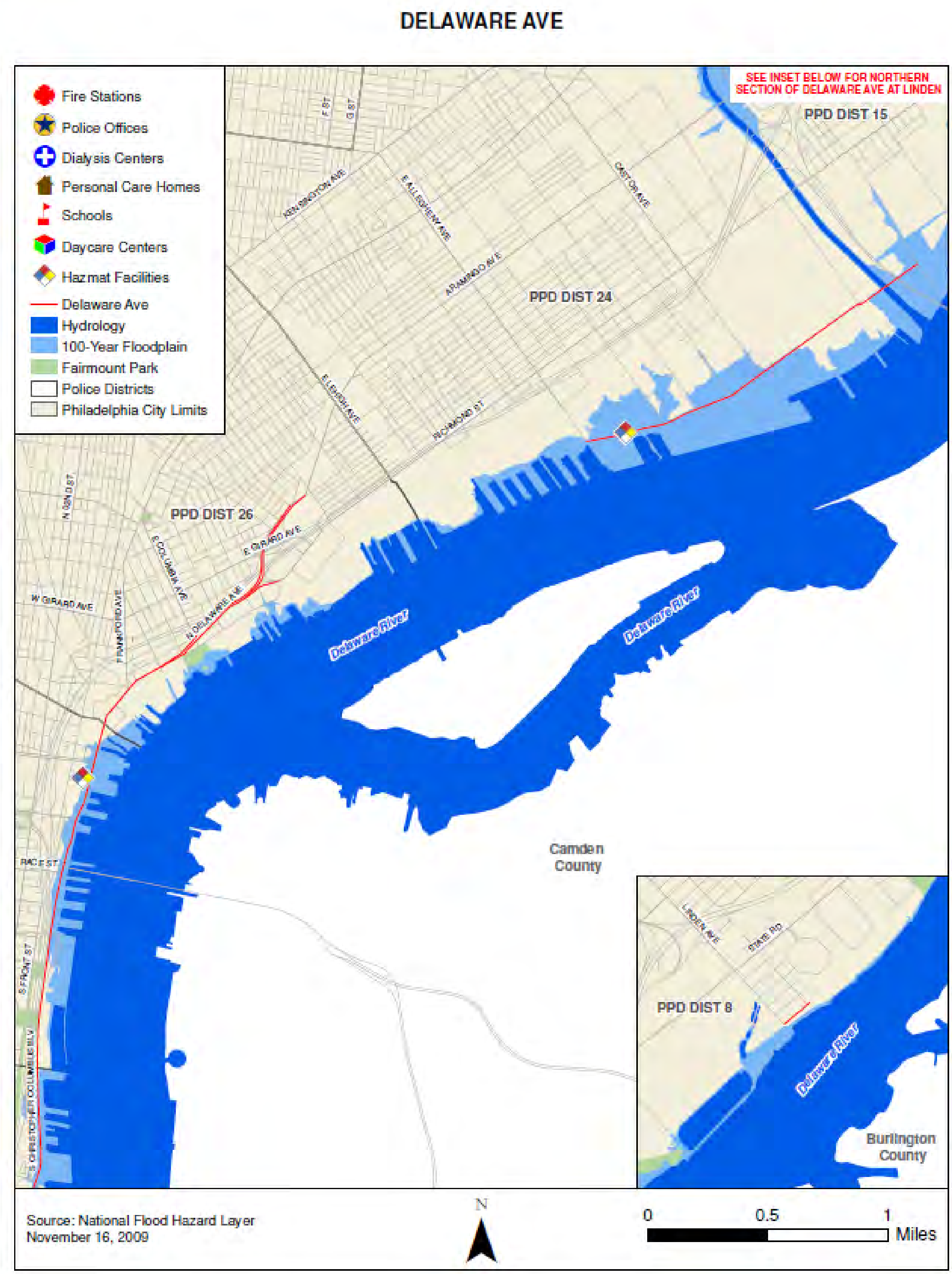
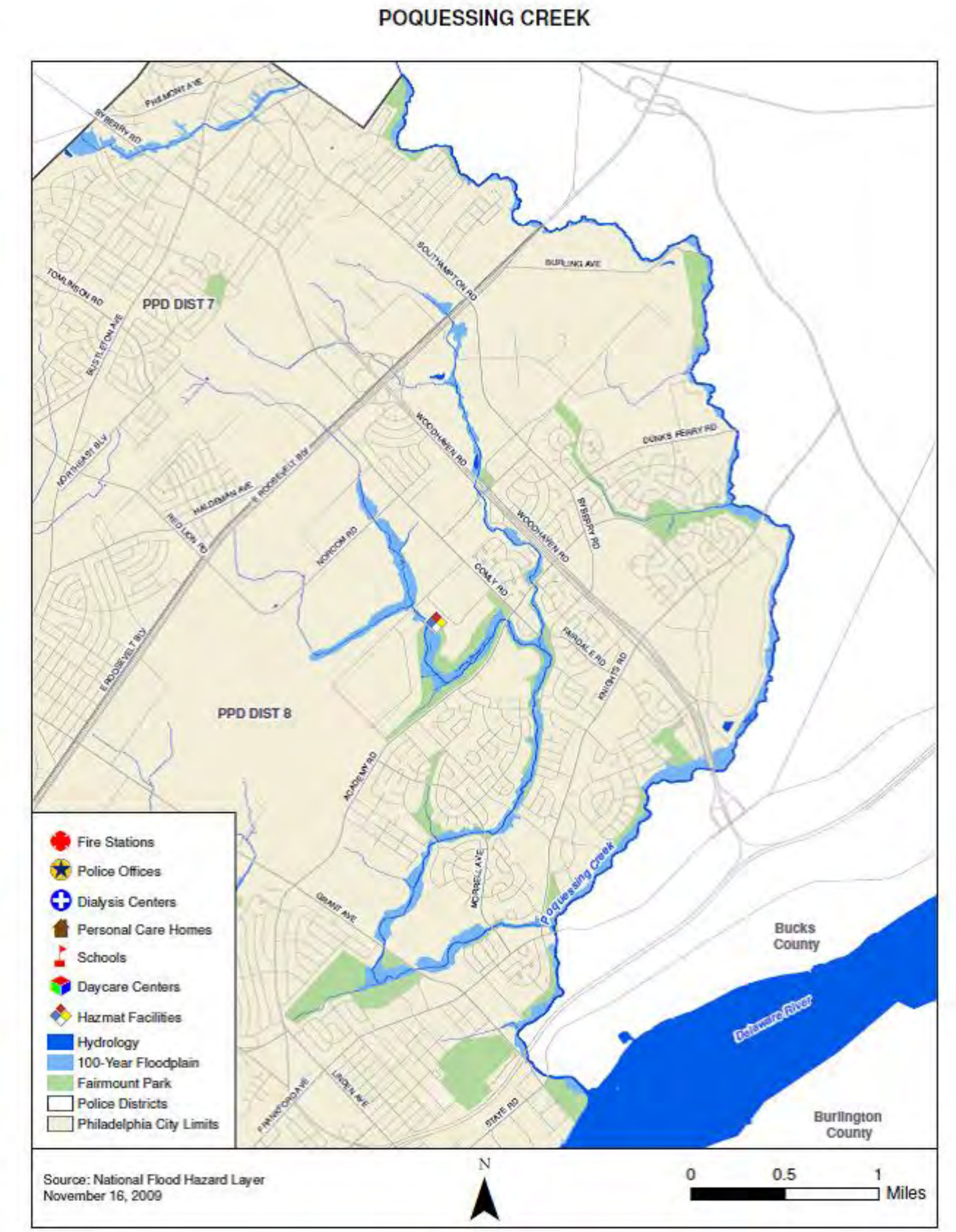

DELAWARE AVE
Fire Stations
Police Offices
Dialysis Centers
Personal Care Homes
Schools
Daycare Centers
Hazmat Facilities
Delaware Ave
Hydrology
100-Year Floodplain
Fairmount Park
Police Districts
Philadelphia City Limits
SEE INSET BELOW FOR NORTHERN SECTION OF DELAWARE AVE AT LINDEN
PPD DIST 15
PPD DIST 24
PPD DIST 26
PPD DIST 8
Delaware River
Delaware River
Delaware River
Camden County
Burlington County
Source: National Flood Hazard Layer
November 16, 2009
N
0
0.5
1
Miles

Figure 4.2.4-9


POQUESSING CREEK
PPD DIST 7
PPD DIST 8
Poquessing Creek
Delaware River
Bucks County
Burlington County
Fire Stations
Police Offices
Dialysis Centers
Personal Care Homes
Schools
Daycare Centers
Hazmat Facilities
Hydrology
100-Year Floodplain
Fairmount Park
Police Districts
Philadelphia City Limits
Source: National Flood Hazard Layer
November 16, 2009
N
0
0.5
1
Miles

4.2.4.3 Range of Magnitude

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the time of year, the coverage area of the storm, and the land's ability to absorb the amount of water. Two general types of storm systems can produce large amounts of precipitation, convective systems and non-convective systems. Convective events are quick-hitting, heavy rainfall events that usually have a lifespan of an hour or two. Non-convective events are steady rain events that can take place over the course of several hours and last as long as 24 hours.

In the case of riverine or flash flooding, once a river, stream or creek reaches flood stage (shown in Table 4.2.4-10), the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat.

Table 4.2.4-10	NWS Flood Categories	
	Convective	**Non-Convective**
Minor Flooding An Urban and/or Small Stream Flood Advisory would be issued for this event.	For Urbanized Areas: • Rainfall rates of 0.5 inch per hour lasting more than one hour. Minimal or no property damage. Minimal risk to the public. For Rural Areas: • Rainfall rates from .75 to 1.0 inch per hour lasting more than one hour. Minimal or no property damage. Minimal risk to the public.	• There is less of a distinction between urbanized and rural areas in non-convective events. • Rainfall rates from 0.25 to 0.5 per hour depending on duration of event. • A 0.5 inch rainfall rate over six hours can have similar impacts compared to a 0.25 inch rainfall rate over 12 hours. • Minimal or no property damage. Minimal risk to the public.

Moderate Flooding A Flood or Flash Flood Warning would be issued for this event.	For Urbanized Areas: • Rainfall rates of at least 1.0 inches per hour lasting more than one hour. Impacts include inundation of structures, road closures, evacuations of people and/or the transfer of property to higher ground. For Rural Areas: • Rainfall rates from 1.25 to 1.50 inches per hour lasting more than one hour. Impacts include inundation of structures, road closures, evacuations of people and/or the transfer of property to higher ground.	• There is less of a distinction between urbanized and rural areas in non-convective events. • Rainfall rates from 0.5 to .75 per hour depending on duration of event. • A .75 inch rainfall rate over six hours can have similar impacts compared to a 0.5 inch rainfall rate over ten hours. • Impacts include inundation of structures, road closures, evacuations of people and/or the transfer of property to higher ground.
Major Flooding A Flood or Flash Flood Warning would be issued for this event.	For Urbanized Areas: • Rainfall rates of at least 1.50 inches per hour lasting more than one hour. Impacts include extensive inundation of structures, road closures and a significant evacuation of people and/or transfer of property to higher ground. For Rural areas: • Rainfall rates from 1.75 to 2.0 inches per hour lasting more than one hour. Impacts include extensive inundation of structures, road closures, and a significant evacuation of people and/or transfer of property to higher ground.	• There is less of a distinction between urbanized and rural areas in non-convective events. • Rainfall rates from 0.75 to 1.0 per hour depending on duration of event. • A 1.0 inch rainfall rate over six hours can have similar impacts compared to a 0.75 inch rainfall rate over eight hours. • Impacts include extensive inundation of structures, road closures, and a significant evacuation of people and/or the transfer of property to higher ground.

The following table lists the hydrologic gages in Philadelphia. There are three other gages in Philadelphia county that are monitored by the PADEP, but do not have established flood stages. They include Cobbs Creek (*COBP1*), Tacony Creek (*TACP1*), and Poquessing Creek (*POQP1*). Hydrologic information can be obtained from the NWS Advanced Hydrologic Prediction Services (AHPS) web page.[108]

Table 4.2.4-11 Hydrologic Gages in Philadelphia

River/Creek	Stages
Philadelphia – Schuylkill River Site Identifier (PADP1) Daily river forecast point. Can be viewed in AHPS via map or drop down Schuylkill River menu.	Action Stage 10.0 ft. Flood Stage 11.0 ft. Moderate Category 13.0 ft. Major Category 15.5 ft. Record 17.0 ft. (10/4/1869)
Wissahickon – Wissahickon Creek Site Identifier (PHAP1) No forecasts available.	Action Stage 4.5 ft. Flood Stage 5.0 ft. Moderate Category 7.0 ft. Major Category 9.0 ft. Record 11.5 ft. (9/16/1999)
Frankford – Frankford Creek Site Identifier (FCRP1) No forecasts available.	Action Stage 6.0 ft. Flood Stage 7.0 ft. Moderate Category 8.0 ft. Major Category 10.0 ft. Record 13.9 ft. (9/28/2004)
Pennypack – Pennypack Creek Site Identifier (PLLP1) No forecasts available.	Action Stage NA Flood Stage 7.0 ft. Moderate Category 9.0 ft. Major Category 11.0 ft. Record 14.8 ft. (9/16/1999)
USCG Pier – Delaware River Site Identifier (PHBP1) Tidal gage. Can be viewed in AHPS via drop down Delaware River menu.	Action Stage 7.8 ft. Flood Stage 8.2 ft. Moderate Category 9.2 ft. Major Category 10.2 ft. Record 10.5 ft. (11/25/1950)

The NWS issues the following products when issues warrant.

[108] Information provided by NWS Mount Holly hydrologist.

Table 4.2.4-12	**NWS Flood Products**
Products	**Description**
Urban and/or Small Stream Advisory	Alerts the public to nuisance flooding which is generally non-life-threatening. Issued when rain will cause flooding of streets and low-lying areas in both urban and rural settings. May be upgraded to a Flash Flood Warning if flooding worsens and poses a threat to life and property. Forecaster confidence is at least 80%.
Flash Flood Watch	Usually associated with quick-hitting convective rain events. Indicates current or developing hydrologic conditions are favorable for flash flooding in and close to the watch area, but the occurrence is neither certain or imminent. Issued 24 to 48 hours before a potential event. Forecaster confidence is approximately 50%.
Flood Watch	Usually associated with non-convective events. Indicates current or developing hydrologic conditions are favorable for flooding in and close to the watch area, but the occurrence is neither certain or imminent. Issued 24 to 48 hours before a potential event. Forecaster confidence is approximately 50%.
Flash Flood Warning	Usually associated with quick-hitting convective rain events. Indicates that flooding is occurring or is determined to be imminent within about a six hour period from the start of the causative event. There is a serious risk to life and property. Can be issued several hours before flooding occurs. Forecaster confidence is at least 80%. Can also be issued for ice jams and dam breaks. If the flooding is expected to persist for more than several hours, the product may be converted to Flood Warning.
Flood Warning	Usually associated with non-convective rain events. Indicates that flooding is occurring or is determined to be imminent and is expected to persist for more than a six hour period. There is a serious risk to life and property. Can be issued several hours before flooding occurs. Forecaster confidence is at least 80%.

River Flood Warning	Caused from either a convective or non-convective event. Indicates that flooding is occurring or is determined to be imminent on a gaged and monitored stream. There is a serious risk to life and property. Can be issued several hours before flooding occurs. Forecaster confidence is at least 80%.
Special River Statement	Issued for mainstream rivers when water levels are running high but are expected to remain within banks.
Hazardous Weather Outlook	Identifies the potential for flooding three to seven days in advance. If there is a >50% chance that an advisory, watch, or warning will be needed in some capacity, the event is mentioned in the HWO.
Area Forecast Discussion	Provides a discussion of the meteorological thinking which went into the preparation of the forecast. Typically will contain the predicted precipitation amounts for an upcoming event as well as a discussion of anticipated flooding conditions. The NWS issues an AFD approximately four times a day but can update it more frequently based on significant forecast changes.
Coastal Flood Advisory	Issued for minor tidal flooding. Impacts include nuisance flooding across roads or low-lying areas. Isolated property damage. Generally non-life-threatening.
Coastal Flood Warning	Issued for moderate or severe tidal flooding. Impacts for moderate flooding range from flooded roads to property damage. Severe flooding impacts include widespread flooding with significant property damage. Both moderate and severe tidal flooding can be life-threatening.

4.2.4.4 Past Occurrences

Table 4.2.4-13 summarizes the Presidential Disaster or Emergency Declarations, and the Gubernatorial Declarations for flood events in Philadelphia. Most of the flooding-related declared disasters in Philadelphia have been associated with a tropical or extra tropical disturbance (hurricanes, tropical storms, Nor'easters), either passing over or located within close proximity to Philadelphia.

Table 4.2.4-13	**Flooding: Declared Disaster History 1955-2011**	
Date	**Type**	**Action**
September 2011	Tropical Storm Lee	Emergency Measures Declaration for Public Assistance and Hazard Mitigation

August 2011	Hurricane Irene	Gubernatorial and Presidential – Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation
September 2006	Tropical Depression Ernesto	Gubernatorial
June 2006	Proclamation of Emergency - Flooding	Gubernatorial and Presidential – Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation
September 2005	Proclamation of Emergency - Katrina	Gubernatorial
September 2004	Tropical Depression Ivan	Major Disaster for Individual Assistance
August 2004	Severe Storm & Flooding	Major Disaster for Individual Assistance and Hazard Mitigation
September 2003	Hurricane Isabel/Henri	Gubernatorial and Presidential Declaration – Major Disaster
September 1999	Hurricane Floyd	Gubernatorial and Presidential Declaration – Major Disaster
June 1998	Severe Storms/ Tornadoes	Gubernatorial
January 1996	Flooding	Gubernatorial and Presidential – Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation
July 1994	Flooding	SBA – Physical Disaster and Economic Injury Disaster Loans
June 1972	Flood (Agnes)	President's Declaration of Major Disaster – Governor's Proclamation
September 1971	Flood	Governor's Proclamation & President's Declaration of Major Disaster
September 1955	Flood Diane	President's Declaration of Major Disaster

According to the NCDC, there have been 118 flooding events, flash, local or riverine in Philadelphia since 1993. The NWS Middle Atlantic Forecast Center (MARFC) chronicles historical flood events for the USGS station along the Schuylkill River. Table 4.2.4-14 categorizes all the flood events that have occurred since 1769 in Philadelphia. Table 4.2.4-15 summarizes the top ten highest historical crests on the Schuylkill River. Note: the MARFC Complete Flood List for Philadelphia identifies three other flood events not listed within the table below (9/8/1769, 9/3/1775, and 10/13/1846). River crests for each event were not identified and therefore not listed within Table 4.2.4-14. In addition, MARFC does not list information on the Delaware River or the local streams or creeks which run through Philadelphia.

Table 4.2.4 -14		Historical Floods: Schuylkill River at Philadelphia					
Latitude: 39.968		Period of Record: 1769-Present				Longitude: -75.189	
Flood Stage: 11 ft.		Last Flood: 9/8/2011				Number of Floods: 64	
Minor = 11.0 ft. – 12.99 ft.				Moderate = 13.0 ft. – 15.4 ft.		Major = 15.5 ft.+	
45 Occurrences				13 Occurrences		1 Occurrence	
Crest Date	Crest	Crest Date	Crest	Crest Date	Crest	Crest Date	Crest
9/8/2011	12.52 ft.	12/21/1973	11.47 ft.	8/28/2011	13.56 ft.	10/4/1869	17.0 ft.
9/7/2011	12.01 ft.	6/29/1973	11.43 ft.	10/1/2010	13.05 ft.		
4/15/2007	11.34 ft.	8/28/1971	11.26 ft.	9/17/1999	14.10 ft.		
6/28/2006	12.51 ft.	4/2/1970	11.11ft	1/19/1996	13.36 ft.		
10/9/2005	12.07 ft.	3/7/1967	11.31 ft.	6/23/1972	14.65 ft.		
4/3/2005	11.74 ft.	9/12/1960	11.58ft.	9/13/1971	13.28 ft.		
9/29/2004	11.86 ft.	8/13/1955	11.25 ft.	8/19/1955	14.32 ft.		
9/18/2004	11.33 ft.	12/11/1952	11.7 ft.	11/25/1950	14.32 ft.		
6/21/2003	11.43 ft.	11/22/1952	12.41 ft.	6/2/1946	14.57 ft.		
3/11/2001	11.03 ft.	4/28/1952	11.92 ft.	8/9/1942	13.1 ft.		
3/22/2000	11.04 ft.	12/30/1948	12.0 ft.	7/9/1935	14.1 ft.		
12/14/1996	11.39 ft.	9/19/1945	11.92 ft.	8/24/1933	14.7 ft.		
10/19/1996	11.86 ft.	1/1/1945	11.06 ft.	3/1/1902	14.8 ft.		
3/9/1995	11.23 ft.	11/9/1943	11.19 ft.				
12/5/1993	12.41 ft.	12/30/1942	11.36 ft.				
7/7/1984	12.31 ft.	5/24/1942	12.44 ft.				
5/30/1984	11.42 ft.	3/15/1940	11.72 ft.				
12/13/1983	11.06 ft.	3/4/1940	11.23 ft.				
4/16/1983	11.42 ft.	2/3/1939	11.08 ft.				
2/26/1979	11.54 ft.	3/12/1936	11.62 ft.				
1/25/1979	12.97 ft.	1/3/1936	11.7 ft.				
1/26/1978	12.33 ft.	9/30/1934	11.3 ft.				
1/28/1976	12.13 ft.						

Table 4.2.4-15	Top Ten Highest Historical Crests: Schuylkill River in Philadelphia	
Crest	**Date of Flood**	**Weather Comments**
17.0 ft.	10/4/1869	On October 4, the "Saxby Gale" hurricane brought widespread heavy rain to the northeastern U.S., from Virginia to Maine. Eastern Pennsylvania collected more than 5 inches. Severe flooding throughout the Mid-Atlantic and New England.
14.8 ft.	3/1/1902	A series of snowstorms followed by heavy rains caused flooding on the Lehigh and Delaware Rivers as well as the most destructive flood on the Susquehanna in the Wyoming Valley since 1865.
14.7 ft.	8/24/1933	A strong Category 1 storm, the Chesapeake-Potomac Hurricane brought more than 10 inches of rain to Maryland, Delaware and Southern New Jersey. Other locations throughout the Mid-Atlantic measured more than 4 inches of rain.
14.65 ft.	6/23/1972	Hurricane Agnes made landfall again over southeastern New York on June 22 and moved westward into Pennsylvania. Rainfall totals from June 20-25 range from 2-3 inches in the Upper Potomac to 18 inches near Shamokin, Pennsylvania.
14.57 ft.	6/2/1946	The weather summary is unavailable at this time.
14.32 ft.	11/25/1950	Record-breaking cold air spawned a coastal "bomb" that retrograded back to the lower Great Lakes underneath a deep closed vortex. Several inches of rain fell across the area.
14.32 ft.	8/19/1955	Hurricane Diane made landfall 5 days after Hurricane Connie. Hurricane Diane produced several inches of rain with locally heavier amounts of 10 to 20 inches.
14.10 ft.	9/17/1999	Hurricane Floyd produced heavy rainfall from Virginia to Long Island. Rainfall totals ranged from 12 inches in Delaware to 16.57 inches in Newport News, Virginia. Two dams burst in New Jersey and several flood records were broken in New Jersey.
14.1 ft.	7/9/1935	10 inches of rain fell at Cortland, NY in 48 hours.
13.56 ft.	8/28/2011	Hurricane Irene brought heavy rains and flooding 26-28 August 2011. Area averaged rainfall from gauge and radar data indicated a broad swath of 3 to 10 inches with over 13” at a couple of spots.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) was created by the United States Congress through the National Flood Insurance Act of 1968. It enables property owners in participating communities to purchase federally-backed flood insurance. To maintain NFIP eligibility, Philadelphia has adopted a floodplain management ordinance to regulate proposed development in floodplains, and has designated a local floodplain administrator (PCPC) to enforce that ordinance. The intent of Philadelphia's ordinance is to ensure that new construction does not exacerbate existing flood hazards and is better designed to withstand flooding. This is accomplished in the following ways: newly constructed structures are required to be raised 18 inches above the base flood elevation (BFE); new construction is prohibited within the floodway; manufactured mobile homes are restricted within Philadelphia; and certain hazardous chemicals are prohibited from being stored within floodplains. Philadelphia has also established Flood Insurance Rate Maps (FIRMs) that depict floodways, the 1-percent annual chance flood zones and the 0.2-percent annual chance flood zones (as described in Section 4.2.4.2). Though the FIRM floodplain determinations are set by FEMA, PCPC has the authority to determine the BFE in Zone A. As FIRMs are updated, PCPC conducts public outreach on the availability and value of flood insurance. Mitigation actions related to this program are included in Section 6.4.1.

The NFIP also collects information on insured structures, including the number and location of flood insurance policies, number of claims per insured property, dollar value of each claim, and repetitive loss claims. Repetitive loss insurance claims indicate areas where floodplain occupancy continues in spite of repeated inundation. Repetitive loss properties are structures insured under the NFIP, which have had at least two paid flood losses of more than $1,000 over any 10-year period since 1978. A property is considered a severe repetitive loss property either when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value.

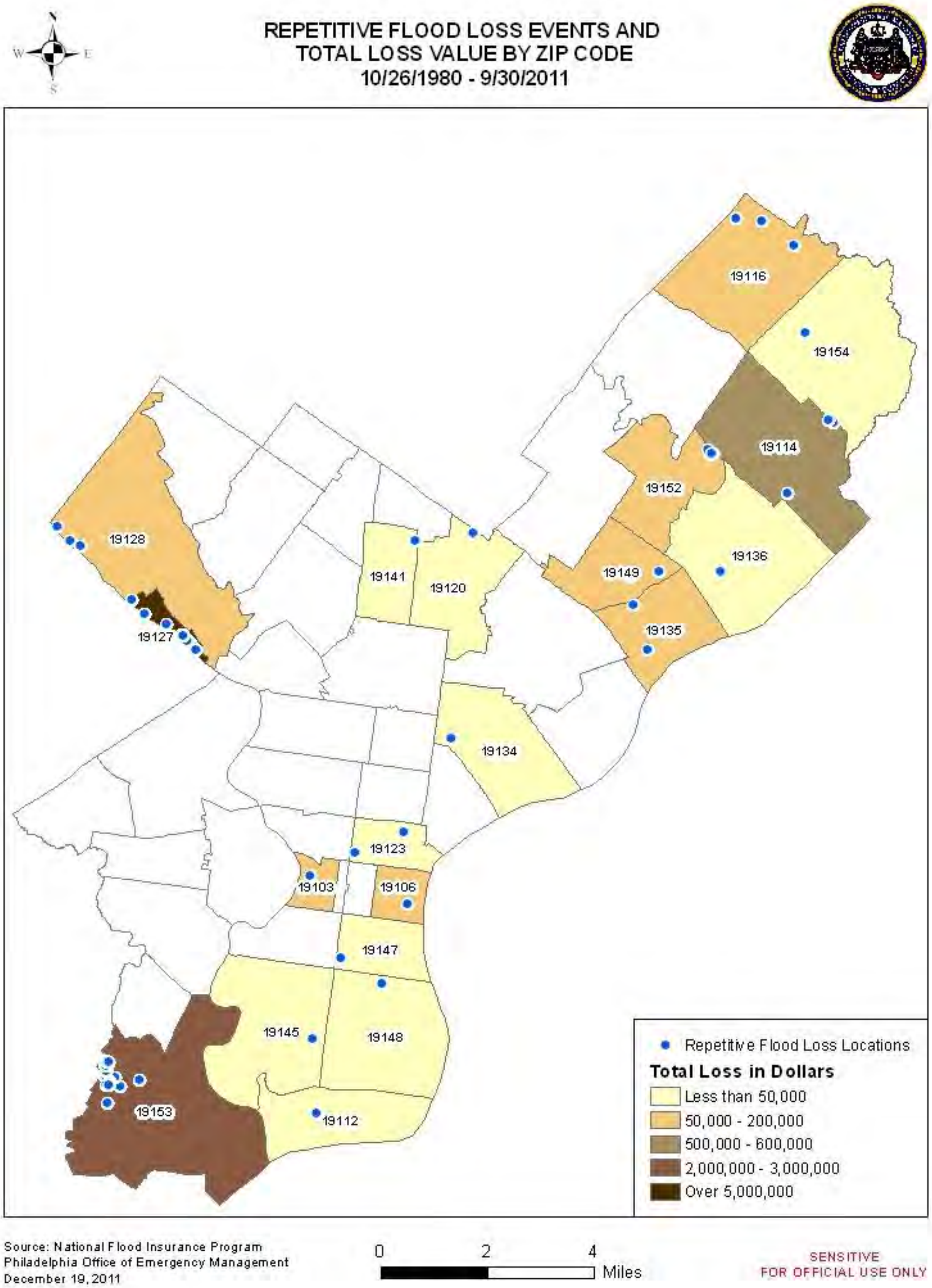
NFIP data helps indicate the location of potential flood events. The following table and map identifies the regions in Philadelphia by zip code with recorded repetitive loss policies and the amount in USD of payouts. Repetitive loss properties are a high priority for flood mitigation.

Table 4.2.4-16 Philadelphia Repetitive Loss Data by Zip code and Building Type from 10/26/1980 – 9/30/2011

Zip code	Losses	Total Paid	Zip code	Losses	Total Paid
19103	2	$108,392	19134	2	$14,622
19106	4	$64, 941	19135	4	$65,790
19112	4	$39,746	19136	3	$18,535
19114	11	$576,653	19141	2	$12,940
19116	10	$67,649	19145	2	$25,765

19120	2	$2,522	19147	5	$24,238
19122	4	$63,578	19148	2	$8,987
19123	4	$43,609	19149	5	$60,886
19127	55	$5,686,702	19152	13	$103,213
19128	14	$168,496	19153	128	$2,189,778
19130	3	$30,504	19154	2	$4,991
Total Zip codes: 22		**Total Losses: 281**		**Total Payouts: $9,317,596**	
Residential Losses: 198			**Non-Residential Losses: 83**		

Figure 4.2.4-17 Repetitive Flood Loss



4.2.4.5 Future Occurrences

Given the history of flood events that have affected Philadelphia and the many factors that contribute to the causes of flooding, it can be expected that future flooding will occur in Philadelphia. The probability of future flooding in Philadelphia is high, especially within communities located in the 1-percent annual chance area.

4.2.4.6 Vulnerability Assessment

Flooding is a significant concern for Philadelphia. To assess vulnerability, potential losses were calculated for the city for 100-year mean return period flood events. The flood hazard exposure and loss estimate analysis is presented below. In an attempt to improve the accuracy of the damage estimates, an effort was made to refine the general building stock (GBS) data packaged with HAZUS as part of a Level 2 analysis. A Level 2 analysis consists of both default data included in HAZUS, as well as detailed local information about local elevation, building inventories, utility and transportation systems data and other Philadelphia-based information.

More specifically, Office of Property Assessment (OPA), formerly BRT, tax account data from June 2009 was used to upgrade the HAZUS aggregated data tables, including building counts, square footage, and exposure by census block; City GIS data was also incorporated for critical facilities. For capital stock loss estimates, OPA (previously BRT) building market values were used instead of building replacement costs, as this was the best currently available source of data. While OPA (previously BRT) also provides assessed values for buildings throughout the City, they are generally well below market value and are not thought to adequately represent replacement costs. Building content values were also estimated as a percentage of the market value using the HAZUS default equations by building occupancy type.

A floodwater depth grid was created from the 1-percent annual chance flood zones and associated base flood elevations and cross sections from the National Flood Hazard Layer (NFHL), which is based on the January 17, 2007 DFRIM. This was overlaid with a 2008 digital elevation model (DEM) at approximately 15-foot resolution. This floodwater depth grid does not account for storm water drainage issues that commonly occur in urban areas. Upon review by PWD, it was determined that most flood complaints are random and do not necessarily come from areas within the 1-percent annual. Furthermore, this type of flooding due to urban drainage issues is more commonly associated with flash flooding and may not necessarily be reflective of a 1-percent annual chance flood event.

Impact to Philadelphia

The 1 percent annual chance area covers an area of 18.8 square miles, including a portion of all 24 police districts and 39 of 63 neighborhoods within the City of Philadelphia. Figure 4.2.4-18 is a basic representation of the City of Philadelphia's 1-percent annual chance area. This map provides a general reference of the areas of Philadelphia vulnerable to flooding during a 1-percent annual chance flood event. The extent of flooding and related flood damages is also based on elevation and depth of flooding, which are shown in Figure 4.2.4-19.

Figure 4.2.4-18: 1-percent Annual Chance Area

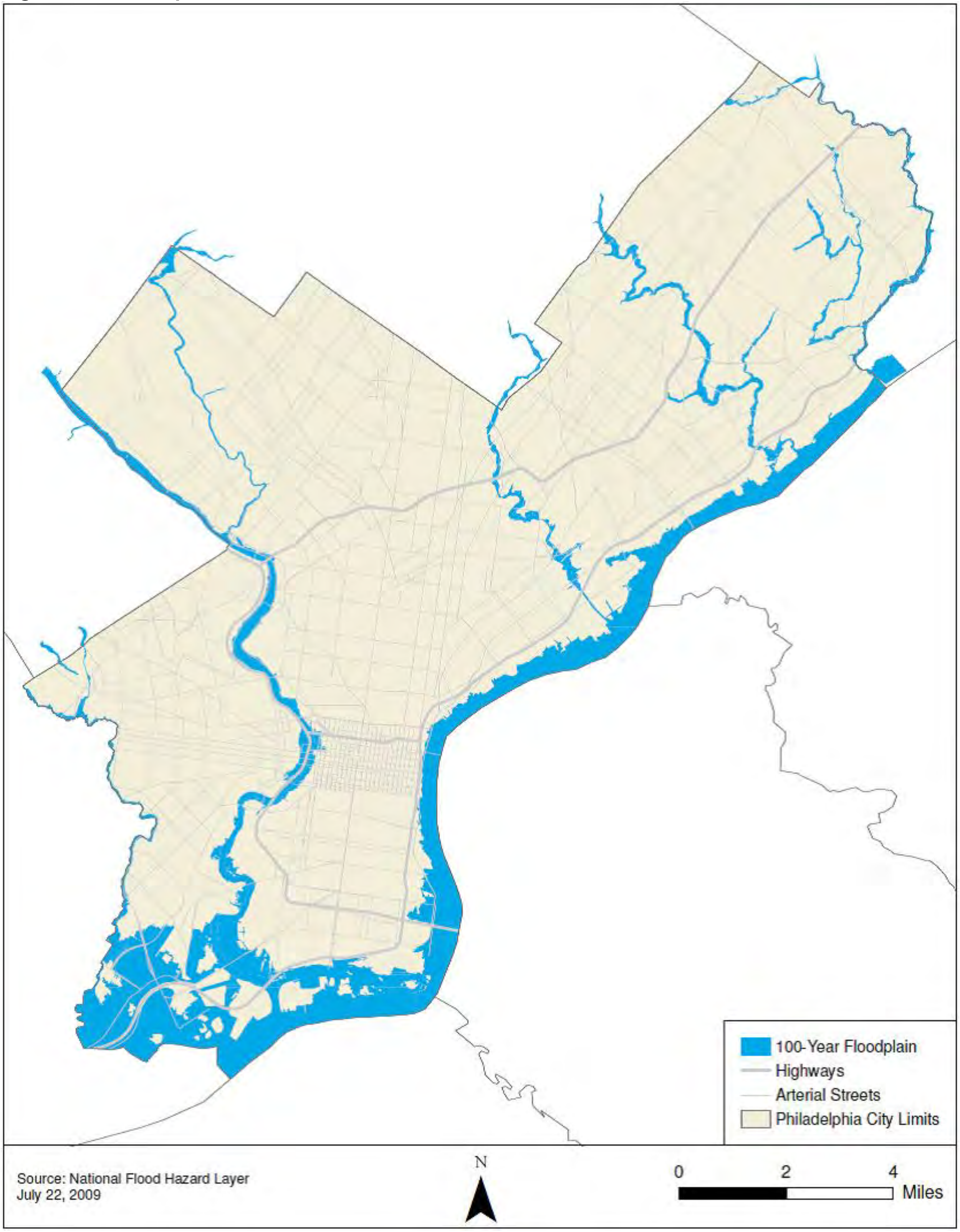
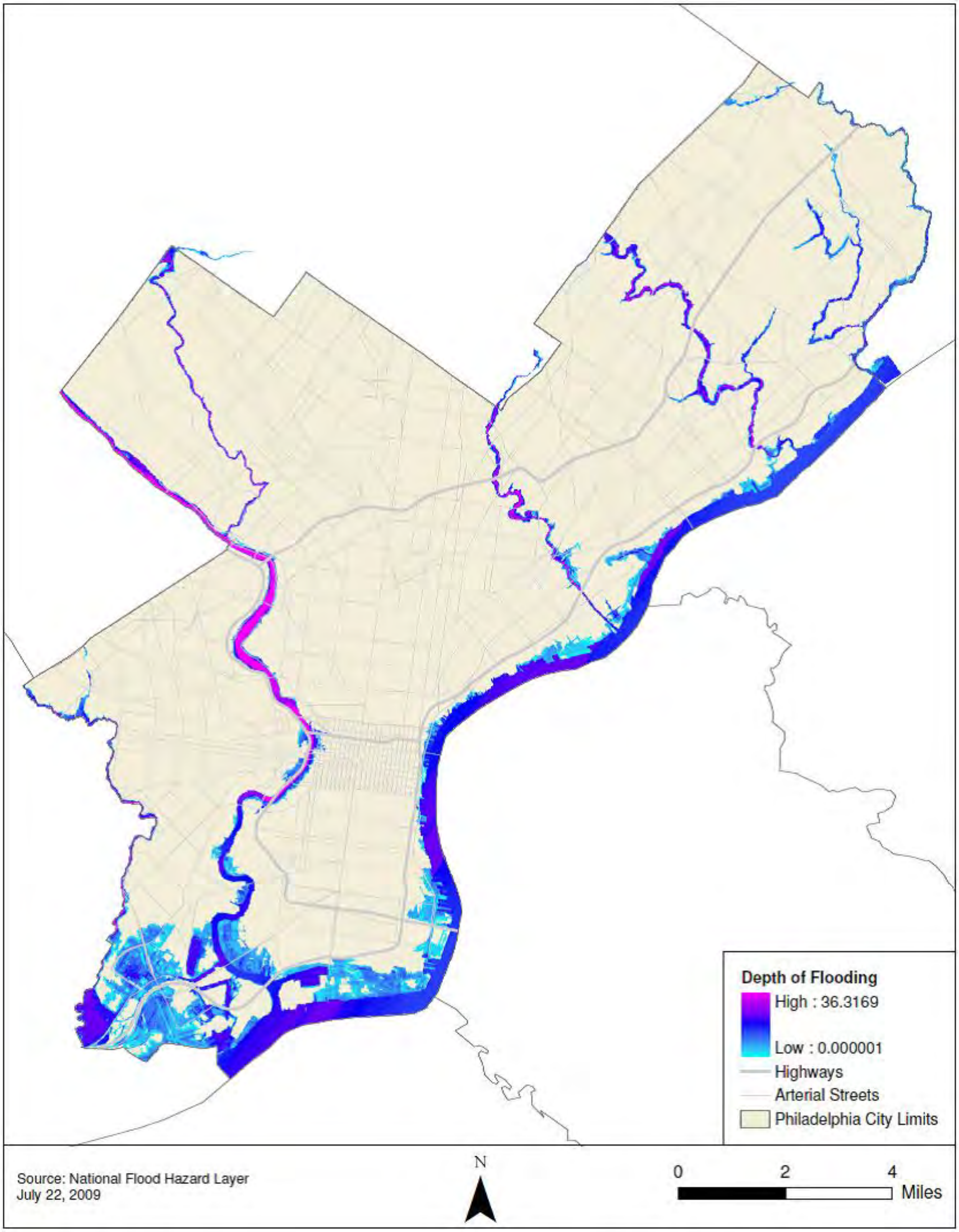


Figure 4.2.4-19: Flood Depth Grid



Environmental Vulnerability
Floods can have a significant impact on the environment depending upon their magnitude. A severe flood can overload sewer systems, which can result in the leakage of raw sewage into bodies of water. There are 460 hazardous material facilities located within floodplains in Philadelphia. Damage to one of these buildings can lead to the potential for toxic materials to be released into the waterways. Other environmental impacts of flooding include stream bed changes, catchment run-offs, erosion, the emergence of health issues due to water-borne diseases, and the loss of vegetation and wildlife.

Structural Vulnerability
According to the June 2009 OPA (previously BRT) tax account data, there are an estimated 530,000 buildings in the City of Philadelphia. Approximately 3,600 of those are located within the 1-percent annual chance area, including a number of critical facilities, listed in the table below.

Table 4.2.4-20 Critical Assets Located in the 1-percent Annual Chance Floodplain		
Critical Asset	**Total Number in City**	**Number in Floodplain**
Rail Stations	48	3
Subway/Subsurface Trolley Stations	57	1
Airports	2	1
Police Stations	22	1
Fire/EMS Stations	62	3
Emergency Operations Center	1	0
Schools	438	5
Colleges/Universities	30	0
Hospitals	31	0
Dialysis Centers	43	1
Nursing Homes	51	0
Water/Wastewater Treatment Facilities	6	1
Electric Substations	Number Unknown	2+
Hazardous Material Reporting Facilities	405	42

The table below provides the estimated building damage count and extent of damage by occupancy type based on the HAZUS output for a 100-year flood. The general building stock data input into HAZUS was classified into residential, commercial, industrial, education, religion, and government land use categories, but only residential, commercial and industrial had significant building damage.

Table 4.2.4-21 Estimated Building Damage Count and Extent of Damage by Occupancy Type

Occupancy Type	Percent of Building Damage							
	None	1-10%	11-20%	21-30%	31-40%	41-50%	> 50%	Total
Residential	1,521	0	200	222	476	423	524	3,366
Commercial	0	0	13	9	2	1	1	26
Industrial	0	0	20	0	1	0	1	22
Total	**1,521**	**0**	**233**	**231**	**479**	**424**	**526**	**3,414**

Source: HAZUS

It should be noted that the total number of buildings in the 1-percent annual chance area is different from the number of buildings potentially damaged by flooding. Damage estimates take into account elevation and depth of flooding, not just location within the floodplain.

Potential Loss Estimate
The table below breaks down the total direct economic loss citywide that may result from a 100-year flood event as calculated by HAZUS. Total direct economic loss due to flooding includes not only building and content loss but projected loss of income, worker wages, and inventories. This increases potential losses in commercial or industrial areas, where larger numbers of jobs may be unavailable as a result of flood damage.

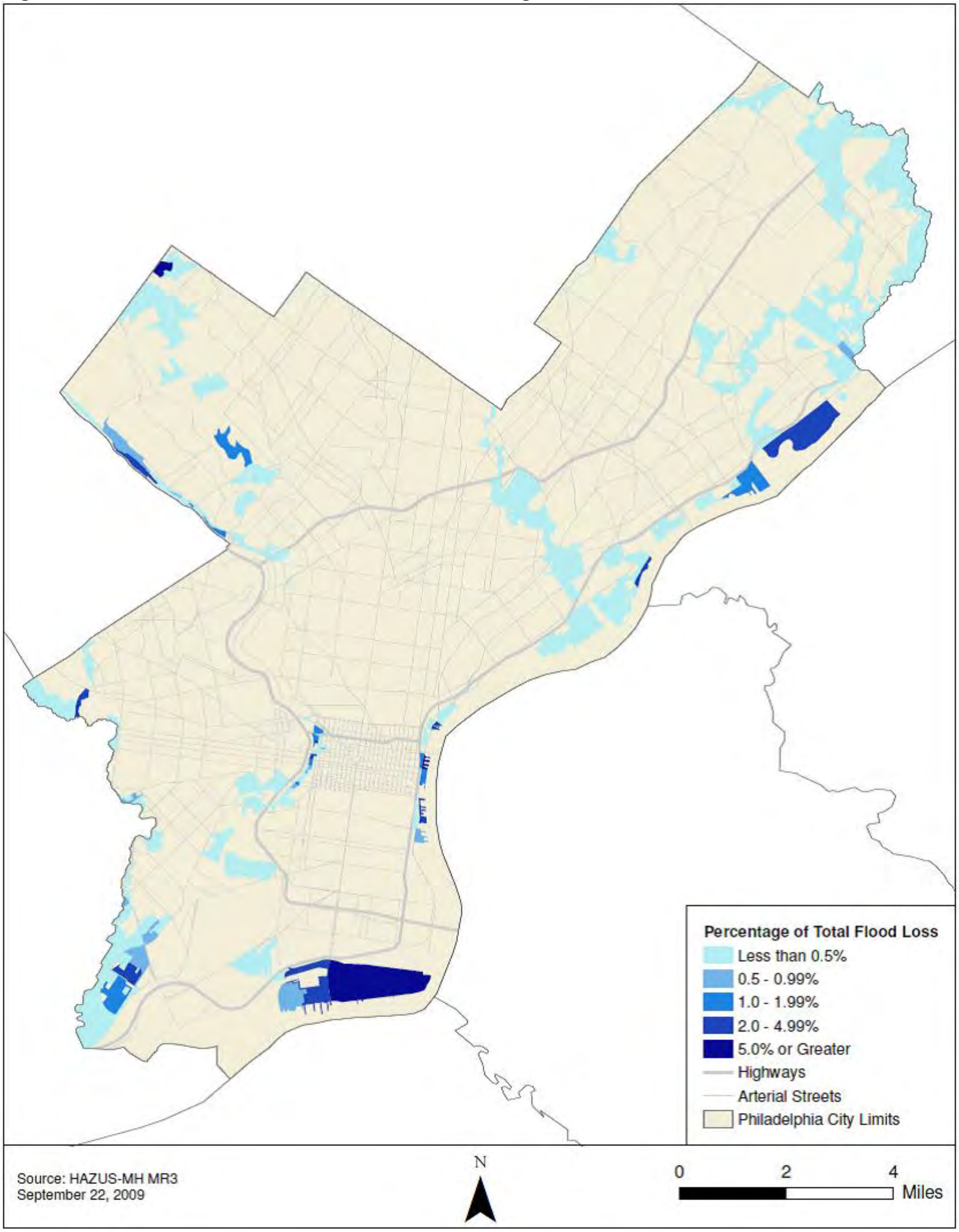
HAZUS calculates flood damage to general building stock as a percentage based on depth of flooding and then uses an equation to convert to dollar loss estimates. The equations used in this model to calculate damages are the HAZUS defaults, but the general building stock replacement values and flood depth data were updated by the Philadelphia Office of Emergency Management using 2009 OPA (previously BRT) data, a digital elevation model, and Digital Flood Insurance Rate Maps (DFIRM)[109] data.

[109] These maps are used to calculate the cost insurance premiums; establish flood risk zones and base flood elevations to militate against potential future flood damages to properties.

Table 4.2.4-22 Direct Economic Loss from a 100-Year Flood Event	
Type of Loss	**Dollar Amount ($)**
Building Loss	211,514,000
Contents Loss	340,797,000
Inventory Loss	81,646,000
Relocation Cost	1,213,000
Income Loss	2,859,000
Rental Income Loss	941,000
Wage Loss	4,226,000
Total Loss	**643,196,000**

Figure 4.2.4-23 shows the spatial distribution of this economic loss throughout the City in terms of percentage of total loss based on full replacement values. The areas with the highest potential loss include several blocks on the east and west ends of Center City adjacent to the Delaware and Schuylkill Rivers, as well as blocks in Manayunk along the Schuylkill River. In addition, the Navy Yard in South Philadelphia and areas in Southwest and Northeast Philadelphia could experience significant economic loss during a 1-percent annual chance flood event.

