THE CITY OF HOLYOKE

HAZARD MITIGATION PLAN Update 2015

DRAFT

Adopted by the Holyoke City Council on _____

Prepared by:
The Holyoke Hazard Mitigation Planning Committee

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The Pioneer Valley Planning Commission

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Introduction

The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) define Hazards Mitigation as any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards such as flooding, storms, high winds, hurricanes, wildfires, and earthquakes. Mitigation efforts undertaken by communities will help to minimize damages to buildings and infrastructure, such as water supplies, sewers, and utility transmission lines, distribution lines and generating facilities, as well as natural, cultural and historic resources.

Planning efforts, like this one undertaken by the City of Holyoke with technical assistance provided by the Pioneer Valley Planning Commission (PVPC), make mitigation a proactive process. Pre-disaster planning emphasizes actions that can be taken before a natural disaster occurs. Future property damage and loss of life can be reduced or prevented by a mitigation program that addresses the unique geography, demography, economy, and land use of a community within the context of each of the specific potential natural hazards that may threaten a community.

Preparing a Local Natural Hazards Mitigation Plan before a disaster occurs can save the community money and will facilitate post-disaster funding. Costly repairs or replacement of buildings and infrastructure, as well as the high cost of providing emergency services and rescue/recovery operations, can be avoided or significantly lessened if a community implements the mitigation measures detailed in the Plan. FEMA requires that a community adopt a Pre-Disaster Mitigation Plan as a condition for mitigation funding. For example, the Hazards Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Pre-Disaster Mitigation Program are all programs which require a community to have an approved Hazards Mitigation Plan before being eligible for funding.

Hazard Mitigation Workgroup

In 2015, the City of Holyoke completed a Hazard Mitigation Plan in collaboration with the Pioneer Valley Planning Commission. All portions of the plan were reviewed and updated as necessary. Planning for hazard mitigation in Holyoke involved a _____ member workgroup:

- ____
- ____
- ____
- ____
- ____

The hazard mitigation planning process for the City included the following tasks:

- Reviewing and incorporating existing plans and other information.
- Identifying the natural hazards that may impact the community.
- Conducting a Vulnerability/Risk Assessment to identify the infrastructure at the highest risk for being damaged by the identified natural hazards, particularly flooding.
- Identifying and assessing the policies, programs, and regulations the community is currently implementing to protect against future disaster damages.
- Identifying deficiencies in the current strategies and establishing goals for updating, revising or adopting new strategies.
- Adopting and implementing the final Hazard Mitigation Plan.

The key product of this process is the development of an Action Plan with a Prioritized Implementation Schedule.

Workgroup Meetings

Meetings of the Hazard Mitigation Planning Workgroup, were held on the dates and locations listed below. Agendas for each meeting are included in Appendix B. Meetings held in 2015 included a review of the entire Hazard Mitigation Plan and updates to the document. After the _____meeting, the plan was then submitted to MEMA for initial review. After MEMA reviewed the document and provided feedback, another set of meetings was held in _____ to further update and edit the Hazard Mitigation Plan to meet FEMA and MEMA requirements.

Workgroup Meeting Date	Location
August 17, 2015	Office of Planning & Economic Development
September 22, 2015	Fire Department Headquarters

Public Meetings

Monthly: Updates regarding the Hazard Mitigation Plan were provided to monthly LEPC meetings.

: The Hazard Mitigation Plan was posted on the Pioneer Valley Planning Commission's website for public comment.

: The final draft of the Hazard Mitigation was presented to the Conservation Commission for review and comment.

Public Meetings

November 6, 2012: The Mayor agreed to begin the process of updating the City's Local Hazard Mitigation Plan.

_____2015: The City Council adopted the Local Hazards Mitigation Plan. Hearing held at City Hall.

Agendas and sign-in sheets for each meeting can be found in Appendix B.

Participation by Public and Neighboring Communities

____ public planning sessions were held as part of the development of the Holyoke plan – on ____. Both meetings occurred after the Hazard Mitigation Workgroup had provided input on hazards and mitigation strategies relevant to the community. Notice of both public meetings was posted at Holyoke City Hall in compliance with the Commonwealth of Massachusetts' open meeting law. Public meeting agendas and notices can be found in Appendix B.

On _____ the Pioneer Valley Planning Commission sent a press release to all area media outlets to inform the public that a draft of the Holyoke Hazard Mitigation Plan had had been placed on PVPC's website. The release also indicated that hard copies were available at PVPC's offices and that all residents, businesses and other concerned parties of Holyoke and adjacent communities were encouraged to comment on the plan.

Citizens from adjacent municipalities were encouraged to comment on Holyoke's plan. The Pioneer Valley Planning Commission's regional scope ensured that residents and government officials throughout the Pioneer Valley saw the press release and request for comments.

The press release and a screen shot of PVPC's website showing the link to the press release can be found in Appendix B.

Public participation will be a critical component of the Hazard Mitigation Plan maintenance process. The Hazard Mitigation Workgroup will hold all meetings in accordance with Massachusetts open meeting laws.

City Council Meeting

In _____add date_____, 2015 the City Council agreed to begin the process of developing a Hazard Mitigation Plan. Once the plan was provisionally approved by FEMA, the City Council held a public hearing on the plan and adopted it.

Community Setting

Most of Holyoke's population is nestled between the Connecticut River and the Mount Tom/East Mountain range, midway from the Vermont and Connecticut state borders. West of the mountain is a small, mostly suburban part of Holyoke. The City is the third largest community in the Greater Springfield Metropolitan Statistical Area, after Springfield itself and Chicopee. Holyoke is on the west bank of the Connecticut River, with South Hadley and Chicopee across the river to the east and Easthampton, Southampton, Westfield, and West Springfield on the city's western boundary.

Holyoke is a densely populated city of 22.44 square miles (14, 367 acres). Most of its 39,880 residents live east of Mount Tom, in the historical urban, industrial, and commercial portion of the City. In contrast to the urban core, West Holyoke, located on the west side of East Mountain, is a sparsely populated, mostly rural/ agricultural section of the City.

Holyoke as an industrial city exists today because of the Connecticut River and the major falls in the river at the bend between Holyoke and South Hadley. In 1847 the falls were dammed to provide hydroelectric power and to divert water into a series of three canals on the Holyoke side. The owners of the dam and canals, the Hadley Falls Company, also planned and began construction of an entire small city surrounding the large brick mills lining the canals. The Dam, canals and hydroelectric facilities are now owned and operated by the City of Holyoke Gas & Electric Department. Today, railroads, mills, and flood control dikes continue to line almost the entire riverfront.

This slow settlement of the Holyoke area changed dramatically in the mid-1800s, with the building of the Hadley Falls dam in 1847 and the coming of the railroad in 1845. A consortium of Boston investors decided to take advantage of the 60-foot drop of the Connecticut River to provide water power for textile mills on the western (Holyoke) side of the river. Over the course of a few years, they bought a thousand acres of farmland, built a dam across the Connecticut, constructed three levels of canals, and established a series of large mills along the canals. Most importantly, they laid out the plan for Holyoke which still exists today--a grid system of streets parallel to the river and canals, places for parks and institutions such as churches and schools, and areas for industry, stores and residences.

With the industrial expansion came commercial development, centered around High and Maple Streets, and residential development spreading out from the city center west into the Highlands, Oakdale and Elmwood neighborhoods. These neighborhoods were single-, two-, and three-family homes, while the neighborhoods immediately adjacent to the mills and downtown (South Holyoke, the Flats, Churchill, and Prospect Heights) tended to have many tenements and multi-family apartment buildings.