Figure 4.2.4-23: Direct Economic Loss Due to Flooding



However, it should also be noted that this model may not accurately assess damages to larger, high replacement cost facilities located in the floodplain, particularly, Philadelphia International Airport and Sunoco Refinery, which cover significant geographic areas that may experience varying extents of flood damage throughout.

Included in the total loss is damage to residential structures, which is estimated to displace 4,022 households during a 1-percent annual chance flood event. The following table provides HAZUS information on the estimated number of people displaced[110] and the number of people that would require short-term sheltering[111] based Census 2000 population data.

Table 4.2.4-24 Estimated Shelter Needs by Police District during a 100-Year Flood Event

Police District	People Displaced	People Requiring Short-Term Shelter
Central Division	**1,459**	**1,398**
District 6	434	417
District 9	1,025	981
District 22	0	0
District 23	0	0
East Division	**216**	**180**
District 24	183	166
District 25	33	14
District 26	0	0
Northeast Division	**4,725**	**4,220**
District 2	81	68
District 7	569	498
District 8	3,339	3,043
District 15	736	611
Northwest Division	**494**	**334**
District 5	222	170
District 14	109	89
District 35	28	10
District 39	135	65
South Division	**52**	**19**
District 1	0	0
District 3	49	19
District 4	0	0

[110] Displaced persons are individuals who would be evacuated under the assumption that any portion of a census block that is flooded initially would have all of the residents removed from the area.

[111] The number of persons requiring sheltering is a subset of the displaced or evacuated population based on the extent of projected building damage within a census block and weighted by income and age, such that elderly and low-income persons are more likely to require sheltering.

Table 4.2.4-24 Estimated Shelter Needs by Police District during a 100-Year Flood Event		
Police District	**People Displaced**	**People Requiring Short-Term Shelter**
District 17	3	0
Southwest Division	**5,119**	**4,930**
District 12	5,086	4,925
District 16	0	0
District 18	31	5
District 19	2	0
Total	**12,065**	**11,081**

Source: HAZUS, 2009

4.2.5 Tropical Cyclones – Hurricanes and Tropical Storms

4.2.5.1 Hazard Description

Hurricanes and Tropical Storms

A tropical cyclone is a general term for large thunderstorm complexes rotating around an area of low-pressure that has formed over warm tropical or sub-tropical ocean water. These complexes go by a variety of names depending on their intensity and location. According to the NOAA Hurricane Research Division, tropical cyclones are classified as follows:[112]

- Tropical Disturbance: A discrete tropical weather system of apparently organized convection - generally 200 to 600 km (100 to 300 nmi) in diameter - originating in the tropics or subtropics, having a non-frontal migratory character, and maintaining its identity for 24 hours or more. It may or may not be associated with a detectable perturbation of the wind field. Disturbances associated with perturbations in the wind field and progressing through the tropics from east to west are also known as easterly waves.
- Tropical Depression: A tropical cyclone in which the maximum sustained wind speed (using the U.S. 1 minute average standard) is up to 33 kt (38 mph, 17 m/s). Depressions have a closed circulation.
- Tropical Storm: A tropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1 minute average standard) ranges from 34 kt (39 mph,17.5 m/s) to 63 kt (73 mph, 32.5 m/s). The convection in tropical storms is usually more concentrated near the center with outer rainfall organizing into distinct bands.
- Hurricane: When winds in a tropical cyclone equal or exceed 64 kt (74 mph, 33 m/s) it is called a hurricane (in the Atlantic and eastern and central Pacific

[112] Hurricane Research Division. Frequently Asked Questions: What is a tropical disturbance, tropical depression or tropical storm? NOAA. Retrieved 10 December 2011.

Oceans). Hurricanes are further designated by categories on the Saffir-Simpson scale.

Figure 4.2.5-1 Progressive levels of organized disturbed weather in the tropics[113]

Source: NOAA, 2011

For a tropical disturbance to reach hurricane status, several conditions must be met:[114]

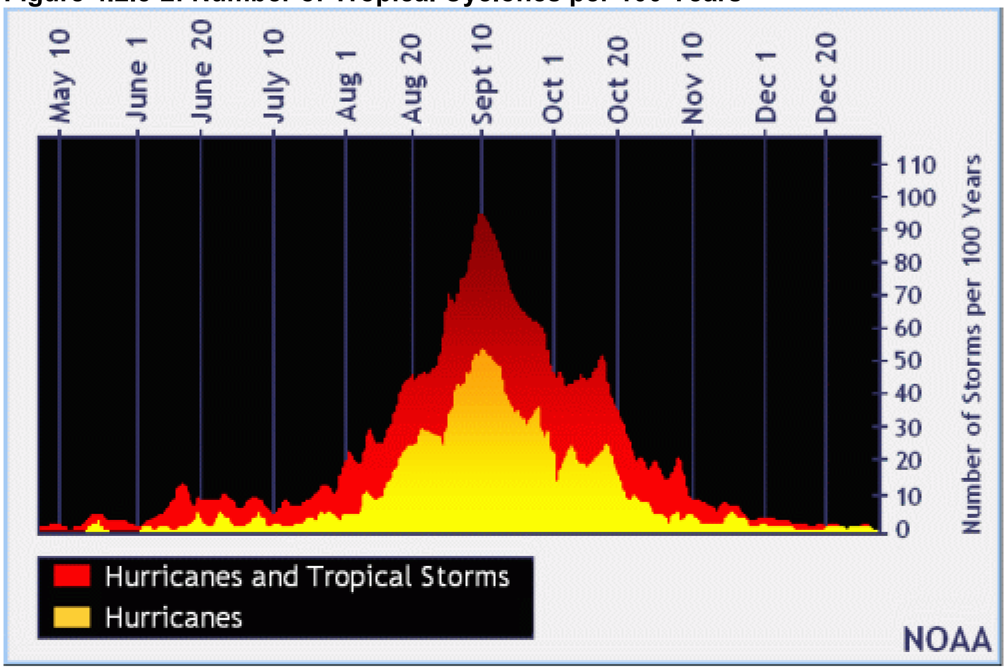
- Warm tropical waters must be at least 80°F, ideally to the depth of a few hundred feet. Warm water means plenty of evaporation and this plenty of water vapor to fuel the thunderstorm. Water temperatures off New Jersey and Delaware rarely get this warm for long periods of time and over a large area. Consequently, for a tropical system to affect Philadelphia, it has to form farther south and move northward.
- The mid-troposphere (approx. 3 miles up from the earth's surface) must be relatively moist (high dewpoints), to allow the continuing development of widespread thunderstorm activity.
- The wind speed and direction must not vary greatly from lower to higher levels in the atmosphere, (low values of vertical wind shear). Strong high-altitude winds or winds that change direction with height tend to blow tops of thunderstorms, interrupting development.
- A tropical disturbance must be at least 300 miles from the equator. This insures non-negligible amounts of the Coriolis force (a fictitious force used to account for the apparent deflection of a body in motion with respect to the earth) to provide circulation within the system.

Atlantic hurricanes form off the coast of Africa or in the Caribbean Sea, or Gulf of Mexico. Hurricanes can produce violent winds, tornadoes, powerful waves and storm surge, and torrential rains and floods. By the time most tropical systems reach Pennsylvania, they do not have hurricane-force winds.

[113] Ibid
[114] Hurricane Research Division. Frequently Asked Questions: How do tropical cyclones form? NOAA. Retrieved 10 December 2011.

The official hurricane season for the Atlantic Basin (the Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico) is from June 1 to November 30. As seen in the graph below, the peak of the season is from mid-August to late October. However, deadly hurricanes can occur any time in the hurricane season.[115]

Figure 4.2.5-2: Number of Tropical Cyclones per 100 Years[116]



Source: NOAA, 2011

4.2.5.2 Location

Philadelphia is located about 80 miles inland from the mouth of the Delaware Bay (30 miles inland from where the Delaware River meets the Bay) and approximately 60 miles from the Atlantic Coast. As such, Philadelphia is located in an area where tropical cyclones could track inland causing heavy rain and strong winds. Tropical cyclones are regional events that can affect an area hundreds of miles long. Therefore, all neighborhoods within Philadelphia are equally subject to the impacts of these storms.

Figure 4.2.5-3 shows wind speed zones developed by the American Society of Civil Engineers based on information including 40 years of tornado history and over 10years of hurricane history.[117] This wind zone map represents the strongest wind speeds anticipated throughout Pennsylvania. According to this map, Philadelphia falls within wind zone II (wind speeds up to 160 mph) and wholly within the identified Hurricane Susceptibility Region.

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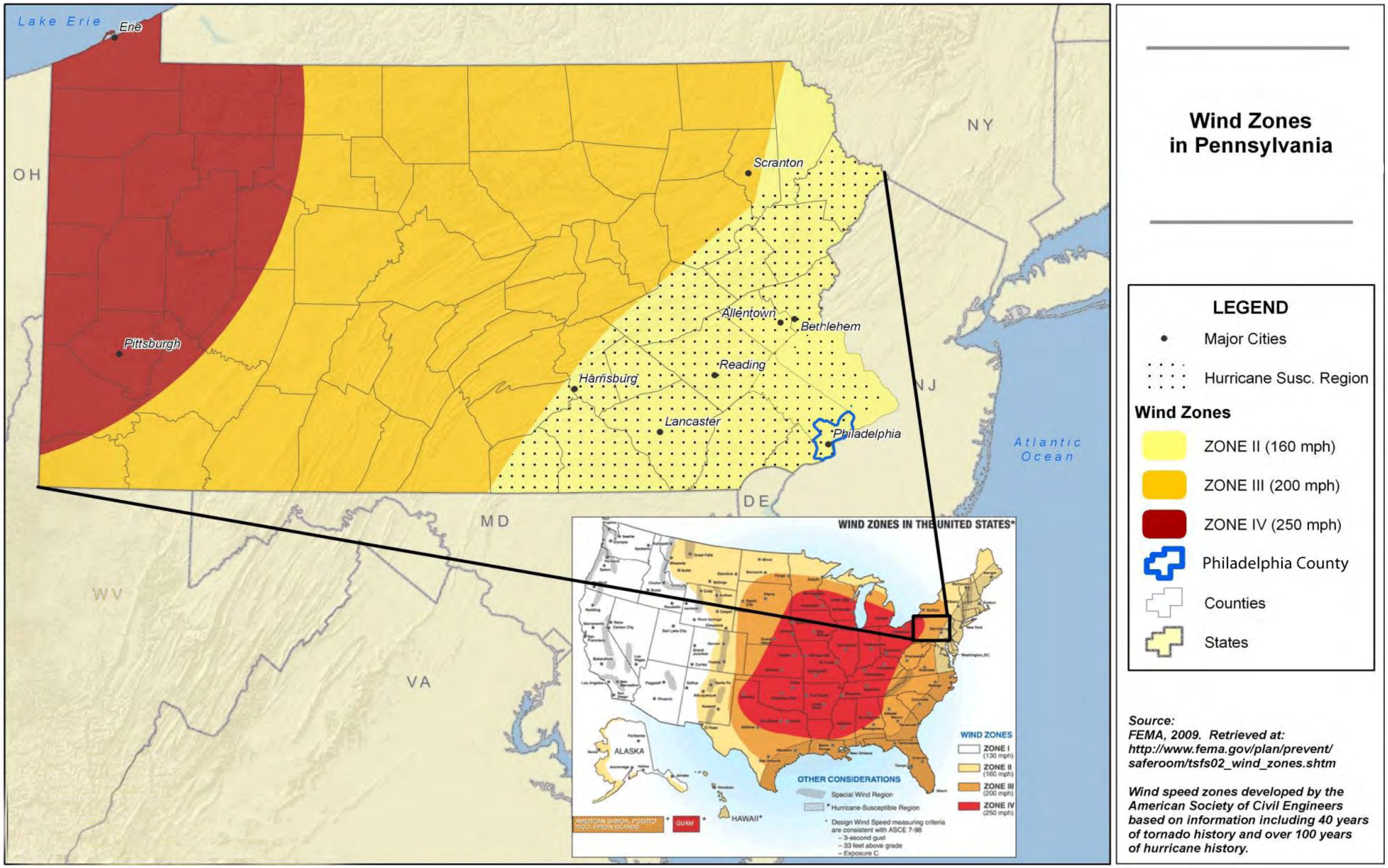
115 National Hurricane Center. Tropical Cyclone Climatology. National Weather Service. Retrieved 10 December 2011

116 Ibid.

117 Federal Emergency Management Agency. Wind Zones in the United States. Retrieved 10 December 2011.

Figure 4.2.5-3 Wind Zones



4.2.6.3 Range of Magnitude

Hurricanes are classified by their wind speed on a damage-potential scale developed by Herbert Saffir, a consulting engineer, and Robert Simpson, a NWS meteorologist, in the 1970s. The Saffir-Simpson Scale (Table 4.2.5-4) is divided into five categories based on the highest 1-minute average wind speed in the storm. A hurricane's category typically changes as it intensifies or weakens. Meteorologists describe Category 3 through Category 5 hurricanes as major hurricanes.

Table 4.2.5-4 Saffir-Simpson Hurricane Scale

Category	Storm Surge	Winds	Damage	Damage Description
1	6.1 – 10.5 ft.	74-95 mph	Moderate	• Damage primarily to trees and unanchored homes • Some damage to poorly constructed signs • Coastal road flooding
2	13.0-16.6 ft.	96-110 mph	Moderate – Severe	• Some roofing material, door, and window damage to buildings • Considerable damage to shrubbery and trees • Flooding of low-lying areas
3	14.8-25 ft.	111-130 mph	Extensive	• Some structural damage to residences and utility buildings • Foliage blown off trees and large trees blown down • Structures close to the coast will have structural damage by floating debris
4	24.6-31.3 ft.	131-155 mph	Extreme	• Curtain wall failures with utilities and roof structures on residential buildings • Shrubs, trees, and signs all blown down • Extensive damage to doors and windows • Major damage to lower floors of structures near the shore

5	Not predicted	>155 mph	Catastrophic	• Complete roof failure on many residences and industrial buildings • Some complete building and utility failures • Severe, extensive window and door damage • Major damage to lower floors of all structures close to shore

Source: National Hurricane Center, 2011

Wind speeds in most hurricanes diminish exponentially once they make landfall; their wind speed is generally reduced in half within about 7 hours after the storm crosses the coastline.[118] However, hurricanes occasionally do not lose their strength and transition to become extratropical cyclones, cyclones in the middle or high latitudes often associated with an extensive cold front. In 1954, Hurricane Hazel made landfall in North Carolina, yet maintained close to 100mph winds when entering the Philadelphia region. More information on Hazel is provided in the following section.

4.2.6.4 Past Occurrences

NOAA's Coastal Services Center maintains records of all coastal storms occurring in the Atlantic Basin since the 1850s. Table 4.2.5-5 lists all coastal storms having centers of circulation to past through or within 65 statute miles of Philadelphia. Figure 4.2.5-6 below shows the path of hurricane and tropical storm events within 100 miles of Philadelphia.

Table 4.2.5-5 Previous Coastal Storms Near Philadelphia

Year	Event	Peak Intensity	Strength In/Near Philadelphia
2011	Irene	Cat. 2 Hurricane	Tropical Storm
2008	Hanna	Cat. 1 Hurricane	Tropical Storm
2000	Gordon	Cat. 1 Hurricane	Extra-Tropical Storm
1999	Floyd	Cat. 5 Hurricane	Tropical Storm
1996	Bertha	Cat. 3 Hurricane	Tropical Storm

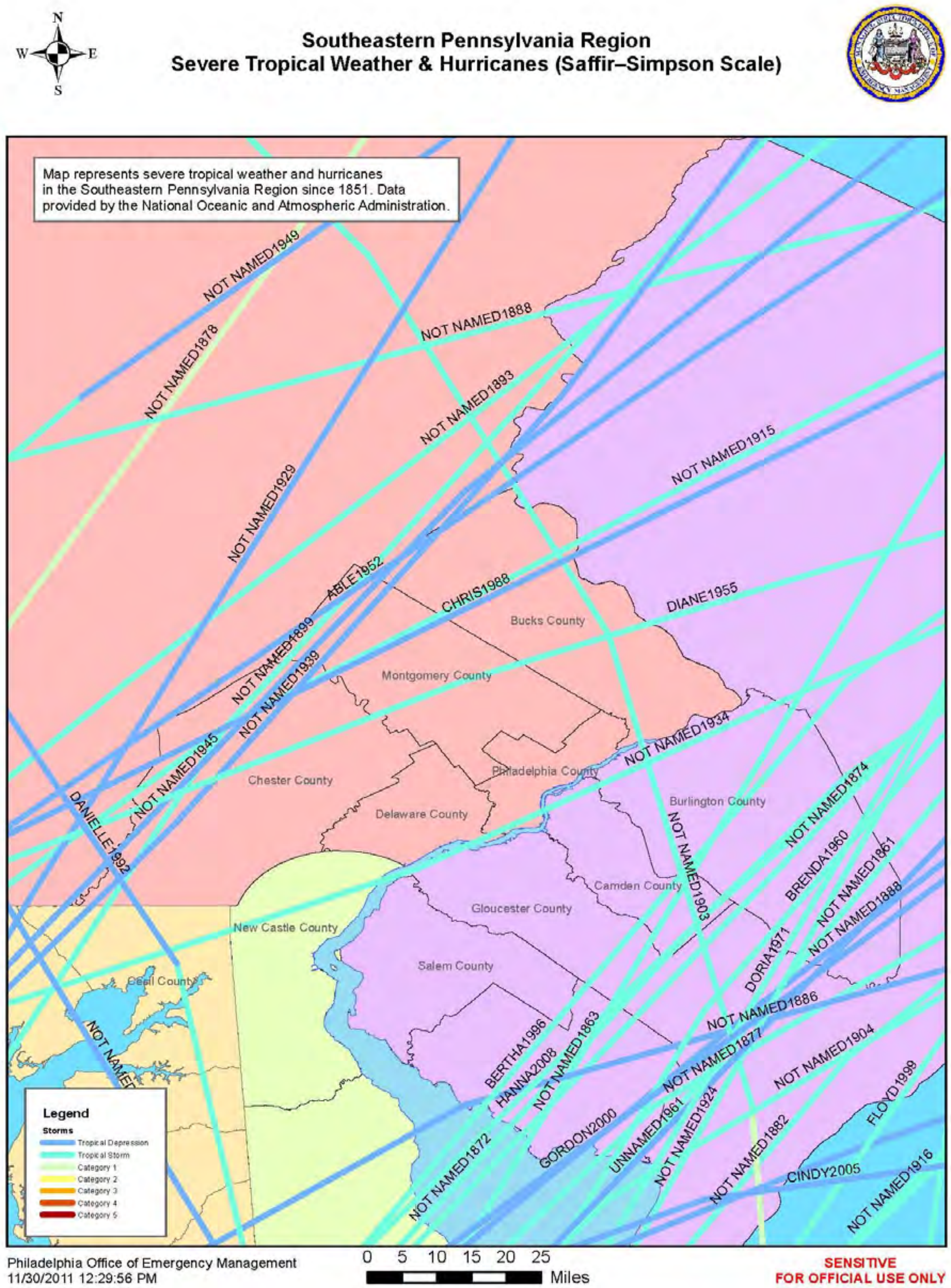
[118] Keller, Blodgett. Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes. Second Edition.2008.

1992	Danielle	Tropical Storm	Tropical Storm
1988	Chris	Tropical Storm	Tropical Depression
1971	Doria	Tropical Storm	Tropical Storm
1961	Unnamed	Tropical Storm	Tropical Storm
1960	Brenda	Tropical Storm	Tropical Storm
1955	Diane	Cat. 3 Hurricane	Tropical Storm
1952	Able	Cat. 2 Hurricane	Tropical Storm
1945	Not Named	Cat. 4 Hurricane	Extra-Tropical Storm
1939	Not Named	Cat. 1 Hurricane	Tropical Depression
1934	Not Named	Cat. 1 Hurricane	Extra-Tropical Storm
1929	Not Named	Cat. 4 Hurricane	Extra-Tropical Storm
1915	Not Named	Cat. 1 Hurricane	Tropical Storm
1903	Not Named	Cat. 2 Hurricane	Tropical Storm
1899	Not Named	Cat. 2 Hurricane	Extra-Tropical Storm
1893	Not Named	Cat. 3 Hurricane	Tropical Storm
1888	Not Named	Tropical Storm	Extra-Tropical Storm
1886	Not Named	Cat. 2 Hurricane	Tropical Depression
1882	Not Named	Tropical Storm	Tropical Storm
1877	Not Named	Cat. 3 Hurricane	Extra-Tropical Storm
1874	Not Named	Cat. 1 Hurricane	Tropical Storm
1872	Not Named	Cat. 1 Hurricane	Tropical Storm
1866	Not Named	Cat. 1 Hurricane	Tropical Storm
1863	Not Named	Tropical Storm	Tropical Storm

1861	Not Named	Cat. 1 Hurricane	Tropical Storm

Source: NOAA, 2011

Figure 4.2.5-6 Severe Tropical Cyclones Passing through Southeastern PA



It is important to note that a number of hurricane and tropical storm events have affected Philadelphia even without tracking through or near the City. The data below highlights some memorable tropical systems in Philadelphia.[119],[120]

Table 4.2.5-7 Previous Tropical Cyclones in Philadelphia

Date	Event	Description
September 2011	Tropical Storm Lee	• 6.35 inches of rain reported at PHL • Significant flash flooding in East Germantown area • 1 fatality • 2.99 inches of rain in a 3-hour period • High crest on Schuylkill - 12.53 ft. • High crest on Wissahickon Creek – 10.89 ft. • High crest on Cobbs Creek – 16.79 ft. • Total hours above flood stage Schuylkill River – 31.5 hours • Kelly Drive remained closed between Midvale Ave and 25th Street for 72 consecutive hours • Heavy rains and rockslides closed the Schuylkill Expressway
August 27-28, 2011	Hurricane Irene	• 5.7 inches of rain; 2.39 inches of rain in a 3-hour period • SEPTA halted all commuter rail service during the evening of August 27th • PHL closed at 10:30pm on the 27th and reopened Monday August 29th • Thousands were left without power, more than 400 trees fell in the City, 7 buildings collapsed and 20 roads were closed • PECO restored all power by August 31st • Worst creek and river flooding since Hurricane Floyd in 1999 • High tide reached 9.89 ft. along the Delaware; moderate tidal flooding begins at 9.2ft. • Highest winds recorded were 52mph at PHL; 45mph at PNE • Schuylkill River has moderate flooding and its 7th highest crest on record; crested at 13.57ft. • Total hours above flood stage Schuylkill River – 21 hours

[119] Ibid.
[120] National Climatic Data Center. Storm Reports:Pennsylvania:Philadelphia:Flood. National Oceanic and Atmospheric Administration. Retrieved 13 December 2011.

		• Total consecutive hours Kelly Drive flooded – 23 hours • Wissahickon Creek at its mouth had major flooding; tied its 2nd highest crest on record – 10.54ft. • Pennypack Creek at the Rhawn Street Bridge had moderate flooding, crested at 9.39ft. • Frankford Creek at Castor Ave had major flooding, 2nd highest crest on record – 13.15ft. • High crest on Cobbs Creek – 14.83 ft.
September 28-29, 2004	Hurricane Jeanne	• Approximately 4-9 inches within Philadelphia; highest amounts in the Northwest • Storm totals – 9.12inches in Roxborough, 5.98 inches at Fairmount Dam, 5.77 inches and 3.63 inches at PHL • Widespread poor drainage and creek flooding occurred throughout the City • Heaviest rains coincided with evening commute • Schuylkill Expressway shut down for a period of time after 1ft of water covered the road; numerous rescues were made • 1 fatality in the East Falls section of the City • 400 people were evacuated off a commuter train due to loose soil underneath rails • Several buildings collapsed • Frankford Creek at Castor Ave crested at 13.91ft (flood stage – 7ft.) • Wissahickon Creek crested at 10.14ft (flood stage – 5ft.) • Pennypack Creek crested at 12.63ft (flood stage – 7ft.) • Schuylkill River crested at 11.86ft (flood stage – 11ft.) • $290 million in losses throughout PA
September 18, 2003	Hurricane Isabel	• Worst outage on record for PECO Energy in Southeast Pennsylvania – approximately 572,425 lost power; estimated $20 million for PECO to install 81 miles of new cable and 7,600 new fuses and circuit breakers • Moderate tidal flooding occurred – Delaware crested at 9.47ft.; storm surge 5.43ft. • Wind gust to 49 mph • Rain total 1.14 inches • 1 injury due to flying debris

June 17, 2001	Tropical Storm Allison	• 3.38 inches of rain recorded at PHL; 2.62 inches at Franklin Institute • Severe flooding in the Wissahickon and Pennypack water basins • Flooding occurred along the Wissahickon Creek causing several road closures; Creek crested at 9.73ft (flood stage 5ft.) • Pennypack Creek crested at 13.12ft (flood stage – 7ft.) • Frankford Creek at Castor Ave crested at 8.821ft (flood stage – 7ft.)
September 16, 1999	Hurricane Floyd	• 6.63 inches of rain was reported in 1-day (12am – 11:59pm) at PHL - set an all-time record; • During the course of 24 hours 8.12 inches recorded at Franklin Institute; 8.09 inches at Temple University, 7.11 inches at Fairmount Park and 6.77 inches at PHL • In a matter of hours, rivers and creeks exceeded flood above the flood stage Manayunk sustained severe flooding • Delaware River near Washington crested at 9.4ft; moderate tidal flooding begins at 9.2ft. • Peak wind gusts recorded – 48mph at PHL • 1 fatality recorded in Fairmount Park • Approximately 412,000 PECO customers without power • School children were dismissed from school early
June 22, 1972	Hurricane Agnes	• Record damage • About 75 percent of Pennsylvania received at least 6 inches of rain • In Philadelphia, a relatively light 4-5 inches fell; • Manayunk and Center City along the River flooded. • The Schuylkill's crest of 14.67 feet at Fairmount Park • The highest level it has reached in the 20th century.
August 27-28, 1971	Tropical Storm Doria	• Weak tropical storm • Winds minimal, gusting briefly to 38 mph • 6.5 inches over a two-day period
August 18. 1955	Hurricane Diane	• Arrived less than a week after Connie • Caused additional flooding in both the Delaware and Schuylkill Rivers
August 13, 1955	Hurricane Connie	• Tracked well west of Philadelphia • Winds of 40 to 60 mph were reported • 5.5 inches of rain was reported • Significant flooding caused, especially along Delaware Ave. from Spring Garden Street to South Street.

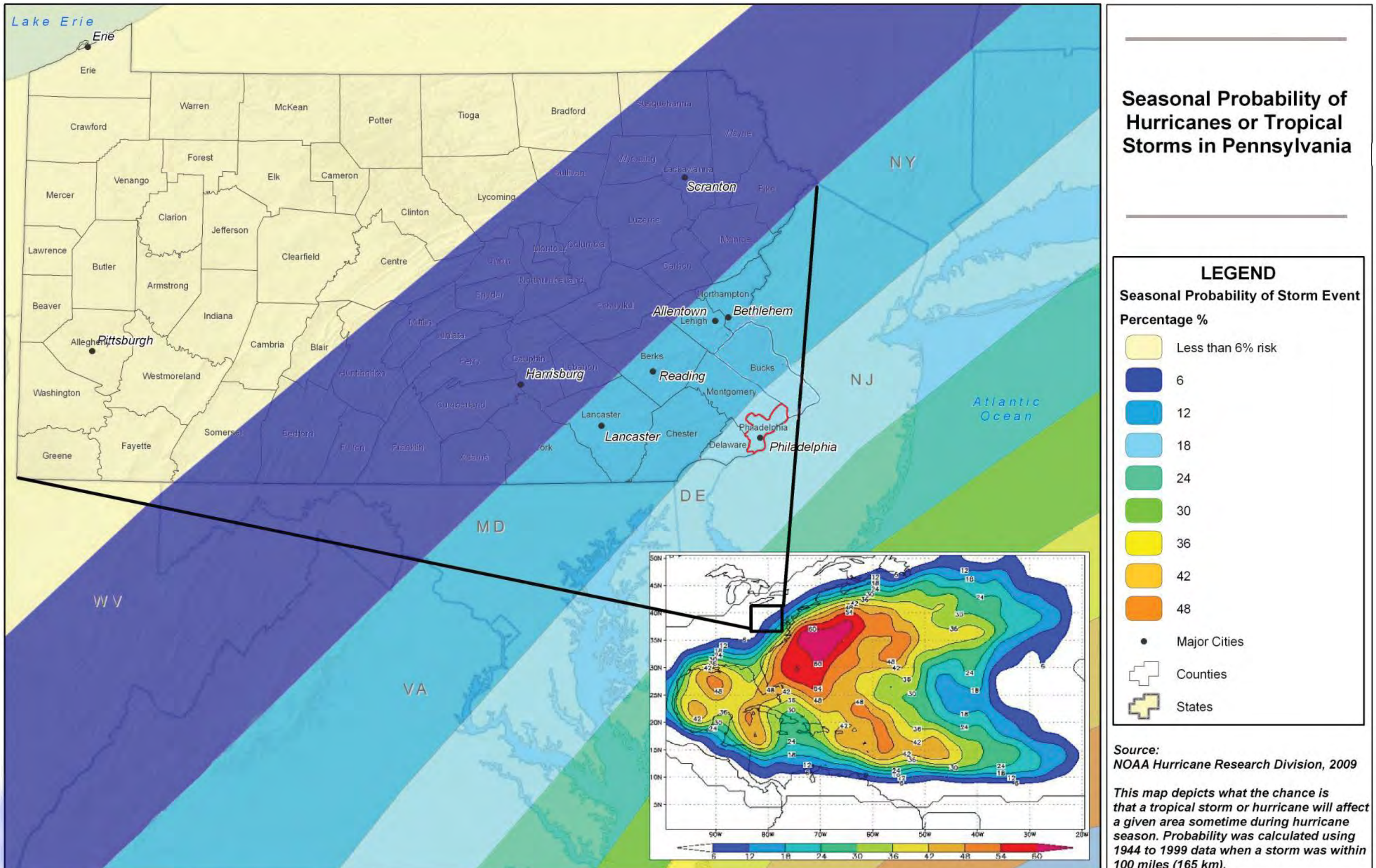
October 15, 1954	Hurricane Hazel	• Did not produce much rain, less than an inch of rain was recorded. • More of a windstorm, producing the highest wind gusts ever officially recorded in Philadelphia at 94 mph. • All across the region, wind caused widespread destruction. Homes and buildings were damaged, trees were uprooted, and transportation, communication and utility services were disrupted.
August 23, 1933	Not Named	• Known as the "Chesapeake-Potomac" hurricane • Made landfall near the North Carolina/Virginia border • 5.6 inches of rain over a 3 day period was recorded in Philadelphia
September 16, 1903	Not Named	• Last recorded hurricane landfall on the New Jersey shore, until Hurricane Irene in 2011. • Category 1 storm at the time of landfall • Center passed close to Philadelphia.
October 23, 1878	Not Named	• Center passed west of Philadelphia, putting the City on the most dangerous side of the storm. • Hurricane force winds and considerable damage reported throughout the area. • Peak wind reported 72 mph • 7 people killed. • Damage was approximately $2 million.
September 3, 1821	Norfolk and Long Island Hurricane	• Center of this storm passed over Cape Henlopen, DE and Cape May, NJ as a Category 3 or Category 4 hurricane. • Philadelphia experienced strong winds, which knocked down trees and chimney, and over 4 inches of rain fell from this system.

4.2.5.5 Future Occurrences

NOAA's Hurricane and Research Division published information regarding the chance that a tropical storm or hurricane will affect a given area during the entire Atlantic hurricane season (Figure 4.2.5-8).[121] Based on historical data between 1944 and 1999, this map reveals there is approximately an 18 percent chance of Philadelphia experiencing a tropical storm or hurricane event between June and November of any given year. Note that this figure does not provide information on the probability of various storm intensities.

[121] Hurricane Research Division. Frequently Asked Questions: What is my chance of being struck by a tropical storm or hurricane? NOAA. Retrieved 13 December 2011

Figure 4.2.5-8: Seasonal Probability of Hurricane or Tropical Storms



4.2.5.6 Vulnerability Assessment

High winds and flooding are the primary hazards associated with tropical cyclones. High winds often result in power outages, disruptions to transportation corridors and equipment, loss of workplace access, significant property damage, injuries and loss of life, and the need to shelter and care for individuals impacted by these events. A large amount of damage can be inflicted by trees, branches, and other objects that fall onto power lines, buildings, roads, vehicles, and, in some cases, individuals.

Additionally, tropical cyclones can bring heavy rains and storm surge, which can cause significant flooding. Storm surge is an abnormal rise in sea level accompanying an intense storm, whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the storm.[122] In general, storm surge is greatest in the right forward quadrant of the storm as it makes landfall. In simple terms the right forward quadrant includes the area of the storm that is in front of the storm's eyewall and on the right side of the storm. The height of the surge is generally greatest near the time of maximum wind speed and is greater if landfall takes place at high tide. In addition, the shape of the coastline affects storm surge. In a narrow Bay, such as the Delaware Bay, storm surge may increase as water sloshes back and forth in the partially enclosed body of water. Therefore, a worst-case scenario for Philadelphia would include a high magnitude hurricane moving up the Delaware Bay during high tide with the center of the storm slightly to the west of Philadelphia.

Due to Philadelphia's mid-latitude, inland location, by the time most storms reach the area, they fail to satisfy the definition of a hurricane or tropical storm. However, the City has experienced flooding in association with hurricanes and tropical storms in the past. Flooding due to heavy rains was addressed under the Flood Hazard Profile within this plan, but storm surge related flooding will be covered in this section.

Data and Methodology

Two computer models were used to assess the two primary impacts associated with hurricanes: SLOSH for storm surge and HAZUS for hurricane winds.

NOAA's Sea, Lake, and Overland Surge from Hurricanes (SLOSH) Display Package estimates storm surge heights for different hurricane scenarios and can be used to assess potential flooding and need for evacuation. The SLOSH analysis presented here is based on maximum storm surge heights at high tide for all hurricanes of a given category. Separate maximum composite storm surge grids for Category 1, 2, and 3 hurricanes in the Delaware Bay SLOSH basin (de2) were overlaid with a 2008 Digital Elevation Model (DEM) of the City to identify areas that may potentially flood in each category of storm. Each area is identified by the lowest category hurricane that would affect it. Results are intended to be inclusive, such that areas affected by a lower category hurricane would also be affected by more intense hurricanes.

[122] Ibid

HAZUS is FEMA's methodology for estimating potential losses from disasters, and contains a hurricane module that focuses on hurricane winds and estimates related effects on population and infrastructure. This model was applied using the same general building stock data compiled for the flood hazard analysis. No additional modifications were made to the hurricane model, as reliable data was not readily available.

Impact to Philadelphia
The likelihood for hurricane-strength winds in Philadelphia is relatively low because of its northern, inland location. Wind speeds of 74 mph and higher are generally considered hurricane-strength; Philadelphia has approximately a one percent chance of experiencing this in any given year. The following table shows the peak wind gusts that Philadelphia could experience associated with a hurricane and the related probability of occurrence.

Table 4.2.5-9 Peak Wind Gusts Associated with Hurricanes in Philadelphia

Return Period	Likelihood of Exceeding in any Given Year	Peak Wind Gust
10-Year	10%	37 - 40 mph
20-Year	5%	49 – 53 mph
50-Year	2%	63 – 68 mph
100-Year	1%	73 – 78 mph
200-Year	0.5%	81 – 86 mph
500-Year	0.2%	92 – 96 mph
1000-Year	0.1%	98 – 103 mph

Environmental Vulnerability
The environmental impacts associated with tropical cyclones in Philadelphia are consistent with those described for flood hazards in Section 4.2.4.6 and wind hazards in Section 4.2.6.6.

Structural and Economic Vulnerability
Building damages associated with these winds are given in Table 4.2.5-10 and related economic losses in Table 4.2.5-11, no building damage or economic loss is associated with the 10 or 20-year return periods. Thus, the likelihood of experiencing building damage or economic loss due to hurricane winds in Philadelphia is approximately 2 percent in any given year, although total destruction of buildings is less likely.

Figure 4.2.5-10 Building Damage Counts due to Hurricane Winds (Probabilistic)					
Return Period	**Minor Damage**	**Moderate Damage**	**Severe Damage**	**Destruction**	**Total**
10-Year	0	0	0	0	0
20-Year	0	0	0	0	0
50-Year	2,398	146	7	0	2,551
100-Year	8,539	1,369	16	0	9,924
200-Year	24,376	6,240	77	1	30,693
500-Year	62,170	21,790	427	68	84,456
1000-Year	90,447	37,141	1,159	385	129,132

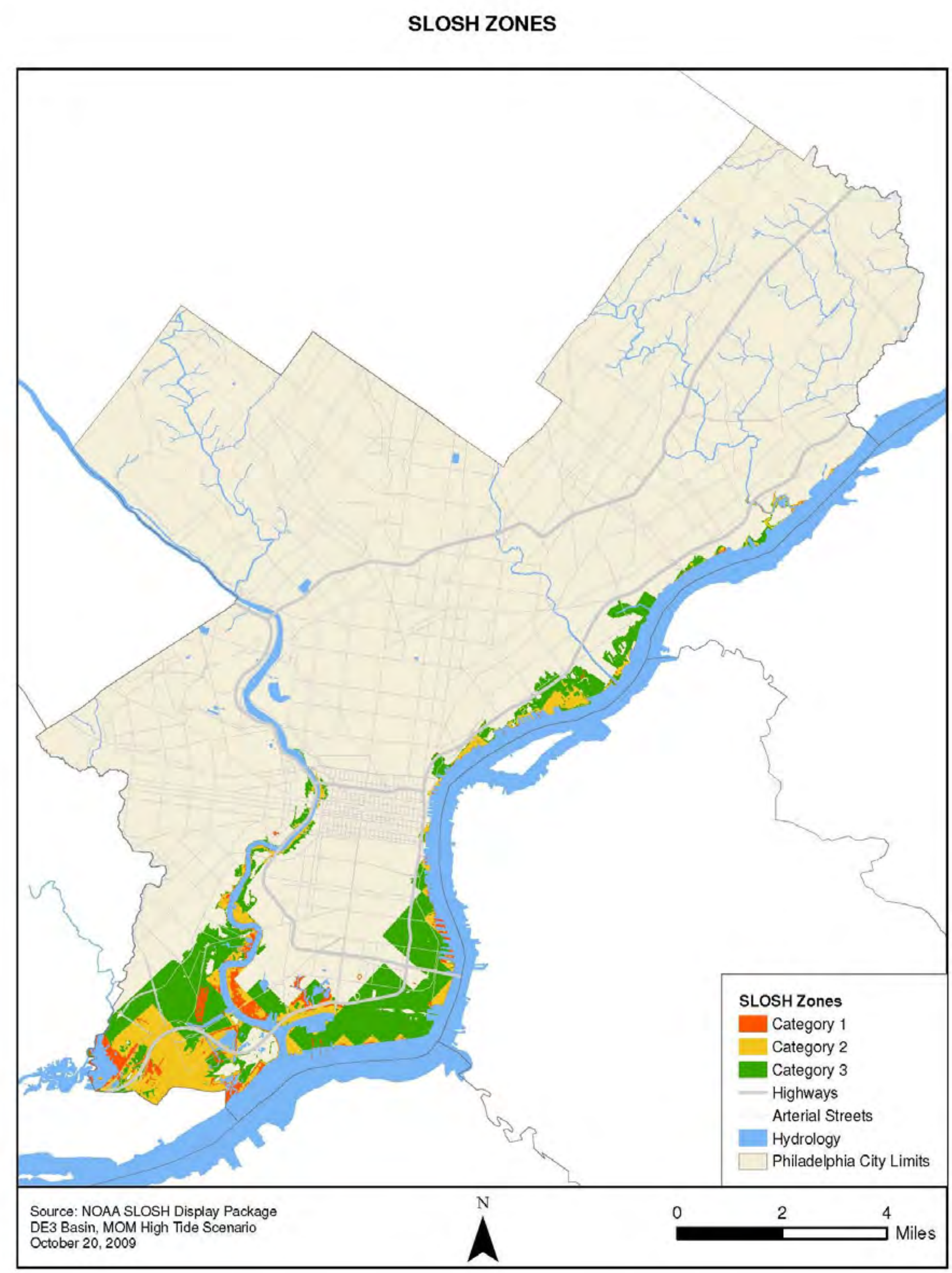
Figure 4.2.5-11 Direct Economic Loss (in Dollars) due to Hurricane Winds (Probabilistic)			
Return Period	**Capital Stock Losses**		**Business Interruption (Income) Losses**
	Residential	**Total**	
10-Year	$0	$0	$0
20-Year	$0	$0	$0
50-Year	$14,152,000	$16,119,000	$3,076,000
100-Year	$59,106,000	$66,050,000	$19,795,000
200-Year	$155,136,000	$201,116,000	$86,986,000
500-Year	$374,638,000	$651,762,000	$309,873,000
1000-Year	$589,146,000	$1,321,511,000	$618,496,000
Annualized	$4,192,000	$8,087,000	$3,659,000

Table 4.2.5-12 provides more specific information on economic losses associated with a 100-year return period or hurricane winds with a 1 in 100 (1 percent) chance of occurring in any given year in Philadelphia. In contrast to flooding, damages related to hurricane winds would more significantly affect the exterior and structure of buildings themselves, as opposed to building contents and inventory, particularly because total destruction of buildings is not expected during a 100-year event.

Table 4.2.5-12 Direct Economic Loss from a 100-Year Hurricane Wind Event	
Type of Loss	**Dollar Amount**
Building Loss	$62,464,000
Contents Loss	$2,668,000
Inventory Loss	$917,000
Business Interruption Losses	$19,796,000
Total Loss	**$85,845,000**

In addition to wind damage, there is a possibility for flood damage from hurricane storm surge and a different subset of population and infrastructure that may be affected or further impacted. Table 4.2.5-13 shows the SLOSH zones associated with Category 1, 2, and 3 hurricanes in Philadelphia. SLOSH zones represent areas that may experience flooding from hurricane storm surge. Though they may overlap, these are different from areas in the 1-percent annual chance floodplain, which may flood due to natural tidal flooding and rainfall.

Map 4.2.5-13: SLOSH Zones



Of particular concern are critical facilities located within the SLOSH zones that potentially could be damaged by storm surge flooding or may require special consideration during an evacuation. Table 4.2.5-14 lists the critical assets located in the Category 1, 2, and 3 SLOSH zones.

Table 4.2.5-14 Critical Assets in the SLOSH Zones in Philadelphia

Critical Asset	Total Number	Number in SLOSH Zone 1	Number in SLOSH Zone 2	Number in SLOSH Zone 3
Rail Stations	48	0	2	0
Subway/Subsurface Trolley Stations	57	0	0	0
Airports	2	0	1	0
Police Stations	22	0	0	0
Fire/EMS Stations	61	0	1	1
Emergency Operations Center	1	0	0	0
Schools	438	0	1	4
Colleges/Universities	30	0	0	0
Hospitals	31	0	0	0
Dialysis Centers	43	0	0	1
Nursing Homes	51	0	0	1
Water/Wastewater Treatment Facilities	6	0	1	1
Electric Substations	Total Unknown	0	1	4
Hazardous Material Reporting Facilities	398	1	19	56

4.2.6 Windstorm and Tornado

4.2.6.1 Hazard Description

Windstorm

A windstorm is classified as wind that is strong enough to cause at least light damage to trees and buildings and may or may not be accompanied by precipitation. Typically, wind speeds in a windstorm exceed 34 miles per hour (mph). Wind damage during windstorms can be attributed to gusts (short burst of high-speed winds) or longer periods of stronger sustained winds. Although tornadoes also produce wind damage, they are classified separately within this profile.

Types of Windstorms:

- *Downburst* – A downburst is a strong downdraft current of air from a cumulonimbus cloud, often associated with intense thunderstorms.[123] Downdrafts produce damaging winds at the earth's surface, which at times can be stronger than tornado winds. Downbursts are categorized according to their size, as either a microburst or a macroburst. The term straight-line wind is applied to differentiate damage from a downburst, which lacks significant curvature and tornado damage, which has significant curvature.

  A microburst is a convective downdraft with an affected outflow area of less than 2.5 miles wide and peak winds lasting less than 5 minutes. Microbursts may induce dangerous horizontal/vertical wind shears, which can adversely affect aircraft performance, and cause property damage. A macroburst is a convective downdraft with an affected outflow area of at least 2.5 miles wide and peak winds lasting between 5 and 20 minutes. Intense macrobursts may cause tornado-force damage of up to an EF3 intensity (explained in greater detail below).

  Windstorms tend to last for just a few minutes when caused by downbursts from thunderstorms, as opposed to hours or days when they result from large-scale weather systems, such as nor'easters or intense winter storms (these hazards are elaborated on in separate sections of this plan).

- *Derecho* – A derecho is a widespread and usually fast-moving windstorm associated with convection.[124] Derechos include any family of downburst clusters produced by an extratropical system, and can produce damaging straight-line winds over areas hundreds of miles long and more than 100 miles across. Types of derechos are categorized from the storm they derive. Multiple bow echoes, (radar echoes that are linear but bent outward in a bow shape) embedded in an extensive squall line (a line of active thunderstorms) produce a serial derecho. This type of derecho typically is associated with strong migratory low-pressure system and can be hundreds of miles long. A progressive derecho is associated with a relatively short line of thunderstorms that may take the shape of a single bow echo. A third type of derecho is known as a hybrid derecho, and has the characteristics of both serial and progressive derechos.

- *Straight-line Winds* – Generally, any wind that is not associated with rotation, used mainly to differentiate them from tornadic winds. Any of the above type of windstorms can be generally classed as straight-line.

[123] Ibid.
[124] Ibid.

- *Gustnado (or Gustinado)* – A gustnado is a small, whirlwind which forms as an eddy in thunderstorm outflows.[125] Gustnadoes do not connect with any cloud-base rotation and are not tornadoes. Since their origin is associated with cumuliform clouds, gustnadoes will be classified as thunderstorm wind events.

Tornado

According to the glossary of meteorology, a tornado is "a violently rotating column of air, in contact with the surface, pendant from a cumuliform cloud, and often (but not always) visible as a funnel cloud."[126] When tornadoes do occur without any visible funnel cloud, debris at the surface is usually the indication of the existence of an intense circulation in contact with the ground. On a local scale, the tornado is the most intense of all atmospheric circulations. Its vortex, typically a few hundred meters in diameter, usually rotates cyclonically with wind speeds as high as 300mph.