Today, Holyoke strongly reflects its industrial history, with many of the mills and associated housing still standing in and near the downtown. The City still follows, in large part, the original plan

proposed by the builders of the dam. More recent development has filled in much of the area between the downtown and the mountains, leaving the city with a dense urban core and a less densely developed mountain range and western half of the city.

As of 2012, the total land area of Holyoke is approximately 14,367 acres with roughly 7,163, or approximately 50 percent, of those acres as developed land. Approximately 6,000 acres are in various forms of protection, and approximately 1,000 acres are currently undeveloped but considered "developable."[1]

Infrastructure

Holyoke's geography has been a major factor in the development of its infrastructure. The city's planned development concentrated development around the river; the primary source of power for the region's industries and, by extension, a natural location for housing for workers, and Mt. Tom provided a natural growth boundary to the west. This contributed to the dense network of gridded streets that characterize Holyoke.

Roads and Highways

Holyoke has several major highways crossing the city. Interstate 91, with three exits in Holyoke, stretches north-south east of the mountain and west of most of the urbanized portion of the City. State Highway Route 5 parallels I-91 a little to the east. Before I-91 was built, Route 5 was the major north-south road in the Connecticut River Valley. Interstate 391 starts in downtown Springfield, runs north through Chicopee, and ends in Holyoke at the south end of High Street. Just south of the Holyoke city line, the Massachusetts Turnpike, Interstate 90, runs east-west through West Springfield. The Holyoke Mall at Ingleside was built in part because of its advantageous location at the intersection of I-91 and the Mass Pike (I 90).

State Highway Route141 runs from Easthampton northwest of the city, over the Mount Tom/East Mountain range, to end in downtown Holyoke. State Highway Route 202 starts in Westfield and runs east though downtown to cross the Connecticut River on the Mueller Bridge into South Hadley. State Highway Route 116 crosses the river from South Hadley Falls to downtown Holyoke on the Vietnam Veterans Bridge, runs south a little ways through the industrial section of the city, and recrosses the river into Chicopee on the Willimansett Bridge.

The City of Holyoke maintains 130.46 miles of accepted municipal streets.

Bradley Airport, near Hartford, Connecticut, is the closest major airport, approximately 40 minutes south of Holyoke. The Barnes Municipal Airport in Westfield and Westover Air Force Base in Chicopee are closer, local airports, which do not serve large commercial carriers.

Rail Lines

[1] Statistics sourced from the *City of Holyoke Open Space and Recreation Plan* 2013-2018, page 17. Available at http://www.holyoke.org/wp-content/uploads/2012/10/reducedfinal2.pdf.

An active freight rail line runs along the Connecticut River from the southern border of Holyoke to the northern border with Northampton. There are also several spurs which service industry along the Canal System and from Westfield. The Boston and Main Railroad serves the industrial downtown with connections north to Northampton and northward, and south to Chicopee, Springfield, and southward. Holyoke industry is also serviced by the Pioneer Valley Railroad (PVRR). PVRR is a short line railroad running east - west serving industries, warehouse operations and transload facilities in Holyoke and Westfield.

Passenger rail returned to Holyoke in August 2015 with the recent opening of the Holyoke Passenger Rail Platform. The Amtrak Vermonter, which now has two daily stops in Holyoke, provides residents with local access to passenger rail. Holyoke is situated within the Sustainable Knowledge Corridor, a region of New England that includes the Hartford and Springfield metropolitan regions connected by Amtrak's New Haven Rail Line, which runs north-south from Connecticut to Vermont. The Vermonter operates daily between Washington and St. Albans, VT, with service to Philadelphia, New York, Hartford, CT, Springfield, MA and Essex Junction, VT, and other intermediate stops.

Public Transportation

The City of Holyoke is serviced by the Pioneer Valley Transport Authority (PVTA) which provides public transportation throughout the Pioneer Valley. The PVTA operates seven bus routes throughout Holyoke, with connections to Westfield, Easthampton, Northampton, South Hadley, Chicopee, West Springfield, and Springfield. The Holyoke Transportation Center opened in 2010 at the former site of the Holyoke Fire Department Headquarters at 206 Maple Street. The facility includes 7 bays for PVTA and Peter Plan bus service as well as a ticket counter and waiting area. The mixed use facility serves as the main transportation hub in the City with transit connections to the region, New England, and beyond.

Public Drinking Water Supply

The Holyoke Water Works operates and maintains the municipal water supply and distribution system for the city of Holyoke. The system includes four separate reservoirs and approximately 200 miles of distribution water mains, which supply five separate pressure zones within the city. The four reservoirs are the Tighe-Carmody Reservoir, McLean Reservoir, Ashley Reservoir and Whiting Street Reservoir. Presently, only the Tighe-Carmody Reservoir and McLean Reservoir supply the city with water and the other supplies are considered emergency/back-up reserve and not directly connected to the system. The five pressure zones are: High Service, Low Service, West Heights, West Holyoke and Reduced West Heights.

Holyoke's drinking water comes primarily from the Tighe-Carmody Reservoir in Southampton via a 6.6 mile concrete cylinder pipe constructed in 1997. The water supply is augmented with water from the McLean Reservoir, located in Holyoke, by means of a transfer pump station located in the watershed of the Ashley Reservoir. To date, Holyoke has maintained a waiver from filtration and all of the city water is treated at the Water Treatment Facility at 600 Westfield Road, also constructed in 1997 and adjacent to the McLean Reservoir. In order for Holyoke to maintain its filtration waiver and meet new State and Federal requirements, a new Ultraviolet Disinfection Facility is presently being constructed and expected to be online in 2015. Almost the entire city is supplied with municipal

water; fewer than 1% of city residents, mostly in the West Holyoke and Smith's Ferry areas, have private wells.

The Tighe-Carmody Reservoir, located in the City of Southampton, is the primary source of water for the City. The reservoir has a surface area of 365 acres, a storage capacity of 4.8 billion gallons, and a watershed area of 14.5 square miles. It has an estimated safe yield of 13 million gallons per day. The other three reservoirs are all located within the City limits. The McLean Reservoir, located west of the Ashley Watershed, has a storage capacity of 365 million gallons and a drainage area of 0.47 square miles. It has an estimated safe yield of 0.5 million gallons a day. The Ashley Reservoir has a storage capacity of 795 million gallons and a drainage area of 2.6 square miles. The Whiting Street Reservoir, located off Route 141, has a storage capacity of 479 million gallons and a drainage area of 1.67 square miles.

The Holyoke Water Works follows a strict Watershed Resource Protection Plan to maintain the waiver from filtration and to demonstrate the continuing effort to ensure a safe drinking water supply. This Plan is used to identify threats to the drinking water supply sources, protect the watersheds from identified threats and to develop a plan to protect water quality from future threats.

Sewer Service

Sewer service is provided for most of the urban part of Holyoke. Areas not serviced include West Holyoke and a small part of Smith's Ferry. A secondary wastewater treatment plant has allowed for an increase in industrial development in the Ingleside area as well as additional residential development in the Whiting Farms area. Currently there are no plans for expansion of sewer service in West Holyoke or Smith's Ferry. The City owns, operates and maintains the System, which consists of the Holyoke Wastewater Treatment Plant (the "Plant"), a wastewater collection system (the "Wastewater Collection System"), a storm water system (the "Storm Water System"), a combined sewer overflow system (the "CSOs"), and related facilities and programs. The Plant is located in the southern portion of Holyoke on Berkshire Street, adjacent to the Connecticut River, and provides primary and secondary treatment. The Plant was designed for an average daily flow of 17.5 million gallons per day ("mgd") and a peak flow of 37.0 mgd.