4.2.7.2 Location

Windstorms and tornadoes can occur anywhere throughout Philadelphia. Figure 4.2.6-1 displays wind speed zones developed by the American Society of Civil Engineers. Based on 40 years of tornado history and more than 100 years of hurricane history, the United States has been divided into four zones that geographically reflect the frequency and strength of extreme windstorms. The identification of wind speeds can be used as a basis for design and evaluation for the structural integrity of shelters and critical facilities in these zones. Philadelphia 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, or other windstorm event. Therefore, shelters and critical structures in Philadelphia should be able to withstand wind speeds of up to 160 mph, or the equivalent to an EF3 tornado event (explained in further detail in the 'Range of Magnitude' section of this hazard).[127]

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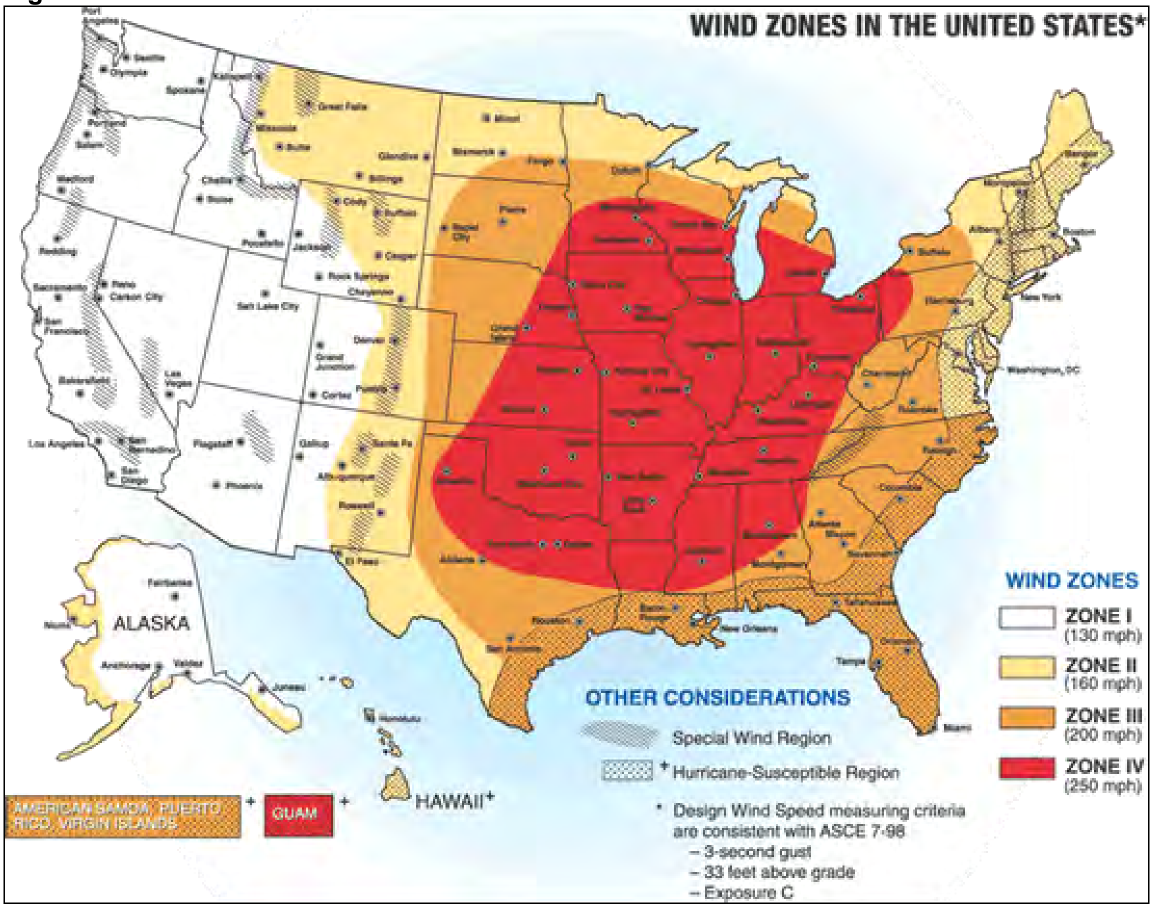
[125] Ibid.
[126] Glossary of Meteorology: Tornado. Retrieved 20 December 2012.
[127] Federal Emergency Management Agency. Taking Shelter from the Storm. Retrieved 3 January 2012.

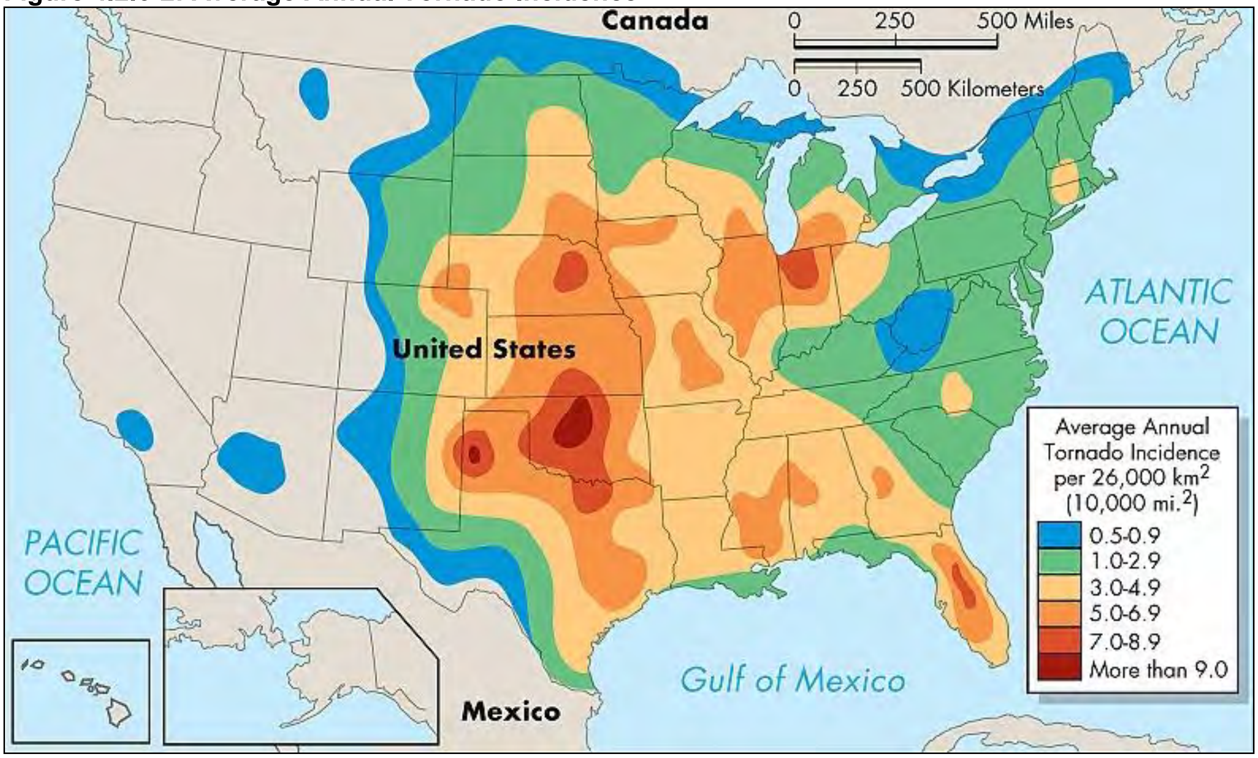
Figure 4.2.6-1Wind Zones



Source: FEMA, 2010

Figure 4.2.6-2 displays the average occurrence of tornadoes per 10,000mi.^{2} in the United States and southernmost Canada from 1950-2000. Data for this map was taken from the National Severe Storm Forecast Center, NWS.

Figure 4.2.6-2: Average Annual Tornado Incidence



Source: Christopherson, 2006

4.2.6.3 Range of Magnitude

Wind is simply the air in motion as a result of a pressure gradient. The unequal heating of the earth by the sun creates differences in air pressure. Since wind moves from areas of high pressure to areas of low pressure, the greater the differentials in pressure, the higher the wind speed. Table 4.2.6-3 illustrates the estimation of wind speed and corresponding typical effects, according to the Beaufort Wind Scale.[128]

Table 4.2.6-3		Beaufort Wind Scale		
Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move

128 National Weather Service: Miami-South Florida. Beaufort Wind Scale. Retrieved 10 January 2012.

3	7-10	Gentle Breeze	Large wavelets, crest begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft. taking longer form, may whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft., whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-20 ft., white foam streaks of breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 ft.) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 ft.), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 ft.) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (30-45 ft.) waves, foam patches cover sea, visibility more reduced	If experienced on land, widespread damage
12	64+	Hurricane	Air filled with foam, waves over 45 ft., sea completely white with driving spray, visibility greatly reduced	Violence and destruction

Source: SPC, 2011

When conditions warrant, NWS issues wind-related weather products described in Table 4.2.6-4 for Philadelphia.

Table 4.2.6-4	NWS Wind Products
Product	**Criteria**
High Wind	Sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.
High Wind Advisory	This product is issued by the NWS when high wind speeds may pose a hazard.
High Wind Watch	This product is issued by the NWS when there is the potential of high wind speeds developing that may pose a hazard or is life threatening.
High Wind Warning	This product is issued by the NWS when high wind speeds may pose a hazard or is life threatening. The criteria for this warning vary from state to state.
Extreme Wind Warning	Extreme Wind Warning (EWW) informs the public of the need to take immediate shelter in an interior portion of a well-built structure due to the onset of extreme tropical cyclone winds. An EWW for extreme tropical cyclone winds should be issued when both of the following criteria are met: a. Tropical cyclone is a category 3 or greater on the Saffir Simpson hurricane scale as designated by NHC, CPHC or JTWC. b. Sustained tropical cyclone surface winds of 100 knots (115 mph) or greater are occurring or are expected to occur in a WFO's county warning area within one hour.

Source: NWS Glossary, 2011

Tornadoes form where there are large differences in atmospheric pressure over short distances, as often results during a major storm, such as a supercell or a severe thunderstorm. The Fujita Scale (F-Scale) is the standard measurement for rating the strength of a tornado. The NWS bases this scale on an analysis of damage after a tornado to infer wind speeds. This scale was designed to connect the Beaufort Scale with the speed of sound atmospheric scale, or Mach speed. On February 1, 2007, the Enhanced Fujita Scale (EF-Scale) replaced the use of the F-Scale. The EF-Scale is considerably more complex and enables surveyors to assess tornado severity with greater precision.[129] Table 4.2.6-5 details both scales.

[129] Storm Prediction Center: The Enhanced Fujita Scale (EF Scale). Retrieved 28 December 2011.

Table 4.2.6-5 F-Scale and EF Scale

F-Scale	Wind Estimate (mph)[1]	EF-Scale	Wind Estimate (mph)[1]	Typical Damage[2]
F0	45-78	EF0	65-85	Light damage. Some damage to chimneys. Branches broken off trees. Shallow-rooted trees pushed over; signboards damaged.
F1	79-117	EF1	86-110	Moderate damage. Peels surface off roofs. Mobile homes pushed off foundations or overturned. Moving autos blown off roads.
F2	118-161	EF2	111-135	Considerable damage. Roofs torn off frame houses. Mobile homes demolished. Boxcars overturned. Large trees snapped or uprooted. Light-object missiles generated. Cars lifted off ground.
F3	162-209	EF3	136-165	Severe damage. Roofs and some walls torn off well-constructed houses. Trains overturned. Most trees in forest uprooted. Heavy cars lifted off the ground and thrown.
F4	210-261	EF4	166-200	Devastating damage. Well-constructed houses leveled. Structures with weak foundations blown away some distance. Cars thrown and large missiles generated.
F5	262-317	EF5	Over 200	Incredible damage. Strong frame houses leveled off foundations and swept away. Automobile-sized missiles fly through the air in excess of 100 meters (109 yards). Trees debarked.

[1] *Wind speeds are the maximum estimated for a 3-second gust*
[2] *Accurate placement on this scale involves expert assessment of the degree of damage to 28 indicators including homes, buildings, towers, poles and trees.*

Source: Keller, Blodgett (2008)

When conditions warrant, the NWS issues the tornado-related weather products described in Table 4.2.6-6.

Table 4.2.6-6 NWS Tornado Products	
Product	**Criteria**
Tornado Watch	This product is issued by the NWS when conditions are favorable for the development of tornadoes in and close to the watch area. Their size can vary depending on the weather situation. They are usually issued for a duration of 4 to 8 hours. They normally are issued well in advance of the actual occurrence of severe weather. During the watch, people should review tornado safety rules and be prepared to move a place of safety if threatening weather approaches.
Tornado Warning	This product is issued when a tornado is indicated by the WSR-88D radar or sighted by spotters; therefore, people in the affected area should seek safe shelter immediately. They can be issued without a Tornado Watch being already in effect. They are usually issued for a duration of around 30 minutes. After it has been issued, the affected NWFO will follow it up periodically with Severe Weather Statements. These statements will contain updated information on the tornado and they will also let the public know when warning is no longer in effect.
Tornado Emergency	An exceedingly rare tornado warning issued when there is a severe threat to human life and catastrophic damage from an imminent or ongoing tornado. This tornado warning is reserved for situations when a reliable source confirms a tornado, or there is clear radar evidence of the existence of a damaging tornado, such as the observation of debris.

Source: NWS Glossary, 2011

4.2.6.4 Past Occurrences

Windstorm events may be the result of thunderstorms, hurricanes, tropical storms, winter storms, or nor'easters. Between 1995 and 2011, there were 49 events in

Philadelphia with wind speeds greater than 34mph.[130] These windstorms have injured individuals, damaged buildings and vehicles, downed trees and power lines, and disrupted transportation, communication and power services. Table 4.2.6-7 depicts the date, location and description of these windstorms.[131]

Table 4.2.6-7	Historic Occurrences of Windstorms	
Date	**Location**	**Description**
4/16/2011	Citywide	• Peak wind gust 46mph recorded at PHL
4/5/2011	Citywide	• Peak wind gust 52mph recorded at PHL • Downed tree limbs and wires
12/1/2010	Citywide	• Peak wind gust 50mph recorded at PHL
9/30/2010	Citywide	• Peak wind gust 44mph recorded at PHL • PHL reported 2 hour delays at of arrival flights; 130 departure flights were cancelled or delayed • SEPTA suspended service on commuter rail line due to downed trees
5/8/2010	Citywide	• Peak wind gust 51mph recorded at PNE
3/10/2010	Citywide	• Peak wind gust 56mph recorded at PNE; 47mph PHL • AMTRAK forced to suspend rail service between Philadelphia and New York City
1/25/2010	Citywide	• High winds 62mph recorded at PHL • High winds 46mph recorded at PNE • Truck overturned on Walt Whitman Bridge • Trucks were restricted from crossing the Betsy Ross and Commodore Barry Bridges
12/9/2009	Citywide	• Peak wind gust 50mph recorded at PHL • Tree limbs and poles knocked down

[130] National Climatic Data Center, NCDC, Storm Events, Pennsylvania, Philadelphia County Windstorms. Retrieved 10 December 2011.
[131] Ibid

9/11/2009	Citywide	• Peak wind gust 48mph recorded at PNE • Tree limbs knocked down
5/12/2008	Citywide	• Peak wind gust 49mph recorded at PHL; 47mph PNE • Tractor Trailers restricted from crossing Commodore Barry Bridge • PHL reported 3 hour delays at of arrival flights; 130 departure flights were cancelled or delayed
3/5/2007	Citywide	• Peak wind gust 46mph recorded at PNE
3/2/2007	Citywide	• Peak wind gust 45mph recorded at PHL
12/2/2006	Citywide	• Peak wind gust 45mph recorded at PHL
4/5/2006	Citywide	• Peak wind gust 45mph recorded at PHL; 55mph at PNE
3/15/2006	Citywide	• Peak wind gust 48mph recorded at PHL • Trees limbs were knocked down in the Manayunk section of the City
3/14/2006	Citywide	• Peak wind gust 46mph recorded at PHL
2/25/2006	Citywide	• Peak wind gust 47mph recorded at PHL
2/24/2006	Citywide	• Peak wind gust 43mph recorded at PHL
2/17/2006	Citywide	• High winds 45mph recorded at PHL; 49mph PNE • Downed trees caused disruptions on commuter rail lines
1/18/2006	Citywide	• High winds 49mph recorded at PHL
1/15/2006	Citywide	• Peak wind gusts of 53mph recorded at PHL • 45,000 PECO customers without power
11/22/2005	Citywide	• Peak wind gusts of 38mph recorded at PHL
11/10/2005	Citywide	• Peak wind gusts of 43mph recorded at PHL

3/8/2005	Citywide	• Peak wind gusts of 47mph recorded at PHL; 48mph at PNE
12/23/2004	Citywide	• Peak wind gusts of 43mph recorded at PHL
12/19/2004	Citywide	• Peak wind gusts of 41mph recorded at PHL
12/1/2004	Citywide	• Wind gusts of 53mph recorded at PNE; 52mph at PHL • 6,000 PECO customers without power • Debris blown off Center City buildings • Tress down along Schuylkill Expressway
11/24/2004	Citywide	• Peak wind gust of 39mph recorded at PHL
11/5/2004	Citywide	• Wind gusts of 39mph recorded at PHL; 46 mph at PNE • Damage sustained to signs along Delaware Avenue • Closed parking lot in the vicinity of damaged signs
12/11/2003	Citywide	• Wind gusts of 45mph recorded at PHL • Damaged sustained to the 27th floor of the Independence Blue Cross Tower on Market St. • Markey Street closed during evening commute
11/29/2003	Citywide	• Wind gusts of 46mph recorded at PHL
11/19/2003	Citywide	• Wind gusts of 49mph recorded at PHL • 3 injuries reported • Vehicles damaged by debris
11/13/2003	Citywide	• High winds 58mph recorded at PHL • 1 injury due to a partial collapse of a three-story building
10/15/2003	Citywide	• Wind gusts of 48 mph recorded at PNE; 47mph at PHL
9/19/2003	Citywide	• High winds 49mph recorded at PHL
5/16/2003	Citywide	• Wind gust of 33mph recoded at PHL • Telephone pole knocked down on Frankford Avenue

5/12/2003	Citywide	• Wind gusts of 44mph recorded at PNE; 39mph recorded at PHL
2/23/2003	Citywide	• High winds 43mph recorded at PHL
2/12/2003	Citywide	• High winds 45mph recorded at PHL • High winds 46mph recorded at PNE
2/4/2003	Citywide	• High winds 47mph recorded at PHL
12/12/2000	Citywide	• High winds 53mph recorded at PHL • High winds 57mph recorded at FDR Park • High winds 54mph recorded at PNE • Reports of windows blown out of Center City buildings
10/2/1999	Citywide	• High winds 45mph recorded at PHL
9/16/1999	Citywide	• High winds 48mph recorded at PHL
3/6/1997	Citywide	• High winds 51mph reported at PHL • High winds 58mph reported at PNE • Several down trees blocking roadways reported • Uprooted tree crushed automobile reported • No injuries/fatalities
11/8/1996	Citywide	• Intensity unknown • Several uprooted trees reported • No injuries/fatalities reported
3/19/1996	Citywide	• Intensity unknown • No injuries/fatalities reported
1/27/1996	Citywide	• Reported wind gust of 60mph in Northeast Philadelphia • No injuries/fatalities reported
1/19/1996	Citywide	• High winds 58mph reported at PHL • High winds 67mph Center City, Philadelphia • No injuries/fatalities reported
11/11/1995	Citywide	• High winds over 50mph • 29,000 Philadelphia Electric Company customers lost power • No injuries/fatalities reported

Since reliable record keeping began in 1950, eight tornadoes have touched down in Philadelphia, all being classified an F2 or weaker. Table 4.2.6-8 lists the tornado events that have occurred in Philadelphia between 1950 and 2011.[132] Figure 4.2.6-9 also depicts the approximate location of previous events whose center of circulation were located in, or tracked through, Philadelphia.

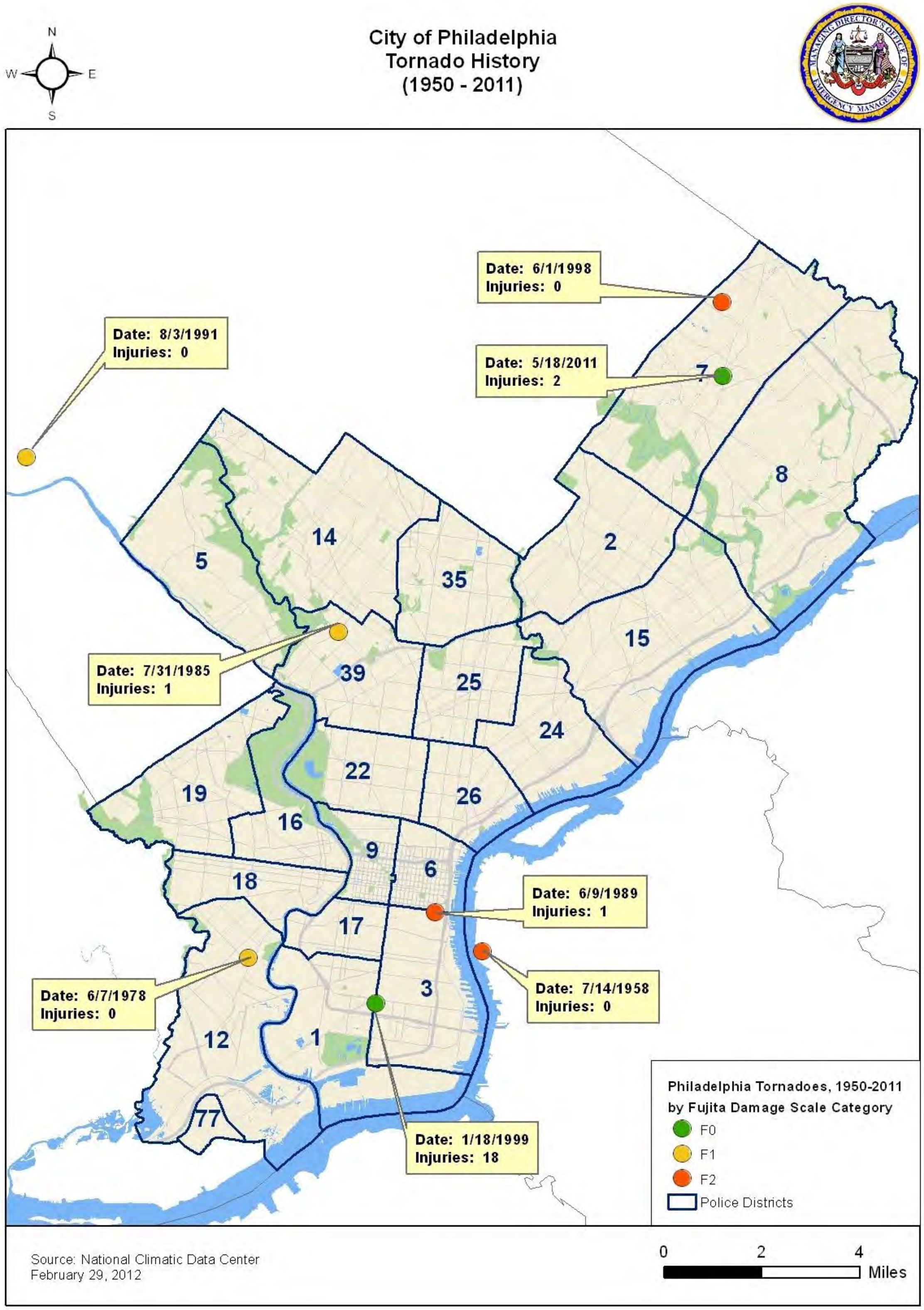
Table 4.2.6-8 Historic Occurrences of Tornadoes

Date	Location	Description
5/18/2011	Northeast Philadelphia (Intersection of Red Lion Rd and Northeast Ave)	• EF0 tornado* • Property damage $50K • Fatalities 0/ Injuries 2 • Roof collapses
1/18/1999	South Philadelphia – Macaroni Plaza	• F0 tornado • Length 0.2 miles • Width 20 yards • Property damage $2.5K • Fatalities 0/ Injuries 18 • 1,000 PECO customers without power • 20 AMTRAK, SEPTA and NJ Transit trains stranded
6/1/1998	Northeast Philadelphia	• F2 tornado • Length 5.6 miles • Width 200 yards • Property damage $1.8M • Fatalities 0/ Injuries 0
8/3/1991	Moved from Montgomery County into Northwest Philadelphia	• F1 tornado • Length 2.0 miles • Width 100 yards • Property damage $2.5K • Fatalities 0/ Injuries 0
6/9/1989	Society Hill	• F2 tornado • Length 0.5miles • Width 50 yards • Property damage $25.0K • Fatalities 0/ Injuries 1

[132] National Climatic Data Center, NCDC, Storm Events, Pennsylvania, Philadelphia County Tornadoes. Retrieved 10 December 2011.

7/31/1985	Northwest Philadelphia (West Mount Airy, Chestnut Hill)	• F1 tornado • Length 1.5 miles • Width 20 yards • Property damage $2.5K • Fatalities 0/ Injuries 1
6/7/1978	Southwest Philadelphia (Kingessing Area)	• F1 tornado • Length 0.5miles • Width 100 yards • Property damage $25.0K • Fatalities 0/ Injuries 0
7/14/1958	Southeast Philadelphia	• F2 tornado • Length 9.8miles • Width 27 yards • Property Damage $2.5K • Fatalities 0/ Injuries 0
*NWS moved from the F-Scale to the EF-Scale in 2007		

Figure 4.2.6-9 Tornado History



4.2.6.5 Future Occurrences

Windstorms are a common occurrence in Philadelphia, making them a highly probable hazard in the future. Based on historic occurrences, Philadelphia experiences high-wind events at least once a year. Tornadoes, however, are infrequent occurrences within Philadelphia, though as mentioned above, they are not unprecedented. Over the past 61 years, eight tornadoes have hit Philadelphia, six of which were scaled EF/F0 or EF/F1. Based on historic frequency, an estimated thirteen tornadoes will hit the Philadelphia every 100 years.

4.2.6.6 Vulnerability Assessment

Impact to Philadelphia

Severe wind storms and tornadoes pose a significant risk to life and property in Philadelphia by creating conditions that disrupt essential systems such as public utilities, telecommunications, and transportation routes. Fallen trees and debris are common after high wind events, which can block access to roads, bring down power and utility lines, and damage building stock. Areas with tall buildings, such as Center City and University City, are at greater risk as increased wind pressure occurs at greater heights. Construction sites are also especially vulnerable to high winds. Loose tools and construction materials, cranes, scaffolding, and other building appurtenances may loosen from exposure to high winds and become flying debris.

Environmental Vulnerability

In the case of both windstorms and tornadoes the greatest impact on the natural environmental is on trees and woodland. High winds can easily uproot trees, shrubs and bushes. Street trees in particular are highly susceptible to high winds. A street tree is defined as a tree located between the sidewalk and the curb. There are approximately between 137,000 - 150,000 street trees located within Philadelphia. In addition hazardous material facilities should meet design requirements for wind zones in order to prevent the release of hazardous materials into the environment.

Structural Vulnerability

Structural vulnerability is related to a building's construction type. Wood structures and manufactured homes are more susceptible to wind damage, while steel and concrete buildings are more resistant. Mobile homes are considered to be the most susceptible structures to tornadoes and windstorms, though the number of mobile homes in Philadelphia is less than one percent. High-rise buildings are also highly susceptible for damage caused by high winds and/or tornadoes. For high rise buildings Philadelphia adheres to the National Code requirement for Structural Wind Load Designs as spelled out in ASCE-7 and Uniform Building Code (UBC).

Potential Loss Estimate

There are direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services. Industry and commerce can suffer losses from interruptions in electric service and extended road closures. In addition, they can also sustain direct losses to buildings, personnel, and other vital equipment. Table 4.2.6-10 depicts Philadelphia's potential losses due to tornadoes and windstorms, as estimated in the 2010 Pennsylvania Hazard Mitigation Plan. Please note that this may be an over estimate of the potential losses within Philadelphia due to the large amount of impacted mobile homes.

Table 4.2.6-10 Philadelphia's Potential Losses due to Windstorms

Impacted Mobile Homes	Critical Facilities	Total Number of Impacted Buildings	Dollar Value of Exposure, Buildings and Contents
791	423	384,331	$178,799,846,000

Source: PA 2010 HMP, 2010

4.2.7 Winter Storm

4.2.7.1 Hazard Description

Winter storm events consist of cold temperatures, heavy snow or ice and sometimes-strong winds. In Pennsylvania, winter storms begin as low-pressure systems that either move through the state following the jet stream or develop as extra-tropical cyclonic weather systems over the Atlantic. In North American severe winter storms generally form in eastern Colorado, central Alberta Canada or along the coast of North Carolina or the northern Gulf of Mexico. Storms originating in Colorado and along the coast, coastal storms otherwise known as Nor'easters, generally produce heavy snowfall. In contrast, fast-moving storms forming east of the Canadian Rockies in Alberta Canada, called Alberta Clippers, are generally drier with less snow and extremely cold temperatures.[133]

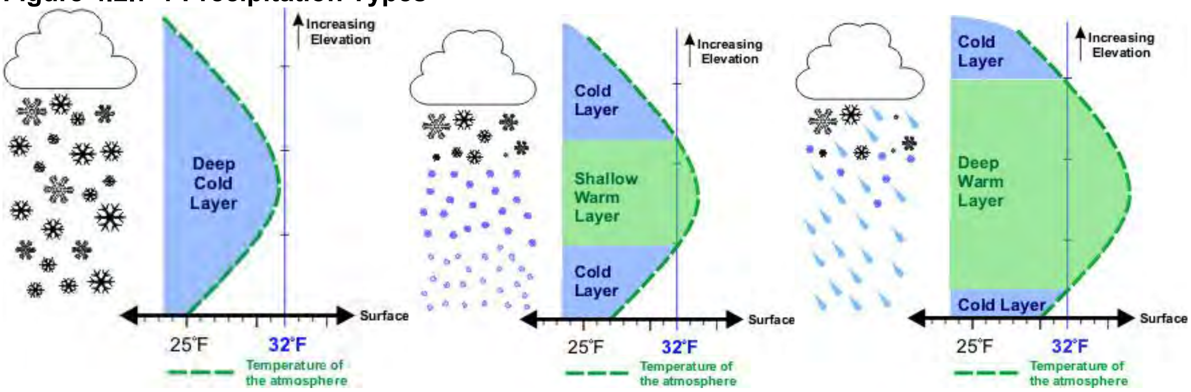
In winter weather storms the thickness of cold air at the surface determines the type of precipitation. Figure 4.2.7-1 illustrates the three primary precipitation types that occur during winter storms: snow, sleet, and freezing rain.[134]

- Snow is produced when temperatures are cold both aloft and at the ground. The snow does not melt as it falls and temperatures at or below 32 degrees near the ground allows it to accumulate.
- Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops or refrozen partially melted snowflakes, and is formed when temperatures at or slightly above freezing aloft produce rain that freezes to ice pellets, as it falls into a cold layer of air. Sleet usually bounces when hitting a surface and does not stick to objects. However, it can produce a "sand like" accumulation like snow.
- Freezing rain forms when warm temperatures aloft, generally several degrees above freezing, produces rain that falls onto a surface with temperatures below

[133] Ibid
[134] Ibid

32 degrees, causing the liquid rain to freeze on impact forming a coating or glaze of ice.

Figure 4.2.7-1 Precipitation Types



Snow Profile **Sleet Profile** **Freezing Rain Profile**

Source: NWS Jetstream, 2011

Several winter storm hazards are possible, including heavy snow (snowstorms), blizzards, sleet, freezing rain, and ice storms. Additionally, though they can occur during any time of year, most-extra-tropical cyclones, particularly Nor'easters, generally take place during the winter months and so will be considered as a winter storm hazard for the purposes of this HMP. The types of winter weather hazards are further defined below.[135]

- ***Heavy Snowstorm***: A heavy snowstorm is a snow event generally accumulating 4 inches or more in depth in 12 hours or less; or snowfall accumulating 6 inches or more in depth in 24 hours or less. A 'snow squall' can occur during a snowstorm, and is defined as an intense, but limited in duration, period of moderate to heavy snowfall, accompanied by storm, gusty surface winds and possibly lightning (also known as thundersnow) with the possibility of significant accumulation.
- ***Blizzard***: Blizzards are characterized by low temperatures, wind gust of 35 mph or more, and falling and/or blowing snow that reduces visibility to 0.25 miles or less, all prevailing for an extended period of time (three or more hours).
- ***Sleet or Freezing Rain***: Heavy sleet is a relatively rare event defined as an accumulation of ice pellets covering the ground to a depth of 0.5 inches or more. Freezing rain is rain that falls as liquid but freezes into glaze upon contact with the ground.
- ***Ice Storm***: An ice storm is used to describe occasions when damaging accumulation of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power

[135] Ibid

and communication. Significant ice accumulations are usually accumulations of .25 inches or greater.

- ***Nor'easter***: Nor'easters, named for the strong northeasterly winds blowing in ahead of the storm, are also referred to as a type of extra-tropical storms (mid-latitude storms or Great Lakes storms). A nor'easter is a macro-scale (large in size) extra-tropical cyclone whose winds originate from the northeast, especially in coastal areas of the Northeastern United States. Wind gusts associated with these storms can exceed hurricane force in intensity. Nor'easters contain a cold core of low barometric pressure from forming over mid-latitudes. The strongest winds are close to the earth's surface.

  Nor'easters can cause heavy snow, rain, gale force winds and oversized waves (storm surge) that can cause flooding, structural damage, power outages and unsafe human conditions. Nor'easters that track offshore are more devastating than ones that track inland. Offshore Nor'easters result in heavy snow, blizzards, ice, and strong winds, whereas those that track inland produce mostly rain events. If a significant pressure drop occurs within a Nor'easter, this change can turn an extra-tropical cyclone storm into what is commonly known as a 'bomb'. Bombs are characterized be a pressure drop of at least 24 millibars (units of atmospheric pressure) within 24 hours. This is similar to a rapid intensification of a hurricane.

4.2.7.2 Location

Historically Philadelphia is prone to winter weather, and particularly snowstorm events due to northern location and proximity to the Atlantic Ocean. Winter weather has reached the City as early in the year as October, as was the case in 2011, but usually is not in full force until December, when winter temperatures average between 20°F and 40°F. All areas of the City are susceptible to winter storms, however; roads and bridges are especially vulnerable because of transportation accidents and disruptions related to severe winter storms.

4.2.7.3 Range of Magnitude

The magnitude or severity of a winter weather storm depends on several factors including temperatures, wind speed, types of precipitation, rate of deposition (how fast the snow is falling), and the time of day and/or year the storm occurs. The extent of a winter storm can be classified by meteorological measurements and by evaluation its societal impacts.

Unlike the Enhanced-Fujita and Saffir-Simpson Scales that characterize tornadoes and hurricanes, there is no widely used scale to classify snowstorms. However, the Northeast Snowfall Impact Scale (NESIS) was developed by Paul Kocin of the Weather Channel and Louis Uccellini of the NWS to characterize and rank high-impact Northeast snowstorms, including Nor'easter events. NESIS differs from other meteorological indices in that it uses population information in addition to meteorological measurements, thus providing an indication of a storm's societal impact.[136]

NESIS scores are a function of the area affected by the snowstorm, the amount of snow and the number of people living in the path of the storm. This distribution of snowfall and population information are combined in an equation that calculates a NESIS score, which varies from around one for smaller storms to over 10 for extreme storms. The raw score is then converted into one of the five NESIS categories. Table 4.2.7-2 summarizes this scale.[137]

Table 4.2.7-2		**NESIS Scale**	
Category	**Description**	**NESIS Range**	**Definition**
1	Notable	1.0-2.49	These storms are notable for their large areas of 4 inches accumulation and small areas of 10 inches
2	Significant	2.5-3.9	Includes storms that produce significant areas of greater than 10-inch snows while some include small areas of 20-inch snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations (greater than 30 inches)
3	Major	4-5.9	This category encompasses the typical major northeast snowstorm, with large areas of 10 inch snows (generally between 50 and 150 x 103 mi^2 – with significant areas of 20 inch accumulations
4	Crippling	6-9.9	These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast, U.S, with impacts to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-inch snowfalls, and each case is marked by large areas of 20 inch and greater snowfall accumulations.

[136] Kocin, Uccellini: A Snowfall Impact Scale Derived from Northeast Storm Snowfall Distributions. Retrieved 4 January 2012.
[137] Ibid

5	Extreme	10+	These storms represent those with the most extreme snowfall distributions, blanketing large areas and population with snowfalls greater than 10, 20 and 30 inch accumulations exceed 200 x 103mi^2 and affect more than 60 million people

The Dolan-Davis Nor'easter Intensity Scale categorizes the magnitude, severity and/or intensity of a Nor'easter. This scale primarily deals with beach and coastal deterioration, which does not apply to Philadelphia. Though this scale is not commonly used, it does allow the comparison of various Nor'easters by using the duration and height of the waves produced at the coast.[138]

Table 4.2.7-3 Dolan/Davis Nor'easter Intensity Scale

Storm Class	Average Wave Height	Average Duration	Impact
1	6 ft.	8 hr.	Minor beach erosion
2	8 ft.	18 hr.	Some beach erosion and property damage
3	11 ft.	34 hr.	Extensive beach erosion, significant dune loss, many structures lost
4	16.5 ft.	63 hr.	Severe beach erosion and recession, wider scale of building loss
5	23 ft.	96 hr.	Extreme beach erosion, massive over wash, extensive property damage

Finally, the NWS issues the following winter weather products for Philadelphia as conditions warrant.

Table 4.2.7-4 NWS Winter Weather Products

Winter Storm Outlook	
Winter Storm Outlook	Issued prior to a Winter Storm Watch. The Outlook is given when forecasters believe winter storm conditions are possible and are usually issued 3 to 5 days in advance of a winter storm. Winter Storm Outlooks are contained in the Hazardous Weather Outlook product available on the NWS Website at www.weather.gov/phi.

138 Ibid

NWS Watches	
Blizzard Watch	Issued when sustained winds of 35 MPH or greater are possible (50 percent chance or higher), resulting in blowing snow that reduces visibility to ¼ mile or less. The NWS strives to issue Blizzard Watches 36 to 48 hours prior to the actual onset of blizzard conditions. Blizzards are very rare in Philadelphia.
Winter Storm Watch	Alerts the public to the possibility of a blizzard, heavy snow, heavy freezing rain, or heavy sleet. Winter Storm Watches are usually issued 12 to 48 hours before the beginning of a Winter Storm.
Wind Chill Watch	Issued when air temperatures, real or apparent, could drop to minus 25 degrees Fahrenheit or lower (50 percent chance or higher).
Note: Forecasters have discretion to issue any of the above watches for slightly less severe conditions in order to account for extenuating circumstances. For example, if 3 inches of snow is possible on an extremely busy travel day (Wednesday before Thanksgiving, for instance), or when 2 or 3 inches of snow are possible very early or very late in the season when snow is normally NOT a major concern.	
NWS Advisories	
Winter Weather Advisory	Issued when winter weather conditions are expected to cause significant inconvenience and may be hazardous if proper caution is not exercised. Winter Weather Advisories can be issued for any of the following weather events: 2 to 4 inches of snow, blowing snow, trace to ¼ of ice from freezing rain, and wind chill for apparent temperatures between minus 10 and minus -25 degrees Fahrenheit.
Wind Chill Advisory	Issued when wind chill temperatures are expected to be a significant inconvenience to life with prolonged exposure, and, if caution is not exercised, could lead to hazardous exposure.
NWS Warning	
Blizzard Warning	Issued for sustained or gusty winds of 35 mph or more, and falling or blowing snow creating visibilities at or below ¼ mile; these conditions should persist for at least three hours.
Heavy Snow Warning	Issued when snow accumulations of 4 inches or more are expected in a 12-hour period (80 percent chance or higher), or when 6 inches or more are possible in a 24-hour period. The NWS strives to issue Heavy Snow Warnings 12 to 24 hours prior to the onset of actual heavy snow conditions.

Ice Storm Warning	Issued when ¼ inch or more of ice due to freezing rain is expected (80 percent chance or higher), resulting in fallen trees and powerlines, as well as very slippery road conditions. The NWS strives to issue Ice Storm Warnings 12 to 24 hours prior to the onset of actual ice conditions.
Winter Storm Warning	Issued when hazardous winter weather in the form of heavy snow, heavy freezing rain, or heavy sleet is imminent or occurring. Winter Storm Warnings are usually issued 12 to 24 hours before the event is expected to begin.
Wind Chill Warning	Issued when wind chill temperatures are expected to be hazardous to life within several minutes of exposure.
Note: Forecasters have discretion to issue any of the above warnings for slightly less severe conditions in order to account for extenuating circumstances. For example, if 3 inches of snow are expected on an extremely busy travel day (Wednesday before Thanksgiving, for instance), or when 2 or 3 inches of snow are expected very early or very late in the season when snow is normally NOT a major concern.	

4.2.7.4 Past Occurrences

Philadelphia averages 20.5 inches of snowfall annually, based on 60 years of data from NCDC. Historically, seasonal totals range from just a trace during the 1972/1973 season to 78.7 inches during the 2009-2010 season.[139] Table 4.2.7-5 below depicts the ten greatest snowstorms in terms of snowfall for Philadelphia.

Table 4.2.7-5 Top Ten Snow Storms in Philadelphia

Total Inches recorded at PHL	Date	Details

[139] Ibid

30.7 inches	January 7-8, 1996	• Named the Blizzard of '96, even though based on the strict definition, the storm was not a blizzard • Parts of nine states, from Virginia to Massachusetts received 2 ft. or more of snow • Mayor declared a State of Emergency – only essential emergency vehicles were allowed on roadways • Took approximately 2-days for PennDot to clear streets and main arteries. • PFD experienced access problems due to unplowed streets • Philadelphia schools closed for a week • Snow loads were dumped into the Schuylkill River, damming the River • Schuylkill River near Manayunk froze, causing ice flows to dam river and cause flooding • SEPTA shutdown • PHL airport closed for 3-day period
28.5 inches	February 5-6, 2010	• 28.5 inches recorded at PHL, 22.0 inches at Roxborough • Statewide Disaster Emergency declared by Governor • Snow Emergency declared by Mayor Speed limits were reduced on the Delaware River bridges • Amtrak and SEPTA suspended services • PHL canceled flights in and out of Philadelphia on the February 6th • Philadelphia schools were closed on 2/8 • Trash pick-ups delayed
23.2 inches	December 19-20, 2009	• 23.2 inches recorded at PHL, 10.5 inches at Somerton • 77% of flights canceled from PHL, those that were not had 6 hour delays – delays continued into the 21st • Retail shops and malls closed early • NFL – Eagles game delayed until 4pm • Trash pick-ups delayed • SEPTA reported suspensions and delays along bus and regional rail service

21.3 inches	February 11-12, 1983	• Named the Megalopolitan Snowstorm because 20 inches or more fell on the major four cities of the Mid-Atlantic • Winds of 25-35 mph were recorded with gusts over 40 mph • Transportation services were delayed or suspended for PHL, Amtrak and SEPTA • Thundersnow was recorded
21.0 inches	December 25-26, 1909	• Named the Christmas Day Snowstorm • In sections of the City snowdrifts were 4-5 feet high
19.4 inches	April 3-4, 1915	• Occurred over Easter weekend • Over 19 inches fell in under 12 hours • Broke the snowfall record for April – old record was set back in 1841 • No storm has come close to matching the April record
18.9 inches	February 12-14, 1899	• Named the Blizzard of '99 • Formed in tandem with one of the greatest outbreaks of Artic air on record • The 18.9 inches fell in addition to the 12 inches already on the ground from an earlier storm • The snow depth exacerbated the cold, high temperatures did not exceed beyond 10°F February 11-13
18.7 inches	February 16-17, 2003	• Snow emergency declared • 2 fatalities • Several roof and porch collapses • PHL closed on the 17^{th} • Greyhound suspended services on the 17^{th} • SEPTA ran on weekend service • Snow removal cost approximately $8 million
16.7 inches	January 22-24, 1935	• N/A

15.8 inches	February 9-10, 2010	• 19.5 inches recorded at Rockledge, 17.0 inches at Pine Valley, 15.8 inches at PHL, 13.9 inches at Green Lane • 37mph peak wind gusts at PHL • State of Emergency declared by Governor • PECO declared a snow emergency – 9th highest power outage in PECO history; 17.000 customers lost power in Philadelphia • 2 fatalities occurred in Philadelphia • Philadelphia schools were closed from February 10-11. • PHL closed on February 10th and reopened the afternoon of the 11th • SEPTA regional rail and bus service suspended services from February 10-11 • Trash pick-ups delayed

Between 1955 and 2011, Philadelphia acquired 5 Presidential Disaster / Emergency Declarations, and 5 Gubernatorial Declarations related to winter storms, classified as one or a combination of the following disaster types: severe storms, blizzard, snowstorm, heavy snow and flooding.

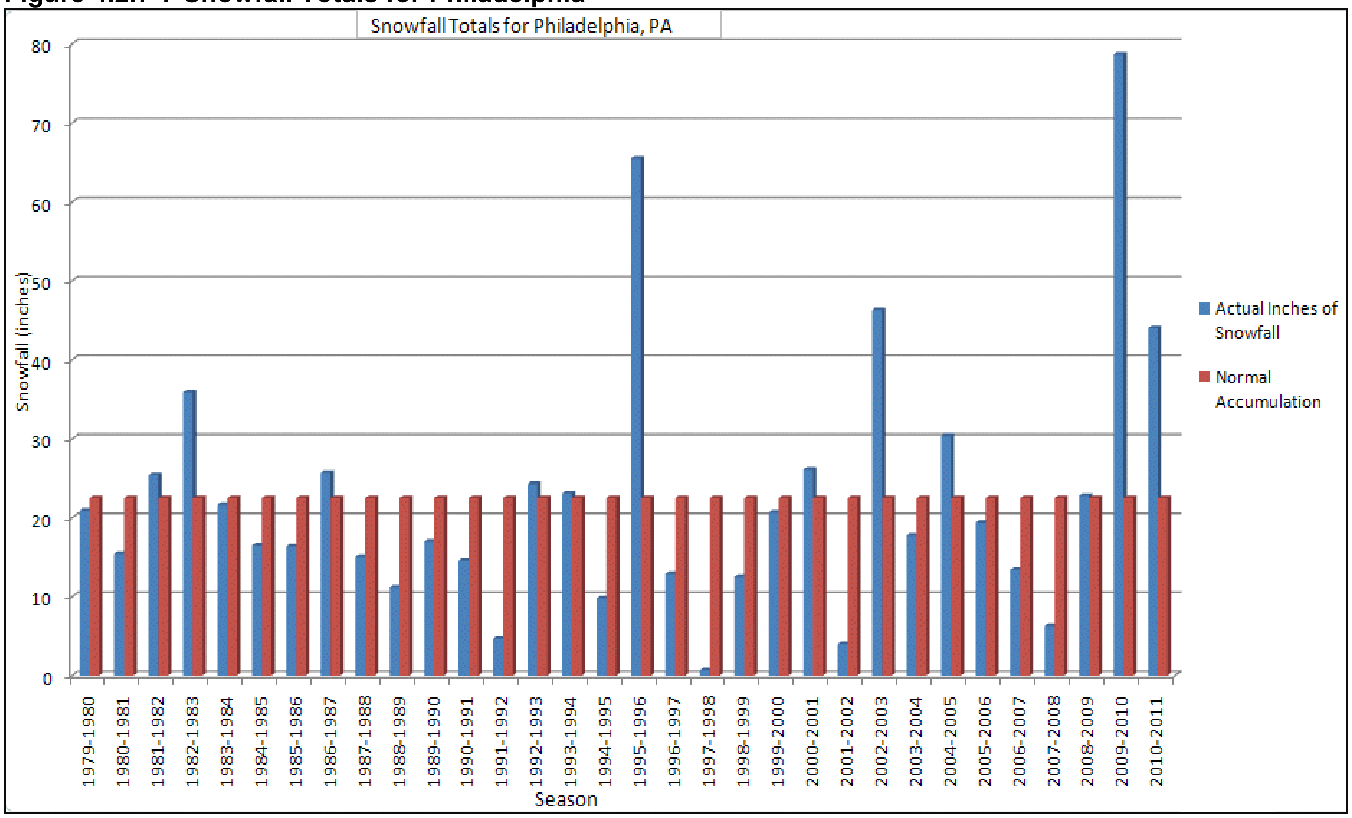
Table 4.2.7-6 Disaster Declarations for Winter Weather

Date	Event	Actions
April, 2010	Severe Winter Storms & Snowstorms	Major Disaster for Public Assistance
February, 2007	Severe Winter Storm	Governor's Proclamation of Disaster Emergency – to utilize all available resources and personnel as is deemed necessary to cope with the magnitude and severity of this emergency situation
February, 2003	Severe Winter Storm	Governor's Proclamation of Disaster Emergency
January, 1996	Flooding	Governor's Proclamation; President's Declaration of Major Disaster
January, 1996	Severe Winter Storms	Major Disaster for Individual Assistance and Public Assistance

January, 1994	Winter Storm/Severe Storm	Governor's Proclamation; President's Declaration of Major Disaster
March, 1993	Blizzard	Governor's Proclamation; President's Declaration of Major Disaster
January, 1978	Heavy Snow	Governor's Proclamation
January, 1966	Heavy Snow	Governor's Proclamation
February, 1958	Heavy Snow	Governor's Proclamation

Figure 4.2.7-7 identifies snowfall totals for Philadelphia since 1979, as well as the average amount of snow accumulation for the area annually. The figure clearly shows years above and below normal.

Figure 4.2.7-7 Snowfall Totals for Philadelphia



Source: NOAA, 2011

4.2.7.5 Future Occurrences

Winter storms are a regular annual occurrence in Philadelphia and should be considered high likely. Table 4.2.7-8 shows the probability of receiving measurable snowfall (more than 0.1 inches of snowfall defined by NWS) by month and season in

Philadelphia. These probabilities were calculated by NCDC and are based on at least 54 years of non-missing data.[140]

Table 4.2.7-8 Probability of Measurable Snowfall (PHL)

Month	Probability	Number of Years with Non-Missing Data
January	96.6%	58
February	87.9%	58
March	75.9%	58
April	22.4%	58
May	0.0%	58
June	0.0%	58
July	0.0%	58
August	0.0%	58
September	0.0%	58
October	1.8%	57
November	26.3%	57
December	76.8%	56
Winter	98.2%	56
Spring	79.3%	58
Summer	0.0%	56
Autumn	28.1%	57
Annual	100%	54

4.2.7.6 Vulnerability Assessment

Impact to Philadelphia

Severe winter weather can immobilize a region, shutting down all air and rail transportation, stranding commuters, stopping the flow of supplies and disrupting medical and emergency services. Winter weather can also cause building collapses and can bring down trees, electrical wires, telephone poles, lines and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. In addition, severe winter weather can affect rail beds and the switch systems. Winter weather may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces.

[140] National Climatic Data Center. Probability of Receiving Measurable Snowfall: Philadelphia WSCMO AP, Pennsylvania. Retrieved 10 January 2012.

Snow accumulation and frozen/slippery road surfaces increase the frequency and impact of traffic accidents for the general population, resulting in personal injuries. The elderly are the most susceptible to winter storms due to their increased risk of injury and death from falls, overexertion during snow removal, and/or hypothermia. Severe winter storm events can also reduce the ability of these populations to access emergency services.

In addition, winter storms can cause riverine, local and flash flooding. Private residences and business located in the floodplain are therefore vulnerable during winter months. Severe winter storms can cause flooding through ice jams (in hydrologic terms, a stationary accumulation that restricts or blocks streamflow[141]), blockage of streams or through snow melt. Residential properties most at-risk for such flooding events are identified in the Flood Hazard section of this plan.

Environmental Vulnerability
Environment impacts often include damage to trees and other vegetation due to heavy snow loading and ice build-up. The treatment of roadway surfaces with salt, chemicals and other de-icing materials can impair adjacent surfaces and containment waterways. The potential for flooding can cause additional environmental impacts; these are explained within Section 4.2.4.6 of this plan.

Structural Vulnerability
Building collapses and structural damage can occur when snow accumulates on flat rooftops, or porch awnings. Also as snow melts, it can collect in depressed or recessed areas, a condition commonly known as ponding. This additional weight either from snow accumulation or ponding jeopardizes a buildings structural soundness and may lead to total collapse.

Vulnerability to the effects of winter storms on buildings is dependent on the age of the building, what building codes may have been implemented at the time of construction, the type of construction and condition of the structure (how well has the structure been maintained). Individual structure data was not available for this HMP so it was difficult to determine the exact number and type of structures within Philadelphia that have a heightened vulnerability to winter storm snow loading and ponding.

Economic Vulnerability
The cost of snow and ice removal, salting roads, repairing roads from the freeze/thaw process, and the loss of business can have a severe economic impact on Philadelphia. There is a network of approximately 2,575 miles of city and state roads within Philadelphia. The responsibility for maintaining these roadways during winter storms is split among PennDOT, the Streets Department and the Philadelphia Department of Parks and Recreation. Of the 360 miles of state roads, PennDOT maintains 50 miles of limited access state highways, including I-95 and I-76. The remaining 310 miles are

[141] Ibid

state roads that the state contracts with the City for snow and ice removal. This amounts to a total of 2,525 miles of city and state roads that the City maintains. The Department of Parks and Recreation removes snow and ice from 35 miles of Park roads, including roadways that bisect Fairmount Park including Lincoln Drive, Kelly Drive and Martin Luther King (MLK) Drive. Snow and ice removal on the remaining 2,490 miles of city streets is the responsibility of the Philadelphia Streets Department.[142]

In addition, riverine, local and flash flooding caused by winter storms can impact businesses most highly susceptible to that hazard. More information on flooding and its economic impact can be found in the flood hazard profile in Section 4.2.4 of this Plan.

4.3 Hazard Vulnerability Summary

The hazard vulnerability section of this document is divided into four main components: methodology, hazard ranking, potential loss estimates, and future development and vulnerability.

4.3.1 Methodology

The risk assessment process used for Philadelphia's 2012 HMP is consistent with the process and steps presented in the Federal Emergency Management Agency (FEMA) 386-2, State and Local Mitigation Planning How-to- Guide, Understanding Your Risks – Identifying Hazards and Estimating Losses.

This process, broken down into four unique steps, identifies (step 1), and profiles (step 2) the hazards of concern and assesses the vulnerability of assets (population, structures, critical facilities and the economy) at risk in Philadelphia (steps 3 and 4). The results of these steps are included within Section 2: Community Profile, and Section 4: Risk Assessment of this plan.

4.3.2 Hazard Ranking

4.3.2.1 Hazard Ranking Results

After the completion and review of Steps 1-4 in the risk assessment, a Philadelphia Priority Risk Ranking Assessment was conducted by the Hazard Mitigation Planning Committee. This assessment further prioritizes within the natural hazards identified as of most concern to Philadelphia (Section 4.1), and ranks the seven natural hazards identified in this plan into risk levels.

Four risk factors were taken into consideration in developing the priority ranking: probability of occurrence, impact on population, impact on infrastructure, and the impact on the economy, further elaborated upon in the next portions of this plan. The final rankings were determined by a group consensus after considering what level of concern

[142] Philadelphia Streets Department Snow and Ice Operations Plan. Retrieved 21 February 2012.

was most appropriate for the City of Philadelphia based on the hazard.[143] Table 4.3.2-1 presents the hazard probability category assigned for each hazard.

Table 4.3.2-1	Hazard Ranking Results in Philadelphia	
#	**Hazard of Concern**	**Hazard Ranking Category**
1	Extreme Temperature	A
2	Winter Storm	A
3	Flooding	A
4	Windstorm/Tornado	B
5	Tropical Cyclone	B
6	Earthquake	C
7	Drought	C

Phase II of this plan will include a further hazard risk ranking, which will include natural hazards which pose a lesser amount of risk to the area, as well as human caused disasters.

4.3.2.2 Hazard Ranking Methodology

The methodology for ranking each hazard in Philadelphia was broken down into two main categories: the probability of occurrence and the impact to the community.

Probability of Occurrence

The probability of occurrence is an estimate of how often a hazard event occurs. A review of historic events assists with this determination. After the Hazard Mitigation Planning Committee thoroughly reviewed each hazard profile a census was reached on how frequent a hazard affects Philadelphia. An 'A' classification indicates that the hazard has a likelihood of affecting Philadelphia every 1-5 years, a 'B' classification, every 5-10 years, and a 'C' classification every 10 years or more. The table below depicts this census ranking and the primary vulnerability factor(s) behind each classification.

Table 4.3.2-2	Probability of Occurrence: Philadelphia	
Hazard of Concern	**Probability Category**	**Vulnerability**

[143] Each of the eight hazards identified in this plan have been determined to be of higher risk to Philadelphia. However, it should be noted that the discussion of probability categories with the HM Planning Committee was in terms of 'Low,' 'Medium,' and 'High,' for ease of discussion. The probabilities were then translated into alphanumeric categories (Low=C; Medium=B; High=A) in the drafting phase of the plan.

Extreme Temperature	A	• Occur biannually in summer and winter months • 83 extreme temperature events (13 extreme cold, 70 extreme heat) over a 17 year span (between 1994 and 2011)
Winter Storm	A	• Philadelphia averages 22.8 inches of snowfall annually • Between 1955 and 2011, Philadelphia experienced 5 Presidential Disaster or Emergency Declarations, and 5 Gubernatorial Declarations related to winter storms
Flooding	A	• Can result in any month of the year • There have been 118 flooding events, flash, local or riverine in Philadelphia since 1993 • Between 1955 and 2011, Philadelphia experienced 15 Presidential Disaster/Emergency Declarations, and/or Gubernatorial Declarations related to flooding
Windstorm/ Tornado	B*	• Windstorms are consider high probably, as they occur annually • Between 1995 and 2011, there were 49 events in Philadelphia with wind speeds greater than 34mph • Tornadoes are less frequent • Since reliable record keeping began in 1950, 8 tornadoes have touched down in Philadelphia, all being classified an F2 or weaker
Tropical Cyclone	B	• From 1861-2011 29 tropical cyclones have had centers of circulation past through or within 65 statute miles of Philadelphia • Based on historical data between 1944 and 1999, there is approximately an 18 percent chance of experiencing a tropical storm or hurricane event between June and November of any given year
Earthquake	C	• Hundreds of earthquakes have occurred in or around Philadelphia; however there has only been one 4.0 magnitude earthquake since 1737.

Drought	C	• One Presidential and five Gubernatorial Declarations have been issued as a result of the drought emergencies • Since 1980 there have been 9 drought watches, 12 drought warnings and 6 drought emergencies

*Windstorm/Tornado received a 'B' probability ranking by averaging the frequency of each hazard; windstorms received an 'A' ranking, while tornadoes received a 'C' ranking.

Impact to Philadelphia

The impact of each hazard in Philadelphia is further broken down into three categories: impact on the population, impact on the infrastructure, and the impact on the economy. Each impact ranking was based on the documented historic losses and projected losses detailed in the hazard profiles, as well as a subjective assessment by the Hazard Mitigation Planning Committee considering the most realistic (based on historic data) worst case scenario for Philadelphia. Table 4.3.2-1 illustrates this census ranking and the main determination factor(s) behind each classification.

Table 4.3.2-3 Impact to Philadelphia (Population, Infrastructure, and Economy)

Hazard of Concern	Impact Category	Vulnerability
Extreme Temperature	Population: A	• Fatalities caused by extreme temperatures ranks the highest in the United States, with 140 deaths on average the past ten years
	Infrastructure: A	• Brownouts and blackouts can occur during extreme heat • Roads and bridges can buckle due to expansion in heat • Gas and water mains can burst due to cold • Fire hazard increases
	Economy: B	• Higher electric and gas bills • Repairs to roads and infrastructure
Winter Storm	Population: B	• Accidents are likely to occur • Transportation for emergency medical services is hindered
	Infrastructure: B	• May collapse roofs • Flooding/flash flooding can occur
	Economy: A	• Cost accrued from snow and ice removal, salting roads, repairing roads from the freeze/thaw process, and the loss of business

Flooding	Population: C	• Few injuries and deaths occur, mostly within vehicles driving through flooded roads • Mold contaminates homes and buildings
	Infrastructure: B	• Disruption in transportation services from closed roads and rail lines • Damaged buildings and homes in floodplains
	Economy: A	• Direct Economic Loss from a 100-Year Flood Event could be in the multi-millions
Windstorm, Tornado	Population: C	• Minimal fatalities/injuries
	Infrastructure: A	• Damage can be sustained to building, especially high-rises • Powerlines can go down, knocking out power for several days
	Economy: A	• Direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services could be in the multi-billions
Tropical Cyclone	Population: C	• Minimal fatalities/injuries
	Infrastructure: B	• Similar to flooding and windstorm
	Economy: B	• Direct economic loss from a 100-year hurricane event would be nearly $100 million
Earthquake	Population: A	• Numerous fatalities/injuries
	Infrastructure: A	• Significant structural damage would be sustained due to the older buildings of Philadelphia
	Economy: A	• Economic loss would be in the multi-millions due to damage structures
Drought	Population: B	• Health issues related to use restrictions and lack of hygiene
	Infrastructure: C	• Does not affect infrastructure such as highways, bridges and buildings
	Economy: C	• Losses towards water-reliant businesses • Loss of crops

The table below indicates the rankings for all considerations made in ranking each of Philadelphia's main hazards, as well as the final hazard ranking that was determined by the Hazard Mitigation Planning Committee as a result of the full hazard assessment.

Table 4.3.2-4 Philadelphia Hazard Ranking Matrix

Hazard of Concern	Probability of Occurrence	Population Impact	Infrastructure Impact	Economic Impact	Final Hazard Ranking
Extreme Temperature	A	A	A	B	A
Winter Storm	A	B	B	A	A
Flooding	A	C	B	A	A
Windstorm/ Tornado	B	C	A	A	B
Tropical Cyclone	B	C	B	B	B
Earthquake	C	A	A	A	C
Drought	C	B	C	C	C

4.3.3 Potential Loss Estimates

To address the requirements of the Disaster Mitigation Act of 2000 and better understand the potential vulnerability and losses associated with natural hazards of concern, Philadelphia used standardized tools including the HAZUS-MH modeling software, combined with local, state, and federal data to conduct the vulnerability assessment and determine potential loss estimates.

4.3.3.1 HAZUS-MH Methodology

HAZUS-MH is a nationally applicable standardized methodology and software program, developed by FEMA, which is under contract with the National Institute of Building Sciences. The program estimates potential losses from earthquakes, hurricane winds, and floods. In HAZUS-MH, current scientific and engineering knowledge is coupled with Geographic Information Systems (GIS) technology to produce estimates of hazard-related damage before, or after, a disaster occurs.[144]

Potential loss estimates analyzed in HAZUS-MH for this Hazard Mitigation plan include:

- Physical damage to residential and commercial buildings, schools, critical facilities, and infrastructure.
- Economic loss, including lost jobs, business interruptions, repair and reconstruction costs.

[144] Federal Emergency Management Agency (FEMA). HAZUS: FEMA's Methodology for Estimating Potential Losses from Disasters. Retrieved 24 January 2012.

HAZUS-MH is designed to generate estimates of hazard-related damage to a city or a region for a specific hazard event or it can model the effects of probabilistic events. Probabilistic events are modeled by looking at the damage caused by an event that is likely to occur over a given period of time, known as a return period. For example, HAZUS-MH can estimate the damage caused by a flood that is likely to occur once every 500 years (which has a 1 in 500 or 0.2 percent chance of occurring in a given year). In this HMP, HAZUS-MH hazards include earthquakes, floods, and tropical cyclones in Philadelphia.

HAZUS-MH uses demographic and general building stock (GBS) data, which is used to estimate hazard-related damage. Philadelphia supplemented this default data with 2009 OPA data, a high resolution 2008 digital elevation model, and DFIRM data, because an initial review found that for the City as a whole, the default GBS data provided with HAZUS-MH did not adequately reflect actual conditions.

4.3.3.2 Non-HAZUS-MH Methodology

Non-HAZUS-MH natural hazards in this plan include drought, extreme temperatures, pandemic, winter storms, and windstorms/tornadoes. Vulnerable populations and existing infrastructure were evaluated using the best available data to assess vulnerability to these natural hazards and to help identify appropriate mitigation efforts.

4.3.3.3 Limitations

Within this HMP, the risk assessment, and the loss estimates rely on the best data and methodologies available to Philadelphia. Uncertainties are inherent in any loss-estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct such a study
- Incomplete or dated inventory, demographic, or economic parameter data
- The unique nature, geographic extent, and severity of each hazard
- Mitigation measure already employed and the amount of advance notice residents have to prepare for a specific hazard event

These factors can result in a range of uncertainties in loss estimates. Therefore, potential exposure and loss estimates are approximate. These results do not predict precise results and should be used to understand relative risk.

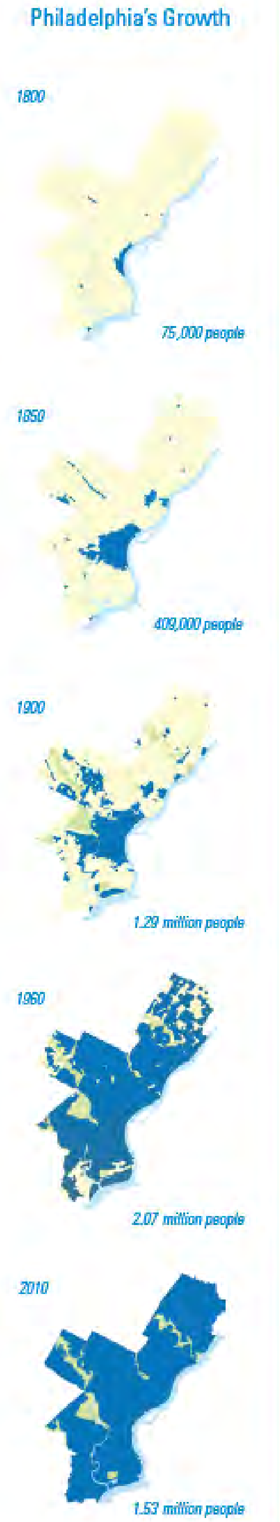
4.3.4 Future Development and Vulnerability

In its history, Philadelphia has experienced both the boom of population growth and the bust of population decline. Philadelphia's population peaked by the early 1950's. As in many cities of the Northeast, a decades-long period of de-industrialization resulted in closed factories, population loss, vacant land, and urban decay. Yet by 2010, reinvestment and economic diversification stabilized and reversed the declining population, and for the first time in 50 years, the City experienced a population gain of0.6 percent, according to the U.S. Census Bureau.

In early 2010, the Philadelphia Planning Commission (PCPC) developed an aspirational population forecast for 2035 taking into account historic trends, recent trends, and current conditions. The PCPC forecast for 2035 utilizes a range of forecasts based on different assumptions, including the extrapolation of long-term and short-term trends as well as the consideration of the impacts of future conditions and interventions on births, deaths, and migration. These separate forecasts were then averaged to reflect a likely future outcome within a range of possible outcomes.

As shown on table 4.3.4-1, the combination of five different forecasts yield an average forecast of approximately 1.63 million Philadelphia residents by 2035. This suggests a population increase of 100,000 people over 25 years, a significant increase which has not been experienced since before 1950.

Figure 4.3.4-1



Summary of Five Population Forecast Models

	Population Forecast Model and Assumptions	2010 Base Population (millions)	2035 Forecast Population (millions)	2010-2035 Change	Notes
1.	Decennial Census Trend. Composite *Averages high, medium, and low interpretations of decennial Census trends, 1980-2010*	1.53	**1.45**	–80,000	*Ranges from high of 1.88m to low of 1.26m*
2.	DVRPC Forecast Adjusted to 2010 Base *Same annual changes to 2035 as Delaware Valley Regional Planning Commission "Connections" Plan*	1.53	**1.53**	0	*Slight decrease through 2015, followed by slight increase*
3.	City Share of Region. Composite *Average high, medium, and low interpretations of trends in city's share of 12-county region, 1970-2010*	1.53	**1.65**	120,000	*Ranges from high of 1.83m to low of 1.48m*
4.	Annual Estimates Census Trend *Extension to 2035 of 2000-2010 changes reported by Census Annual Estimates Program*	1.53	**1.66**	130,000	*Reflects annual growth rate of approximately 0.3 percent*
5.	High Demand/High Capacity *Substantial increase in retention and immigration of domestic and foreign residents*	1.53	**1.85**	320,000	*Reflects City's capacity to accomodate growth from combined effects of city-friendly trends and policies in immigration, the economy, and the environment*
	Average	1.53	**1.63 (rounded)**	100,000 (rounded)	

	***Philadelphia2035* Forecast**	2010	2035	2010-2035 Change
1.	*Population*	1,530,000	**1,630,000**	+100,000
2.	*Households*	600,000	**638,000**	+38,000
3.	*Jobs*	675,000	**715,000**	+40,000
4.	*Residents per job*	2.27	**2.28**	+0.01

Source: PCPC, Philadelphia2035

Based on this estimated population increase, it is also predicted that that Philadelphia will also see an increase in its vulnerability to natural hazards over the next 25 years. However Philadelphia has several initiatives that will influence future development and have the potential to decrease the hazard vulnerability in the future. Discussed in detail in Section 5.1.2.1 of this plan, these initiatives include:

- Philadelphia2035 Plan
- GreenPlan Philadelphia
- Zoning Codes
- National Flood Insurance Program
- The Watershed Stormwater Plan
- Numerous hazard-specific and function-specific planning efforts

5. Capability Assessment

5.1 Philadelphia Capability Assessment

The purpose of conducting a capability assessment is to determine the ability to implement a comprehensive mitigation strategy, and to identify potential opportunities for establishing or enhancing specific mitigation policies, programs or projects.

Philadelphia's capability assessment has two primary components: an inventory of the relevant plans, ordinances and/or programs already in place; and an analysis of the City's capacity to carry them out. The careful examination of these capabilities will determine existing gaps, shortfalls or weaknesses associated with ongoing government activities that could hinder proposed mitigation actions and possibly exacerbate hazard vulnerability. The capability assessment also highlights the positive mitigation measures already in place or being implemented throughout Philadelphia, which should continue to be supported and enhanced, if possible, through future mitigation efforts.

5.1.1 Conducting the Capability Assessment

In order to facilitate the inventory anylsis of Philadelphia's capabilities, a detailed Capability Assessment Survey was distributed to the members of the Hazard Mitigation Planning Committee. The detailed survey requested information on a variety of capability indicators such as existing local plans, policies, programs and ordinances that contribute to and/or hinder Philadelphia's ability to implement hazard mitigation actions. Other indicators included information related to Philadelphia's fiscal, administrative and technical capabilities such as acess to local budgetary and personnel resources for mitigation purposes. The information provided by the Hazard Mitigaiton Planning Committee in response to the survey was incorporated into a database for further analysis by upper-level government offcals. These same offcals were also asked to comment on the current political climate in Philadelphia to implement mitigation actions.

5.1.2 Capability Assessment Findings

The findings of the capability assessment are summarized in this plan to provide insight into Philadelphia's capacity to implement hazard mitigation actions. All information is based upon the responses provided by the Hazard Mitigation Planning Committee and the analysis of government officials.

5.1.2.1 Planning and Regulatory Capability

Planning and regulatory capability is based on the implementation of plans, ordinances and programs that demonstrate a local jurisdiction's commitment to guiding and managing growth, development and redevelopment in a responsible manner while maintaining the general welfare of the community.[145] The assessment is designed to provide a general overview of the key planning and regulatory tools or programs in

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[145] Ibid

place or under development for Philadelphia, along with their potential effect on loss reduction.

Table 5.1.2-1 provides a summary of the relevant local plans, ordinances and programs already in place or under development for Philadelphia.

Table 5.1.2-1 Planning and Regulatory Capability

Planning /Regulatory Tool	Status			
	In Place	Updating	Under Development	Not Applicable
Hazard Mitigation Plan			X	
Emergency Operations Plan	X	X		
Hazard Based Emergency Plans	X	X	X	
Function Based Emergency Plans	X	X	X	
Evacuation Plan	X	X		
Continuity of Operations Plan			X	
National Flood Insurance Program	X			
National Flood Insurance Program - Community Rating System				X
Floodplain Regulations	X			
Floodplain Management Plan	X			
Zoning Codes	X			
Subdivision Regulations	X			
Comprehensive Land Use Plan			X	
Open Space Management Plan			X	
Stormwater Management Plan	X			
Watershed Management Plan	X			

Capital Improvement Plan	X			
Economic Development Framework	X			
Historic Preservation Plan			X	
Building Codes	X			
Firewise				x
Storm Ready			X	

Emergency Management

Emergency management is a comprehensive, integrated program of mitigation, preparedness, response and recovery for emergencies of any kind. In Philadelphia the responsibility of ensuring the City's readiness to these emergencies falls under the Managing Director's Office of Emergency Management (MDO-OEM). To achieve their mission, roles of MDO-OEM include, but are not limited to:

- Oversee the development of City plans for large scale emergencies and disasters,
- Conduct training and exercises to evaluate the effectiveness of plans and policies,
- Educate the public on preparedness, and
- Coordinate and support responses to and recovery from emergencies.

Hazard Mitigation Plan

A hazard mitigation plan represents a community's blueprint for how it intends to reduce the impact of natural hazards on people and the built environment. The essential elements of a hazard mitigation plan include a risk assessment, capability assessment and mitigation strategy. State, Indian tribal, and local governments are required to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000, provides the legal basis for state, local, and Indian tribal governments to undertake a risk-based approach to reducing risks from natural hazards through mitigation planning.

Emergency Operations Plan

The Pennsylvania Emergency Management Services Code, Title 35, requires all political jurisdictions in the Commonwealth to have an Emergency Operations Plan (EOP), an Emergency Management Coordinator (EMC), and an Emergency Operations Center (EOC). Philadelphia's EOP is an all-hazards plan that complies with the National Incident Management System (NIMS) and is the basis for a coordinated and effective response to any disaster that may affect lives and property in Philadelphia.

Hazard-based Planning
Numerous City agencies have developed hazard specific plans that focus on the natural and man-made hazards that impact the City of Philadelphia. These plans include, but are not limited to the Winter Weather Emergency Plan, Emergency Heat Plan, and Emergency Flood Response Plan.

Function-based Planning
Philadelphia MDO-OEM has developed a series of function-based plans that focus on how various hazard scenarios impact the City's phases of operation. These plans include, but are not limited to the Mass Casualty Plan, Mass Care and Shelter Plan, and Repatriation Plan.

Evacuation Plan
Evacuation is one of the most widely used methods of protecting the public from hazard impacts. Evacuation plans include descriptions of the area(s) being evacuated, the demographics and characteristics of people within those area(s), transportation routes to safe areas, and how the community will support individuals who do not have access to their own transportation.

Continuity of Operations Plan
Continuity of Operations Planning is the process of developing advance arrangements and procedures which enable an organization to continue its essential functions despite events that threaten to disrupt them. The continuity discipline aims to identify emergency or unconventional means to replace or work around those deficiencies in the short term until the organization can be reconstituted on a normal basis.

Participation in the NFIP and Floodplain Management Plan/Floodplain Regulations
The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968, which enabled property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damages. Participation in the NFIP is based on an agreement between communities and the federal Government. If a community adopts and enforces a floodplain management ordinance to reduce future flood risk to new construction in floodplains, the federal Government will make flood insurance available within the community as a financial protection against flood losses. This insurance is designed to provide an insurance alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods.

Philadelphia is an active participant in the NFIP. As of September 30, 2011 there are 3,907 insurance policies in force within Philadelphia. Of the 3,907 insurance polices, 2,915 are within the Special Flood Hazard Area (SFHA) or 1-percent annual chance floodplain, and 992 are located outside of the SFHA.

A floodplain management plan provides a framework for action regarding the corrective and preventative measures in place to reduce flood-related impacts.
PCPC is the lead coordinating agency within Philadelphia regarding the NFIP, and is responsible for updating the floodplain management ordinances for the City. Philadelphia is currently in the process of updating those ordinances.

Zoning Codes
Zoning seeks to protect public health, safety and welfare by regulating the use of land and controlling the type, size and height of buildings. The Philadelphia Zoning Commission is charged with enforcing a zoning code that is easy to understand, improves the City's planning process, promotes positive development, and preserves the character of Philadelphia's neighborhoods.

Subdivision Regulations
Subdivision is defined as the division of any parcel of land into a number of lots, blocks or sites as specified in a local ordinance, law, rule or regulation, with or without streets or highways, for the purpose of sale, transfer of ownership, or development. Title 14 of the Philadelphia City Code and Home Rule Charter contains the land subdivision regulations for the city.

Comprehensive Land Use Plan
A comprehensive land use plan establishes the overall vision for what a community wants to be and serves as a guide to future governmental decision making. Typically a comprehensive plan contains sections on demographics, land use, transportation elements and community facilities. Given the broad nature of the plan and its regulatory standing in many communities, the integration of hazard mitigation measures into the comprehensive plan can enhance the likelihood of achieving risk reduction goals, objectives and actions. The Philadelphia 2035: Comprehensive Plan is managed by the PCPC but dozens of other organizations and individuals assisted with the development of the plan. Philadelphia2035 is one component of a broader initiative known as the "Integrated Planning and Zoning Process." The process is designed to align Philadelphia's zoning code changes with comprehensive and strategic planning, all of which is informed by a formalized public education and outreach organization, the Citizens Planning Institute.

As the citywide plan of Philadelphia2035 is completed, the PCPC is geared up to prepare 18 strategic district plans over the course of the next several years. Each district plan will produce, among many other outputs, a proposed land use plan for the district. That land-use plan will serve as the basis for zoning map revisions, an important activity of the Zoning Code reform work.

Open Space Management Plan
An open space management plan is designed to preserve, protect and restore largely undeveloped lands in their natural state, and to expand or connect areas in the public domain such as parks, greenways and other outdoor recreation areas. In many

instances open space management practices are consistent with the goals of reducing hazard losses such as the preservation of wetlands or other flood-prone areas in natural state in perpetuity. Under the direction of the PCPC a comprehensive open space management plan, GreenPlan Philadelphia, is being developed. The City is currently working on a number of fronts to improve the city's open space network including the efforts of the Neighborhood Transformation Imitative, the New River City initiative, the Philadelphia Water Department's stormwater management plan, and the Philadelphia School District's Campus Park Program. The comprehensive citywide open space management plan will knit together these various efforts and help to build the successful open space system.

Stormwater Management Plan
A stormwater management plan is designed to address flooding associated with stormwater runoff. As of June 1, 2011 the Philadelphia Water Department's "Green City, Clean Waters", stormwater management plan, was approved by the EPA and PADEP. The purpose of the plan is to modify the stormwater infrastructure in Philadelphia to reduce the amount of contaminated water that enters rivers and streams. The plan is expected to reduce the amount of sewer overflow entering city waterways by 5 to 8 billion gallons per year. This is an 80 to 90 percent reduction in flow. The plan includes several green infrastructure projects to attain water quality goals and also to mitigate climate change impacts while stimulating economic development. The projects include incorporating porous asphalt, bioswales[146], rooftop gardens, street repaving, roadside plantings, and thousands of new trees.

Watershed Management Plan
The PWD has developed Integrated Watershed Management Plans (IWMPs) for each of the five major tributary streams of the Schuylkill and Delaware Rivers, including the Cobbs, Tookany/Tacony-Frankford, Wissahickon, Pennypack and Poquessing. Designed to meet the goals and objectives of numerous water resources-related regulations and programs, integrated watershed management plans recommend the use of adaptive management approaches to implement recommendations watershed-wide.

Capital Improvement Plan
The Capital Program is Philadelphia's six-year plan for investing in its physical infrastructure, community facilities, and public buildings. While much of the Capital Program focuses on improvements to the City's neighborhoods and the quality of life of its citizens, the plan supports numerous other municipal government priorities. More specifically, the Capital Program includes projects that promote economic recovery and job creation, enhance public safety, invest in youth, protect the most vulnerable, and reform city government.

[146] Bioswales are storm water runoff conveyance systems that provide an alternative to storm sewers. They absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters. A road side ditch with vegetation can serve as a bioswale.

Economic Development Framework
The Greater Philadelphia Economic Development Framework was created to satisfy provisions for a Comprehensive Economic Development Strategy (CEDS) for the Greater Philadelphia region, encompassing portions of Pennsylvania, New Jersey, and Delaware. This document was developed according to provisions outlined in 13 CFR § 303.7(c) *Consideration of non-EDA funded CEDS* and was formally approved by the U.S. Economic Development Administration as the Greater Philadelphia region's CEDS on September 30, 2009. This document is the product of a public-private consortium jointly managed by DVRPC (Delaware Valley Regional Planning Commission), Select Greater Philadelphia, and Ben Franklin Technology Partners.

Historic Preservation Plan
A historic preservation plan is intended to preserve historic structures or districts within a community. The Preservation Alliance, in cooperation with the Philadelphia Historical Commission and PCPC, is currently developing the first phase of a multi-year project to create a preservation plan and citywide survey of historic resources.

Building Codes
Building Codes regulate construction standards. In Philadelphia, permits are issued for new construction and renovations of existing structures. L&I is responsible for reviewing plans to ensure they conform to existing code in Philadelphia, and issuing permits. Decisions regarding the adoption of building codes are made through PCPC.

5.1.2.4 Administrative and Technical Capability

The ability for Philadelphia to develop and implement mitigation projects, policies and programs is directly tied to its ability to direct staff time and resources for that purpose. Administrative capability can be evaluated by determining how mitigation-related activities are assigned to City departments, and how adequate the personnel resources are for carrying activities out. Technical capability can generally be evaluated by assessing the level of knowledge and technical expertise of City employees, such as personnel skilled in using GIS to analyze and assess community hazard vulnerability. Table 5.1.2-2 provides a summary of the administrative and technical capability of Philadelphia.

Table 5.1.2-2 Administrative and Technical Capability		
Staff/Personnel Resources	Yes	No
Planners (with land use/land development knowledge)	X	
Planners or engineers (with natural and/or human caused hazards knowledge)	X	
Engineers or professional trained in building and/or infrastructure construction practices (includes building inspectors)	X	
Emergency Manager	X	

Floodplain Manager	X	
Land Surveyors	X	
Scientists or staff familiar with the hazards of the community	X	
Personnel skilled in GIS and/or HAZUS	X	
Grant writers or fiscal staff to handle large/complex grants	X	

Local agencies agency which can provide technical assistance for mitigation activities include, but are not limited:

- Managing Director's Office of Emergency Management
- Philadelphia Fire Department
- Philadelphia Police Department
- Philadelphia Water Department
- Philadelphia Department of Public Health
- Philadelphia Gas Works
- Philadelphia Streets Department
- Philadelphia Licenses and Inspections
- Philadelphia Parks and Recreation
- Philadelphia City Planning Commission
- Philadelphia International Airport
- Office of Innovation and Technology
- Delaware River Port Authority
- Veolia Energy

State agencies agency which can provide technical assistance for mitigation activities include, but are not limited:

- Pennsylvania Department of Community and Economic Development
- Pennsylvania Department of Conservation and Natural Resources
- Pennsylvania Department of Environmental Protection
- Pennsylvania Department of Transportation
- Pennsylvania Emergency Management Agency
- Southeast Pennsylvania Transportation Authority

Federal agencies which can provide technical assistance for mitigation activities include, but are not limited to:

- Army Corp of Engineers
- Department of Housing and Urban Development
- Department of Agriculture
- Economic Development Administration
- Environmental Protection Agency

- Federal Emergency Management Agency
- Small Business Administration

5.1.2.5 Fiscal Capability

The ability to implement mitigation-related activities is closely associated with the amount of money available to implement such policies and projects. This may take the form of outside grant funding awards or locally-based revenue and financing.

Local programs which may provide financial support for mitigation activities include, but are not limited, to:

- Capital Improvement Programming
- Special Purpose Taxes
- Water/Sewer Fees
- Stormwater Utility Fees
- General Obligation, Revenue, and/or Special Tax Bonds
- Partnering Arrangements or Intergovernmental Agreements

State programs which may provide financial support for mitigation activities include, but are not limited to:

- Community Conservation Partnerships Program
- Community Revitalization Program
- Floodplain Land Use Assistance Program
- Growing Greener Program
- Keystone Grant Program
- Local Government Capital Projects Loan Program
- Land Use Planning and Technical Assistance Program
- Pennsylvania Heritage Areas Program
- Pennsylvania Recreational Trails Program
- Shared Municipal Services
- Technical Assistance Program

Federal programs which may provide financial support for mitigation activities include, but are not limited to:

- Community Development Block Grants (CDBG)
- Disaster Housing Program
- Emergency Conservation Program
- Emergency Watershed Protection Program
- Hazard Mitigation Grant Program (HMGP)
- Flood Mitigation Assistance Program (FMA)
- Non-insured Crop Disaster Assistance Program
- Pre-Disaster Mitigation Program (PDM)
- Repetitive Flood Claims Program (RFC)
- Section 108 Loan Guarantee Programs

- Severe Repetitive Loss Grant Program (SRL)
- Weatherization Assistance Program

5.1.2.6 Political Capability

The Capability Assessment Survey was used to capture information on Philadelphia's political capability. Local government officials were asked to score their community on a scale of "unwilling" (0) to "very willing" (5) to adopt policies and programs that reduce hazard vulnerabilities. According to the results of the assessment Philadelphia is moderately willing to adopt policies and programs to reduce hazard vulnerability.

5.1.2.7 Self-Assessment

In addition to the inventory and analysis of specific local capabilities, the Capability Assessment Survey requires Philadelphia to conduct its own self-assessment of the City's capability to implement hazard mitigation activities. In response to the survey, local officials classified each of the aforementioned capabilities as limited, moderate or high. Table 5.1.2-4 summarizes the results of the self-assessment. An "L" indicates limited capability, an "M" indicates moderate capability, and an "H" indicates high capability.

Table 5.1.2-4 Self-Assessment of Local Capability

Capability	Ranking
Planning and Regulatory Capability	H
Administrative and Technical Capability	M
Fiscal Capability	L
Political Capability	M
Overall Capability	**M**

6. Mitigation Strategy

6.1 Introduction

The Mitigation Strategy describes how Philadelphia will reduce or eliminate potential losses from natural hazards identified in Section 4: Risk Assessment. The strategy focuses on existing and potential mitigation actions aimed to mitigate the effects of a natural hazard event on Philadelphia's population, economy, and infrastructure.

6.1.1 Mitigation Planning Approach

The general mitigation planning approach used to develop this plan is based on the FEMA publication: *Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies*.[147] The document includes four steps, which were used to support mitigation planning for this HMP.

- **Step 1: Develop mitigation goals and objectives**. Mitigation goals and objectives were developed using the hazard profiles, vulnerability assessments, risk assessment.
- **Step 2: Identify and prioritize mitigation actions**. Mitigation actions are identified based on the risk assessment, the mitigation goals and objectives, existing policies, and input from the planning committee. The potential mitigation actions were qualitatively evaluated using the PASTEEL method, described in more detail in section 6.4.2.1. They were then prioritized into three categories: highest priority, high priority, and moderate priority.
- **Step 3: Prepare an implementation strategy**. Highest and high priority actions are recommended for first consideration for implementation. However, based on community-specific needs, cost estimation, and available funding, some moderate priority mitigation actions may also be addressed before some of the highest or high priority actions.
- **Step 4: Document the mitigation planning process**. The mitigation planning process is documented throughout this plan.

6.1.2 FEMA Requirements Addressed in this Section

The Hazard Mitigation Planning Committee developed the mitigation strategy consistent with the process and steps presented in FEMA's How-To-Guide: *Developing the Mitigation Plan.* This section satisfies the following requirements:

- **Requirement 201.6(c) (3) (i):** [The hazard mitigation strategy ***shall*** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

[147] Federal Emergency Management Agency (FEMA). Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies (FEMA 386-3). Retrieved 9 February 2012.

- **Requirement 201.6(c)(3)(ii):** [The mitigation strategy ***shall*** include] a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.
- **Requirement: 201.6(c) (3) (iii):** [The mitigation strategy section ***shall*** include] an action plan describing how the actions identified in section (c) (3) (ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization ***shall*** include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

6.2 Mitigation Goals and Objectives

The first step in developing a hazard mitigation strategy is to establish goals and objectives that aim to reduce or eliminate Philadelphia's long term vulnerability to natural hazards. Mitigation goals are general guidelines explaining what Philadelphia wants to achieve in terms of hazard prevention. Objectives are specific, measurable strategies or implementation steps used to achieve the identified goals.

The goals and objectives identified in Table 6.2-1 provide the necessary framework to develop a mitigation strategy. Philadelphia will re-evaluate its hazard mitigation goals and objectives each plan maintenance cycle to ensure they continue to represent Philadelphia's hazard mitigation priorities.

Table 6.2-1	**Hazard Mitigation Goals and Objectives**
Goal 1: Protect Public Health and Safety	
Objective 1.1	Identify communities that would benefit from warning systems.
Objective 1.2	Update systems that provide warning and emergency communications.
Objective 1.3	Reduce impacts of hazards on vulnerable populations.
Objective 1.4	Train emergency responders.
Goal 2: Protect Property	
Objective 2.1	Develop and implement mitigation programs that protect critical facilities and services.
Objective 2.2	Promote disaster-resistant future development by considering known hazards when identifying sites for new facilities and systems.
Objective 2.3	Create redundancies for critical networks such as water, sewer, digital data, power, and communications.
Objective 2.4	Integrate hazard and risk information into land use planning

	mechanisms.
Objective 2.5	Educate public officials and the public about hazard risk, and building requirements.
Objective 2.6	Promote post-disaster mitigation as part of restoration and recovery.
Goal 3: Protect Environment	
Objective 3.1	Develop mitigation strategies that protect the environment.
Objective 3.2	Identify and prioritize hazardous material storage sites.
Goal 4: Promote a Sustainable Economy	
Objective 4.1	Develop mitigation strategies that ensure the continuation of critical business operations.
Objective 4.2	Form partnerships to share resources.
Objective 4.3	Educate businesses about contingency planning.
Objective 4.4	Partner with the private sector to promote employee education about disaster preparedness while at work and at home.
Goal 5: Increase Public Preparedness for Disasters	
Objective 5.1	Enhance understanding of natural hazards and the risks they pose.
Objective 5.2	Update hazard information, including maps and databases.
Objective 5.3	Increase public's knowledge of hazards and protective measures, allowing individuals to appropriately prepare for, respond to, and recover from natural hazard events.

6.3 Identification and Analysis of Mitigation Techniques

Mitigation actions include programs, plans, projects, and policies that help reduce or eliminate the long-term risk to human life and property from natural hazards. FEMA organizes mitigation actions into six broad categories. These categories allow similar types of mitigation actions to be compared and provide a standardized method for eliminating unsuitable actions.

1. **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed. 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, open-space preservation, and stormwater regulations.

2. **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 property renovations however, this category also includes insurance.

3. **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 educational programs.

4. **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.

5. **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) such as dams, dikes, and levees, and safe rooms.

6. **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.

The following table summarizes Philadelphia's mitigation actions by hazard, mitigation action category, and goal/objective addressed.

Table 6.3-1 Summary of Mitigation Actions

Category	Existing	Potential	Total
Mitigation Actions by Hazard			
Drought	1	2	3
Earthquake	0	2	2
Extreme Temperature	4	1	5
Flood	10	17	27
Tropical Cyclone: Hurricane, Tropical Storm	0	1	1
Windstorm, Tornado	3	0	3
Winter Storm	1	8	9
Multi-Hazard	27	40	67

Mitigation Actions by Category*			
Prevention	17	25	42
Property Protection	2	8	10
Public Education and Awareness	16	19	35
Natural Resource Protection	2	1	3
Emergency Services	13	28	41
Structural Projects	2	9	11
Mitigation Actions by Goal/Objective Addressed*			
Goal 1: Protect Public Health and Safety			
Objective 1.1	3	1	4
Objective 1.2	3	5	8
Objective 1.3	24	35	59
Objective 1.4	3	8	11
Goal 2: Protect Property			
Objective 2.1	12	17	29
Objective 2.2	2	8	11
Objective 2.3	8	7	15
Objective 2.4	2	6	8
Objective 2.5	2	3	5
Objective 2.6	2	11	13
Goal 3: Protect Environment			
Objective 3.1	2	4	6
Objective 3.2	0	3	3
Goal 4: Promote a Sustainable Economy			
Objective 4.1	4	9	13
Objective 4.2	6	11	17
Objective 4.3	7	11	18
Objective 4.4	7	9	16
Goal 5: Increase Public Preparedness for Disasters			
Objective 5.1	9	16	25
Objective 5.2	5	14	19
Objective 5.3	17	20	37

*Many mitigation actions address more than one goal and/or objective or category

6.4 Mitigation Action Plan

This section presents mitigation actions for Philadelphia to reduce potential exposure and losses identified as concerns in Section 4: Risk Assessment in this HMP. The planning committee reviewed the Risk Assessment to identify and develop these mitigation actions.

6.4.1 Existing Mitigation Actions

Existing mitigation actions are Philadelphia's programs, plans, projects, and policies currently underway that mitigate natural hazards. By assessing what Philadelphia is currently doing to mitigate natural hazards, the planning committee was able to determine how Philadelphia might expand or improve upon these programs. Table 4.6.1-1 lists the existing mitigation acts identified by the planning committee.

6.4.2 Potential Mitigation Actions

Potential mitigation actions are programs, plans, projects or policies Philadelphia may implement to help reduce or eliminate the long-term risk to human life, property and the environment from natural hazards. The HMP's planning committee identified, analyzed and prioritized all potential actions. It should be noted that some mitigation actions identified may not ultimately be implemented due to prohibitive costs, scale, low benefit/cost analysis ratios, or other concerns. Table 4.6.2-1 lists the potential mitigation acts identified by the Planning Committee.