The Wastewater Collection System consists of approximately 117 miles of pipeline, of which approximately 66% is combined sewerage and storm water pipelines, a total of 14 permitted combined sewer overflows (the "CSOs"), four major interceptors, seven remote pumping stations and seven flood control pumping stations. The CSOs serve to prevent hydraulic overloading of the interceptor sewers, pumping stations and the Plant. 12 out of 14 CSOs discharge to the Connecticut River, one CSO discharges to the First Level Canal (and then the Connecticut River) and one to the Berkshire Street CSO abatement facility constructed in 2007. The Storm Water System consists of approximately 72 miles of separate storm water sewers and 139 stormwater outfalls.

Schools

The City of Holyoke operates ten public schools. There are seven elementary schools: Donahue, Kelly, Lawrence, McMahon, Morgan, Sullivan and E.N. White; one middle school, Peck School, and two high schools, Holyoke High and Dean Technical School. Holyoke Community College is also located in the City. Several private and charter schools are located in Holyoke.

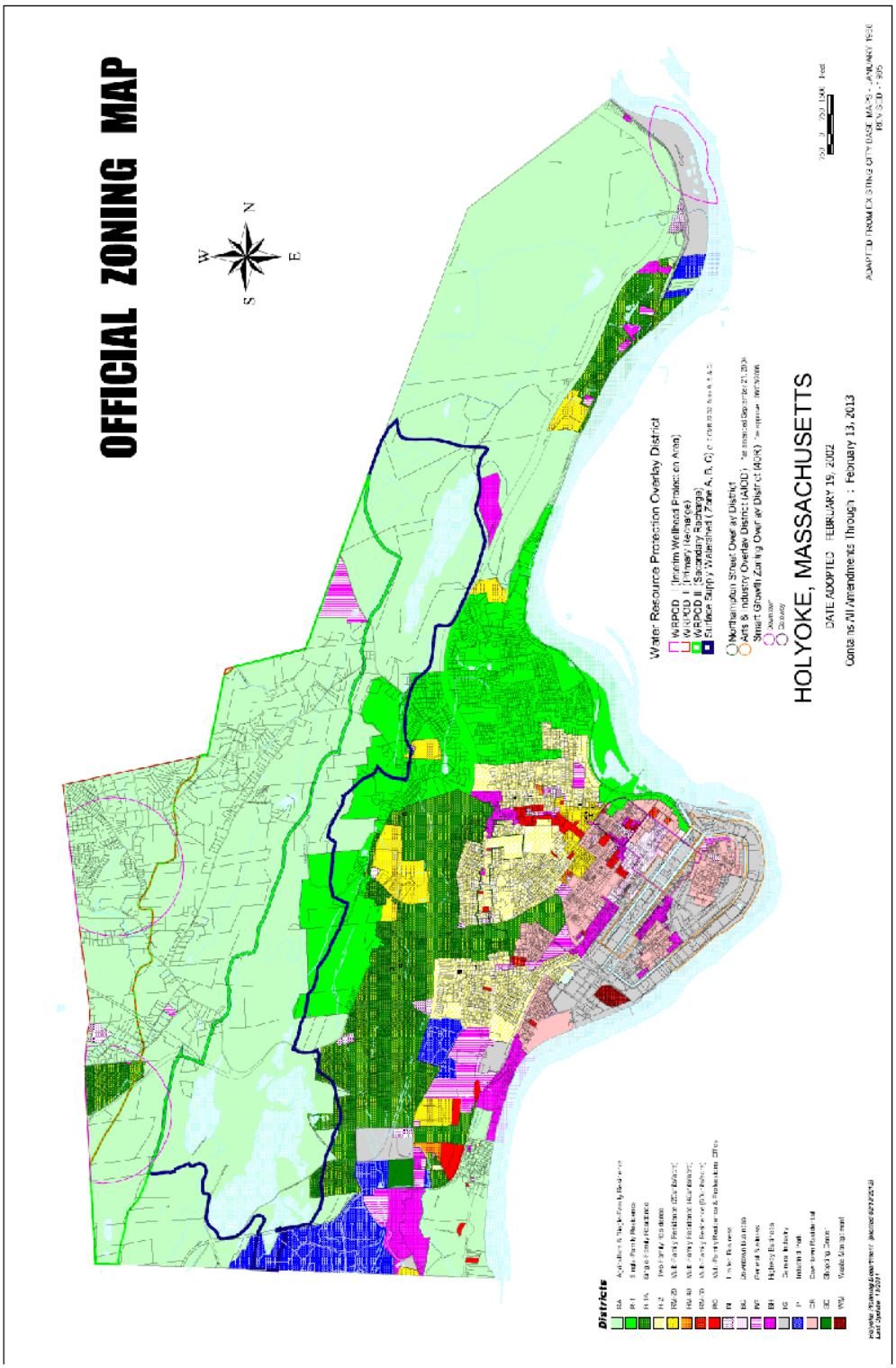
Zoning

West of the City center, zones consists mostly of single and multifamily districts with small pockets of commercial zoning along Northampton Street (Route 5), and neighborhood commercial areas districts throughout the City. Larger lots with residential zoning are located to the north of the City and to the west of the mountain range. These districts to the west have been restricted through zoning to protect the Barnes aquifer and require new lots to have at least 2 acres of minimum lot size and 200 feet of frontage. The City's retail and industrial park zoning is located in the southeast section of the City, just north of Interstate 91 and Interstate 90.

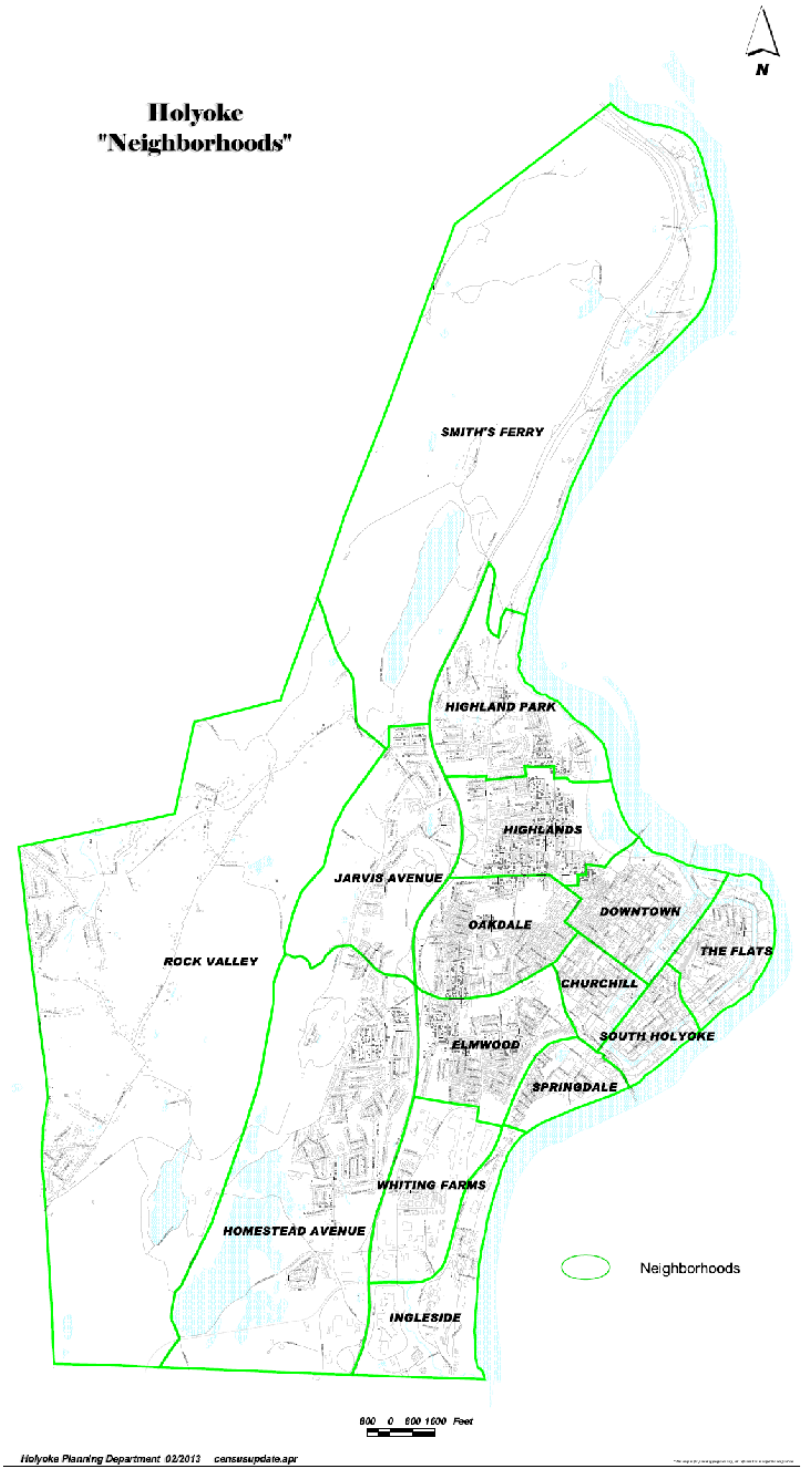
The City's industrial and manufacturing zones are located in the City's historical manufacturing district, along the banks of Holyoke's canal system and west of the Connecticut River. The City's densest residential zoning, which allows for the greatest height and the most relaxed parking regulations, can be found in Downtown in the vicinity Beech Street, North Bridge Street and Jackson Street.