Table 4.6.1-1	Existing Hazard Mitigation Actions						
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Completion Status**	**Estimated Project Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**
Drought	*Adjust and restrict irrigation systems at all PPR facilities for water conservation.*	*PARKS & RECREATION*	*Ongoing*	*$10,000*	*Capital Budget*	*Prevention*	*3.1*
Extreme Temperature	*Provide air quality alerts to the public.*	*PDPH*	*Ongoing*	*$500/ alert*	*HHS*	*Public Education and Awareness*	*1.3; 5.1; 5.3*
Extreme Temperature	*Conduct outreach and coordinate personnel to keep the Philadelphia homeless population safe during extreme cold and extreme heat events.*	*OSH*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Emergency Services*	*1.3*
Extreme Temperature	*Develop health bulletins for seasonally appropriate risks.*	*PDPH*	*Ongoing*	*$5,000/ seasonal issue*	*HHS*	*Public Education and Awareness*	*1.3; 5.1; 5.3*
Extreme Temperature	*Discourage citizens from swimming in rivers, streams and Philadelphia fountains.*	*PARKS & RECREATION*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*5.3*
Flood	*Maintain enrollment in NFIP. by implementing floodplain management initiatives, reducing the City's flood risk, and allowing residents to receive discounted flood insurance*	*PCPC*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*2.4, 2.5*
Flood	*Revise current floodplain ordinances to comply with the latest national standards*	*PCPC*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*5.2*

Table 4.6.1-1 Existing Hazard Mitigation Actions

Hazard	Mitigation Action and Description	Lead/ Supporting Agency(s)	Completion Status	Estimated Project Cost	Possible Funding Source(s)	FEMA Category	Goals and Objectives
Flood	*Require new facilities located in flood zones to be raised above the base flood elevation by 18 inches*	*PCPC*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*2.2, 2.4*
Flood	*Develop and distribute fliers for mold abatement.*	*PDPH*	*Complete*	*Staff Time*	*Agency Operating Budget*	*Public Education and Awareness*	*1.3; 2.6; 5.1; 5.3*
Flood	*Move equipment from flood prone areas, replenish building materials for storm damage repair, and close parks in flood prone areas, ready equipment for flood response.*	*PARKS & RECREATION*	*Pre-event*	*Staff Time*	*Capital Budget*	*Prevention*	*1.3, 2.1*
Flood	*Complete smaller infrastructure projects whose impact is localized.*	*PWD*	*Ongoing*	*$100,000 - $1,000,000 per project*	*PWD Operations/ Capital/Grant Funding*	*Prevention & Structural*	*1.3, 2.1 4.1, 5.2*
Flood	*Complete large infrastructure projects whose impact affects large areas of the city.*	*PWD*	*Ongoing*	*$1,000,000 - $20,000,000 per project*	*PWD Capital Funding*	*Prevention & Structural*	*1.3, 2.1, 2.3, 4.1, 5.2*
Flood	*Preform structural repairs to Fairmont Dam.*	*PWD*	*Design Stage*	*$2,000,000*	*PWD Capital Funding*	*Natural Resource Protection*	*2.1*
Flood	*Complete stream & creek restoration projects.*	*PWD*	*Ongoing*	*$100,000 - $3,000,000 per project*	*PWD Operations/ Capital/Grant Funding*	*Natural Resource Protection*	*1.3, 2.6, 3.1*
Flood	*Prepare equipment and resources necessary to respond to flooding.*	*STREETS*	*Pre-event*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*1.3,2.1*

Table 4.6.1-1 Existing Hazard Mitigation Actions

Hazard	Mitigation Action and Description	Lead/ Supporting Agency(s)	Completion Status	Estimated Project Cost	Possible Funding Source(s)	FEMA Category	Goals and Objectives
Windstorm Tornado	*Ready employees and equipment of impending event, coordinate with other Philadelphia agencies.*	*PARKS & RECREATION*	*Pre-event*	*Staff Time*	*Agency Operating Budget*	*Emergency Services*	*2.1*
Windstorm, Tornado	*Install traffic signal devices which adhere to national standards for wind tolerance.*	*STREETS*	*Ongoing*	*$250,000*	*Agency Operating Budget*	*Prevention*	*2.1*
Windstorm, Tornado	*Ensure adequate material and equipment is available to repair and replace street lights and traffic poles & signs.*	*STREETS*	*Ongoing*	*$10,000-$100,0000*	*Agency Operating Budget, Grants*	*Property Protection*	*1.3*
Winter Storm	*Ready equipment and employees, have necessary supplies on hand, i.e. salt, calcium.*	*PARKS & RECREATION*	*Pre-event*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*2.1*
Multi-Hazard	*Pre-identify emergency sheltering locations for different types of disaster.*	*MDO-OEM*	*Pre-event*	*Staff Time*	*Agency Operating Budget*	*Emergency Services*	*1.3, 4.2, 5.3*
Multi-Hazard	*Develop a list prioritizing City buildings that require redundant power sources.*	*MDO-OEM*	*Complete*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*2.1, 2.2, 2.3*
Multi-Hazard	*Maintain portable EOC in a Box.*	*MDO-OEM*	*Update Equipment Inventory (3 Years)*	*$250,000*	*USDHS, UASI, Grants,*	*Emergency Services*	*1.1*
Multi-Hazard	*Continue EOC training and exercises.*	*MDO-OEM*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*1.4*

Table 4.6.1-1			Existing Hazard Mitigation Actions				
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Completion Status**	**Estimated Project Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**
Multi-Hazard	*Purchase satellite communication (Secondary Communications).*	*MDO-OEM*	*2 Years*	*$20,000*	*USDHS, UASI, Grants,*	*Emergency Services*	*1.1*
Multi-Hazard	*Upgrade City Emergency Operations Center.*	*MDO-OEM*	*1 Year*	*$1,000,000*	*Grants*	*Emergency Services*	*1.2, 1.3, 4.1*
Multi-Hazard	*Purchase redundant alert notification system for extreme weather to notify City owned facilities (NOAA Radio).*	*MDO-OEM*	*2 Years*	*$5,000 (each radio)*	*USDHS, UASI, Grants,*	*Emergency Services*	*2.3*
Multi-Hazard	*Provide redundant alternate communication system (HAM Radios).*	*MDO-OEM*	*Ongoing*	*Staff/Volunteer Time*	*USDHS, UASI, Grants,*	*Emergency Services*	*2.3*
Multi-Hazard	*Provide redundant power in emergency operations (Portable 8K generator).*	*MDO-OEM*	*Update Equipment Inventory (5 Years)*	*$8,000*	*USDHS, UASI, Grants,*	*Emergency Services*	*2.3*
Multi-Hazard	*Execute weekly equipment testing & exercises.*	*MDO-OEM*	*Ongoing*	*$5,000 (equipment maintenance)*	*USDHS, UASI, Grants,*	*Emergency Services*	*2.1*
Multi-Hazard	*Maintain mobile command vehicle.*	*MDO-OEM*	*Update Equipment Inventory (3 Years)*	*$15,000*	*USDHS, UASI, Grants,*	*Emergency Services*	*2.3*
Multi-Hazard	*Regional MOU's*	*Multiple Agencies*	*Ongoing*	*N/A*	*Grants*	*Emergency Services*	*2.3, 4.2*

Table 4.6.1-1	Existing Hazard Mitigation Actions						
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Completion Status**	**Estimated Project Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**
Multi-Hazard	*Distribute and educate public on Ready Philadelphia guides for general preparedness and business continuity information.*	*MDO-OEM*	*Ongoing*	*$40,000*	*USDHS-UASI Grant*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*
Multi-Hazard	*Provide public outreach throughout Philadelphia with Ready Philadelphia by presenting and tabling at community and private sector events.*	*MDO-OEM*	*Ongoing*	*Staff Time / $5,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*
Multi-Hazard	*Implement Ready Notify Campaign to increase subscription to the ReadyNotifyPA system*	*MDO-OEM*	*2 years*	*$250,000*	*Grants*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*
Multi-Hazard	*Implement Ready Region, a program aimed at educating the public on preparedness.*	*MDO-OEM*	*2 years*	*$500,000*	*Grants*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*
Multi-Hazard	*Utilize ReadyNotifyPA, an advanced warning system which provides emergency text and email alerts.*	*MDO-OEM*	*Ongoing*	*$1,000,000*	*Grant*	*Public Education and Awareness*	*1.1, 1.2, 1.3, 5.3*

Table 4.6.1-1	Existing Hazard Mitigation Actions						
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Completion Status**	**Estimated Project Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**
Multi-Hazard	*Partner with Community Groups such as local community organizations, including civic, business, town watch, faith-based, senior, special needs and tenant associations to promote emergency preparedness and mitigation efforts.*	*MDO-OEM*	*Ongoing*	*$5,000*	*USDHS-UASI Grant*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*
Multi-Hazard	*Continue Emergency Rest Center Train the Trainer which includes Ready Philadelphia curriculum which promotes mitigation strategies for individuals and families.*	*MDO-OEM*	*Ongoing*	*Staff Time/ $1,500(yearly materials)*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 5.1, 5.3*
Multi-Hazard	*Distribute Emergency Rest Center supply kits containing emergency supplies in the event of evacuation.*	*MDO-OEM*	*Ongoing*	*$20,000*	*USDHS, UASI, Grants*	*Public Education and Awareness*	*1.3, 5.1, 5.3*
Multi-Hazard	*Mitigation Training Coordination: Regional Volunteer Management Coordinators may share resources and mitigation training opportunities.*	*MDO-OEM*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Prevention, Public education and Awareness*	*1.3, 1.4, 4.2, 5.1,5.2, 5.3*

Table 4.6.1-1	Existing Hazard Mitigation Actions						
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Completion Status**	**Estimated Project Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**
Multi-Hazard	*Pre-identify and target potential ERCs which are located along Philadelphia evacuation routes, and offer preparedness and mitigation training, and discuss business continuity.*	*MDO-OEM*	*Ongoing*	*Staff Time/ $1,500(yearly materials)*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 4.3, 5.1, 5.3*
Multi-Hazard	*Assist with identifying and closing illegally opened fire hydrants to minimize loss of water pressure and volume.*	*PWD/PFD /PPD*	*Ongoing*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*2.1*
Multi-Hazard	*Conduct community outreach for General Professional Preparedness.*	*PDPH*	*Ongoing*	*$25,000/ year*	*HHS*	*Public Education and Awareness*	*1.3; 1.4; 4.2; 4.3; 4.4; 5.1; 5.3*
Multi-Hazard	*Increasing Health Alert Network Recipients.*	*PDPH*	*Ongoing*	*$5,000/ year*	*HHS*	*Prevention, Public Education and Awareness*	*4.2; 5.2*
Multi-Hazard	*Develop and issue community-based bulletins, describing health risk and actions to minimize morbidity and mortality. Bulletins translated into 17 languages.*	*PDPH*	*Ongoing*	*$5,000/ issue*	*DHHS*	*Public Education and Awareness*	*1.3; 4.2; 4.4; 5.1; 5.3*
Multi-Hazard	*Development of COOP Planning for PDPH internally to keep Health Dept. running after disaster to prevent secondary infections/illness.*	*PDPH*	*Ongoing*	*$100,000/ year*	*HHS*	*Prevention*	*2.3; 2.5; 4.1*

Table 4.6.1-1	Existing Hazard Mitigation Actions						
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Completion Status**	**Estimated Project Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**
Multi-Hazard	*Purchase a communications system capable of notifying and communicate critical emergency information and actions to be taken by airport employees and the surrounding communities to reduce the impacts prior to, during, or in response to an emergency or disaster.*	*PHL*	*6-12 months to have a customized system developed and operational*	*$1,000,000*	*Grants, Capital Program and/or Operating Budget*	*Emergency Services*	*1.2*
Multi-Hazard	*Maintain portable generators for key traffic intersections.*	*STREETS*	*Ongoing*	*$1,000,000*	*Agency Operating Budget*	*Property Protection*	*2.1*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Drought	*Provide public outreach for water conservation.*	*PWD*	*2 years*	*$200,000*	*Grants*	*Public Education and Awareness*	*1.2, 5.2, 5.3*	*Moderate*
Drought	*Dredge the river intake of the Belmont WTP.*	*PWD*	*10 years*	*$300,000*	*PWD/Grants*	*Structural Project*	*4.1*	*Moderate*
Earthquake	*Retrofit City owned buildings to withstand a magnitude 8 earthquake.*	*Public Property*	*8 years*	*$100 million*	*Grants*	*Property Protection, Structural Project*	*2.1; 2.2; 2.3*	*Moderate*
Earthquake	*Evaluate various seismic building design enhancements using HAZUS-MH to identify enhancements that reduce losses generated by earthquakes.*	*MDO-OEM*	*2 years*	*Staff Time*	*Agency Operating Budget*	*Emergency Services*	*2.2, 2.4, 2.6*	*Highest*
Extreme Temperature	*Target community outreach to at-risk individuals.*	*PDPH*	*2 years*	*Staff Time/ $5,000 yearly*	*Grants*	*Prevention, Public Education and Awareness*	*1.1; 1.3; 5.3*	*Moderate*
Flood	*Enhance swift-water rescue.*	*PFD/PPD*	*5 years*	*$150,000*	*Grants*	*Emergency Services*	*1.4, 3.2, 4.2, 4.3, 4.4*	*Moderate*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Flood	*Evaluate various building enhancements using HAZUS-MH to identify opportunities to reduce flooding.*	*MDO-OEM*	*2 years*	*Staff Time*	*Agency Operating Budget*	*Emergency Services*	*2.2, 2.4, 2.6*	*Highest*
Flood	*Incorporate Flood Safety Training into Community Emergency Response Team Curriculum: Adapt CERT curriculum to educate team members on strategies that will mitigate the impact of flooding on the community.*	*MDO-OEM*	*2 years*	*$10,000*	*USDHS, UASI, Grants, Citizen Corps Grant*	*Public Education and Awareness*	*1.3, 5.1, 5.2,5.3*	*High*
Flood	*Acquisition, elevation and relocation of properties as feasible*	*Multiple Agencies*	*10 years*	*$10 million*	*HMGP*	*Prevention, Structural*	*1.3, 2.1*	*High*
Flood	*Disseminate mitigation information and help provide technical assistance to property owners affected by flood events.*	*Multiple Agencies*	*5 years*	*Staff time/ $15,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 5.1, 5.3*	*High*

Table 6.4.2-1 Potential Hazard Mitigation Actions

Hazard	Mitigation Action and Description	Lead/ Supporting Agency(s)	Project Timeframe	Estimated Cost	Possible Funding Source(s)	FEMA Category	Goals and Objectives	Prioritization
Flood	*Compile and map Severe Repetitive Loss properties through the city. Determine SRL funding eligibility and target these properties for outreach.*	*Multiple Agencies*	*5 years*	*Staff time/ $15,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 5.1, 5.3*	*High*
Flood	*Develop flood and storm surge impact model for sewer system allowing the system to be tested under various conditions to appropriately target and prioritize mitigation actions.*	*MDO-OEM /PWD*	*>10 Years*	*$10 million*	*Capital Budget/ Grants*	*Emergency Services*	*5.1, 5.2*	*High*
Flood	*Improve drainage into streams and tributaries.*	*PARKS & RECREATION*	*10 years*	*$100,000*	*Grants*	*Structural, Prevention*	*1.3, 2.1*	*High*
Flood	*Evaluate structures in floodplains, require use of permeable materials in hard surface applications to reduce run-off.*	*PARKS & RECREATION*	*10 years*	*$100,000*	*Grants*	*Structural, Prevention*	*1.3, 2.1*	*High*
Flood	*Limit development adjacent to natural areas.*	*PARKS & RECREATION / PCPC / L&I*	*5 years*	*$250,000*	*Grants*	*Prevention, Natural Resource Protection*	*1.3, 2.1, 3.1*	*High*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Flood	*Elevate the electrical and HVAC equip. at Waterworks.*	*PWD*	*5 years*	*$100,000*	*Grants*	*Structural*	*2.6*	*Moderate*
Flood	*Enlarge culverts of the Poquessing Creek tributaries to protect roadway and residences.*	*STREETS*	*10 years*	*$300,000*	*Capital Budget*	*Structural*	*1.3*	*Highest*
Flood	*Redesign roadways and bridges to lesson occurrence/impact of flooding.*	*STREETS*	*10 years*	*$500,000*	*Grants*	*Property Protection*	*1.3, 2.2*	*Highest*
Flood	*Buy equipment to upgrade capability to survey flood prone bridges and roads.*	*STREETS*	*10 years*	*$100,000*	*Grants*	*Prevention*	*2.2, 2.4*	*Moderate*
Flood	*Establish a smart detour plan for flooding of Wissahickon Creek, Schuylkill River and Cobbs Creek.*	*STREETS*	*5 years*	*$25,000*	*Grants*	*Prevention*	*1.3*	*Highest*
Flood	*Upgrade drainage capacity on Streets Department maintained drains.*	*STREETS*	*10 years*	*$100,000*	*Staff Time*	*Property Protection, Structural Project*	*1.3, 2.1*	*Moderate*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Flood	*Improve/enhance flood vulnerability data. Enhance planning by using surveys to more accurately define flood vulnerability.*	*PCPC*	*2 Years*	*$10,000*	*Grants*	*Property Protection, Prevention*	*1.3, 2.2, 2.4, 3.1, 5.1, 5.2*	*High*
Tropical Cyclone	*Hazards U.S. Multi-Hazard (HAZUS-MH) Modeling: Determine losses generated by tropical cyclones and engineering effectiveness and cost-benefit of various mitigation actions.*	*MDO-OEM*	*2 Years*	*Staff Time*	*Agency Operating Budget*	*Emergency Services*	*2.4, 2.6*	*Highest*
Winter Storm	*Educate property owners about the impacts of snow load, snow drift loads, and sliding snow loads.*	*Multiple Agencies*	*2 Years*	*Staff time/ $15,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*2.6, 3.4, 5.3*	*High*
Winter Storm	*Obtain standard pickup trucks upgraded for plowing and salting.*	*PWD/OFM/ PARKS*	*10 years*	*$200,000*	*Grant*	*Emergency Services*	*1.3*	*Moderate*
Winter Storm	*Upgrade equipment and vehicles for Brine usage in storm operations.*	*STREETS*	*10 years*	*$6,000,000*	*Grants*	*Prevention*	*1.3, 2.6*	*Highest*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Winter Storm	*Upgrade equipment and vehicles used in storm operations.*	*STREETS*	*10 years*	*$2,000,000*	*Grants*	*Prevention*	*1.3, 2.6*	*Highest*
Winter Storm	*Install GPS on all storm operations vehicles.*	*STREETS*	*10 years*	*$20,000*	*Grants*	*Prevention*	*1.3*	*High*
Winter Storm	*Upgrade Snow HQ technology including and use of the City's police/traffic camera system.*	*STREETS*	*10 years*	*$200,000*	*Grants*	*Prevention*	*1.2*	*High*
Winter Storm	*Increase training of staff involved in Winter Operations.*	*STREETS*	*5 years*	*Staff Time*	*Agency Operating Budget*	*Prevention*	*1.4*	*Moderate*
Winter Storm	*Construct ground water interceptors to capture water seeping from rock outcrops to prevent constant ice accumulation on Lincoln and Kelly Drives.*	*STREETS*	*10 years*	*$1,500,000*	*Capital Budget*	*Structural*	*1.3*	*High*

Table 6.4.2-1 Potential Hazard Mitigation Actions

Hazard	Mitigation Action and Description	Lead/ Supporting Agency(s)	Project Timeframe	Estimated Cost	Possible Funding Source(s)	FEMA Category	Goals and Objectives	Prioritization
Multi-Hazard	*Develop a comprehensive and integrated Continuity of Operations Plan (COOP) for all city agencies including corrective provisions.*	*Multiple Agencies*	*12 months, and Ongoing*	*$25,000,000*	*DHS*	*Prevention, Emergency Services*	2.5; 4.1	*Highest*
Multi-Hazard	*Expand existing contracts to remove all dead and dangerous trees, and improve tree pruning frequency to remove dead limbs and branches.*	*PARKS & RECREATION*	*5 Years*	*$100,000*	*Capital Budget*	*Prevention*	*1.3, 2.1*	*Highest*
Multi-Hazard	*Coordinate and provide public outreach on mitigation strategies the public can take to reduce or eliminate the impact of hazards on their services and infrastructure. Opportunities to educate the public include conferences, MDO-OEMs website, social media, and presentations.*	*MDO-OEM*	*5 years*	*Staff Time, $15,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*	*High*

Table 6.4.2-1			Potential Hazard Mitigation Actions					
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Conduct or update natural hazard vulnerability assessments for critical facilities throughout the Philadelphia.*	*MDO-OEM*	*5 years*	*Staff Time*	*Agency Operating Budget*	*Emergency Services*	*2.1*	*Highest*
Multi-Hazard	*Optimize use of HAZUS-MH software for Philadelphia's unique urban environment. The software update will allow Philadelphia to generate more accurate loss estimates for various hazards.*	*MDO-OEM*	*5 years*	*$5,000*	*HMGP, PDM*	*Emergency Services*	*2.4, 2.6*	*Highest*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Develop Ready Philadelphia guides for all-hazards preparedness, hazard specific information, business continuity information, as well as guides for specific vulnerable populations. Brochures will be offered in up to seven languages, large print, Braille and auto CDs.*	*MDO-OEM*	*Ongoing*	*$50,000*	*USDHS-UASI Grant*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*	*High*
Multi-Hazard	*Conduct mitigation training for all Regional Volunteer Management Coordinators so they may share resources and mitigation training opportunities.*	*MDO-OEM*	*2 years*	*Staff Time*	*Agency Operating Budget*	*Prevention, Public education and Awareness*	*1.3, 1.4, 4.2, 5.1,5.2, 5.3*	*High*
Multi-Hazard	*Update and expand Ready Philadelphia for those with functional needs.*	*MDO-OEM*	*5 years*	*Staff Time/ $50,000*	*Grants*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*	*High*

Table 6.4.2-1			Potential Hazard Mitigation Actions					
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Partner with the CERT program once it is online in Philadelphia and continue to partner with other local community organizations, including civic, business, town watch, faith-based, senior, special needs and tenant associations to promote emergency preparedness and mitigation strategies.*	*MDO-OEM*	*5 years*	*$20,000*	*USDHS-UASI Grant*	*Public Education and Awareness*	*1.3, 4.3, 4.4, 5.3*	*High*
Multi-Hazard	*Purchase additional secondary communication systems (i.e. radios).*	*MDO-OEM*	*5 Years*	*$250,000*	*USDHS, UASI, Grants*	*Emergency Services*	*2.3*	*Highest*
Multi-Hazard	*Purchase additional portable redundant power sources.*	*MDO-OEM*	*5 Years*	*$60,000*	*USDHS, UASI, Grants*	*Emergency Services*	*2.3*	*High*
Multi-Hazard	*Enhance the EOC in a Box.*	*MDO-OEM*	*5 years*	*$250,000*	*USDHS, UASI, Grants*	*Emergency Services*	*2.3*	*High*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Support resiliency of the City's private sector though information sharing, partnership building, training and education on preparedness, COOP, mitigation principles and Philadelphia's HMP.*	*MDO-OEM*	*Ongoing*	*Staff Time/ $20,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*4.1,4.2,4.3, 4.4*	*High*
Multi-Hazard	*Purchase event/site specific remote video cameras for better situational awareness.*	*MDO-OEM*	*3 Years*	*$100,000*	*USDHS, UASI, Grants*	*Emergency Services*	*1.2, 4.2*	*High*
Multi-Hazard	*Incorporate Business Continuity into ERC train the trainer: Provide training and a strategy for ERC's to assure continuity of services.*	*MDO-OEM*	*2 years*	*Staff Time/ $1,500*	*Agency Operating Budget*	*Public Education and Awareness*	*4.1, 4.2, 4.3, 5.1, 5.2, 5.3*	*High*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Partner the CERT program, ERC Program, and VOAD partner agencies with local community organizations including civic, faith-based, and tenant associations, to promote mitigation strategies.*	*MDO-OEM*	*3 years*	*Staff Time/ $15,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 4.3, 5.1, 5.3*	*High*
Multi-Hazard	*Pilot Corporate CERT: CERT teams based in businesses with supplemental training focused on business continuity and workplace mitigation strategies such as protecting utility services, redundant communication, and continuity of business services.*	*MDO-OEM*	*1-2 years*	*$50,000*	*USDHS, UASI, grants*	*Public Education and Awareness*	*2.3, 3.1, 4.1, 4.2, 4.3, 4.4, 5.3*	*High*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Promote post disaster mitigation strategies throughout SEPA region, targeting communities that are most vulnerable. VOAD partner agencies may implement mitigation strategies.*	*MDO-OEM*	*3 years*	*Staff Time/ $15,000*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 2.6, 4.2. 5.1, 5.2, 5.3*	*High*
Multi-Hazard	*CERT Community Mapping: Community teams may pre-identify critical infrastructure and offer mitigation strategies including business continuity and Ready Philadelphia information.*	*MDO-OEM*	*3 years*	*Staff Time, $1,500*	*Agency Operating Budget, Grants*	*Public Education and Awareness*	*1.3, 4.3, 5.1, 5.2, 5.3*	*High*
Multi-Hazard	*Prioritize Emergency Shelters locations by applicable factor (e.g. projected demand).*	*MDO-OEM*	*1-2 Years*	*$15,000*	*Grants*	*Emergency Services*	*1.3, 4.2, 5.3*	*High*

Table 6.4.2-1	Potential Hazard Mitigation Actions							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Determine losses generated by various natural disasters and engineering effectiveness and cost-benefit of various mitigation measures using HAZUS-MH or other computer modeling software. Evaluate various building enhancements using prototypical Philadelphia building types.*	*MDO-OEM*	*6 Months*	*Staff Time*	*Grant/Agency Operating Budgets*	*Emergency Services*	*2.5, 5.1, 5.2*	*Highest*
Multi-Hazard	*Natural Hazard Event Database: Create a natural hazard event database to capture description, severity, location, impact, and potential loss/damage estimate from an event. This data will be used to update the hazard analysis and mitigation actions for Philadelphia, as well as allow the city to be better prepared for future events.*	*MDO-OEM*	*5 Years*	*$10,000*	*Agency Operating Costs*	*Emergency Services*	*5.1, 5.2*	*High*

Table 6.4.2-1 Potential Hazard Mitigation Actions

Hazard	Mitigation Action and Description	Lead/ Supporting Agency(s)	Project Timeframe	Estimated Cost	Possible Funding Source(s)	FEMA Category	Goals and Objectives	Prioritization
Multi-Hazard	*Develop vegetation data for Philadelphia for use in HAZUS-MH and other hazard-impact models This will allow for better debris estimates and will identify areas more susceptible to the urban-heat island effect.*	*MDO-OEM/PARKS & RECREATION / PCPC*	*5 Years*	*$10,000*	*Agency Operating Costs*	*Prevention*	*5.1, 5.2*	*High*
Multi-Hazard	*Implement program to track and study areas impacted by natural disasters using the RIC data and GIS technology.*	*MDO-OEM*	*5 years*	*$25,000*	*TBD*	*Emergency Services*	*1.3, 2.1, 5.1, 5.2, 5.3*	*High*
Multi-Hazard	*Target affected areas for post-disaster outreach and Ready PA materials. Encourage property owners to incorporate mitigation measures during recovery.*	*Multiple Agencies*	*5 years*	*Staff Time/ $15,000*	*Agency Operating Budget, Grants*	*Emergency Services*	*1.3, 2.1, 5.1, 5.2, 5.3*	*High*
Multi-Hazard	*Enhance fatality management by obtaining body bag stockpile, morgue and forensic expansion and collection.*	*PDPH*	*2 years*	*$5 million*	*HHS*	*Property Protection, Prevention, Emergency Services*	*4.1*	*High*

Table 6.4.2-1			Potential Hazard Mitigation Actions					
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Expand lab capacity to rapidly identify and subtype organisms.*	*PDPH*	*2 years*	*$10 million*	*HHS*	*Emergency Services, Prevention*	*4.1*	*High*
Multi-Hazard	*Expand scope of practice and facility capacity for City Health Centers.*	*PDPH*	*5 years*	*$100 million*	*HHS*	*Prevention, Emergency Services, Public Education and Awareness*	*1.3; 1.4; 2.2*	*High*
Multi-Hazard	*Hire more doctors and nurses for health centers and outreach.*	*PDPH*	*2 years*	*$5 million*	*HHS*	*Emergency Services*	*1.4; 4.1*	*Moderate*
Multi-Hazard	*Expand community immunizations capacity.*	*PDPH*	*5 years/ Ongoing*	*$20 million*	*HHS*	*Public Education and Awareness, Emergency Services*	*1.3; 5.3*	*High*
Multi-Hazard	*Purchase portable equipment to assist in first responder R&R during extended operations.*	*PFD/MDO-OEM*	*Ongoing*	*$500,000*	*UASI, DHS, Agency Operating Budget*	*Prevention, Emergency Services*	*1.4, 2.1, 2.3, 3.1, 3.2, 4.2*	*High*
Multi-Hazard	*Install generators in fire stations to provide power during blackouts and emergency operations.*	*PFD*	*Ongoing*	*$1 million*	*UASI, DHS, Agency Operating Budget*	*Prevention, Emergency Services*	*2.1, 2.3*	*Moderate*

Table 6.4.2-1	**Potential Hazard Mitigation Actions**							
Hazard	**Mitigation Action and Description**	**Lead/ Supporting Agency(s)**	**Project Timeframe**	**Estimated Cost**	**Possible Funding Source(s)**	**FEMA Category**	**Goals and Objectives**	**Prioritization**
Multi-Hazard	*Pre-identify locations to stand up fire operations and staging in case fire stations are impacted by disaster.*	*PFD/L&I/ Public Property*	*Ongoing*	*$1 million*	*UASI, DHS, Agency Operating Budget*	*Prevention, Emergency Services*	*1.2, 2.1, 2.2, 2.5, 2.6, 1.4, 3.2 4.2, 4.3, 4.4, 5.1*	*High*
Multi-Hazard	*Upgrade PFD emergency operations technology (i.e. allow for real time traffic updates in CAD)*	*PFD*	*Ongoing*	*$500,000*	*UASI, DHS, Agency Operating Budget*	*Emergency Services*	*1.4 4.2, 4.4*	*Moderate*
Multi-Hazard	*Develop a list of City owned property that can temporarily be used to store emergency debris & snow (by district).*	*Public Property*	*5 years*	*$250,000*	*Grants*	*Emergency Services*	*1.3,2.6,4.1, 5.2*	*Moderate*
Multi-Hazard	*Establish an open-end contract to purchase or rent material/equipment for unforeseen events.*	*STREETS*	*5 years*	*$50,000*	*Grants*	*Prevention*	*1.3, 2.1*	*High*
Multi-Hazard	*Install battery back-up traffic signal controllers (75,000 each) 10% of signals in City.*	*STREETS*	*10 years*	*$50,000*	*Grants*	*Property Protection*	*2.1*	*High*
Multi-Hazard	*Purchase portable trailer lights for each Streets Department facility or yard.*	*STREETS*	*10 years*	*$50,000*	*Grants*	*Property Protection*	*2.1*	*High*

Table 6.4.2-1 Potential Hazard Mitigation Actions

Hazard	Mitigation Action and Description	Lead/ Supporting Agency(s)	Project Timeframe	Estimated Cost	Possible Funding Source(s)	FEMA Category	Goals and Objectives	Prioritization
Multi-Hazard	*Strengthen the traffic signals beyond the national standards in reference to wind tolerance.*	*STREETS*	*10 years*	*$100,000*	*Grants*	*Prevention*	*1.3*	*Moderate*
Multi-Hazard	*Equip drawbridges with back-up generators*	*STREETS*	*5 years*	*$15,000*	*Grants*	*Property Protection*	*2.1*	*High*
Multi-Hazard	*Enhance the capability and reach of the reverse 9-1-1 telephone notification system.*	*STREETS*	*5 years*	*$25,000*	*Grants*	*Public Education*	*1.2*	*Moderate*

6.4.2.1 Prioritization of Hazard Mitigation Actions

The Hazard Mitigation Planning Committee conducted a qualitative evaluation of potential mitigation actions using the PASTEEL (political, administrative, social, technical, economic, environmental and legal) review method. PASTEEL is an evaluation process developed by PEMA that is a systematic method to help identify the benefits and constraints of a particular mitigation action. The table below provides a summary of the PASTEEL criteria.

Table	PASTEEL Summary Table
Criteria	**Description**
P	**Political criteria**: Does the action have public and political support?
A	**Administrative criteria**: Is there adequate staffing and funding available to implement the action in a timely manner?
S	**Social criteria:** Will the action be acceptable by the community or will it cause any one segment of the population to be treated unfairly?
T	**Technical criteria**: How effective will the action be in avoiding or reducing future losses?
E	**Economic criteria:** What are the costs and benefits of the action and does it contribute to community economic goals?
E	**Environmental criteria:** Will the action provide environmental benefits and will it comply with local, state and federal environmental regulations?
L	**Legal criteria**: Does the community have the authority to implement the proposed measure?

The mitigation actions identified in table 6.4.2 were prioritized according to the criteria defined below.

- **Highest Priority**: A project that meets at least 18 favorable PASTEEL criteria considerations
- **High Priority**: A project that meets at least 12 favorable PASTEEL criteria considerations
- **Moderate Priority**: A project that meets less than 12 favorable PASTEEL criteria considerations

After much discussion during the February 2, 2012 meeting the planning committee concluded that the agency submitting the mitigation action, had the ultimate authority to determine the level of prioritization for their mitigation action. Based on the action an agency could weigh one or more criteria within the PASTEEL matrix to produce the most appropriate prioritization level. This must then be documented under the comments column within the PASTEEL matrix.

Mitigation Actions	PA STEEL Criteria Considerations: + Favorable; - Less favorable; N Not Applicable																							
	P Political		**A** Administrative			**S** Social		**T** Technical			**E** Economic				**E** Environmental					**L** Legal				
	Political Support	Public Support	Staffing	Funding Allocation	Maintenance / Operations	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HAZMAT / Waste Site	Consistent w/ Community Environmental Goals	Consistent w/ Federal Laws	State Authority	Existing Local Authority	Potential Legal Challenge	**Summary**	**Comments**
Provide public outreach for water conservation.	+	_	_	*N*	*N*	+	_	+	+	*N*	+	+	+	*N*	+	*N*	*N*	_	+	+	+	*N*	11 (+) 4(-) 7 (N)	***Moderate Priority***
Dredge the river intake of the Belmont WTP.	+	_	N	N	N	_	+	+	_	N	+	+	N	N	_	N	N	N	N	N	+	_	6(+) 5(-) 11(N)	***Moderate Priority***
Retrofit City owned buildings to withstand a magnitude 8 earthquake.	+	+	-	-	-	+	+	+	+	+	+	-	N	-	N	N	-	N	N	N	+	-	9 (+) 7(-) 6 (N)	***Moderate Priority***
Evaluate various seismic building design enhancements using HAZUS-MH to identify enhancements that reduce losses generated by earthquakes.	+	+	+	+	+	+	+	+	N	+	+	+	N	+	+	N	+	N	+	+	+	+	18 (+) 0(-) 4 (N)	***Highest Priority***

Target community outreach to at-risk individuals.	-	+	-	-	-	+	+	-	+	N	+	-	-	-	N	N	N	-	N	N	+	-	6 (+) 10(-) 6 (N)	***Moderate Priority***
Enhance swift-water rescue.	+	+	+	-	+	+	N	+	+	N	+	+	N	-	N	N	N	N	N	N	+	-	10 (+) 3(-) 9 (N)	***Moderate Priority***
Evaluate various building enhancements using HAZUS-MH to identify opportunities to reduce flooding	+	+	+	+	+	+	+	+	N	+	+	+	N	+	+	N	+	N	+	+	+	+	18 (+) 0(-) 4 (N)	***Highest Priority***
Incorporate Flood Safety Training into Community Emergency Response Team Curriculum: Adapt CERT curriculum to educate team members on strategies that will mitigate the impact of flooding on the community.	+	+	+	-	+	+	+	+	+	+	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 1(-) 7 (N)	***High Priority***
Acquisition, elevation and relocation of properties as feasible	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	*N*	N	***High Priority***

Disseminate mitigation information and help provide technical assistance to property owners affected by flood events.	+	+	+	+	+	+	+	+	-	+	+	+	+	-	N	N	N	N	N	+	+	+	15 (+) 2(-) 5 (N)	***High Priority***
Compile and map Severe Repetitive Loss properties through the city. Determine SRL funding eligibility and target these properties for outreach.	+	+	+	+	+	+	+	+	-	+	+	+	+	-	N	N	N	N	N	+	+	+	15 (+) 2(-) 5 (N)	***High Priority***
Develop flood and storm surge impact model for sewer system allowing the system to be tested under various conditions to appropriately target and prioritize mitigation actions.	+	+	–	–	–	+	+	+	-	*N*	+	–	+	*N*	+	+	+	+	+	*N*	+	*N*	13 (+) 5(-) 4 (N)	***High Priority***
Improve drainage into streams and tributaries.	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	N	+	+	+	+	N	17 (+) 2(-) 2(n)	***High Priority***
Evaluate structures in floodplains, require use of permeable materials in hard surface applications to reduce run-off.	+	+	-	-	-	+	+	+	+	+	+	+	N	+	+	N	N	+	+	+	+	+	16 (+) 3(-) 3(n)	***High Priority***

Limit development adjacent to natural areas.	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	+	17 (+) 3(-) 2(n)	***High Priority***
Elevate the electrical and HVAC equip. at Waterworks.	+	+	N	N	+	N	N	+	+	N	+	+	N	N	N	N	N	N	N	N	N	N	7(+) 15(N)	***Moderate Priority***
Enlarge culverts of the Poquessing Creek tributaries to protect roadway and residences.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Highest Priority***
Redesign roadways and bridges to lesson occurrence/impact of flooding.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Highest Priority***
Buy equipment to upgrade capability to survey flood prone bridges and roads.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Moderate Priority***
Establish a smart detour plan for flooding of Wissahickon Creek, Schuylkill River and Cobbs Creek.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Highest Priority***
Upgrade drainage capacity on Streets Department maintained drains.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Moderate Priority***

Improve/enhance flood vulnerability data. Enhance planning by using surveys to more accurately define flood vulnerability.	+	+	+	+	+	+	+	+	-	+	+	+	+	-	N	N	N	N	N	+	+	+	15 (+) 2(-) 5 (N)	***High Priority***
Hazards U.S. Multi-Hazard (HAZUS-MH) Modeling: Determine losses generated by tropical cyclones and engineering effectiveness and cost-benefit of various mitigation actions.	+	+	+	+	+	+	+	+	N	+	+	+	N	+	+	N	+	N	+	+	+	+	18 (+) 0(-) 4 (N)	***Highest Priority***
Educate property owners about the impacts of snow load, snow drift loads, and sliding snow loads.	+	+	–	–	–	+	+	+	-	*N*	+	+	*N*	*N*	+	+	+	+	+	*N*	+	*N*	13 (+) 4(-) 5 (N)	***High Priority***
Obtain standard pickup trucks upgraded for plowing and salting.	+	+	N	N	–	+	+	+	+	N	+	-	+	N	N	N	N	N	N	N	N	N	8(+) 2(-) 12(N)	***Moderate Priority***
Upgrade equipment and vehicles for Brine usage in storm operations.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Highest Priority***
Upgrade equipment and vehicles used in storm operations.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Highest Priority***

Install GPS on all storm operations vehicles.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***High priority***
Upgrade Snow HQ technology including and use of the City's police/traffic camera system.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***High Priority***
Increase training of staff involved in Winter Operations.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Moderate Priority***
Construct ground water interceptors to capture water seeping from rock outcrops to prevent constant ice accumulation on Lincoln and Kelly Drives.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***High Priority***
Develop a comprehensive and integrated Continuity of Operations Plan (COOP) for all city agencies including corrective provisions.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	N	N	+	+	+	18 (+) 0(-) 4 (N)	***Highest Priority***
Expand existing contracts to remove all dead and dangerous trees, and improve tree pruning frequency to remove dead limbs and branches.	+	+	-	-	+	+	+	+	+	+	+	+	+	+	N	N	+	+	+	+	+	+	18 (+) 2(-) 2(n)	***Highest Priority***

Coordinate and provide public outreach on mitigation strategies the public can take to reduce or eliminate the impact of hazards on their services and infrastructure. Opportunities to educate the public include conferences, MDO-OEMs website, social media, and presentations.	+	+	+	–	+	+	+	+	+	*N*	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	13 (+) 1(-) 8 (N)	***High Priority***
Conduct or update natural hazard vulnerability assessments for critical facilities throughout the Philadelphia.	+	+	+	+	+	+	+	+	N	+	+	+	N	+	+	N	+	N	+	+	+	+	18 (+) 0(-) 4 (N)	***Highest Priority***
Optimize use of HAZUS-MH software for Philadelphia's unique urban environment. The software update will allow Philadelphia to generate more accurate loss estimates for various hazards.	+	+	+	+	+	+	+	+	N	+	+	+	N	+	+	N	+	N	+	+	+	+	18 (+) 0(-) 4 (N)	***Highest Priority***

Develop Ready Philadelphia guides for all-hazards preparedness, hazard specific information, business continuity information, as well as guides for specific vulnerable populations. Brochures will be offered in up to seven languages, large print, Braille and auto CDs.	+	+	+	–	+	+	+	+	+	*N*	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	13 (+) 1(-) 8 (N)	***High Priority***
Conduct mitigation training for all Regional Volunteer Management Coordinators so they may share resources and mitigation training opportunities.	+	+	+	+	+	+	+	+	-	+	+	+	N	N	+	N	N	N	N	+	+	+	15 (+) 1(-) 6 (N)	***High Priority***
Update and expand Ready Philadelphia for those with functional needs.	+	+	+	–	+	+	+	+	+	*N*	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	13 (+) 1(-) 8(N)	***High Priority***

Partner with the CERT program once it is online in Philadelphia and continue to partner with other local community organizations, including civic, business, town watch, faith-based, senior, special needs and tenant associations to promote emergency preparedness and mitigation strategies.	+	+	+	–	+	+	+	+	+	+	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 1(-) 7 (N)	***High Priority***
Purchase additional secondary communication systems (i.e. radios).	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	N	N	+	+	N	+	N	18 (+) 0(-) 4 (N)	***Highest Priority***
Purchase additional portable redundant power sources.	+	+	+	+	+	+	+	+	N	+	+	+	N	+	N	N	N	+	N	N	+	N	14 (+) 0(-) 8 (N)	***High Priority***
Enhance the EOC in a Box.	+	+	+	+	+	+	+	+	+	+	+	+	*N*	+	*N*	*N*	*N*	*N*	*N*	*N*	+	*N*	14 (+) 0(-) 8 (N)	***High Priority***

Support resiliency of the City's private sector though information sharing, partnership building, training and education on preparedness, COOP, mitigation principles and Philadelphia's HMP.	+	+	+	+	+	+	+	+	-	+	+	+	+	N	N	N	N	N	N	+	+	-	14 (+) 2(-) 6 (N)	***High Priority***
Purchase event/site specific remote video cameras for better situational awareness.	+	*N*	+	+	+	+	+	+	+	+	+	+	*N*	+	*N*	*N*	*N*	*N*	*N*	*N*	+	*N*	13 (+) 0(-) 9 (N)	***High Priority***
Incorporate Business Continuity into ERC train the trainer: Provide training and a strategy for ERC's to assure continuity of services.	+	+	+	–	+	+	+	+	+	+	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 1(-) 7 (N)	***High Priority***
Partner the CERT program, ERC Program, and VOAD partner agencies with local community organizations including civic, faith-based, and tenant associations, to promote mitigation strategies.	+	+	+	–	+	+	+	+	+	+	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 1(-) 8 (N)	***High Priority***

Pilot Corporate CERT: CERT teams based in businesses with supplemental training focused on business continuity and workplace mitigation strategies such as protecting utility services, redundant communication, and continuity of business services.	+	+	+	–	+	+	+	+	+	+	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 1(-) 7 (N)	***High Priority***
Promote post disaster mitigation strategies throughout SEPA region, targeting communities that are most vulnerable. VOAD partner agencies may implement mitigation strategies.	+	+	+	–	+	+	+	+	+	+	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 1(-) 7 (N)	***High Priority***
CERT Community Mapping: Community teams may pre-identify critical infrastructure and offer mitigation strategies including business continuity and Ready Philadelphia information.	+	+	+	–	+	+	+	+	+	+	+	+	*N*	*N*	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 1(-) 7 (N)	***High Priority***

Prioritize Emergency Shelters locations by applicable factor (e.g. projected demand).	+	+	+	+	+	+	+	+	+	+	+	+	N	+	N	N	N	+	N	+	+	-	16 (+) 1(-) 5 (N)	***High Priority***
Determine losses generated by various natural disasters and engineering effectiveness and cost-benefit of various mitigation measures using HAZUS-MH or other computer modeling software. Evaluate various building enhancements using prototypical Philadelphia building types.	+	+	+	+	+	+	+	+	N	+	+	+	N	+	+	N	+	N	+	+	+	+	18 (+) 0(-) 4 (N)	***Highest Priority***

Natural Hazard Event Database: Create a natural hazard event database to capture description, severity, location, impact, and potential loss/damage estimate from an event. This data will be used to update the hazard analysis and mitigation actions for Philadelphia, as well as allow the city to be better prepared for future events.	+	+	+	-	+	+	+	+	-	+	+	+	N	+	N	N	N	N	N	+	+	N	13 (+) 2(-) 6 (N)	***High Priority***
Develop vegetation data for Philadelphia for use in HAZUS-MH and other hazard-impact models This will allow for better debris estimates and will identify areas more susceptible to the urban-heat island effect.	+	+	-	-	-	+	+	+	-	N	+	+	N	N	+	+	+	+	+	N	+	N	13 (+) 4(-) 5 (N)	***High Priority***
Implement program to track and study areas impacted by natural disasters using the RIC data and GIS technology.	+	+	+	+	+	+	+	+	+	+	+	+	N	+	N	N	N	N	+	+	+	+	17 (+) 0(-) 5 (N)	***High Priority***

Target affected areas for post-disaster outreach and Ready PA materials. Encourage property owners to incorporate mitigation measures during recovery.	+	+	+	+	+	+	+	+	-	+	+	+	+	-	N	N	N	N	N	+	+	+	15 (+) 2(-) 5 (N)	***High Priority***
Enhance fatality management by obtaining body bag stockpile, morgue and forensic expansion and collection.	+	+	-	-	-	+	+	+	+	+	+	+	N	-	N	N	N	N	N	+	+	+	12 (+) 4(-) 6 (N)	***High Priority***
Expand lab capacity to rapidly identify and subtype organisms.	+	+	+	-	-	+	+	+	+	+	+	-	N	-	N	N	N	N	N	+	+	+	12(+) 4(-) 6 (N)	***High Priority***
Expand scope of practice and facility capacity for City Health Centers.	+	+	-	-	-	+	+	+	+	+	+	+	+	-	N	N	N	N	N	+	+	+	13(+) 4 (-) 5 (N)	***High Priority***
Hire more doctors and nurses for health centers and outreach.	+	+	-	-	-	+	+	+	+	+	+	+	N	-	N	N	N	N	N	N	+	+	11 (+) 4(-) 7 (N)	***Moderate Priority***
Expand community immunizations capacity.	+	+	-	-	+	+	+	+	+	+	+	+	+	-	N	N	N	N	N	+	+	+	14 (+) 3(-) 5 (N)	***High Priority***
Purchase portable equipment to assist in first responder R&R during extended operations.	+	+	+	-	+	+	+	+	+	+	+	-	*N*	+	*N*	*N*	*N*	*N*	*N*	+	+	+	14 (+) 2(-) 6 (N)	***High Priority***

Install generators in fire stations to provide power during blackouts and emergency operations.	+	+	+	-	+	+	+	+	+	N	+	+	N	-	N	N	N	N	N	N	+	N	11 (+) 2(-) 9 (N)	***Moderate Priority***
Pre-identify locations to stand up fire operations and staging in case fire stations are impacted by disaster.	+	+	+	-	+	+	*N*	+	+	+	+	-	*N*	-	*N*	*N*	*N*	*N*	*N*	+	+	+	12 (+) 3(-) 7 (N)	***High Priority***
Upgrade PFD emergency operations technology (i.e. allow for real time traffic updates in CAD)	+	+	+	-	+	+	N	+	+	N	+	+	N	-	N	N	N	N	N	N	+	-	10 (+) 3(-) 9 (N)	***Moderate Priority***
Develop a list of City owned property that can temporarily be used to store emergency debris & snow (by district).	+	–	N	N	+	–	+	+	+	N	+	+	+	N	+	N	N	N	N	–	+	–	10(+) 4(-) 8(N)	***Moderate Priority***
Establish an open-end contract to purchase or rent material/equipment for unforeseen events.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***High Priority***
Install battery back-up traffic signal controllers (75,000 each) 10% of signals in City.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***High Priority***

Purchase portable trailer lights for each Streets Department facility or yard.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***High Priority***
Strengthen the traffic signals beyond the national standards in reference to wind tolerance.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Moderate Priority***
Equip building and drawbridges with back-up generators	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***High Priority***
Enhance the capability and reach of the reverse 9-1-1 telephone notification system.	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N		***Moderate Priority***

7. Plan Maintenance

7.1 Update Process Summary

The HMP is required to include a formal plan maintenance process to ensure that the plan remains an active and relevant document. The plan maintenance process must include a method and schedule for monitoring, evaluating and updating the plan and describe how, when and by whom the work will be done. This section must also include an explanation on how mitigation actions will be incorporated into existing planning mechanisms, such as comprehensive plans and ordinances, and a description on the public's continued involvement.

7.2 Monitoring, Evaluation and Updating the Plan

The planning committee intends to remain intact as the organization responsible for monitoring, evaluating and updating Philadelphia's HMP. MDO-OEM will continue to act as the coordinating agency for the planning committee. Beginning in April, 2012 Philadelphia will begin to develop Phase II of the HMP. This phase will include human-caused hazards, as well as additional natural hazards not profiled in the first phase of the HMP. Each participating agency is expected to maintain representation on the planning committee for Phase II of Philadelphia's HMP. Additional City agencies will also be requested to serve on the planning committee for Phase II of the HMP.

In the interim, each participating planning committee member will monitor and evaluate the effectiveness of their agency's projects, programs and policies. During the development of Phase II, the planning committee will review the goals and action items developed in Phase I to determine their relevance to changing situations in the City, as well as changes in state or federal policy. The Planning Committee will also look at any changes in City resources that may influence the plan implementation. All portions of Phase I of the HMP will be reviewed to determine if the information should be updated or modified, given any new available data. The Planning Committee will evaluate the content of the Phase I HMP using the following criteria:

- Are the mitigation actions effective?
- Are there any changes in land development that affect mitigation priorities?
- Are the goals, objectives, and mitigation actions relevant given changes in Philadelphia?
- Are the goals, objectives and mitigation actions relevant given any changes to state or federal regulations or policy?
- Is there new data that affects the Risk Assessment portion of the plan?
- Is there new data that affects the Capability Assessment portion of the plan?
- Is there new data that affects the prioritization of mitigation actions?

Following the completion of Phase II of the HMP development, the Philadelphia HMP plan will be updated every five years, as required by FEMA.

7.3 Incorporation into Other Planning Mechanisms

With MDO-OEM oversight, each planning committee member is responsible for implementing its specific mitigation actions identified in this plan. This includes incorporating these actions into other planning documents such as comprehensive plans and zoning ordinances as necessary. Agencies are responsible for obtaining funds from outside sources to implement the mitigation actions.

7.4 Continued Public Involvement

Philadelphia is committed to the continued involvement of the public in the hazard mitigation process. During all phases of plan maintenance, the public will have the opportunity to provide feedback on the HMP. Phase I of the HMP will be available for review on the MDO-OEM website through June 2013. Individuals will have an opportunity to submit comments through an active link on the website. MDO-OEM will compile all comments and present them to the Planning Committee at the planning meetings for Phase II of the Philadelphia HMP. The planning committee will consider these comments for incorporation into the Phase II revision. MDO-OEM will host another series of public involvement meetings, educating the public on the Phase II revision of the HMP. To promote the revision of the HMP, MDO-OEM will post a notice on its website requesting feedback on the updated Plan.

8. Plan Adoption

Adoption by the local governing bodies demonstrates the commitment of Philadelphia to fulfill the mitigation goals and objectives outlined in the HMP. Adoption legitimizes the HMP and authorizes responsible agencies to execute their responsibilities. The HMP was submitted to the Pennsylvania State Hazard Mitigation Officer and FEMA on March 1, 2012. Philadelphia will proceed with formal adoption proceedings when FEMA provides conditional approval of this HMP. Following adoption of the HMP, Philadelphia will submit a copy of the resolution showing formal adoption of the HMP to PEMA, who will then forward the acceptance to FEMA.

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Glossary

This resource defines terms that are used in or support the Hazard Mitigation Plan. These definitions were based on terms defined in documents included in the reference section, with modifications appropriate to address Philadelphia specific definitions and requirements.

100-year flood – A flood that has a 1-percent chance of being equaled or exceeded in any given year. This flood event is also referred to as the base flood. The term "100-year flood" can be misleading; it is not the flood that will occur once every 100 years. Rather, it is the flood elevation that has a 1- percent chance of being equaled or exceeded each year. Therefore, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management to determine the need for flood insurance.

500-year flood – A flood that has a 0.2-percent chance of being equaled or exceeded in any one year.

Action Stage - The stage which, when reached by a rising stream, represents the level where the NWS or a partner/user needs to take some type of mitigation action in preparation for possible significant hydrologic activity.

Aggregate Data – Data gathered together across an area or region (for example, census tract or census block data).

Agricultural Drought - Links the various characteristics of meteorological drought to agricultural impacts, while focusing on precipitation shortages and soil-water deficits.

Alberta Clipper - A fast moving low pressure system that moves southeast out of Canadian Province of Alberta (southwest Canada) through the Plains, Midwest, and Great Lakes region usually during the winter. This low pressure area is usually accompanied by light snow, strong winds, and colder temperatures. Another variation of the same system is called a "Saskatchewan Screamer"

Annualized Loss – The estimated long-term value of losses from potential future hazard occurrences of a particular type in any given single year in a specified geographic area. In other words, the average annual loss that is likely to be incurred each year based on frequency of occurrence and loss estimates. Note that the loss in any given year can be substantially higher or lower than the estimated annualized loss.

Asset – Any man-made or natural feature that has value, including but not limited to people, buildings, infrastructure (such as bridges, roads, and sewer and water systems), and lifelines (such as electricity and communication resources or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks).

At-Risk – Exposure values that include the entire building inventory value in census blocks that lie within or border the inundation areas or any area potentially exposed to a hazard based on location.

Base Flood – Flood that has a 1-percent probability of being equaled or exceeded in any given year. It is also known as the 100-year flood.

Base Flood Elevation (BFE) – Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The BFE is used as the standard for the National Flood Insurance Program.

Bathymetry - The science of measuring depths of the oceans, lakes, seas, etc.

Beaufort Scale - The Beaufort wind scale is a system used to estimate and report wind speeds when no measuring apparatus is available. It was invented in the early 19th Century by Admiral Sir Francis Beaufort of the British Navy as a way to interpret winds from conditions at sea.

Benefit – Net project outcomes, usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of conducting a benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including a reduction in expected property losses (building, content, and function) and protection of human life.

Blizzard - Characterized by low temperatures, wind gusts of 35 mph or more and falling and/or blowing snow that reduces visibility to 0.25 miles or less for an extended period of time (three or more hours).

Bow Echo - A radar echo which is linear but bent outward in a bow shape. Damaging straight-line winds often occur near the "crest" or center of a bow echo. Areas of circulation also can develop at either end of a bow echo, which sometimes can lead to tornado formation - especially in the left (usually northern) end, where the circulation exhibits cyclonic rotation.

Building – A structure that is walled and roofed, principally aboveground and permanently fixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Building Codes – Regulations that set forth standards and requirements for construction, maintenance, operation, occupancy, use, or appearance of buildings, premises, and dwelling units. Building codes can include standards for structures to withstand natural disasters.

Capability Assessment – An assessment that provides a description and analysis of a community or state's current capacity to address the threats associated with hazards. The capability assessment attempts to identify and evaluate existing policies, regulations, programs, and practices that positively or negatively affect the community or state's vulnerability to hazards or specific threats.

Climate – The meteorological elements, including temperature, precipitation, and wind, which characterize the general conditions of the atmosphere over a period of time (typically 30-years) for a particular region.

Climatology - The science that deals with the phenomena of climates or climatic conditions.

Cold Front - A zone separating two air masses, of which the cooler, denser mass is advancing and replacing the warmer.

Creek - A small stream of water which serves as the natural drainage course for a drainage basin of nominal or small size.

Critical Facility – Facilities that are critical to the health and welfare of the population and that are especially important following a hazard. Critical facilities include essential facilities, transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous material facilities.

Debris – The scattered remains of assets broken or destroyed during the occurrence of a hazard. Debris caused by a wind or water hazard event can cause additional damage to other assets.

Derecho - A widespread and usually fast-moving windstorm associated with convection. Derechos include any family of downburst clusters produced by an extratropical MCS, and can produce damaging straight-line winds over areas hundreds of miles long and more than 100 miles across.

Digital Flood Insurance Rate Maps (DFIRMs) – These maps are used to calculate the cost insurance premiums; establish flood risk zones and base flood elevations to militate against potential future flood damages to properties.

Disaster Mitigation Act of 2000 (DMA 2000) – Law that requires and rewards local and state pre-disaster planning, promotes sustainability as a strategy for disaster resistance, and is intended to integrate state and local planning with the aim of strengthening state-wide mitigation planning.

Downburst - A strong downdraft current of air from a cumulonimbus cloud, often associated with intense thunderstorms. Downdrafts may produce damaging winds at the surface.

Downdraft - A small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation as in a shower or thunderstorm. A downburst is the result of a strong downdraft.

Drainage Area - In hydrologic terms, an area having a common outlet for its surface runoff (also see Watershed).

Drainage Basin - In hydrologic terms, a part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Drought – A period of time without substantial rainfall that persists from one year to the next. Droughts can affect large areas and can impact areas that range from a few counties to several states. Along with decreasing water supplies for human consumption and use, droughts can kill crops, livestock, grazing land, edible plants, and even in severe cases, trees.

Drought Emergency - 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.

Drought Index - In hydrologic terms, computed value which is related to some of the cumulative effects of a prolonged and abnormal moisture deficiency. (An index of hydrological drought corresponding to levels below the mean in streams, lakes, and reservoirs.)

Drought Warning – A drought warning 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.

Drought Watch - A drought watch is a period to alert government agencies, public water suppliers, water users and the public regarding the potential for future drought-related problems. The focus is on increased monitoring, awareness and preparation for response if conditions worsen. A request for voluntary water conservation is made.

Dry Floodproofing - In hydrologic terms, a dry floodproofed building is sealed against floodwaters. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings like doors windows, sewer lines and vents are closed, whether permanently, with removable shields, or with sandbags. The flood protection level should be no more than 2 or 3 feet above the top of the foundation because the buildings walls and floors cannot withstand the pressure of deeper water.

Duration – The length of time a hazard occurs.

Earthquake – A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.

Enhanced Fujita Scale - National Weather Service's revised Fujita-scale, which is a complex, systematic approach to measuring the strength of a tornado.

Excessive Heat Outlook – Issued when the potential exists for an excessive heat event in the next 3-7 days. The purpose of issuing an Outlook is to provide information those who need considerable lead-time to prepare for and Excessive Heat Event, such as public health officials, emergency managers, and public utilities.

Excessive Heat Warning/Advisory - Either of these may be issued when an Excessive Heat Event is expected in the next 36 hours. These are issued when an event is occurring, is imminent, or has a very high probability of occurring. A Warning is used for conditions posing a threat to life or property. An Advisory is for less serious conditions that cause significant discomfort and if caution is not taken, could lead to a threat to life and/or property.

Excessive Heat Watch - Issued when conditions are favorable for an Excessive Heat Event in the next 12 to 48 hours. This is used when the risk of an Excessive Heat Event has increased but its occurrence and time frame is still uncertain. The purpose is to allow those who need to set plans in motion enough lead time to do so.

Exposure – The number and dollar value of assets that are considered to be at risk during the occurrence of a specific hazard.

Extent – The size of an area affected by a hazard or the occurrence of a hazard.

Extra-Tropical Cyclone - A cyclone in the middle and high latitudes often being 2000 kilometers in diameter and usually containing a cold front that extends toward the equator for hundreds of kilometers.

Extreme Cold – Extreme cold events are days where the mean daily temperature, the average between the high-recorded temperature and the low-recorded temperature over a 24-hour period, falls below 32°F.

Extreme Heat - Extreme heat is when summertime temperatures hover 10 degrees or more above the average high temperature for a region and last for several weeks.

Eye Wall - It is an organized band of cumuliform clouds that immediately surrounds the center (eye) of a hurricane. The fiercest winds and most intense rainfall typically occur near the eye wall.

Federal Emergency Management Agency (FEMA) – Independent agency (now part of the Department of Homeland Security) created in 1978 to provide a single point of accountability for all federal activities related to disaster mitigation and emergency preparedness, response, and recovery.

Flash Flood – A flood occurring with little or no warning where water levels rise at an extremely fast rate.

Flood – A general and temporary condition of partial or complete inundation of normally dry land areas resulting from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.

Flood Depth – Height of the flood water surface above the ground surface.

Flood Elevation – Height of the water surface above an established datum (for example, the National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or mean sea level).

Flood Fringe – Areas outside the regulatory floodway but still inundated by the designated 1-percent annual chance flood (often referred to as the floodway fringe).

Flood Hazard Area – Area shown to be inundated by a flood of a given magnitude on a map.

Flood Insurance Rate Map (FIRM) – Official maps of a community, prepared by the FEMA that shows both the special flood hazard areas and the risk premium zones applicable to the community.

Flood Mitigation Assistance (FMA) Program – A program created as a part of the National Flood Insurance Report Act of 1994. FMA provides funding to assist communities and states in implementing actions that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other NFIP insurance structures, with a focus on repetitive loss properties.

Flood Prevention - In hydrologic terms, measures that are taken in order to keep flood problems from getting worse. Planning, land acquisition, river channel maintenance, wetlands protection, and other regulations all help modify development on floodplains and watersheds to reduce their susceptibility to flood damage. Preventive measures are usually administered by the building, zoning, planning and/ or code enforcement offices of the local government.

Floodplain – Any land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that becomes inundated with water during a flood.

Floodproofing - In hydrologic terms, the process of protecting a building from flood damage on site. Floodproofing can be divided into wet and dry floodproofing. In areas subject to slow-moving, shallow flooding, buildings can be elevated, or barriers can be constructed to block the water's approach to the building. These techniques have the advantage of being less disruptive to the neighborhood. It must be noted that during a flood, a floodproofed building may be isolated and without utilities and therefore unusable, even though it has not been damaged.

Floodway - In hydrologic terms,
(1) a part of the flood plain, otherwise leveed, reserved for emergency diversion of water during floods. A part of the flood plain which, to facilitate the passage of floodwater, is kept clear of encumbrances.
(2) The channel of a river or stream and those parts of the flood plains adjoining the channel, which are reasonably required to carry and discharge the floodwater or floodflow of any river or stream.

Flurries - Snow flurries are an intermittent light snowfall of short duration (generally light snow showers) with no measurable accumulation (trace category).

Freezing Rain - Rain that falls as a liquid but freezes into glaze upon contact with the ground.

Frequency – A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average.

Front - A boundary or transition zone between two air masses of different density, and thus (usually) of different temperature. A moving front is named according to the advancing air mass, e.g., cold front if colder air is advancing.

Fujita Scale (F-Scale) - Standard measurement for rating the strength of a tornado.

Funnel Cloud - A condensation funnel extending from the base of a towering cumulus, associated with a rotating column of air that is not in contact with the ground (and hence different from a tornado). A condensation funnel is a tornado, not a funnel cloud, if either a) it is in contact with the ground or b) a debris cloud or dust whirl is visible.

Geographic Information System (GIS) - A computer-based graphics program that allows the superposition of plan-maps of thematic elements, such as roads, rivers, land use patterns, and the like to aid in local or regional planning activities.

Ground Water - In hydrologic terms, water within the earth that supplies wells and springs; water in the zone of saturation where all openings in rocks and soil are filled, the upper surface of which forms the water table.

Gustnado - (or Gustinado) - A gustnado is a small, whirlwind which forms as an eddy in thunderstorm outflows. They do not connect with any cloud-base rotation and are not tornadoes. Since their origin is associated with cumuliform clouds, gustnadoes will be classified as Thunderstorm Wind events. Like dust devils, some stronger gustnadoes can cause damage.

Hazard – A source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation - Reduction or alleviation of the loss of life, personal injury, and property damage that could result from a disaster through long- and short-term strategies. Hazard mitigation involves strategies such as planning, policy changes, programs, projects, and other activities that could mitigate the impacts of hazards.

Hazard Mitigation Plan - A collaborative document that identifies hazards that could affect a community, assesses vulnerability to hazards, and represents consensus decisions reached on how to minimize or eliminate the effects of hazards.

Hazards U.S. Multi-Hazard (HAZUS-MH) - A nationally applicable standardized methodology and software program, developed by FEMA, which is under contract with the National Institute of Building Sciences. The program estimates potential losses from earthquakes, hurricane winds, and floods. In HAZUS-MH, current scientific and engineering knowledge is coupled with Geographic Information Systems (GIS) technology to produce estimates of hazard-related damage before, or after, a disaster occurs.

Heat Index – The Heat Index or the "Apparent Temperature" is an accurate measure of how hot it really feels when the Relative Humidity (RH) is added to the actual air temperature.

Household – A household consists of all the people who occupy a housing unit. A house, an apartment or other group of rooms, or a single room, is regarded as a housing unit when it is occupied or intended for occupancy as separate living quarters;

that is, when the occupants do not live and eat with any other persons in the structure and there is direct access from the outside or through a common hall.

A household includes the related family members and all the unrelated people, if any, such as lodgers, foster children, wards, or employees who share the housing unit. A person living alone in a housing unit, or a group of unrelated people sharing a housing unit such as partners or roomers, is also counted as a household. The count of households excludes group quarters.

Householder - The householder refers to the person (or one of the people) in whose name the housing unit is owned or rented (maintained) or, if there is no such person, any adult member, excluding roomers, boarders, or paid employees. If the house is owned or rented jointly by a married couple, the householder may be either the husband or the wife. The person designated as the householder is the "reference person" to whom the relationship of all other household members, if any, is recorded.

Hurricane – An intense tropical cyclone, formed in the atmosphere over warm ocean areas, in which wind speeds reach 74 miles-per-hour or more and blow in a large spiral around a relatively calm center or "eye." Hurricanes develop over the North Atlantic Ocean, northeast Pacific Ocean, or the South Pacific Ocean (east of 160°E longitude). Hurricane circulation is counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Hydrography – Pertains to the measurement and description of bodies of water, including oceans, lakes, and rivers.

Hydrological Drought - A drought caused by deficiencies in surface and subsurface water supplies.

Hydrology – Hydrology is concerned with the circulation of water and its constituents through the hydrologic cycle.

Infrastructure – The public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, transportation system (such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, dry docks, piers and regional dams).

Ice Jam - An accumulation of ice in a river that acts as a natural dam and can flood low-lying areas upstream. They occur when warm temperatures and heavy rains cause rapid snow melt.

Ice Storm – Term used to describe occasions when damaging accumulations of ice are expected during freezing rain situations.

Intensity – A measure of the effects of a hazard occurring at a particular place.

Inventory – The assets identified in a study region. It includes assets that can be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Level 1 Analysis – A HAZUS-MH analysis that yields a rough estimate or preliminary analysis based on the nationwide default database included in HAZUS-MH. A Level 1 analysis is a great way to begin the risk assessment process and prioritize high-risk communities without collecting or using local data.

Level 2 Analysis – A HAZUS-MH analysis that requires the input of additional or refined data and hazard maps that will produce more accurate risk and loss estimates. Assistance from local emergency management personnel, city planners, GIS professionals, and others may be necessary for this level of analysis.

Linguistically Isolated - A linguistically isolated household is one in which all persons age 14 years or older who speak a language other than English do not speak English "very well".

Loss Estimation – The process of assigning hazard-related damage and loss estimates to inventory, infrastructure, lifelines, and population data. HAZUS-MH can estimate the economic and social loss for specific hazard occurrences. Loss estimation is essential to decision making at all levels of government and provides a basis for developing mitigation plans and policies. It also supports planning for emergency preparedness, response, and recovery.

Macroburst - A convective downdraft with an affected outflow area of at least 2½ miles wide and peak winds lasting between 5 and 20 minutes. Intense macrobursts may cause tornado-force damage of up to F3 intensity.

Magnitude – A measure of the strength of a hazard occurrence. The magnitude (also referred to as severity) of a given hazard occurrence is usually determined using technical measures specific to the hazard. For example, ranges of wind speeds are used to categorize tornados.

Major Disaster Declarations – Post-disaster status requested by a state's governor when local and state resources are not sufficient to meet disaster needs. It is based on the damage assessment, and an agreement to commit state funds and resources to the long-term recovery.

Major Hurricane - A hurricane which reaches Category 3 (sustained winds greater than 110 mph) on the Saffir/Simpson Hurricane Scale.

Meteorological Drought - Defined in terms of the departure from a normal precipitation pattern and the duration of the drought hazard. Definitions of meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

Meteorology - The science dealing with the atmosphere and its phenomena. A distinction can be drawn between meteorology and climatology, the latter being primarily concerned with average, not actual, weather conditions

Microburst - A convective downdraft with an affected outflow area of less than 2½ miles wide and peak winds lasting less than 5 minutes. Microbursts may induce dangerous horizontal/vertical wind shears, which can adversely affect aircraft performance and cause property damage.

Middle Latitudes -
1) The latitude belt roughly between 35 and 65 degrees North and South. Also referred to as the temperate region.
Or
2) with specific reference to zones of geomagnetic activity, "middle latitudes" refers to 20º to 50º geomagnetic

Mitigation Actions – Specific actions that help achieve your goals and objectives.

Mitigation Goals – General guidelines that explain what you want to achieve. They are usually broad policy-type statements, long term, and represent global visions.

Mitigation Objectives – Strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific and measurable.

Modified Mercalli Intensity - A scale used for measuring the intensity of an earthquake. The scale quantifies the effects of an earthquake on the Earth's surface, humans, objects of nature, and man-made structures on a scale of I through XII, with I denoting a weak earthquake and XII one that causes almost complete destruction.

National Climatic Data Center - The agency that archives climatic data from the National Oceanic and Atmospheric Administration, as well as other climatological organizations.

National Flood Insurance Program (NFIP) – Federal program created by Congress in 1968 that makes flood insurance available in communities that enact minimum floodplain management regulations in 44 Code of Federal Regulations (CFR) §60.3.

National Hurricane Center - One of three branches of the Tropical Prediction Center (TPC). This center maintains a continuous watch on tropical cyclones over the Atlantic, Caribbean, Gulf of Mexico, and the Eastern Pacific from 15 May through November 30. The Center prepares and distributes hurricane watches and warnings for the general public, and also prepares and distributes marine and military advisories for other users. During the "off-season" NHC provides training for U.S. emergency managers and representatives from many other countries that are affected by tropical cyclones. NHC also conducts applied research to evaluate and improve hurricane forecasting techniques, and is involved in public awareness programs.

Nautical Mile - A unit of distance used in marine navigation and marine forecasts. It is equal to 1.15 statute miles or 1852 meters. It is also the length of 1 minute of latitude.

Nor'easter – A strong low pressure system that affects the Mid-Atlantic and New England States. It can form over land or over the coastal waters. These winter weather events are notorious for producing heavy snow, rain, and tremendous waves that crash onto Atlantic beaches, often causing beach erosion and structural damage. Wind gusts associated with these storms can exceed hurricane force in intensity. A nor'easter gets its name from the continuously strong northeasterly winds blowing in from the ocean ahead of the storm and over the coastal areas.

Objectives – Objectives define strategies or implementation steps to attain the identified goals. Unlike goals, objectives are specific and measurable.

Ordinance – A term for a law or regulation adopted by local government.
Planning – The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.

Post-disaster mitigation – Mitigation actions taken after a disaster has occurred, usually during recovery and reconstruction.

Preparedness – Actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration – A post-disaster status that puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities in the areas of human services, public assistance (infrastructure support), and hazard mitigation. If declared, funding comes from the President's Disaster Relief Fund and disaster aid programs of other participating federal agencies.

Priority Hazards – Hazards considered most likely to impact a community based on frequency, severity, or other factors such as public perception. These are identified using available data and local knowledge.

Probability – A statistical measure of the likelihood that a hazard event will occur.

Public education and outreach programs – Any campaign to make the public more aware of hazard mitigation and mitigation programs, including hazard information centers, mailings, public meetings, etc.

Recovery – The actions taken by an individual or community after a catastrophic event to restore order and lifelines in the community.

Regulation – Most states have granted local jurisdictions broad regulatory powers to enable the enactment and enforcement of ordinances that deal with public health, safety, and welfare. These include building codes, building inspections, zoning, floodplain and subdivision ordinances, and growth management initiatives.

Repetitive Loss Property – A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1,000 each have been paid within any 10-year period since 1978.

Resources – Resources include the people, materials, technologies, money, etc., required to implement strategies or processes. The costs of these resources are often included in a budget.

Risk – The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment – A methodology used to assess potential exposure and estimated losses associated with priority hazards. The risk assessment process includes four steps: (1) identifying hazards, (2) profiling hazards, (3) conducting an inventory of assets, and (4) estimating losses.

Risk Factors – Characteristics of a hazard that contribute to the severity of potential losses in the study area.

Riverine – Of or produced by a river (for example, a riverine flood is one that is caused by a river overflowing its banks).

Saffir-Simpson Scale – This scale categorizes or rates hurricanes from 1 (Minimal) to 5 (Catastrophic) based on their intensity. It is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region.

Snow - Precipitation in the form of ice crystals, mainly of intricately branched, hexagonal form and often agglomerated into snowflakes, formed directly from the freezing [deposition] of the water vapor in the air.

Socioeconomic Droughts - Occur when physical water shortage begins to affect the population, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good.

Special Flood Hazard Area (SFHA) – An area within a floodplain having a 1-percent or greater chance of flood occurrence in any given year (that is, the 100-year or base flood zone); represented on FIRMS as darkly shaded areas with zone designations that include the letter "A" or "V."

Stafford Act – The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law (PL) 100-107 was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Thunderstorm - A local storm produced by a cumulonimbus cloud and accompanied by lightning and thunder. It forms from a combination of moisture, rapidly rising warm air and a force capable of lifting air such as a warm and cold front, a sea breeze, or a mountain.

Topographic – Map that shows natural features and indicate the physical shape of the land using contour lines based on land elevation. These maps also can include man-made features (such as buildings and roads).

Topography – The physical features of a surface area including relative elevations and the position of natural and man-made features.

Tornado - A violently rotating column of air, usually pendant to a cumulonimbus, with circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud roaring noise. On a local scale, it is the most destructive of all atmospheric phenomena.

Transportation Systems – One of the lifeline system categories. This category includes: airways (airports, heliports, highways), bridges, tunnels, roadbeds, overpasses, transfer centers; railways (tracks, tunnels, bridges, rail yards, depots), and waterways (canals, locks, seaports, ferries, harbors, dry docks, piers).

Tropical Cyclone - A warm-core, non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters with organized deep convection and a closed surface wind circulation about a well-defined center.

Tropical Depression - A tropical cyclone in which the maximum 1-minute sustained surface wind is 33 knots (38 mph) or less.

Tropical Disturbance - A discrete tropical weather system of apparently organized convection--generally 100 to 300 mi in diameter--originating in the tropics or subtropics, having a non-frontal migratory character and maintaining its identity for 24 hours or more. It may or may not be associated with a detectable perturbation of the wind field.

Tropical Storm - A tropical cyclone in which the maximum 1-minute sustained surface wind ranges from 34 to 63 knots (39 to 73 mph) inclusive.

Urban Heat Island Effect - Develop when built surfaces replace a large portion of natural land. Incoming solar radiation is trapped during the day and is then re-radiated at night. This slows the cooling process, keeping nighttime air temperatures high, relative to temperatures in less urbanized areas.

Utility Systems – One of the lifeline systems categories. This category includes potable water, wastewater, oil, natural gas, electric power facilities and communication systems.

U.S. Geological Survey (USGS) - The federal agency chartered in 1879 by congress to classify public lands, and to examine the geologic structure, mineral resources, and products of the national domain. As part of its mission, the USGS provides information and data on the Nation's rivers and streams that are useful for mitigation of hazards associated with floods and droughts.

Vulnerability – Description of how exposed or susceptible an asset is to damage. This value depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. If an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct affects.

Vulnerability Assessment – Evaluation of the extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard occurrences on the existing and future built environment.

Watershed – Area of land that drains down gradient (from areas of higher land to areas of lower land) to the lowest point; a common drainage basin. The water moves through a network of drainage pathways, both underground and on the surface. Generally, these pathways converge into streams and rivers, which become progressively larger as the water moves downstream, eventually reaching an estuary, lake, or ocean.

Wet Floodproofing - In hydrologic terms, an approach to floodproofing which usually is a last resort. Flood waters are intentionally allowed into the building to minimize water pressure on the structure. Wet Floodproofing can include moving a few valuable items to a higher place or completely rebuilding the floodable area. Wet floodproofing has an advantage over other approaches: no matter how little is done, flood damage will be reduced. Thousands of dollars in damage can be avoided just by moving furniture and appliances out of the flood-prone area.

Wetland - In hydrologic terms, an area that is regularly wet or flooded and has a water table that stands at or above the land surface for at least part of the year.

Wind Chill Index - The temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold.

Windstorm – A storm characterized by high wind velocities; associated with cyclonic storms (e.g. hurricanes), thunderstorms and tornadoes.

Winter Storms - Includes ice storms and blizzards. Extreme cold often accompanies winter storms. The National Weather Service (NWS) characterizes blizzards as being combinations of winds in excess of 35 mph with considerable falling or blowing snow, which frequently reduces visibility.

Zone – A geographical area shown on a National FIRM that reflects the severity or type of flooding in the area.

Zoning Ordinance – Designation of allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

Acronyms

ACS	American Community Survey
AHPS	Advanced Hydrologic Prediction Services
AQI	Air Quality Index
ASCE	American Society of Civil Engineers
BRT	Board of Revision of Taxes
CDBG	Community Development Block Grants
CDC	Center for Disease Control and Prevention
CEDS	Comprehensive Economic Development Strategy
CONRAIL	Consolidated Rail Corporation
CP	Canadian Pacific
CPC	Climate Prediction Center
DBHIDS	Department of Behavioral Health/Intellectual disAbility Services
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
DMA 2000	Disaster Mitigation Act of 2000
DOD	Department of Defense
DPP	Department of Public Property
DRPA	Delaware River Port Authority
DVRPC	Delaware Valley Regional Planning Commission
ED	Emergency Declaration
EF	Enhanced Fujita

EIDL	Economic Injury Disaster Loan
EMC	Emergency Management Coordinator
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance Grant Program
GBS	General Building Stock
GDP	Gross Domestic Product
GED	General Educational Development
GIS	Geographic Information Systems
HAZUS	Hazards U.S.
HHWS	Heat Health Watch/Warning System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HUD	Housing and Urban Development
L&I	Department of Licenses & Inspection
MARFC	Middle Atlantic Forecast Center
MDO-OEM	Managing Director's Office of Emergency Management

MGT	Million Gross Tons
MLK	Martin Luther King
MMI	Modified Mercalli Intensity
MSA	Metropolitan Statistical Areas
NCDC	National Climatic Data Center
NDMC	National Drought Mitigation Center
NEHRP	National Earthquake Reduction Program
NESIS	Northeast Snowfall Impact Scale
NFHL	National Flood Hazard Layer
NFIA	National Flood Insurance Act
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NIMS	National Incident Management System
NJDOT	New Jersey Department of Transportation
NJ Transit	New Jersey Transit Corporation
NOAA	National Oceanic and Atmospheric Administration
NOWDATA	NOAA online weather data
NPS	National Park Service
NWS	National Weather Service
OIT	Office of Innovation and Technology
OMB	Office of Management and Budget
OPA	Office of Property Assessment
OSH	Office of Supportive Housing

PADEP	Pennsylvania Department of Environmental Protection
PATCO	Port Authority Transit Corporation
PCPC	Philadelphia City Planning Commission
PD	Presidential Disaster
PDM	Pre-Disaster Mitigation Program
PDPH	Philadelphia Department of Public Health
PDPH – DDC	Philadelphia Department of Public Health Division of Disease Control
PDPH - MEO	Philadelphia Department of Public Health Medical Examiner's Office
PEMA	Pennsylvania Emergency Management Agency
PennDOT	Pennsylvania Department of Transportation
PFD	Philadelphia Fire Department
PFD EMS	Philadelphia Fire Department Emergency Medical Services
PGA	Peak Ground Acceleration
PGW	Philadelphia Gas Works
PHA	Philadelphia Housing Authority
PHL/PNE	Philadelphia International Airport/Philadelphia Northeast Airport
PPD	Philadelphia Police Department
PP&R	Philadelphia Parks and Recreation
PSDI	Palmer Severity Drought Index
PWD	Philadelphia Water Department
RFC	Repetitive Flood Claims

RL	Repetitive Loss
SA	Spectral Acceleration
SBA	Small Business Administration
SEPTA	Southeastern Pennsylvania Transportation Authority
SFHA	Special Flood Hazard Area
SLOSH	Sea, Lake and Overland Surge from Hurricanes
SRL	Severe Repetitive Loss
STREETS	Philadelphia Department of Streets
UBC	Uniform Building Code
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WTP	Water Treatment Plant

Listing of Appendices

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Appendix B: Frequently Asked Questions Hand-out
Appendix C: Press Releases for Public Meetings
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Appendix J: Natural Hazard Personal Preparedness

Appendix A: Questionnaire

This appendix includes the questionnaire that was distributed to Philadelphia residents. In addition a summary of the questionnaire responses is included in this appendix. The questionnaire was available on the MDO-OEM website for residents to complete in electronic format and was distributed during Hazard Mitigation Public Meetings, Emergency Preparedness Workshops, and the Global Citizen MLK Day of Service Health & Wellness Fair & Civic Engagement Expo. All questionnaires were completed online, collected at meetings or returned to MDO-OEM through pre-paid envelopes and all results were compiled.

Managing Director's Office of Emergency Management
City of Philadelphia
HAZARD MITIGATION PLAN

The Office of Emergency Management is currently partnering with several governmental and non-governmental agencies to develop Phase I of the Philadelphia Hazard Mitigation Plan to address natural hazards in Philadelphia. To identify and plan for future natural disasters, we would like your feedback. By completing this questionnaire, you will help us understand your perceptions about natural hazards in Philadelphia. Your answers are confidential and will be used only for the preparation of the City's Natural Hazard Mitigation Plan. We will not provide your answers to any other group or interest.

Please return this form by February 16:

- **Submitting it at a one of the public meetings,**
- **Emailing it to us at oem@phila.gov**
- **Mailing it to the Office of Emergency Management, 240 Spring Garden Street, Philadelphia, PA 19123 ATTN: Hazard Mitigation Plan Questionnaire**

1. Please check your age range:

☐ Under 18	☐ 26-30	☐ 36-40	☐ 46-50	☐ 56-60
☐ 18-25	☐ 31-35	☐ 41-45	☐ 51-55	☐ 61 or older

2. How long have you lived in Philadelphia? ______________________

3. What zip code do you live in? _______________

4. What is your address (optional)? ______________________________________

5. In the past 10 years, which of the following types of natural hazard events have you experienced within Philadelphia? Check all that apply.

☐ Drought	☐ Flood
☐ Earthquake	☐ Hurricane, Tropical Storm, Nor'easter
☐ Extreme Heat	☐ Tornado, Wind Storm
☐ Extreme Cold	☐ Winter Storm

6. For each of the following natural hazards, please check your level of concern:

Natural Hazards	Extremely Concerned	Moderately Concerned	Slightly Concerned	Not At All Concerned
Drought	☐	☐	☐	☐
Earthquake	☐	☐	☐	☐
Extreme Heat	☐	☐	☐	☐
Extreme Cold	☐	☐	☐	☐
Flood	☐	☐	☐	☐
Hurricane, Tropical Storm, Nor'easter	☐	☐	☐	☐
Tornado, Wind Storm	☐	☐	☐	☐
Winter Storm	☐	☐	☐	☐

7. What steps, if any, have you taken to prepare for a natural disaster? Check all that apply.

- ☐ Created a fire escape plan
- ☐ Made an evacuation plan
- ☐ Made a family/household emergency plan
- ☐ Prepared a disaster supply kit to shelter in place in your home
- ☐ Prepared an "Go Kit", full of emergency supplies, to grab and go if you need to evacuate
- ☐ Signed up for emergency alerts through ReadyNotifyPA
- ☐ Received CPR/First Aid training
- ☐ Designed or retrofitted a home using hazard-resistant construction techniques or retrofits
- ☐ Have Homeowner's or Renter's Insurance
- ☐ Other (Please specify)

8. Do you ... ☐ Own your home? ☐ Rent home or apartment?

9. To the best of your knowledge, is your residence located in a designated floodplain?

☐ Yes ☐ No

10. If yes, do you have flood insurance? ☐ Yes ☐ No

11. If you do not have flood insurance, what is your primary reason for not carrying it?

____

____

____

____

12. Did you consider the impact a natural disaster could have on your home before you purchased it/moved into it? ☐ Yes ☐ No

13. If your property were located in a designated "high hazard" area, or had received repeated damage from a natural hazard event, would you consider one of the following? Please check all that apply.

- ☐ Structural elevation of your property
- ☐ Flood-proofing of your property
- ☐ None of the above

14. Please provide any other comments you have regarding natural hazards, hazard mitigation or this hazard mitigation planning process:

____

____

____

READY PHILADELPHIA Or Not?

Summary of Responses

Note: Not all questions were answered by each respondent; therefore, the percentage presented has been calculated based on the number of respondents that answered the specific question and not the overall number of questionnaires submitted either online or via hard-copy.

Question #1:

How long have you lived in Philadelphia? (82 Responses)

0-5 years	6-15 years	16-25 years	26-35 years	36-45 years	46+ years
15.85%	12.20%	17.07%	19.51%	14.63%	20.73%

Question #2:

Age Range (82 Responses)

Under 18	18-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61 or older
2.44%	13.41%	20.73%	18.29%	1.22%	10.98%	8.54%	8.54%	8.54%	7.32

Question #3:

What is your Zip Code (82 Responses)

Zip code information is not provided for the purposes of this report but is available upon request.

Question #4:

What is your Address?

Home addresses are not provided for the purposes of this report.

Question #5:

In the past 10 years, which of the following types of natural hazard events have you experience within Philadelphia? (82 Responses)

Hazard	Response (%)
Drought	4.84%
Earthquake	15.95%
Extreme Heat	16.81%
Extreme Cold	13.96%
Flood	15.95%
Hurricane, Tropical Storm, Nor'easter	15.67%
Tornado, Wind Storm	4.84%
Winter Storm	19.09%

Question #6:
For each of the following natural hazards, please check your level of concern:

Natural Hazard	Extremely	Moderately	Slightly	Not At All
Drought	6.10%	15.85%	23.17%	54.88%
Earthquake	21.95%	10.98%	40.24%	26.83%
Extreme Heat	29.27%	36.59%	13.41%	20.73%
Extreme Cold	36.59%	28.05%	13.41%	21.95%
Flood	28.05%	32.93%	19.51%	19.51%
Hurricane, Tropical Storm	24.39%	40.24%	17.07%	18.29%
Tornado, Wind Storm	19.51%	17.07%	30.49%	32.93%
Winter Storm	42.68%	37.80%	12.20%	7.32%

Question #7:
What Steps have you taken to prepare for a natural disaster?

Action Items	Responses (%)
Created a fire escape plan	11.48%
Made an evacuation plan	11.48%
Made a family/household emergency plan	13.40%
Prepared a disaster supply kit to shelter in place in your home	9.57%
Prepared a "Go Kit", full of emergency supplies, to grab and go if you need to evacuate	11.48%
Signed up for emergency text/email alerts through ReadyNotifyPA.org	9.57%
Received CPR/First Aid training	15.31%
Designed or retrofitted a home using hazard-resistant construction techniques or retrofits	0.00%
Have Homeowner's or Renter's Insurance	18.66%
None	6.70%

Question #8:
Do you own or rent your home?

Own	Rent
43.9%	56.1%

Question #9:
To the best of your knowledge, is your residence located in a designated floodplain?

Yes	No
10.98%	89.02%

Question #10:
If yes, do you have flood insurance?

Yes	No
12.5%	87.5%

Question #11:
If you do not have flood insurance, what is your primary reason for not carrying it?

Response
I plan on applying for flood insurance.
These answers are the best that I can give because this is not my home. I just rent for a temporary period until I can find permanent housing for myself.
My residence does not have issues with floods or is not known as being on a flood plain.
I have renter's insurance
Can't afford it.
Insurance co. won't write it.
There is no reason to get it
I didn't know I lived in a flood plain until the recent storm last year 2011.
Not in a floodplain
Not in a floodplain. Live on a hill.
None
I'm not the owner or main renter.
Cost

I can't afford it
Not a home owner yet.
Never thought of it.
Not necessary
Was not required to carry it, plus not in a flood plane
At the address we don't need it.
I live in a Center City apartment building on the 6th floor.
Only 11 years old
I don't believe it's necessary.
Finances - lack of funds.
Not living in a flood plain
Not sure if insurance covers it.

Question #12:
Did you consider the impact a natural disaster could have on your home before you purchased it/moved into it?

Yes	No
8.54%	91.46%

Question #13:
If you property were located in a designated "high hazard" area, or had received repeated damage from a natural hazard event, would you consider one of the following?

Mitigation Action	Response (%)
Structural elevation of your property	20.62%
Flood-proofing of your property	32.99%
None of the above	46.39%

Question #14:
Other Comments:

Public Comments

This workshop was great it made me think about how I need to prepare me and my family for things that can really have a serious impact on me and my family and community.
The instructors were very good.
Hazard mitigation is good.
I think home insurance should cover all natural and man-made hazards/disasters
I believe that there should be more disaster education in schools. I didn't really get involved with disaster outreach until college.
Great! Thank you for preparing our city.
No comment.
I should be safer.
Southwest Philadelphia has a lot of swamp area.
I need to become more aware of the process.
There needs to be more talk from the city about what the public can do to make themselves more prepared for disasters.
People on the upper floor might have difficulty evacuating.
It's a pretty level area where I live. I am concerned about man-made violence in Philadelphia (murders).
I like Philadelphia because of our low-level emergency risk vs. other major cities like DC, NYC, Miami, Los Angeles, San Francisco, etc.
Does the city plan on conducting emergency drills for residents in neighborhoods?
*Live in college dorm
More on how to receive more info. Join a neighborhood evacuation team.
It's definitely an area that all Americans need to pay more attention to: Equip people with tools, and hopefully experience doesn't have to be the teacher.
The City has to reestablish their emergency fallout shelters. Where are they?

Appendix B: Frequently Asked Questions Hand-out

This appendix includes additional information on hazard mitigation and the plan. This document was distributed at hazard mitigation community meetings and was available to view on MDO-OEM's website.

Managing Director's Office of Emergency Management
City of Philadelphia
Hazard Mitigation Planning

Q. What is natural hazard mitigation?
A. Natural hazard mitigation is any cost-effective and sustained action taken to reduce or eliminate the long-term risk to human life or property from natural hazards.

Q. What is a Hazard Mitigation Plan?
A. The Hazard Mitigation Plan contains geographic and demographic information, together with a citywide risk and vulnerability assessment to outline a mitigation strategy. The plan details goals, objectives, and specific tasks or actions to reduce risk.

Q. Why develop a Hazard Mitigation Plan?
A. Several reasons for us to develop a plan include:

- Protecting Philadelphia residents, businesses and built environment;
- Creating a city resilient to natural hazards;
- Breaking the "Preparedness, Response, Recovery Cycle" related to emergencies;
- Fulfilling the planning requirement for the City to be eligible for future hazard mitigation grant funding.

Q. Who is developing Philadelphia's plan?
A. Many governmental and non-governmental representatives are working closely with MDO-OEM to develop the plan. These agencies include:

- Office of Emergency Management
- Philadelphia Gas Works (PGW)
- Philadelphia Water Department
- Pennsylvania Electric Company (PECO)
- Philadelphia Office of Innovation and Technology
- Veolia Energy
- Streets Department
- Licenses and Inspections
- Parks and Recreation/Fairmount Park
- PENNDOT
- Philadelphia Fire Department Emergency Medical Services
- Philadelphia Fire Department Hazardous Materials
- Philadelphia Police Department
- Philadelphia City Planning Commission
- Philadelphia Department of Public Health
- Philadelphia International Airport
- Southeast Pennsylvania Transportation Authority
- Amtrak

Q. What are the hazards considered in this plan?
A. The following natural hazards are addressed in the plan:

- Drought
- Earthquakes
- Flooding
- Winter Storms
- Extreme Heat
- Extreme Cold
- Hurricanes, Tropical Storms, Nor'easter
- Windstorms/Tornadoes

Q. What is Philadelphia doing to make it more resilient to natural hazards?

A. Part of the plan development process includes identifying what initiatives the City is taking or could take to reduce the effects of natural hazards. These initiatives are called "mitigation strategies."

Q. How can I prepare for Natural Hazards?

A. Prepare now for any kind of emergency, including Natural Hazards.

1. First, develop a Family Emergency Plan for everyone, including pets, in your household.
2. Next, develop a Family Communication Plan to stay in touch with family if you are separated during the emergency.
3. Put together a 3-day kit of emergency supplies for all family members and pets. Visit www.phila.gov/ready for a more detailed list of emergency supplies to include in your kit.

Q. How can I stay informed when a Natural Hazard affects Philadelphia?

A. You can stay informed during Natural Hazards by:

- Listening to local news or NOAA weather radio;
- Watching Government Access Station Channel 64;
- Calling Philly 311;
- Visiting www.phila.gov/ready;
- Following Office of Emergency Management on Twitter, MySpace, FaceBook, Blogger, and LinkedIn;
- Signing up for emergency text alerts from ReadyNotifyPA

Q. How can I comment on the Natural Hazards Mitigation Plan for Philadelphia?

All comments and questionnaires must be received by February 16, 2012.

- Fill out and return the feedback questionnaire:
  - At one of the public meetings
  - Mail the questionnaire to Office of Emergency Management, 240 Spring Garden Street, Philadelphia, PA 19123 ATTN: Hazard Mitigation Plan Questionnaire
  - Email OEM at oem@phila.gov
  - Call 311 and ask for a Hazard Mitigation Plan Questionnaire

Natural Hazard Mitigation Plan Public Meetings will be held:

Thursday, December 15, 2011, 6:00-8:00 p.m.
Salvation Army Roxborough Corps
6730 Ridge Avenue

Saturday, January 7, 2012, 10:00 a.m.-noon
Federation Housing Inc., Rieder House
10102 Jamison Avenue
(Snow Date: Tuesday, January 17, 6:00-8:00 p.m.)

Tuesday, January 24, 6:00-8:00 p.m.
Mercy Eastwick Wellness Center, 2821 Island Avenue
(Snow Date: Thursday, January 26, 6:00-8:00 p.m.)

Wednesday, February 8, 6:00-8:00 p.m.
Free Library of Philadelphia – Central Branch
Skyline Room, 4th Floor
1901 Vine Street
(No Snow Date)

Thursday, February 16, 6:00-8:00 p.m.
Salvation Army Tabernacle Corps.
3150 North Mascher Street
(No Snow Date)

READY PHILADELPHIA *Or Not?*

Appendix C: Press Releases for Public Meetings

This appendix includes the press releases disseminated to media and the public for all public meetings convened during the development of the Philadelphia Natural Hazard Mitigation Plan. MDO-OEM sent a total of eleven press releases informing the press and the public of the five public meetings.

NEWS NEWS

Managing Director's Office of Emergency Management

Liam O'Keefe, Deputy Managing Director
Samantha Phillips, Assistant Managing Director

Contact: Joan Przybylowicz, 215-260-4262

December 14, 2011

For Immediate Release:

Reducing Risks from Natural Hazards: Phase 1 Rollout of Philadelphia's Draft Natural Hazards Mitigation Plan

The Managing Director's Office of Emergency Management invites the public to learn about the Natural Hazards Mitigation Plan being developed for Philadelphia. Phase One of the plan will be rolled out on Thursday, December 15, 5:30 to 7:30 p.m. at The Salvation Army Corps' Roxborough Community Center, 6730 Ridge Avenue.

Between 5:30 and 6:00 p.m., residents will view a series of poster displays featuring the natural hazards. The Office of Emergency Management will provide a brief presentation about the development of the Hazard Mitigation Plan at 6:00 p.m. After the presentation, residents will have more time to review the poster displays and provide their feedback and concerns about natural hazards in their community.

Phase One of the Natural Hazard Mitigation Plan will address a comprehensive list of natural hazards -- droughts, floods, extreme temperatures, earthquakes, wind storms and tornadoes, hurricanes and tropical storms, Nor'easters, and severe winter storms -- that may impact Philadelphia. The purpose of the Natural Hazards Mitigation Plan is to reduce or eliminate long-term risks to human life or property from natural disasters through cost-effective and sustained mitigation actions.

"We welcome the public to join us on December 15 to offer their thoughts about the natural hazards of concern to them and businesses in their community," said Deputy Managing Director for Emergency Management Liam O'Keefe.

The Office of Emergency Management will hold a series of meetings from mid-December through mid-February throughout Philadelphia to rollout the various phases of the Natural Hazards Mitigation Plan. Additional phases of the plan will focus on risk assessments of the natural hazards, as well as identifying short and long-term mitigation strategies for reducing risks associated with the natural hazards.

The public is encouraged to visit www.phila.gov/ready to:

- Find more information about natural hazards that can affect Philadelphia;
- Get a copy of the Natural Hazards Plan Questionnaire
- Obtain a listing of future public meetings about the plan;
- Learn how to prepare for natural hazards; and
- Sign up for emergency text alerts from ReadyNotifyPA

The public can submit comments about the plan through several options:

- Attending a public meeting and completing a Natural Hazards Plan Questionnaire
- Sending an email to oem@phila.gov
- Calling 3-1-1 to request a copy of the Natural Hazards Plan Questionnaire
- Mailing the questionnaire to Philadelphia Office of Emergency Management,
  240 Spring Garden Street, Philadelphia, PA 19123
  ATTN: Hazards Mitigation Plan

Questionnaires must be completed and submitted to the Office of Emergency Management by February 16, 2012.

Additional Natural Hazard Mitigation Plan public meetings will be held:

Saturday, January 7, 2012, 10:00 a.m.-noon
Federation Housing Inc., Rieder House
10102 Jamison Avenue
(Snow Date: Tuesday, January 17, 6:00-8:00 p.m.)

Tuesday, January 24, 6:00-8:00 p.m.
Mercy Eastwick Wellness Center
2821 Island Avenue
(Snow Date: Thursday, January 26, 6:00-8:00 p.m.)

Wednesday, February 8, 6:00-8:00 p.m.
Free Library of Philadelphia – Central Branch
Skyline Room, 4th Floor
1901 Vine Street
(No Snow Date)

Thursday, February 16, 6:00-8:00 p.m.
Salvation Army Tabernacle Corps.
3150 North Mascher Street
(No Snow Date)

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NEWS NEWS

Managing Director's Office of Emergency Management

Liam O'Keefe, Deputy Managing Director
Samantha Phillips, Assistant Managing Director

Contact: Joan Przybylowicz, 215-260-4262

December 30, 2011

For Immediate Release:

Reducing Risks from Natural Hazards: Rollout of Philadelphia's Draft Natural Hazards Mitigation Plan

The Managing Director's Office of Emergency Management invites the public to learn about the Natural Hazards Mitigation Plan being developed for Philadelphia. The plan will be rolled out on Saturday, January 7, 2012, 10:00 a.m. through noon at the Federation Housing Inc., Rieder House, 10102 Jamison Avenue in Northeast Philadelphia. (Snow Date: Tuesday, January 17, 6:00-8:00 p.m.)

Between 10:30 and 11:00 a.m., residents will view a series of poster displays featuring the natural hazards. The Office of Emergency Management will provide a brief presentation about the development of the Hazard Mitigation Plan at 11:00 a.m. After the presentation, residents will have more time to review the poster displays and provide their feedback and concerns about natural hazards in their community.

The Natural Hazard Mitigation Plan will address a comprehensive list of natural hazards -- droughts, floods, extreme temperatures, earthquakes, wind storms and tornadoes, hurricanes and tropical storms, Nor'easters, and severe winter storms -- that may impact Philadelphia. In addition, the Office of Emergency Management will provide a risk assessment, which includes prioritizing the natural hazards that have the potential of impacting Philadelphia. The purpose of the Natural Hazards Mitigation Plan is to reduce or eliminate long-term risks to human life or property from natural disasters through cost-effective and sustained mitigation actions.

The Office of Emergency Management will continue to hold a series of meetings through mid-February around Philadelphia to rollout the various components of the Natural Hazards Mitigation Plan. Future components of the plan will focus on identifying short and long-term mitigation strategies for reducing risks associated with the natural hazards.

Deputy Managing Director for Emergency Management Liam O'Keefe encourages the public to the attend meetings. "It's important for us to hear about Philadelphians' concerns about natural hazards that could impact their neighborhoods, so we welcome them to attend any of the upcoming meetings."

Additional Natural Hazard Mitigation Plan public meetings will be held:

Tuesday, January 24, 6:00-8:00 p.m.
Mercy Eastwick Wellness Center
2821 Island Avenue
(Snow Date: Thursday, January 26, 6:00-8:00 p.m.)

Wednesday, February 8, 6:00-8:00 p.m.
Free Library of Philadelphia – Central Branch
Skyline Room, 4th Floor
1901 Vine Street
(No Snow Date)

Thursday, February 16, 6:00-8:00 p.m.
Salvation Army Tabernacle Corps
3150 North Mascher Street
(No Snow Date)

The public is encouraged to visit www.phila.gov/ready to:

- Find more information about natural hazards that can affect Philadelphia;
- Get a copy of the Natural Hazards Plan Questionnaire;
- Obtain a listing of future public meetings about the plan;
- Learn how to prepare for natural hazards; and
- Sign up for emergency text alerts from ReadyNotifyPA

The public can submit comments about the plan through several options:

- Attending a public meeting and completing a Natural Hazards Plan Questionnaire
- Sending an email to oem@phila.gov
- Calling 3-1-1 to request a copy of the Natural Hazards Plan Questionnaire
- Mailing the questionnaire to Philadelphia Office of Emergency Management, 240 Spring Garden Street, Philadelphia, PA 19123
  ATTN: Hazards Mitigation Plan

Questionnaires must be completed and submitted to the Office of Emergency Management by February 16, 2012.

###

NEWS NEWS

Managing Director's Office of Emergency Management

Liam O'Keefe, Deputy Managing Director
Samantha Phillips, Assistant Managing Director

Contact: Joan Przybylowicz, 215-260-4262

January 20, 2012

For Immediate Release:

Reducing Risks from Natural Hazards: Rollout Continuation of Philadelphia's Draft Natural Hazards Mitigation Plan

The Managing Director's Office of Emergency Management invites the public to learn about the Natural Hazards Mitigation Plan being developed for Philadelphia. The plan will be rolled out on Tuesday, January 24 2012, 6:00 p.m. to 8:00 p.m. at the Mercy Eastwick Wellness Center in Southwest Philadelphia. (Snow Date: Thursday, January 26, 6:00-8:00 p.m.)

At the rollout, residents will view a series of poster displays featuring the natural hazards and have an opportunity to provide their feedback and concerns about natural hazards in their community.

The Natural Hazard Mitigation Plan will address a comprehensive list of natural hazards -- droughts, floods, extreme temperatures, earthquakes, wind storms and tornadoes, hurricanes and tropical storms, Nor'easters, and severe winter storms -- that may impact Philadelphia. In addition, the Office of Emergency Management will provide a risk assessment, which includes prioritizing the natural hazards that have the potential of impacting Philadelphia. The purpose of the Natural Hazards Mitigation Plan is to reduce or eliminate long-term risks to human life or property from natural disasters through cost-effective and sustained mitigation actions.

The Office of Emergency Management will continue to hold a series of meetings through mid-February around Philadelphia to rollout the various components of the Natural Hazards Mitigation Plan. Future components of the plan will focus on identifying short and long-term mitigation strategies for reducing risks associated with the natural hazards.

Deputy Managing Director for Emergency Management Liam O'Keefe encourages the public to the attend meetings. "It's important for us to hear about Philadelphians' concerns about natural hazards that could impact their neighborhoods, so we welcome them to attend any of the upcoming meetings."

The two remaining Natural Hazard Mitigation Plan public meetings will be held:

Wednesday, February 8, 6:00-8:00 p.m.
Free Library of Philadelphia – Central Branch
1901 Vine Street
(No Snow Date)

Thursday, February 16, 6:00-8:00 p.m.
Salvation Army Tabernacle Corps
3150 North Mascher Street
(No Snow Date)

The public is encouraged to visit www.phila.gov/ready to:

- Find more information about natural hazards that can affect Philadelphia;
- Get a copy of the Natural Hazards Plan Questionnaire;
- Obtain a listing of future public meetings about the plan;
- Learn how to prepare for natural hazards; and
- Sign up for emergency text alerts from ReadyNotifyPA

The public can submit comments about the plan through several options:

- Attending a public meeting and completing a Natural Hazards Plan Questionnaire
- Sending an email to oem@phila.gov
- Calling 3-1-1 to request a copy of the Natural Hazards Plan Questionnaire
- Mailing the questionnaire to Philadelphia Office of Emergency Management, 240 Spring Garden Street, Philadelphia, PA 19123
  ATTN: Hazards Mitigation Plan

Questionnaires must be completed and submitted to the Office of Emergency Management by February 16, 2012.

###

NEWS NEWS

Managing Director's Office of Emergency Management

Liam O'Keefe, Deputy Managing Director
Samantha Phillips, Assistant Managing Director

Contact: Joan Przybylowicz, 215-260-4262

February 1, 2012

For Immediate Release:

Reducing Risks from Natural Hazards:
Rollout Continuation of Philadelphia's Draft Natural Hazards Mitigation Plan

The Managing Director's Office of Emergency Management invites the public to learn about the Natural Hazards Mitigation Plan being developed for Philadelphia. The plan will be rolled out on Wednesday, February 8, 2012, 6:00 p.m. to 8:00 p.m. at the Free Library of Philadelphia, main lobby, 1901 Vine Street.

Residents will have an opportunity to view a series of poster displays featuring the natural hazards, as well as provide their feedback and concerns about natural hazards in their community.

The Natural Hazard Mitigation Plan will address a comprehensive list of natural hazards -- droughts, floods, extreme temperatures, earthquakes, wind storms and tornadoes, hurricanes and tropical storms, Nor'easters, and severe winter storms -- that may impact Philadelphia. In addition, the Office of Emergency Management will provide a risk assessment, which includes prioritizing the natural hazards that have the potential of impacting Philadelphia. The purpose of the Natural Hazards Mitigation Plan is to reduce or eliminate long-term risks to human life or property from natural disasters through cost-effective and sustained mitigation actions.

The Office of Emergency Management will continue to hold a series of meetings through mid-February around Philadelphia to rollout the various components of the Natural Hazards Mitigation Plan. Future components of the plan will focus on identifying short and long-term mitigation strategies for reducing risks associated with the natural hazards.

Deputy Managing Director for Emergency Management Liam O'Keefe encourages the public to the attend meetings. "It's important for us to hear about Philadelphians' concerns about natural hazards that could impact their neighborhoods, so we welcome them to attend any of the upcoming meetings."

One additional Natural Hazard Mitigation Plan public meeting will be held:

Thursday, February 16, 6:00-8:00 p.m.
Salvation Army Tabernacle Corps
3150 North Mascher Street
(No Snow Date)

The public is encouraged to visit www.phila.gov/ready to:

- Find more information about natural hazards that can affect Philadelphia;
- Get a copy of the Natural Hazards Plan Questionnaire;
- Obtain a listing of future public meetings about the plan;
- Learn how to prepare for natural hazards; and
- Sign up for emergency text alerts from ReadyNotifyPA

The public can submit comments about the plan through several options:

- Attending a public meeting and completing a Natural Hazards Plan Questionnaire
- Sending an email to oem@phila.gov
- Calling 3-1-1 to request a copy of the Natural Hazards Plan Questionnaire
- Mailing the questionnaire to Philadelphia Office of Emergency Management, 240 Spring Garden Street, Philadelphia, PA 19123
  ATTN: Hazards Mitigation Plan

Questionnaires must be completed and submitted to the Office of Emergency Management by February 16, 2012.

# # #

NEWS NEWS

Managing Director's Office of Emergency Management

Liam O'Keefe, Deputy Managing Director
Samantha Phillips, Assistant Managing Director

Contact: Joan Przybylowicz, 215-260-4262

February 6, 2012

For Immediate Release:

Reducing Risks from Natural Hazards:
Rollout Continuation of Philadelphia's Draft Natural Hazards Mitigation Plan

The Managing Director's Office of Emergency Management invites the public to learn about the Natural Hazards Mitigation Plan being developed for Philadelphia. The plan will be rolled out on Thursday, February 16, 2012, 6:00 p.m. to 8:00 p.m. at the Salvation Army Tabernacle Corps, 3150 North Mascher Street in North Philadelphia during the final public meeting that will be held.

Residents will have the opportunity to view a series of poster displays featuring the natural hazards and provide their feedback and concerns about natural hazards in their community.

The Natural Hazard Mitigation Plan will address a comprehensive list of natural hazards -- droughts, floods, extreme temperatures, earthquakes, wind storms and tornadoes, hurricanes and tropical storms, Nor'easters, and severe winter storms -- that may impact Philadelphia. In addition, the Office of Emergency Management will provide a risk assessment, which includes prioritizing the natural hazards that have the potential of impacting Philadelphia. The purpose of the Natural Hazards Mitigation Plan is to reduce or eliminate long-term risks to human life or property from natural disasters through cost-effective and sustained mitigation actions.

Deputy Managing Director for Emergency Management Liam O'Keefe encourages the public to the attend meetings. "This is the final public meeting for this round of the plan so we strongly encourage Philadelphians to attend and provide us with their concerns about natural hazards that can impact Philadelphia."

The public is encouraged to visit www.phila.gov/ready to:

- Find more information about natural hazards that can affect Philadelphia;
- Get a copy of the Natural Hazards Plan Questionnaire;
- Obtain a listing of future public meetings about the plan;
- Learn how to prepare for natural hazards; and

- Sign up for emergency text alerts from ReadyNotifyPA

The public can submit comments about the plan through several options:

- Attending a public meeting and completing a Natural Hazards Plan Questionnaire
- Sending an email to oem@phila.gov
- Calling 3-1-1 to request a copy of the Natural Hazards Plan Questionnaire
- Mailing the questionnaire to Philadelphia Office of Emergency Management, 240 Spring Garden Street, Philadelphia, PA 19123
  ATTN: Hazards Mitigation Plan

Questionnaires must be completed and submitted to the Office of Emergency Management by February 16, 2012.

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Appendix D: Newspaper Articles

This appendix includes newspaper articles used to inform the public of the Hazard Mitigation Planning effort in Philadelphia.

City Plan For Natural Hazards Begins To Form

The Managing Director's Office of Emergency Management invites the public to learn about the Natural Hazards Mitigation Plan being developed for Philadelphia. Phase One of the plan will be rolled out on Thursday, Dec. 15, 5:30 to 7:30 p.m. at The Salvation Army Corps' Roxborough Community Center, 6730 Ridge Avenue. (Snow date will be Saturday, Dec. 17 at 10:30 a.m. to 12:30 p.m.)

Between 5:30 and 6:00 p.m., residents will view a series of poster displays featuring the natural hazards. OEM will provide a brief presentation about the development of the Hazard Mitigation Plan at 6:30 p.m. After the presentation, residents will have more time to review the poster displays and provide their feedback and concerns about natural hazards in their community.

Phase One of the Natural Hazard Mitigation Plan will address a comprehensive list of natural hazards – droughts, floods, extreme temperatures, earthquakes, wind storms and tornadoes, hurricanes and tropical storms, Nor'easters, and severe winter storms – that may impact Philadelphia. The purpose of the Natural Hazards Mitigation Plan is to reduce or eliminate long-term risks to human life or property from natural disasters through cost-effective and sustained mitigation actions.

"We welcome the public to join us on Dec. 15 to offer their thoughts about the natural hazards of concern to them and businesses in their community," said Deputy Managing Director for Emergency Management Liam O'Keefe.

OEM will hold a series of meetings from mid-December through mid-February throughout Philadelphia to roll out the various phases of the Natural Hazards Mitigation Plan. Additional phases of the plan will focus on risk assessments of the natural hazards, as well as

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THE PHILADELPHIA DAILY RECORD

identifying short and long-term mitigation strategies for reducing risks associated with the natural hazards.

The public is encouraged to visit www.phila.gov/ready to:

- Find more information about natural hazards that can affect Philadelphia;
- Obtain a listing of future public meetings about the plan;
- Learn how to prepare for natural hazards; and
- Sign up for emergency text alerts from ReadyNotifyPA

The public can submit comments about the plan through several options:

The public can submit comments about the plan by attending a public meeting and completing a Natural Hazards Plan Questionnaire, sending an email to oem@phila.gov or calling 3-1-1 to request a copy of the Natural Hazards Plan Questionnaire.

Questionnaires must be completed and submitted to the Office of Emergency Management by Feb. 16, 2012.

NEWS > NEWS BRIEFS

Disaster preparation

Posted Jan. 5, 2012 | Comments: 0 | Add Comment

The City will hold a series of meetings to receive feedback on the Natural Hazards Mitigation Plan that the Managing Director's Office of Emergency Management is developing.

The City will present the plan, which hopes to reduce or eliminate long-term risks to human life or property from natural disasters through cost-effective and sustained mitigation actions, 10 a.m. to noon Saturday at Federation Housing Inc., Rieder House, 10102 Jamison Ave., in Northeast Philly.

"It's important for us to hear about Philadelphians' concerns about natural hazards that could impact their neighborhoods, so we welcome them to attend any of the upcoming meetings," Deputy Managing Director for Emergency Management Liam O'Keefe said.

Additional public meetings include 6 to 8 p.m. Jan. 24 at Mercy Eastwick Wellness Center, 2821 Island Ave., in Southwest Philly; 6 to 8 p.m. Feb. 8 at Free Library of Philadelphia's Central Branch, 1901 Vine St.; and 6 to 8 p.m. Feb. 16 at Salvation Army Tabernacle Corps, 3150 N. Mascher St., in North Philly.

Call 311, e-mail oem@phila.gov or visit phila.gov/ready.

Contact the South Philly Review at editor@southphillyreview.com.

ADD THIS | Add to Favorites | Print | Send to Friend

MORE

Article: Education assistance

Article: Energy alternate

Article: Young helpers

Article: Neighborhood gatherings 01-26-12

Article: Vote for the 2012 Readers' Choice Awards

Article: Neighborhood gatherings 01-19-12

Article: Theatrical presence

Article: Sweetheart express

COMMENTS

ADD COMMENT

Name: Anonymous

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Email Address: Will not be posted nor published

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Comment:

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User Guidelines

Appendix E: Public Meeting Agendas

This appendix includes the meeting agendas for all the hazard mitigation public meetings conducted during the development of the Philadelphia Natural Hazard Mitigation Plan.

Managing Director's Office of Emergency Management
City of Philadelphia

Hazard Mitigation Planning

Public Meeting: Thursday, December 15, 2011, 5:30-7:30 p.m.

The Salvation Army Corps Community Center
6730 Ridge Avenue, Philadelphia, PA

Program

5:30 p.m. Public Review/Public Feedback of Natural Hazard Display Panels

- Extreme Temperatures: Cold and Heat
- Winter Weather
- Windstorms
- Tornadoes
- Tropical Cyclones/Hurricanes
- Flooding
- Earthquakes
- Droughts

6:00 p.m. Welcome and Introductions
Joan Przybylowicz, Deputy Director for External Affairs

6:05 p.m. Hazard Mitigation Plan Presentation
Caitlin Kelly, Hazard Mitigation Planning Coordinator

6:35 p.m. Personal and Family Preparedness
Edward Vassallo, Ready Coordinator

6:45 p.m. Additional Public Review/Public Feedback of Natural Hazard Display Panels

7:30 p.m. Program Ends

READY PHILADELPHIA Or Not?

Managing Director's Office of Emergency Management
City of Philadelphia

Hazard Mitigation Planning

Public Meeting: Saturday, January 7, 2012, 10:00 a.m. to noon

Federation Housing Inc.
Rieder House
10102 Jamison Avenue

Program

10:00 a.m. Public Review/Public Feedback of Natural Hazard Display Panels

- Extreme Temperatures: Cold and Heat
- Winter Weather
- Windstorms
- Tornadoes
- Tropical Cyclones/Hurricanes
- Flooding
- Earthquakes
- Droughts
- Risk Assessments
- Evacuation Routes

10:30 a.m. Welcome and Introductions
Joan Przybylowicz, Deputy Director for External Affairs

10:35 a.m. Hazard Mitigation Plan Presentation
Caitlin Kelly, Hazard Mitigation Planning Coordinator

11:05 p.m. Personal and Family Preparedness
Joan Przybylowicz, Deputy Director for External Affairs

11:15 a.m. Additional Public Review/Public Feedback of Natural Hazard Display Panels

Noon Program Ends

READY PHILADELPHIA Or Not?

Managing Director's Office of Emergency Management
City of Philadelphia

Hazard Mitigation Planning

Public Meeting: Tuesday, January 24, 2012, 6:00-8:00 p.m.

Mercy Eastwick Wellness Center
2821 Island Avenue

Program

6:00 p.m. **Public Review/Public Feedback of Natural Hazard Display Panels**
- Extreme Temperatures: Cold and Heat
- Winter Weather
- Windstorms
- Tornadoes
- Tropical Cyclones/Hurricanes
- Flooding
- Earthquakes
- Droughts
- Risk Assessments
- Evacuation Routes

6:30 p.m. **Welcome and Introductions**
Joan Przybylowicz, Deputy Director for External Affairs

6:35 p.m. **Hazard Mitigation Plan Presentation**
Caitlin Kelly, Hazard Mitigation Planning Coordinator

7:05 p.m. **Personal and Family Preparedness**
Edward Vassallo, Ready Coordinator

7:15 p.m. **Additional Public Review/Public Feedback of Natural Hazard Display Panels**

8:00 p.m. **Program Ends**

READY PHILADELPHIA Or Not?

Managing Director's Office of Emergency Management
City of Philadelphia

Hazard Mitigation Planning

Public Meeting: Wednesday, February 8, 2012, 6:00-8:00 p.m.

Free Library of Philadelphia, Central Branch
Skyline Room, 4th Floor

Program

6:00 p.m. **Public Review/Public Feedback of Natural Hazard Display Panels**
- Extreme Temperatures: Cold and Heat
- Winter Weather
- Windstorms
- Tornadoes
- Tropical Cyclones/Hurricanes
- Flooding
- Earthquakes
- Droughts
- Risk Assessments
- Evacuation Routes

6:30 p.m. **Welcome and Introductions**
Joan Przybylowicz, Deputy Director for External Affairs

6:35 p.m. **Hazard Mitigation Plan Presentation**
Caitlin Kelly, Hazard Mitigation Planning Coordinator

7:05 p.m. **Personal and Family Preparedness**
Edward Vassallo, Ready Coordinator

7:15 p.m. **Additional Public Review/Public Feedback of Natural Hazard Display Panels**

8:00 p.m. **Program Ends**

READY PHILADELPHIA Or Not?

Managing Director's Office of Emergency Management
City of Philadelphia

Hazard Mitigation Planning

Public Meeting: Thursday, February 16, 2012, 6:00-8:00 p.m.

Salvation Army Tabernacle Corps
3150 North Mascher Street

Program

6:00 p.m. Public Review/Public Feedback of Natural Hazard Display Panels

- Extreme Temperatures: Cold and Heat
- Winter Weather
- Windstorms
- Tornadoes
- Tropical Cyclones/Hurricanes
- Flooding
- Earthquakes
- Droughts
- Risk Assessments
- Evacuation Routes

6:30 p.m. Welcome and Introductions
Joan Przybylowicz, Deputy Director for External Affairs

6:35 p.m. Hazard Mitigation Plan Presentation
Caitlin Kelly, Hazard Mitigation Planning Coordinator

7:05 p.m. Personal and Family Preparedness
Edward Vassallo, Ready Coordinator

7:15 p.m. Additional Public Review/Public Feedback of Natural Hazard Display Panels

8:00 p.m. Program Ends

READY PHILADELPHIA Or Not?

Appendix F: Public Meeting Hazard Boards

This appendix depicts the series of poster displays featuring the natural hazards profiled in the Hazard Mitigation Plan. During the five public meetings residents of Philadelphia were given the opportunity to view these hazard boards and provide their feedback and concerns about natural hazards in their community.

Philadelphia Hazard Mitigation Plan

Natural Hazard Profile: Drought

Philadelphia, similar to other Pennsylvania counties, is subject to periodic droughts that would impact the ability to meet the county's water needs.

Past Occurrences in Philadelphia

- Earliest mention dates back to 1762.
- Philadelphia's driest year, 1922, was at the center of a three-year drought from 1921 to 1923.
- Extreme drought between July 1929 and September 1932. Coincided with infamous Dust Bowl in Kansas, Oklahoma and Texas.
- Most severe drought recorded: 1961 to 1966
- January 1963 to August 1966: a deficit of nearly a year's worth of rain (40 inches of liquid precipitation) occurred.

Summary of Declared Drought Status from 1980-2011 for Philadelphia (PADEP, 2011)			
Drought Phase	**Date**		
Drought Watch	August 2011 – September 2011		
	October 2007 – January 2008		
	April 2006 – June 2006		
	November 2001 – December 2001		
	September 1999 – February 2000		
	March 1999 – June 1999		
	December 1998		
	September 1992 – January 1993		
	July 1988 – December 1988		
Drought Warning	September 2010 – November 2010		
	November 2002 – December 2002		
	December 2001 – February 2002		
	June 1999 – July 1999		
	October 1997 – January 1998		
	November 1995 – December 1995		
	September 1995		
	September 1991 – September 1992		
	March 1989 – May 1989		
	January 1985 – April 1985		
	November 1982 – March 1983		
Drought Emergency	September 2002 – November 2002		
	February 2002 – June 2002		
	July 1999 – September 1999		
	September 1995 – November 1995		
	April 1985 – December 1985		
	November 1980 – April 1982		
Totals	Total Drought Watches	Total Drought Warnings	Total Drought Emergencies
	9	12	6

Future Drought Occurrences

- It is difficult to forecast the severity and frequency of future drought events in Philadelphia
- Difficult to forecast the severity and frequency of future drought events in Philadelphia.
- Occasional drought is a normal, recurrent feature of virtually every climate in the United States.
- Based on national data from 1895 to 1995, Philadelphia experienced severe or extreme drought.
- Future droughts in Philadelphia should be considered possible.

Vulnerability Assessment

Direct impacts include loss of revenue from businesses reliant on water, such as car washes, landscapers, and manufacturers. In a drought, water use restrictions may force businesses to suspend all or a portion of their activities.

Indirect impacts may be far-reaching, including increase in food prices, loss to recreational and tourism industry and air quality affects. The more removed the impact from the cause, the more complex the link to the cause.

Drinking Water Supply

Philadelphia's Drinking Water Sources: Delaware and Schuylkill Rivers.

Due to Philadelphia's fleet of reservoirs, droughts affecting the Delaware River Basin would have little consequences on the city's drinking water. Droughts could affect the city when they occur in areas that supply headwaters to the basins of the Delaware and Schuylkill Rivers. Rainfall inside the City has little effect on the City's drinking water supply since ground water is not a water supply factor.

Structural Vulnerability

Philadelphia is underlain by soils with little to no clays with high shrink/swelling potential; therefore, there is a very low risk of structural damage associated with drought.

Drought Phases in Order of Severity
Drought Watch • Alerts government agencies, public water suppliers, water users and public of the potential for future drought-related problem. • Focuses on increased monitoring, awareness and preparation for response if conditions worsen. • Request for voluntary water conservation is made. Objective of Voluntary Water Conservation Measures: • 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: 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, • prevent the need to impose mandatory water use restrictions. Objective of Voluntary Water Conservation Measures: • Reduce overall water uses by 10-15 percent in the affected areas. • Due to varying conditions, individual water suppliers or municipalities may ask for more stringent conservation actions.

Drought Emergency:
Involves concerted management operations to marshal all available resources to:
• respond to actual emergency conditions
• avoid depletion of water sources
• assure at least minimum water supplies to protect public health and safety
• support essential and high priority water uses
• avoid unnecessary economic dislocations
Mandatory restrictions on non-essential water uses may be imposed if deemed necessary and if ordered by the Governor of Pennsylvania.
Objective of Water Use Restrictions (Mandatory or Voluntary) and Other Conservation Measures:
• Reduce consumptive water use in the affected area by 15 percent
• Reduce total use to the extent necessary to:
  • preserve public water system supplies
  • avoid or mitigate local or area shortages
  • assure equitable sharing of limited supplies

Local Water Rationing: • Not a drought phase • Local municipalities may, with approval of PA Emergency Management Council, implement local water rationing to share a rapidly dwindling or severely depleted water supply in designated water supply service areas. • Water rationing plans require specific limits on individual water consumption to achieve significant reductions in use.
Variances: 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.

Philadelphia Water Department Drought Emergency Restrictions
Throughout a drought emergency, it is illegal to:
• Use water to clean personal, leased or rented vehicles, trailers, and boats by any means other than by bucket;
• Use water to clean sidewalks, streets or gutters, unless determined to be necessary for public health and safety;
• Use water for ornamental purposes, like fountains, waterfalls, and reflecting pools;
• Water gardens, trees, shrubs, except between 5 p.m. and 9 a.m. and then only by a bucket, can, or hand-held hose equipped with an automatic shutoff nozzle;
• Water lawns at all, except newly seeded or sodded lawns, which may be watered between 5 p.m. and 9 a.m. by bucket, can, or hand-held hose equipped with an automatic shutoff nozzle; sprinklers are strictly prohibited;
• Fill residential swimming pools;
• Fill swimming pools serving at least 25 dwelling units such as hotels, motels, and apartment complexes, unless they have filtration equipment to allow for continued use and recycling of water over the swimming season;
• Fill swimming pools unless they are operated by health care facilities used in relation to patient care and rehabilitation;
• Serve water in restaurants, clubs or eating places, unless requested by an individual.

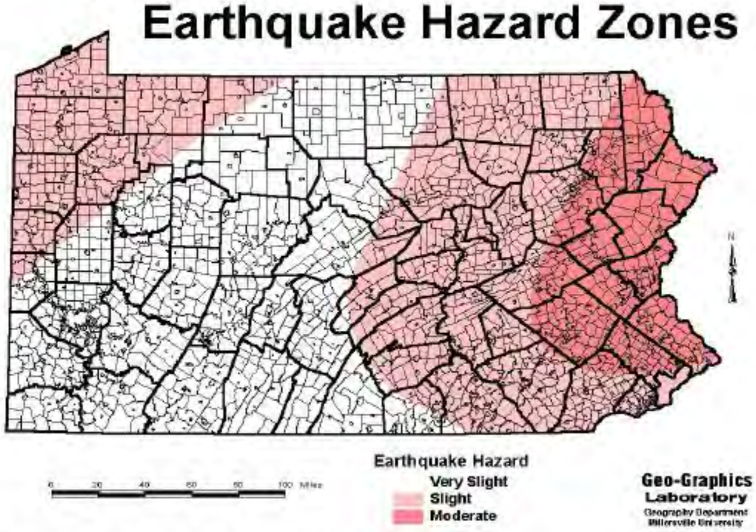
READY PHILADELPHIA Or Not?

Philadelphia Hazard Mitigation Plan

Natural Hazard Profile: Earthquakes

Philadelphia is located within the North American Plate, 2,000 miles west of plate boundary in the Atlantic Ocean. However due to zones of weakness within the plate, earthquakes are a possible hazard in Philadelphia.

Earthquake Hazard Zones



Range and Magnitude (Helpful Definitions)

- Magnitude- Measures energy released at source of earthquake.
- Intensity – Measures strength of shaking produced by earthquake at certain location.

Intensity and magnitude of an earthquake is measured through either the Richter Scale or the Modified Mercalli Scale.

Modified Mercalli Intensity (MMI) scale with associated impacts			
Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only seismographs	<4.2
II	Feeble	Some people feel it	<4.2
III	Slight	Felt by people resting; like a truck rumbling by	<4.2
IV	Moderate	Felt by people walking	<4.2
V	Slightly Strong	Sleepers awake; church bells ring	<4.8
VI	Strong	Trees sway; suspended objects swing; objects fall off shelves	<5.4
VII	Very Strong	Mild alarm, walls crack, plaster falls	<6.1
VIII	Destructive	Moving cars uncontrollable masonry fractures, poorly constructed building damaged	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open	<6.9
X	Disastrous	Ground cracks profusely, many building destroyed, liquefaction and landslides widespread	<7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed, general triggering of other hazards	<8.1
XII	Catastrophic	Total destruction, trees fall, ground rises and falls in waves	>8.1

Past Occurrences

- Thousands of earthquakes have occurred in Pennsylvania over past centuries.

[illegible]			
Magnitude	Probability	Magnitude	Probability
5.0	2.857%	6.4	0.342%
5.1	[illegible]	6.5	[illegible]
5.2	[illegible]	6.6	[illegible]
5.3	[illegible]	6.7	[illegible]
5.4	[illegible]	6.8	[illegible]
5.5	1.301%	6.9	[illegible]
5.6	[illegible]	7.0	[illegible]
5.7	[illegible]	7.1	[illegible]
5.8	[illegible]	7.2	[illegible]
5.9	0.725%	7.3	[illegible]
6.0	[illegible]	7.4	0.015%
6.1	0.545%	7.5	[illegible]
6.2	0.472%	7.6	[illegible]
6.3	[illegible]		

Future Occurrences

- Predictability of the next damaging earthquake is uncertain
- Probabilities of higher magnitude earthquakes near Philadelphia shown below.

Vulnerability Assessment

- Earthquakes are often underestimated
- Philadelphia could be affected by high magnitude earthquake causing
  - Significant financial losses
  - Causalities
  - Disruptions in critical facilities and services in City

Earthquake Impacts		
Economy	Environment	People
Damage/destruction of infrastructure	Induced tsunamis and flooding	Loss of life, livelihoods, property
Disruption of transportation systems	Landslides/Mudslides	Loss of housing
Disruption of communication systems	Poor water quality	Decrease in quality of life
Disruption of marketing systems	Damage to vegetation	Break down of social order
Loss of business	Breakage in sewage or toxic material containments	Disease
Loss of industrial output	Soil liquefaction	Lack of basic necessities
Higher insurance premiums	Increased fire hazard	Increased fire hazard
Increased fire hazard		Loss in aesthetic values
Loss to tourism industry		Increased poverty
Reduction of economic development		Population migrations

READY PHILADELPHIA Or Not?

Philadelphia Hazard Mitigation Plan

Natural Hazard Profile: Extreme Temperatures

Both extreme cold and heat have significant impact on human health and infrastructure.

Structural Vulnerability	
Winter Months	Frozen pipes can create service interruptions in water, drainage and gas supply.
Warm Months	Increased demand for electricity from air conditioners, fans, etc. stresses the infrastructure causing power outages.

Populations Most at Risk to Extreme Temperatures:

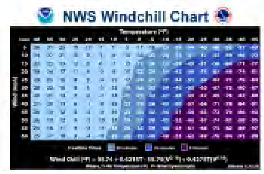
- Elderly, due to age, health conditions and limited mobility to access shelters (13% of population)
- Infants and children up to four years of age (6.6% of population)
- Those who are physically ill
- Those with pre-existing conditions (heart disease, respiratory problems, etc.)
- Low-income people who cannot afford proper heating and cooling (24% of population).
- General public who may overexert during work or exercise in extreme heat or experience hypothermia in extreme cold
- Homeless population – both Philadelphia's Heat and Winter Weather Emergency Plans include outreach to homeless.

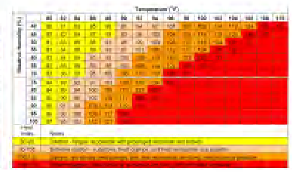
Heat Related Illnesses/Health Concerns

Health Concern	Description
Heat Stroke	Occurs when the body is unable to regulate its temperature. Body temperature may rise to 106 degrees F or higher within 10-15 minutes, which can cause death or permanent disability.
Heat Cramps	Muscle pains or spasms-usually in the abdomen, arms or legs, that may occur in association with strenuous activity.
Sunburn	Red skin, painful and abnormally warm after prolonged sun exposure.
Dehydration	Occurs when the level of water in the body has been reduced.
Heat Rash	Skin irritation caused by excessive sweating during hot, humid weather.

Extreme Cold Related Illnesses/Health Concerns

Illness/Health Concern	Description
Frostbite	Frostbite is the most common injury caused by exposure to cold. In cases of severe frostbite, large blisters appear on and beneath the skin. The affected area is hard, cold and without sensation.
Hypothermia	Hypothermia is the rapid and progressive physical and mental collapse that results from a loss of body heat. Hypothermia can occur in above freezing (32° F) temperatures, and symptoms include uncontrollable shivering, drowsiness or exhaustion, slurred speech, fumbling or staggering, and lack of concern for physical well-being.
Carbon Monoxide Poisoning	Carbon Monoxide gas is undetectable without a monitoring device. Sources include heating systems and any fuel burning appliance, such as poorly ventilated gas ranges and kerosene space heaters.
Exacerbation of Pre-Existing Respiratory Conditions	Cold air constricts soft tissue of the respiratory tract. Individuals with a history of respiratory ailments are particularly susceptible to a worsening of their conditions.
Drowning	Experts estimate half of all drowning victims actually perish from the effects of cold-water hypothermia.





Extreme Cold

Temperature falls below 32°F over a 24-hour period. In Philadelphia, extremely cold temperatures typically accompany a winter storm, often bringing snow and ice.

National Weather Service Wind Chill Products

Product	Description
Wind Chill Watch	Issued when there is a chance that wind temperatures will decrease to at least 20°F below zero during the next 24 to 48 hours
Wind Chill Advisory	Issued when the wind chill could be life threatening if action is not taken. The criteria expected wind chill readings of 10°F to 24°F degrees below zero.
Wind Chill Warning	Issued when wind chill readings are life threatening. Wind chill reading or 25°F below zero or lower are expected.

Extreme Heat

Temperatures hover 10 degrees or more above the average high and last for several week.

Heat Wave: period of at least three days with temperature of 90 degrees or higher.

National Weather Service Heat Products

Product	Criteria
Excessive Heat Outlook	An Excessive Heat Outlook is issued when the potential exists for an excessive heat event in the next 3-7 days.
Excessive Heat Watch	An Excessive Heat Watch is issued when conditions are favorable for an Excessive Heat Event in the next 12 to 48 hours.
Excessive Heat Warning/Advisory	Either of these may be issued when an Excessive Heat Event is expected in the next 36 hours: • Warning is used for conditions posing a threat to life or property. • Advisory is for less serious conditions that cause significant discomfort and if caution is not taken, could lead to a threat to life and/or property.

Past Occurrences

- 83 extreme temperature events (13 extreme cold, 70 extreme heat) in Philadelphia between 1994 and 2011

Hottest Philadelphia Summers by Longest Stretches of 90+ F Days

Dates	Length	Dates	Length
Jul 29- Aug 15, 1988	18 days	Jul 23- Aug 3, 1999	12 days
Jul 20- Aug 5, 1995	17 days	Jul 10- Jul 21, 1952	12 days
Aug 24- Sep 5, 1953	13 days	Jun 25- Jul 6, 1901	12 days

Coldest Days on Record in Philadelphia

Date	Low Temperature (°F)	Date	Low Temperature (°F)
Feb 9, 1934	-11	Jan 21, 1985	-6
Jan 17, 1982	-7	[illegible]	-5
Jan 22, 1984	-7	Dec 30, 1880	-5
Feb 10, 1899	-6	[illegible]	-5
Feb 11, 1899	-6	[illegible]	-5

Hottest Days on Record in Philadelphia

Date	High Temperature (°F)	Date	High Temperature (°F)
Aug 7, 1918	106	July 21, 1930	102
July 10, 1936	104	July 9, 1936	102
July 3, 1966	104	July 4, 1966	102
July 2, 1901	103	July 7, 2010	102
Aug 6, 1918	103		

Hottest Philadelphia Summers by Most 90+ F Days

Year	# of 90+ F days	Year	# of 90+ F days
2010	55	[illegible]	42
1991	53	[illegible]	41
1988	49	[illegible]	41
[illegible]	49		

READY PHILADELPHIA Or Not?

Philadelphia Hazard Mitigation Plan

Natural Hazard Profile: Flooding

A flood is a natural event for rivers and streams. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers, lakes, and oceans that are subject to recurring floods.

Vulnerability

Floods are the most prevalent type of natural disaster occurring in the Commonwealth of Pennsylvania. In Pennsylvania, floods cause over $1 billion worth of property damage annually.

Many neighborhoods in Philadelphia have 100-year flood zones designations. These are the most vulnerable buildings, businesses, and people at risk during a flood event.

Low lying and poor-drainage areas are also susceptible to flash flooding.

Individuals in transit may also be at risk during flash flooding or larger flood events.

The increase in the severity and frequency of flooding may be a result of planned or recent development within the floodplains of the various county streams.

Structural damage, especially to the roof and/or foundation,

National Weather Service Flood Categories	
Category	Description (for urbanized areas)
Minor Flooding	Rainfall rates of 0.5 inch per hour lasting more than one hour. Minimal or no property damage. Minimal risk to the public. Minimal or no property damage and possibly some public inconvenience
Moderate Flooding A Flood or Flash Flood Warning would be issued for this event.	Rainfall rates of at least 1.0 inches per hour lasting more than one hour. Impacts include inundation of structures, road closures, evacuations of people and/or the transfer of property to higher ground.
Major Flooding A Flood or Flash Flood Warning would be issued for this event.	Rainfall rates of at least 1.50 inches per hour lasting more than one hour. Impacts include extensive inundation of structures, road closures and a significant evacuation of people and/or transfer of property to higher ground.

from fast-moving water and long periods of standing water may occur after a flood.

Damage to electrical systems and natural gas lines are possible by flood waters.

Flash Flooding

- Occurs very quickly and with little warning.
- Produces rapid rises in water levels and has devastating flow velocities.
- Urban areas are susceptible to flash floods because a high percentage of the surface area is impervious.
- Likely to cause many problems such as sewer back-ups into residences.

Philadelphia has several areas designated flood prone.

- Delaware River
  - The Philadelphia Naval Base
  - Delaware Avenue underneath the Ben Franklin
  - Northeast Philadelphia, where Linden Avenue meets the Delaware River
- Schuylkill River
  - River Road and some Main Street areas in Manayunk
  - Areas along Kelly and Lincoln Drives
- Streams
  - County streams most prone to flooding include the Pennypack, Poquessing and Cobbs Creeks.
- Cobbs Creek along the western county border and the marsh lands in the southwest sector of the City are very prone to floods.

Philadelphia Disaster History 1972-2007			
Date	Type	Affected Area	Action
Aug/Sept 2011	Hurricane Irene/ Tropical Storm Lee	Statewide	Gubernatorial and Presidential – Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation
Sept/Oct 2010	Flooding	Philadelphia	N/A
June 2006	Proclamation of Emergency-Flooding	Philadelphia	Gubernatorial and Presidential – Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation
Sept 2005	Proclamation of Emergency-Katrina	Statewide	Gubernatorial
Sept 2003	Hurricane Isabel/Henri	Statewide	Gubernatorial and Presidential Declaration – Major Disaster
Sept 1999	Hurricane Floyd	Statewide	Gubernatorial and Presidential Declaration – Major Disaster
June 1998	Severe Storms/ Tornadoes	Philadelphia	Gubernatorial
Jan 1996	Flooding	Statewide	Gubernatorial and Presidential – Major Disaster for Individual Assistance, Public Assistance and Hazard Mitigation
July 1994	Flooding	Philadelphia	SBA – Physical Disaster and Economic Injury Disaster Loans
June 1972	Flood (Agnes)	Statewide	President's Declaration of Major Disaster – Governor's Proclamation
Sept 1971	Flood	Philadelphia	Governor's Proclamation & President's Declaration of Major Disaster
Sept 1955	Flood Diane	Northeastern Counties	President's Declaration of Major Disaster

Philadelphia River Flooding		
	Schuylkill River	Delaware River
Action Stage	10.0 ft	7.8 ft
Flood Stage	11.0 ft	8.2 ft
Moderate	13.0 ft	9.2 ft
Major Category	15.5 ft	10.2 ft
Record	17.0 ft (1869)	10.6 ft (1955)

READY PHILADELPHIA Or Not?

Philadelphia Hazard Mitigation Plan

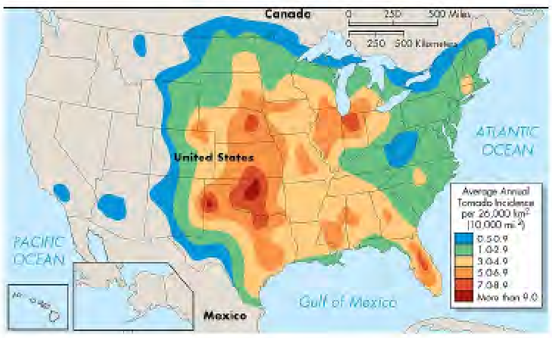
Natural Hazard Profile: Tornadoes

Tornadoes are a violently rotating column of air in contact with the ground, with wind speeds as high as 300mph.

Location

- Tornadoes can occur anywhere in Philadelphia
- United States is divided into 4 Zones.

Average Annual Tornado Incidence per 10,000mi² United States from 1950-2000



The Fujita Scale and Enhanced Fujita Scale

- Fujita Scale (F-Scale) – measurement for rating strength of tornado
  - Analyze tornado damage to determine wind speeds
- Enhanced Fujita Scale (EF- Scale) – More complex; ability to measure tornado severity with greater precision. Replaced F-Scale in 2007.

F-Scale and EF Scale (SPC, 2011)

F-Scale	Wind Estimate (mph)[1]	EF-Scale	Wind Estimate (mph)[1]	Typical Damage[2]
F0	40-72	EF0	65-85	Light damage. Some damage to chimneys. Branches broken off trees. Shallow-rooted trees pushed over; signboards damaged.
F1	73-112	EF1	86-110	Moderate damage. Peels surface off roofs. Mobile homes pushed off foundations or overturned. Moving autos blown off roads.
F2	113-157	EF2	111-135	Considerable damage. Roofs torn off frame houses. Mobile homes demolished. Boxcars overturned. Large trees snapped or uprooted. Light-object missiles generated. Cars lifted off ground.
F3	158-206	EF3	136-165	Severe damage. Roofs and some walls torn off well-constructed houses. Trains overturned. Most trees in forest uprooted. Heavy cars lifted off the ground and thrown.
F4	207-260	EF4	166-200	Devastating damage. Well-constructed houses leveled. Structures with weak foundations blown away some distance. Cars thrown and large missiles generated.
F5	261-318	EF5	Over 200	Incredible damage. Strong frame houses leveled off foundations and swept away. Automobile-sized missiles fly through the air in excess of 100 meters (109 yards). Trees debarked.

[1] Wind speeds are the maximum estimated for a 3-second gust
[2] Accurate placement on this scale involves expert assessment of the degree of damage to 28 indicators including homes, buildings, towers, poles and trees.

The National Weather Service will issue Tornado-related notices when necessary.

National Weather Service Tornado Notices

Notice	Criteria
Tornado Watch	This notice is issued when conditions are favorable for the development of tornadoes. They are usually issued for duration of 4-8 hours. They normally are issued well in advance of the actual occurrence of severe weather. During watch, people should review tornado safety rules, be prepared to move to place of safety if threatening weather approaches.
Tornado Warning	This product is issued when tornado is indicated by the WSR-88D radar or sighted by spotters; therefore, people in affected area should seek safe shelter immediately. They can be issued without a Tornado Watch being already in effect. They are usually issued for duration of 30 minutes. The affected NWFO will follow periodically with Severe Weather Statements containing updated information on the tornado or when warning is no longer in effect.
Tornado Emergency	An exceedingly rare tornado warning issued when there is severe threat to human life/ catastrophic damage from imminent or ongoing tornado. This tornado warning is reserved for situations when reliable source confirms a tornado, or there is clear radar evidence of the existence of damaging tornado.

Past Occurrences

- 1950-2011, less than 8 tornadoes F2 or weaker occurred in Philadelphia

[illegible]

Date	Location	Description
[illegible]	Northeast Philadelphia	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	South Philadelphia	[illegible]
[illegible]	[illegible]	[illegible]

Future Occurrences

- Tornadoes are infrequent in Philadelphia, but can still occur
- Based on historic frequency over the past 61 years, an estimated 13 tornadoes will hit Philadelphia over the next 100 years

Vulnerability Assessment

- Tornadoes pose significant risk to life/ property
  - Injuries
  - Damage to homes/ buildings
  - Fallen trees/ debris
  - Disrupt transportation/ communication/ power

READY PHILADELPHIA Or Not?

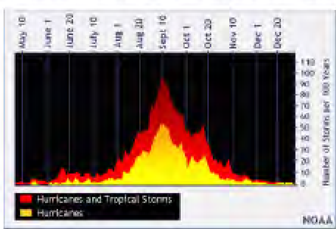
Philadelphia Hazard Mitigation Plan

Natural Hazard Profile: Tropical Cyclones

Tropical cyclones are classified as:

- ***Tropical Disturbance:*** A discrete tropical weather system of apparently organized convection - generally 100 to 300 nmi in diameter - originating in the tropics or subtropics, having a non-frontal migratory character, and maintaining its identity for 24 hours or more.
- ***Tropical Depression:*** A tropical cyclone in which the maximum sustained wind speed (using the U.S. 1 minute average standard) is up to 38 mph.
- ***Tropical Storm:*** A tropical cyclone in which the maximum sustained surface wind speed (using the U.S. 1 minute average standard) ranges from 39 mph to 73 mph.
- ***Hurricane:*** When winds in a tropical cyclone equal or exceed 74 mph. Hurricanes are further designated by categories on the Saffir-Simpson scale.

The official hurricane season for the Atlantic Basin (the Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico) is from June 1 to November 30, the peak of the season is from mid-August to late October.



Hurricanes are classified by their wind speed on a damage-potential scale.

Saffir-Simpson Hurricane Scale (NHC, 2011)

Category	Storm Surge	Winds	Damage	Damage Description
1	4.1 – 10.5 ft.	74-95 mph	Moderate	• Damage primarily to trees and unanchored homes • Some damage to poorly constructed signs • Coastal road flooding
2	12.0-18.8 ft.	96-110 mph	Moderate – Severe	• Some roofing material, door, and window damage to buildings • Considerable damage to shrubbery and trees • Flooding of low-lying areas
3	14.8-25 ft.	111-130 mph	Extensive	• Some structural damage to residences and utility buildings • Foliage blown off trees and large trees blown down • Structures close to the coast will have structural damage by floating debris
4	24.8-31.3 ft.	131-155 mph	Extreme	• Curtain wall failures with utilities and roof structures on residential buildings • Shrubs, trees, and signs all blown down • Extensive damage to doors and windows • Major damage to lower floors of structures near the shore
5	Not predicted	>155 mph	Catastrophic	• Complete roof failure on many residences and industrial buildings • Some complete building and utility failures • Severe, extensive window and door damage • Major damage to lower floors of all structures close to shore

With hurricanes come two primary hazards: high winds and flooding.

High Winds

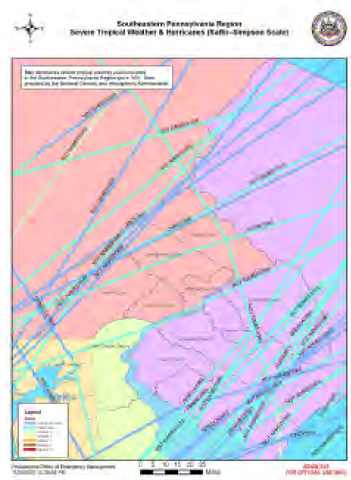
Can cause:

- Power outages
- Fallen objects (including trees, large branches, and debris)
- Disruptions to transportation corridors and equipment
- Loss of workplace access
- Significant property damage
- Injuries and loss of life, and
- The need to shelter and care for individuals impacted by these events.

Flooding

Heavy rains and flooding often occur with tropical cyclones.

Storm surge (water that is pushed toward the shore by the force of the winds swirling around the storm). This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more.



READY PHILADELPHIA Or Not?

Philadelphia Hazard Mitigation Plan

Natural Hazard Profile: Windstorms

Windstorms are winds strong enough to cause light damage to trees and buildings and may or may not be accompanied by rain.

Wind damage can be caused both by gusts (short burst of high-speed winds) or longer periods of sustained wind.

Location

- Windstorms can occur anywhere in Philadelphia
- United States is divided into 4 Zones.
- Zones based on frequency/ strength of extreme windstorms
  - Philadelphia falls in Zone II – Structures should withstand 3-sec 160mph winds

Types of Windstorms

- ***Downburst*** – Strong downdraft current of air from cumulonimbus cloud.
  - Often found with thunderstorms
  - Produce damaging winds at earth's surface over 2.5 miles
- ***Derecho*** – widespread/ fast-moving windstorm
  - Includes a family of downburst clusters
  - Typically associated with strong low-pressure system
  - Produce damaging winds over hundreds of miles
- ***Gustnado*** – small whirlwind, forms during thunderstorms.
  - Not a tornado

Range and Magnitude

- Wind moves from high pressure to low pressure areas
- Greater difference in pressure = higher wind speed

National Weather Service will issue Wind-related notices when necessary.

National Weather Service Wind Notices	
Notice	Criteria
High Wind	Sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.
High Wind Advisory	This product is issued by the NWS when high wind speeds may pose a hazard.
High Wind Watch	This product is issued by the NWS when there is the potential of high wind speeds developing that may pose a hazard or is life threatening.
High Wind Warning	This product is issued by the NWS when high wind speeds may pose a hazard or is life threatening. The criteria for this warning varies from state to state.
Extreme Wind Warning	Extreme Wind Warning (EWW) informs the public of the need to take immediate shelter in an interior portion of a well-built structure due to the onset of extreme winds within the hour.

Past Occurrences

- 1995-2011 - 49 events with wind speed greater than 34mph
- Windstorm damage includes:
  - Injuries
  - Damaged buildings/ vehicles
  - Downed trees/ power lines
  - Disrupted transportation/communication

Future Occurrences

- Windstorms are a highly probable hazard in the future
  - High wind events in Philadelphia at least once a year

Vulnerability Assessment

- Windstorms pose significant risk to life/ property in Philadelphia
  - Damage to homes/ buildings
  - Fallen trees/debris
  - Disruptions to transportation/communication/power

Structural Vulnerability

- Structures susceptible to windstorm damage include:
  - Tall buildings at greater risk of damage
  - Construction sites/ construction materials
  - Wood structures/ manufactured homes

Beaufort Wind Scale (SPC, 2011)				
Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects: On Water	Appearance of Wind Effects: On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft, taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-20 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (30-45 ft) waves, foam patches cover sea, visibility more reduced	Experienced on land, widespread damage
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	Violence and destruction

READY PHILADELPHIA Or Not?

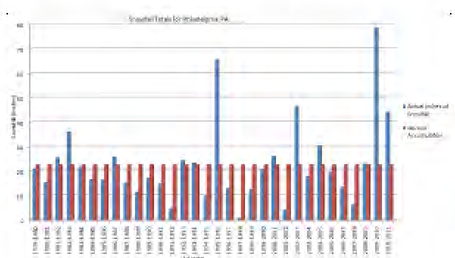
Philadelphia Hazard Mitigation Plan
Natural Hazard Profile: Winter Weather

Snowstorms and winter weather are frequent occurrences in Philadelphia.

Average snowfall is measured at the Philadelphia International Airport.

From 1970-2000 the average snowfall in Philadelphia was 19.3 inches.

Historically, seasonal totals range from just a trace during the 1972/1973 season to 78.7 inches during the 2009/2010 season.



Philadelphia's Biggest Snow Storms		
Rank	Date	Snow Total
1	Jan. 7-8, 1996	30.7"
2	Feb. 5-6, 2010	28.5"
3	Dec. 19-20, 2009	23.2"
4	Feb. 11-12, 1983	21.3"
5	Dec. 25-26, 1909	21.0"
6	April. 3-4, 1915	19.4"
7	Feb. 12-14, 1899	18.9"
8	Feb. 16-17, 2003	18.7"
9	Jan. 22-24, 1935	16.7"
10	Feb. 10-11, 2010	15.8"

A winter weather emergency involves one or more of the following hazardous conditions:

- Severe Cold
- Ice and/or Freezing Rain
- Snow
- Nor'easters
- Severe Freeze

Winter storms can:

- Damage communications systems
- Disrupt utilities services
- Collapse buildings
- Cause motor vehicle accidents
- Down trees
- Disrupt transportation
- Cause road closures
- Produce dangerous conditions for pedestrians
- Interrupt businesses
- Burst water and gas mains

Types of Snow Conditions	
Blizzard	Involves the following conditions: • Sustained 35 mph winds • Snowfall rates of two inches or more per hour • Reduced visibility of a quarter of a mile or less • [illegible] • The following conditions for a period of 3 hours or longer: • Sustained wind or frequent gusts to 35 miles per hour or more; • Considerable falling or blowing snow (i.e., reducing visibility frequently to ¼ mile or less.
Snow Squalls	Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant. Snow squalls are best known in the Great Lakes region.
Snow Showers	Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
Snow Flurries	Light snow falling for short durations. No accumulation or light dusting is all that is expected.

Ice storms can have a greater impact on Philadelphia than heavy snowfall because these storms are more likely to down overhead power lines, telephone service, cable lines, and lead to structural collapses.

Even smaller accumulations of ice on roadways can render them impassable and can affect rail beds and switches of the mass transit system.

People most at risk during winter weather conditions are individuals who spend time outdoors, such as laborers, the elderly, children, individuals in poor physical health, and those without adequate heat service.

Health and safety concerns for winter weather include frostbite, hypothermia, and Carbon Monoxide (CO) Poisoning.

The City of Philadelphia can make the following declarations related to winter weather events:

- ***Code Blue:*** OSH and OCC conduct outreach to homeless individuals.
- ***Code Grey:*** Allows for housing resources to those who would not normally qualify for emergency shelter.
- ***Citywide Snow Emergency:*** Vehicles are prohibited from parking on snow emergency routes and will be towed off Snow Emergency routes.

NWS Winter Storm Outlook	
Winter Storm Outlook	[illegible]
NWS Watches	
Blizzard Watch	[illegible]
Winter Storm Watch	[illegible]
Wind Chill Watch	[illegible]
NWS Advisories	
Winter Weather Advisory	[illegible]
Wind Chill Advisory	[illegible]
NWS Warnings	
Blizzard Warning	[illegible]
Heavy Snow Warning	[illegible]
Ice Storm Warning	[illegible]
Winter Storm Warning	[illegible]
Wind Chill Warning	[illegible]

Philadelphia Disaster History [illegible]			
Date	Type	Affected Area	Action
Feb 2010	Severe Winter Storm	Philadelphia	Gubernatorial and Presidential Declaration – Major Disaster
Feb 2003	Severe Winter Storm	Philadelphia	Gubernatorial and Presidential Declaration – Emergency
Jan 1996	Severe Winter Storms	Statewide	Gubernatorial and Presidential Declaration – Major Disaster (Public Assistance and Hazard Mitigation)
Jan 1994	Severe Winter Storm	Statewide	Gubernatorial and Presidential Declaration – Major Disaster
Mar 1993	Blizzard	Statewide	Gubernatorial and Presidential Declaration – Emergency
[illegible]	Blizzard	Statewide	Governor's Proclamation
[illegible]	Heavy Snow	Statewide	Governor's Proclamation

READY PHILADELPHIA Or Not?

Appendix G: Public Meeting Sign-in Sheets

This appendix documents the public's attendance at the five hazard mitigation public meetings. Sign-in sheets for the third public meeting, held at Mercy Eastwick Wellness Center in Southwest Philadelphia, and the final public meeting, held at Salvation Army Tabernacle Corps in the Kensington section, were not included. Both public meetings were not attended by the public.

Hazard Mitigation Plan
Public Meeting – Thursday, December 15, 2011, 5:30-7:30 p.m.
The Salvation Army Corps Community Center, 6730 Ridge Avenue, Phila. PA

Print Name First Name, Last Name	Address	Zip Code	Phone	Email
Marcella Cooper	6730 Ridge, 19128	19128	215 4825971	Marci.Cooper@salvationarmy.org (use work)
Kieran Kelly	159 Osborn St 19	19128	215-482-7174	KierKel1516@yahoo.com
Glenn Snyder	6723 Mitchell St.	19128	215 483-2468	ggsnyder@AOL.com

Hazard Mitigation Plan
Public Meeting – Saturday, January 7, 2012
Federation Housing, Rieder House, 10102 Jamison Avenue

Name	Address	Zip Code	Phone	Email
Khamphanh Sanouvong	608 Highland Ave Downingtown, PA	19335	610-269-4315	Ksanouvong@the Hickman.o
Andy ~~S~~ Choummanyvong	613 W. Moyamensing Ave Phila PA	19148	215-735-1495	achoummanyvong@yahoo.com
S. Savadh	1942 S. Hollywood	19145	(267) 287-0989	N/A
B. Phanthavong	1942 Hollywood St.	19145	267-844-9565	N/A
MS? redmur		19116		
L. Berardi	10102 Jamison	19116	215-4642792	—

Hazard Mitigation Plan
Public Meeting – Wednesday, February 8, 2012

	Name	Address	Zip Code	Phone	Email
1.	Willie J. Porter	940 S. Paxon St Phila	19143	267-323-9728	portwj_56@yahoo.com
2.	[illegible] Williams	[illegible]	19104	N/A	[illegible]
3.	William Frantz	2121 Walnut St	19103	267 561-2110	Wilifrantz @ yahoo.com
4.	Anthony McNeal	3155 Broad	19107	~~215~~ 215 821 5407	AW.DM @ g Mail.com
5.	Miles Davison	3702 Spruce	19104	215-840-5034	Miles.e.davison@gmail.com
6.	Jamal Bradley	1319 Myrtle	19146	267-207-5032	JamalBradley@[illegible]
7.	Allen dinier	2014 Belmont	19107		
8.	Andrea Blassingame	1635 Titan St Phila	19146	2154720915	anblassingame @ gmail.com
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					

Hazard Mitigation Plan
Public Meeting – Wednesday, February 8, 2012

Name	Address	Zip Code	Phone	Email
1. [illegible]		19126		CARGEO@JUNO.COM
2. Eric Hardaway	1001 [illegible] AVE	19126		Edhard1@VERIZON.NET
3. Holli [illegible]		19126	[illegible]	miss-holli@hotmail
4. George Xanthopoulos		19107		glxanthis@HOTMAIL.COM
5. Phil Weldon	311 S. 20TH	19103		PBweldon@gmail.com
6. Colleen Walsh		19081		cmw2783@gmail.com
7. Jen Nagel		19076		
8. Brian Pitts		19103		BAPST320 GMAIL.COM
9. Noel Medeiros		19103		n9llem@yahoo.com
10. Amelia Longo		19139		amelia.longo@gmail.com
11. Mika Smallwood	P.O. Box 31901 19104	19104		myraon-smallwood@yahoo.com
12. Anisa Smallwood	6315 066th	19151		anisasmallwood@yahoo.com
13. DonaldWEdwards	1212 Ludlow St	19107	(215)554-5786	[illegible]@yahoo.com
14.				
15.				
16.				
17.				

Appendix H: Planning Meeting Agendas

This appendix includes the meeting agendas for all the hazard mitigation planning meetings convened during the development of the Philadelphia Natural Hazard Mitigation Plan.

City of Philadelphia Natural Hazard Mitigation Plan		
Hazard Mitigation Committee Kick-Off Meeting		
Thursday, December 8, 2011 - FAB Auditorium 9:00 – 11:00 am		
Agenda Item/Issues	**Time Allotted**	**Notes/Actions**
1. Introductions	5 minutes	☐ Name ☐ Agency ☐ Title
2. Hazard Mitigation Overview	30 minutes	☐ PowerPoint Presentation ☐ Hazard Mitigation Plan packet materials
3. Discussion of Agency Roles and Expectations	10 minutes	☐ Determine agency point of contact ☐ Review updated matrix
4. Background of Profiles/ Feedback from Group	30 minutes	☐ Community Profile • Physical Environment • Social Environment • Built Environment ☐ Drought • Location • Range of Magnitude • Drought Phases • Assessing Drought Conditions • Past Occurrences • Future Occurrences • Vulnerability Assessment ☐ Earthquake • Location • Range of Magnitude • Past Occurrences • Future Occurrences • Vulnerability Assessment ☐ Extreme Temperatures • Description • Location • Range of Magnitude • Past Occurrences • Future Occurrences • Vulnerability Assessment
5. Risk Assessment	5 minutes	☐ Summary of Risk Factor Approach
6. Meeting Schedule	15 minutes	☐ Planning Meetings ☐ Community Meetings ☐ Joan – Participation in Community Meetings
7. Discuss next steps/ deadlines / and meeting timeline	15 minutes	MDO-OEM will: ☐ Review submission comments to profiles ☐ Email remaining profiles ☐ Email capability assessment criteria ☐ Update matrix and distribute to planning committee Hazard Mitigation Committee will: ☐ Review materials and submit comments on remaining profiles ☐ Develop a capability assessment for agency **Next meeting (Dec 22 2011)**
8. Questions or Comments	10 minutes	☐

City of Philadelphia Natural Hazard Mitigation Plan		
Hazard Mitigation Committee Meeting		
Tuesday, December 20, 2011 - FAB Auditorium 1:00 – 3:00 pm		
Agenda Item/Issues	**Time Allotted**	**Notes/Actions**
1. Introductions	5 minutes	☐ Name ☐ Agency ☐ Title
2. Background of Profiles/ Feedback from Group	45 minutes	☐ Flooding • Description • Location • Range of Magnitude • Past Occurrences • Future Occurrences • Vulnerability Assessment ☐ Tornadoes/Windstorms • Description • Location • Range of Magnitude • Drought Phases • Past Occurrences • Future Occurrences • Vulnerability Assessment ☐ Tropical Cyclones: Hurricanes, Tropical Storms • Description • Location • Range of Magnitude • Past Occurrences • Future Occurrences • Vulnerability Assessment
3. Capability Assessment	30 minutes	☐ Overview ☐ Feedback from Group
4. Risk Assessment	10 minutes	☐ Summary of Risk Factor Approach ☐ Email will be sent out
5. Meeting Schedule	15 minutes	☐ Planning Meetings ☐ Community Meetings • December 15, 2011
6. Discuss next steps/ deadlines / and meeting timeline	5 minutes	MDO-OEM will: ☐ Review planning committee's comments of profiles, capability assessment ☐ Email Risk Assessment and results Hazard Mitigation Committee will: ☐ Review materials and submit comments on remaining profiles ☐ Complete risk assessment matrix **Next meeting (Jan 5 2012)**
7. Questions or Comments	10 minutes	☐

City of Philadelphia Natural Hazard Mitigation Plan		
Hazard Mitigation Planning Committee Meeting		
Thursday, January 5, 2012 - FAB Auditorium 10:00am – 12:00pm		
Agenda Item/Issues	**Time Allotted**	**Notes/Actions**
1. Introductions	5 minutes	☐ Name ☐ Agency ☐ Title
2. Background of Profiles/ Feedback from Group	30 minutes	☐ Winter Storm • Description • Location • Range of Magnitude • Past Occurrences • Future Occurrences • Vulnerability Assessment
3. Risk Assessment	10 minutes	☐ Summary of Risk Factor Approach ☐ Improvements
4. Mitigation Strategies	45 minutes	☐ Mitigation Strategy Approach ☐ Goals and Objectives ☐ FEMA Mitigation Action Categories ☐ Mitigation Tables
5. Meeting Schedule	15 minutes	☐ Planning Meeting • February 2, 2012 ☐ Community Meetings • January 7, 2012
6. Discuss next steps/ deadlines / and meeting timeline	5 minutes	MDO-OEM will: ☐ Review planning committee's comments of profiles, capability assessment ☐ Meet with agencies regarding Mitigation Strategies Hazard Mitigation Committee will: ☐ Review materials and submit comments on hazard profiles ☐ Complete Mitigation Strategies Table and submit by January 26, 2012 **Next meeting (February 5 2012)**
7. Questions or Comments	10 minutes	☐

City of Philadelphia Natural Hazard Mitigation Plan		
Hazard Mitigation Planning Committee Meeting		
Thursday, February 2, 2012 – EOC Lower Level 10:00am – 11:30am		
Agenda Item/Issues	**Time Allotted**	**Notes/Actions**
1. Introductions	5 minutes	☐ Name ☐ Agency ☐ Title
2. Risk Assessment	15 minutes	☐ Overview of Ranking Matrix
3. Mitigation Strategies	30 minutes	☐ Mitigation Matrix • Existing and Potential • Trouble • Improvements • Approved by Agency ☐ Potential Mitigation Prioritization • PASTEEL
4. Hazard Mitigation Plan Timeline	15 minutes	☐ Draft Completed for Planning Committee – Monday, February 13th ☐ Planning Committee Review – Thursday, February 16th ☐ Final Review by OEM – Friday, February 17th ☐ Submit to PEMA – Wednesday, February 29th ☐ Phase II of HMP – Natural and Man-made Hazard – April 2012
5. Meeting Schedule	10 minutes	☐ Planning Meeting • February 16, 2012 (conference call) ☐ Community Meetings • February 8, 2012 • February 16, 2012
6. Outstanding Items	5 minutes	☐ Mitigation Matrix ☐ Prioritization of Strategies ☐ Email regarding outstanding items
7. Discuss next steps/ deadlines / and meeting timeline	5 minutes	MDO-OEM will: ☐ Email outstanding items ☐ Finalize draft of HMP and email out to committee by February 13th Hazard Mitigation Committee will: ☐ Complete Mitigation Strategies Matrix and submit by no later Monday, February 6, 2012 ☐ Read over draft HMP and provide comments at February 16th meeting **Next meeting (February 16 2012)**
8. Questions or Comments	5 minutes	☐

<table>
<tr><th colspan="3">City of Philadelphia Natural Hazard Mitigation Plan</th></tr>
<tr><th colspan="3">Hazard Mitigation Planning Committee Meeting</th></tr>
<tr><th colspan="3">Thursday, February 16, 2012 – Conference Call 10:00am – 11:30am</th></tr>
<tr><th>Agenda Item/Issues</th><th>Time Allotted</th><th>Notes/Actions</th></tr>
<tr><td>1. Introductions</td><td>5 minutes</td><td>☐ Name
☐ Agency
☐ Title</td></tr>
<tr><td>2. Hazard Mitigation Plan Overview</td><td>60 minutes</td><td>☐ Section 1: Introduction
☐ Section 2: Community Profile
• Physical Environment
• Social Environment
• Built Environment
☐ Section 3: Planning Process
• Planning Process Summary
• Planning Committee
• Planning Meetings
• Public Meetings
☐ Section 4: Risk Assessment
• Hazard Identification
• Hazard Profiles
• Vulnerability Summary
☐ Section 5: Capability Assessment
☐ Section 6: Mitigation Strategy
• Introduction
• Goals and Objectives
• Identification
☐ Section 7: Plan Maintenance
• Summary
• Monitoring, Evaluation & Updating
• Incorporation into Other Planning Mechanisms
• Continued Public Involvement
☐ Section 8: Plan Adoption</td></tr>
<tr><td>3. Phase II Hazard Mitigation Plan</td><td>10 minutes</td><td>☐ Begin in April 2012
☐ Human-caused Hazards
☐ Additional Natural Hazards</td></tr>
<tr><td>4. Outstanding Items</td><td>5 minutes</td><td>☐ Mitigation Matrix
☐ Prioritization of Strategies</td></tr>
<tr><td>5. Discuss next steps/ deadlines</td><td>5 minutes</td><td>MDO-OEM will:
☐ Finalize HMP and send to PEMA by March 1, 2012
Hazard Mitigation Committee will:
☐ Provide feedback by February 22, 2012</td></tr>
<tr><td>6. Questions or Comments</td><td>5 minutes</td><td>☐</td></tr>
</table>

Appendix I: Planning Meeting Sign-in Sheets

This appendix documents the planning committee's attendance for the five hazard mitigation planning meetings convened during the development of the Philadelphia Natural Hazard Mitigation Plan.

Philadelphia Office of Emergency Management
December 8, 2011

Hazard Mitigation Kick-Off Meeting

Print Name	Agency	Email	Signature
CAITLIN KELLY	OEM	CAITLIN.KELLY@PHILA.GOV	Caitlin Kelly
John Glass	PHL Airport	john.glass@phl.org	[illegible]
STEVEN ALLES	PDPH	steve.alles@phila.gov	[illegible]
Robert Only	DRPA	RJONLY@drpa.org	[illegible]
Paula Brumbelow	PCPC	paula.brumbelow@phila.gov	[illegible]
Kevin Koch	SIS Dept	Kevin.Koch@phila.gov	[illegible]
Charles Dougherty	PPR	Charles.A.Dougherty@phila.gov	[illegible]
John M Power	SEPTA	jpower@septa.org	John Power
RODNEY STITH	PENNDOT	ROSTITH@PA.GOV	Rodney Stith
Jim Golembeski	PWD	jim.golembeski@phila.gov	[illegible]
Patrick Suddath	Natl. Park Service	patrick_suddath@nps.gov	[illegible]
Matt McCullough	FEMA	matthew.mccullough@dhs.gov	[illegible]
Stephen Gallagher	L&I	Stephen.Gallagher@phila	[illegible]
MARK Lee	PGW	MARK.LEE@PGWORKS.COM	Mark Lee
Patrick Davin	Veolia	pdavin@veoliaenergyna.com	Patrick Davin
Thomas O'Neil	Streets	thomas.oneil@phila.gov	Thomas O'Neil
Angelique O'Donnell	OIT	angelique.odonnell@phila.gov	A. O'Donnell
John Przybylowski	OEM		[illegible]

Philadelphia Office of Emergency Management
December 8, 2011

Hazard Mitigation Kick-Off Meeting

Print Name	Agency	Email	Signature
Richard Bossert	PFD- Ems	richard.bossert@phila.gov	
MICHAEL F. ROESHMAN	PFD-HMAU	MICHAEL.F.ROESHMAN@PHILA.GOV	
LT. Arthur D. Myers	PFD - HMAU	Arthur.Myers@Phila.Gov	

Philadelphia Office of Emergency Management
December 20, 2011

Hazard Mitigation Planning Meeting

Print Name	Agency	Email	Signature
CAITLIN KELLY	OEM	—	Caitlin Kelly
Patrick Davin	Veolia Energy	pdavin@veoliaenergyNA.com	Patrick Davin
Arthur Myers	PFD HMAU	Arthur.Myers@Phila.gov	[illegible]
Kevin Koch	Streets dept	Kevin.Koch@phila.gov	[illegible]
MARK Lee	PGW	MARK.Lee@PGWORKS.com	[illegible]
Mike Zaccagni	Street,	michael.zaccagni@phila.gov	[illegible]
RODNEY STITH	PENN-DOT	ROSTITH@PA.GOV	
Jim Golembeski	PWD	jim.golembeski@phila.gov	[illegible]
JOHN GLASS	PHL	—	CALLED-IN
CHIEF BOSSERT	PFD	—	CALLED-IN
APRIL GERUSO	OEM	—	ATTENDED

Philadelphia Office of Emergency Management
January 5, 2012

Hazard Mitigation Planning Meeting

Print Name	Agency	Email	Signature
John Glass	PHL	john.glass@phl.org	
Jim Mako	Parks & Rec	James.Mako@phila.gov	
Jim Golembeski	PWD	jim.golembeski@phila.gov	
Mark Lee	PGW	mark.lee@pgworks.com	
Lt. Arthur Myers	PFD HMAU	Arthur.Myers@Phila.Gov	
Rodney Stith	PennDOT	rostith@state	
Matt McCullough	FEMA	matthew.mccullough@fema.gov	
Angelique O'Donnell	OIT	angelique.odonnell@phila.gov	
Joan Przybylowicz	OEM	Joan.Przybylowicz@phila.gov	
Patrick Davin	Veolia Energy	pdavin@veoliaenergyna.com	
Thomas O'Neil	[illegible]	[illegible]	
Kevin Koch	Sts dept	Kevin.Koch@phila.gov	

Philadelphia Office of Emergency Management
February 2, 2012

Hazard Mitigation Planning Committee Meeting

Print Name	Agency	Email	Signature
CAITLIN KELLY	OEM	CAITLIN.KELLY@PHILA.GOV	Caitlin Kelly
John Glass	PHL Airport	john.glass@phl.org	[illegible]
Azelgue O'Donnell	OIT	azelgue.odonnell	[illegible]
Jim Golembeski	PWD	jim.golembeski@phila.gov	[illegible]
Steven Alles	PDPH	steve.alles@phila.gov	[illegible]
BENJAMIN White	"	BENJAMIN.WHITE@PHILA	[illegible]
Ed Vassallo	OEM	Edward.Vassallo@phila.gov	[illegible]
Richard Bossert	PFD/EMS	richard.bossert@phila.gov	[illegible]
Lt. Arthur MYERS	PFD / HMAU	Arthur.MYERS@Phila.gov	[illegible]
Matthew McCullough	FEMA	matthew.mccullough@dhs.gov	[illegible]
Thomas O'Farrell	STREETS	thomas.ofarrell@phila.gov	Thomas O'Farrell
James Mako	PARKS	JAMES.MAKO@PHILA.GOV	James Mako

Philadelphia Office of Emergency Management
February 16, 2012

Hazard Mitigation Planning Committee Meeting

Print Name	Agency	Email	Signature
Caitlin Kelly	OEM	------------------------------	Phone Conference
April Geruso	OEM	------------------------------	Phone Conference
Jim Golembeski	PWD	------------------------------	Phone Conference
Thomas O'Farrell	Streets	------------------------------	Phone Conference
James Mako	Parks	------------------------------	Phone Conference
Chief Richard Bossert	PFD	------------------------------	Phone Conference
Lt. Arthur Myers	PFD	------------------------------	Phone Conference
Benjamin Whitfield	PDPH	------------------------------	Phone Conference
John Glass	PHL	------------------------------	Phone Conference
Kelsey Walko	PEMA	------------------------------	Phone Conference
Matt McCullough	FEMA	------------------------------	Phone Conference

Appendix J: Natural Hazard Personal Preparedness

The City of Philadelphia encourages their residents to be prepared for any emergency. Based on the identification of the natural hazards mentioned throughout this HMP, MDO-OEM distributes the following guides to educate the public on minimizing the impact of these potential risks.

READY PHILADELPHIA Or Not?

Earthquake Safety

Earthquakes are **rare** in Philadelphia.
However, **tremors** do occasionally occur
Residents and businesses should **prepare now.**

During an Earthquake

If Indoors	If Outdoors
1. **DROP** to the ground. 2. Take **COVER** under a sturdy table or other piece of furniture. 3. **HOLD ON** until the shaking stops.	1. **STAY** outdoors. 2. **MOVE AWAY** from buildings, streetlights, and utility wires. 3. Once in the open, **STAY** there until the shaking stops.
If there is no table or desk near you: • **Cover** your face and head with your arms. • **Crouch** in an inside corner of the building.	**If you are in a moving vehicle:** • **Stop** as quickly as safety permits. • **Stay** in vehicle. • **Avoid stopping** near or under buildings, trees, overpasses, utility wires.
Do: • **Stay inside** until the shaking stops and it is safe to go outside. • **Stay away** from glass, windows, outside doors, walls, and anything that could fall, such as lighting fixtures or furniture. • **Be aware** that electricity may go out and sprinkler systems or fire alarms may turn on. **Warning! Do Not:** ⊘ **Exit** a building during the shaking. ⊘ **Use** the elevators. **Why Most Injuries Happen** Most injuries happen when people inside buildings try to move to a different location inside or try to leave the building.	**Where are the greatest dangers?** • Directly outside buildings; • At exits; • Alongside exterior walls. **Why Most Casualties Happen** Most earthquake-related casualties result from collapsing walls, flying glass, and falling objects. Ground movement during an earthquake is seldom the direct cause of death or injury. **Lessons Learned** Many of the 120 fatalities from the 1933 Long Beach Earthquake occurred when people ran outside of buildings only to be killed by falling debris from collapsing walls.

READY PHILADELPHIA Or Not?

After an Earthquake

- When the shaking stops, look around to **make sure it is safe to move.**
- **Listen for instructions** from building management or your supervisors. Building management will coordinate with officials to determine if evacuation is warranted.
- **Sheltering in place** (remaining in your building) is often the safest response to an emergency situation.
- If an **evacuation** is recommended, **proceed to your pre-designated Rallying Point**, if your High-Rise Office Building has one. A Rallying Point is typically a park or other public space nearby where further instruction will be given or where further evacuation steps will be taken.
- **Expect aftershocks.** These secondary shockwaves are often less violent than the main quake but may cause additional damage to weakened structures.
- **Look for and extinguish small fires.** Fire is the most common hazard after an earthquake.
- **Listen** to a battery-operated or wind up radio or television, **signup** for emergency text or email alerts from ReadyNotifyPA, **follow** Philadelphia Office of Emergency Management on its social networking sites for the latest emergency information.
- Telephone lines may be overloaded. **Use the telephone ONLY when there is an imminent threat to health and safety for emergency calls to 911.**

Prepare Now

FEMA

- Additional tips on earthquake safety: **http://www.ready.gov/earthquakes**

Philadelphia Office of Emergency Management

- Personal and Family Preparedness: **http://www.phila.gov/ready**
- Sign up for emergency text or email alerts from ReadyNotifyPA: **http://www.phila.gov/ready.** Click on the ReadyNotifyPA logo.
- Philadelphia's High-Rise Office Building Rallying Points: **http://oem.readyphiladelphia.org/highrise**

Slow the Flow

While water is everywhere around us, it's important to use it wisely, especially during the summer when there is a greater demand for more water.

To conserve water, follow these easy steps:

- Repair leaky toilets and faucets. Close your taps tightly.
- Install low-flow showerheads. They save thousands of gallons of water every year.
- Save two to four gallons of water by shutting off the faucet while shaving. Save one to two gallons by shutting off the faucet while brushing your teeth.
- Take short showers—a bath uses more water. If you must take baths, fill the tub only half way.
- Make sure your washing machines and dishwashers are full before you run them.

Hydrants Are for Fires, Not for Fun!

Play Safely

Cool off this summer the safe way. Take a swim at one of the city's public swimming pools or play in the spray at city spray grounds. Children also enjoy cooling off by using a garden hose and lawn sprinkler. For a list of public swimming pools or spray grounds, call 3-1-1.

Swim Healthy!

Swimming is not permitted in Philadelphia creeks. Sewers may overflow. During and right after it rains, polluted water may flow from sewer pipes into creeks. To protect your health, do not come in contact with rivers and streams during and right after it rains.

Hydrants are for Fires, Not for Fun!

Opening fire hydrants to cool off in the summer is never a good idea and it is illegal. Using the wrong tools can damage hydrants and they may not work when firefighters need to use them. It's important that fire hydrants are ready and in good working condition in the event of a fire to protect you and your neighbors.

An open hydrant wastes 1,000 gallons of water per minute and causes low-water pressure in homes, hospitals and businesses. So, remember that hydrants are for fires, not for fun!

READY NOTIFYPA *Find Out First!*

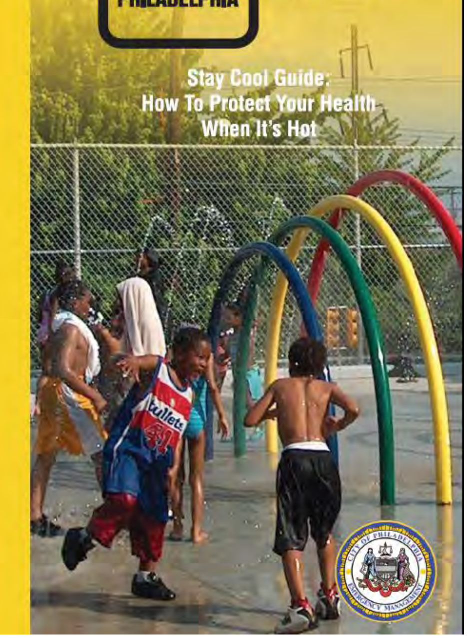
Sign up for ReadyNotifyPA

When situations arise in Southeastern Pennsylvania that may affect you and your family, **ReadyNotifyPA** lets local officials notify you quickly by E-mail, or text message to your cell phone or other E-mail enabled device. Be among the first to find out and stay informed during an emergency. For more information about what to do during an emergency and to sign up for **ReadyNotifyPA**, visit:

www.phila.gov/ready or call 3-1-1

Philadelphia Water Department

READY PHILADELPHIA™ *Or Not?*



Stay Cool Guide: How To Protect Your Health When It's Hot

How To Protect Your Health When It's Hot

Stay Healthy!

During summer months, hot weather can be hard to take. High heat can cause health problems, especially for seniors, pregnant women, infants, and children. You also need to be careful if you:

- Have chronic medical conditions, such as heart disease.
- Are overweight.
- Take certain prescription and non-prescription medications. Always check the label.
- Have had a previous heat-related illness.
- Have been drinking alcohol.
- Use IV drugs.
- Work in a high-heat environment.
- Engage in strenuous physical activity.

Be a Buddy!

Check elderly friends and neighbors when it is very hot. Also check those who have medical conditions. For more help, call the Philadelphia Corporation for Aging Senior Helpline at 215-765-9040.

Ozone and Your Health

When ground level ozone is high, an Ozone Advisory will be issued. Limit your outdoor activity. People with respiratory problems (such as asthma) should be very careful to avoid strenuous activity.

Tips To Stay Cool

- Drink plenty of water. Avoid alcohol and caffeine.
- Maintain a normal diet.
- Wear lightweight, light-colored, loose clothing.
- Wear a wide-brimmed hat or visor, or use an umbrella for shade.
- Wear sunscreen, SPF 15 or higher.
- Slow down. Rest in the shade or a cool place every chance you get.
- Stay out of the heat. Avoid working or playing in the hot sun or other hot areas from 10:00 a.m. to 2:00 p.m.
- Use air conditioners and fans. If you use a fan, make sure your windows are open to release trapped hot air.
- Visit a friend with air conditioning or go someplace cool like a mall, library, or senior center.
- Take a cool shower or bath.
- Read your medication labels. Some medications can cause an adverse reaction in hot weather. Talk to your doctor or pharmacist if you need more information.
- Never leave seniors, children, or pets alone in cars.

Heat-Related Illnesses

Heat Exhaustion is a type of heat-related illness. It can develop after several days of exposure to high temperatures or by not drinking enough fluids.

Warning Signs of Heat Exhaustion:

- Decreased energy
- Nausea
- Feeling faint
- Slight loss of appetite
- Light-headedness
- Tiredness
- Weakness
- Headache
- Muscle cramps

If you have any of these symptoms, go to a cool place, drink fluids, remove excess clothing, and rest. If symptoms get worse, seek medical attention.

Heat Stroke occurs when the body is not able to cool down. It is very serious and can cause death or long-term disability.

Warning Signs of Heat Stroke:

- Very high body temperature (above 103° F)
- Red, hot, and dry skin with no sweating
- Rapid heartbeat
- Throbbing headache
- Feeling dizzy
- Nausea
- Confusion
- Unconsciousness

People who have these symptoms should get **immediate medical attention.** In an emergency, dial 9-1-1. While waiting for help, move the person to a cool area, remove excess clothing, spray with water, and fan the person.

Stay Cool and Save Energy

When the weather gets very hot and humid, we often use more electricity to stay cool. Saving energy saves you money. It's good for the environment and it's easy.

- Clean or change your air conditioner filter at least once a month.
- Only use the air conditioner when you are home.
- Set your air conditioner's thermostat to no lower than 78° F.

Keep these items on hand in case of a power outage:

- Flashlights and extra batteries
- Blankets
- Battery-powered AM/FM radio and extra batteries
- Battery-powered or wind-up clock
- Cellular phone or non-cordless phone with a phone jack that does not need electricity to work.
- Drinking water and ice
- First-aid kit
- Styrofoam coolers
- Canned goods and powdered or boxed milk
- Manual can opener
- Digital quick-response thermometer

In the event of a power outage, do not open your refrigerator or freezer. Your refrigerator will keep foods cool for about four hours. Your freezer will keep foods frozen or safely cold for 24 to 48 hours. You can eat thawed food safely only if it is still "refrigerator cold," meaning it is below 41° F.

If the power outage is expected to last more than four hours, keep refrigerated milk, dairy products, meats, fish, poultry, eggs, gravy, stuffing and left-over food in a cooler packed and surrounded by ice to keep food longer. Use a cooler that will allow you to drain melting ice easily to prevent food from being in water from the melting ice.

When in doubt, throw it out. Discard any food that has an unusual odor, color or texture.

Thunderstorms
Lightning
Flash Flooding
Tornadoes

READY PHILADELPHIA™ Or Not?

An Emergency Preparedness Program for the Philadelphia Region

These can be very dangerous to you and your family.

Are you ready?

Weathering a Storm

If officials tell you to evacuate, grab your Go Bag and leave right away.
Secure lawn furniture or garbage cans that could blow away and cause damage or injury.
In extreme conditions, you may want to shut off power and appliance switches to prevent damage.

Wear the right clothes for the weather conditions.
Listen to KYW 1060 AM so you know what to expect.
Listen to radio broadcasts for detailed weather information from the National Weather Service available 24 hours a day.
Special weather radios are available at local retail stores.

In a Thunderstorm

- Don't touch metal, electrical equipment, telephones, bathtubs, water faucets or sinks.
- Be especially careful with televisions and computer equipment.
- If you are outside, take cover immediately, but DO NOT go near trees.

About Floods

- Not all floods are alike. Some can develop slowly during an extended period of rain, or in a warming trend following a heavy snow.
- Others, such as flash floods, can occur quickly, even without any visible sign of rain.
- Be prepared for flooding no matter where you live, particularly if you are in a low-lying area, near water or downstream from a dam. Even a very small stream or dry creek bed can overflow and create flooding.
- If a flood occurs, go to high ground.
- Never try to drive through deep water.
- If you need to evacuate, grab your Go Bag and leave right away.

Tornado Warnings

- Go to your basement or the lowest point of your home. If you can, go to an interior room or hallway without windows.
- If you cannot find shelter, take cover in a ditch or other deep area.

www.phila.gov/ready 1-877-READY-11

READY PHILADELPHIA™ Or Not?

An Emergency Preparedness Program for the Philadelphia Region

What to have in your Head, Home and Hand

What to have in your Head:

Talk with your family about how to handle emergencies. Be ready to **Shelter in Place** for at least 72 hours. Be ready to evacuate, if officials instruct you.

Decide on emergency meeting places – one close to your home and one outside your neighborhood.

Ask a friend or relative out of state to act as your family's emergency contact. If Philadelphia phone circuits are busy, long distance calls may be easier to make.

Plan for everyone – especially seniors, the disabled and non-English speakers.

Give everyone in your house a copy of your emergency plan and emergency contact information.

Twice a year check:

- Smoke alarm batteries
- Emergency plan and contact information
- Food and batteries in your emergency kits.

Sign Up for ReadyNotifyPA to receive emergency text or email alerts.

Visit ReadyNotifyPA.org or text **PHILA** to **411911**

What to have in your Home:

Put together **Shelter in Place** kit with enough supplies for three days. Include:

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- Non-perishable foods
- Manual can opener and eating utensils
- Plastic sheeting to cover windows; scissors and duct tape
- First-aid kit
- Flashlight and batteries
- Radio and batteries
- A whistle to signal for help
- Iodine tablets or one quart of unscented bleach and an eyedropper (If directed disinfect water by adding eights drops of bleach per gallon of water.)
- Personal/child care items
- Non-electric phone

To Shelter in Place:

- Stay clam and go indoors
- Go to a room with few doors or windows, above street level, access to water and bathroom, a phone jack
- Close and lock all doors, windows and fireplace dampers
- Only seal doors and windows went told to
- Turn off all heating and cooling systems
- Listen to KYW 1060 AM
- Keep your pets with you
- Call 9-1-1 for an emergency

What to have in your Hand:

Prepare a **Go Bag** for your household. Include:

- Copies of important documents
- Extra set of keys
- Credit and ATM cards
- Cash in small bills
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- Flashlight and batteries
- Radio and batteries
- Medication and copies of prescriptions
- First-aid kit
- Comfortable shoes, lightweight rain gear and a blanket
- Emergency contact and meeting place information
- Small regional map
- Personal/child care items

To Evacuate:

- Stay calm and follow official directions
- Secure your home
- Let friends and relatives know where you are going
- Wear study shoes, long pants and a long sleeve shirt.
- DO NOT use elevators
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www.phila.gov/ready 1-877-READY-11

Utilities

Disruption of Utility Services can range from an occasional inconvenience to a health-threatening emergency.

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Are you ready?

If you lose phone service:

Call your phone provider to report the outage.

You could lose phone service during a power outage if your phone requires an electrical outlet to work.

It is a good idea to have a standard cordless phone that does not rely on electricity, but just plugs into a phone jack.

Or, use your cell phone, or borrow one from a friend or neighbor if possible.

If you smell gas:

DO NOT smoke or light lighters or matches.

If the odor is very strong, do not use your phone or operate any light switches or electrical devises. Any spark could cause a fire.

Open windows.
Evacuate immediately.

Then, call: **9-1-1**.

If you have water problems:

Always have a three day supply of bottled water for each family member and pet in your house.

If you see water coming up from the ground or road, or suspect a water main break, call your local water company.

Be ready to provide the following information on the phone:

A description of the condition:

- What is being affected, such as your street or basement;
- The exact location of the problem; and
- Your name, address and telephone number.

If you have no or very low water pressure, call your local water company.

If there is a concern about drinking water quality, officials will tell you what actions to take.

In Philadelphia, call the Water Department: 215-685-6300

If there is a power outage:

Call your power provider immediately.

Disconnect or turn off all appliances that would go on automatically. If several appliances start up at once, they could overload the circuits.

To prevent food spoilage, keep refrigerator and freezer doors closed as much as possible.

- Stay indoors, if possible.
- Stay out of standing water.
- Stay away from downed power lines.
- Do not burn candles.
- Do not burn charcoal indoors.
- Do not use your kitchen gas range or stove for heat.
- Doing so may cause a fire or hazardous smoke.
- Do not use generators indoors. They can create a deadly carbon monoxide buildup.
- Keep a radio tuned to KYW 1060 AM for updates.

PECO Customer Service: 1-800-494-4000
PECO Emergency Hotline: 1-800-841-4141

www.phila.gov/ready

1-877-READY-11

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To Evacuate:

- Stay calm and follow official directions
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When the lights go out.

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Preparation is power.
Are you ready?

Severe storms or region-wide emergencies can, and do, happen. When outages occur, there are some important steps to take to keep your family safe until power is restored.

Prepare now:

- Keep a flashlight with extra batteries on each floor of your home.
- Have a battery-operated clock and radio.
- Store a supply of bottled water for each member of your household.
- Stock easy-to-prepare, non-perishable foods.
- Protect sensitive electronic appliances, like microwave ovens, televisions and computers, with a voltage surge suppressor.
- If someone has a medical condition, plans should be made for alternate sources of power or alternate accommodations in the event of an extended power outage.

Stay safe:

- Avoid using candles. If you do use candles, never leave them unattended.
- Take cover if necessary.
- If outside, be aware of trees and downed wires.
- Do not touch or try to move downed lines.
- Consider all downed lines as energized and extremely dangerous.
- Report any downed lines to PECO immediately.
- If you are in your vehicle and power lines fall on it, stay in your car until emergency personnel can assist you. The car can become energized.

If your home is flooded:

- Contact PECO immediately.
- Stay out of standing water.
- Don't attempt to re-ignite a pilot light.
- Leave the area and don't turn on lights or strike a match.

PECO Customer Service: 1-800-494-4000
PECO Emergency Hotline: 1-800-841-4141

If the lights go out:

- Call PECO as soon as possible. Turn off and unplug most appliances to prevent an electrical overload when power is restored.
- Keep a couple of lights on so you'll know when service is back on.
- Move meats, cheese, milk and other foods into the freezer compartment since it will stay colder longer. If the freezer is partially full, it can keep food frozen for up to 24 hours and up to 48 hours when full.
- Fill the freezer and refrigerator with bottles of water to take up space.
- Wrap the refrigerator and freezer in a blanket to keep them insulated and to preserve foods.

If you use dry ice:

- Dry ice, available at some retail stores, presents safety concerns. But, it can be used to preserve frozen foods for longer than 24 hours.
- Dry ice is a hazardous material and must be handled with care. It can cause severe burns.
- Food that touches dry ice can get freezer burns.
- Dry ice should not be used in a small cooler with food or medicines that are needed and could become frozen.
- PECO cannot supply dry ice during weather-related events.

If you use a generator:

- Use it safely and responsibly.
- Use the manufacturer's power cords.
- Do not connect a generator to your home's wiring.
- Don't overload a generator.
- Never operate a generator in an enclosed space.
- Turn off all connected equipment before shutting down a generator.

www.phila.gov/ready

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