The City has several special overlay districts established for the protection of natural resources and the promotion of economic development. In the western portion of the City, the Water Resource Protection Overlay District protects the Barnes Aquifer, while the Surface Water Protection Overlay District limits uses that would be detrimental to the City's surface water supplies. In the eastern portion of the City, in downtown, the Arts & Industry Overlay District, which roughly tracks those parcels that abut the historic canal system, is designed to promote the reuse and redevelopment of the City's mills, while the Smart Growth Zoning Overlay District is designed to take advantage of the City's transit nodes (PVTA's transportation center and the soon-to-be-constructed train platform) along Dwight Street and encourage mixed-use development.

The Floodplain Overlay District that has been established to prevent development in hazard-prone 100-year floodways. Taken together, Holyoke's zoning is designed to promote economic development and redevelopment in the City's existing commercial, residential and industrial districts while preserving fragile ecosystems and water resources.


OFFICIAL ZONING MAP
HOLYOKE, MASSACHUSETTS
DATE ADOPTED: FEBRUARY 19, 2002
Contains All Amendments Through : : February 13, 2013
Water Resource Protection Overlay District
Districts

Neighborhoods



Bridges

Due to its canal system and location near the Connecticut River, there are numerous bridges throughout the city that serve as critical infrastructure. There are 20 low-lying automobile and railroad bridges associated with the downtown canal system alone, and four bridges spanning the Connecticut that cross into Holyoke.

In a Climate Vulnerability Analysis[2] currently underway at the Pioneer Valley Planning Commission, the bridges spanning the Connecticut are identified as vulnerable to 100-year floods at 39-49' ("highest vulnerability").

Canals

There are three industrial canals (up to 8 miles total) in downtown Holyoke. They are maintained by Holyoke Gas & Electric and the City. Hydroelectric power is generated along the canals. The industrial canals run close to streets and existing buildings and are vulnerable to flooding should the gate house be breached.

Dams and Dikes

There are 13 dams located in Holyoke. Four of these are identified by the State Office of Dam Safety as presenting a Significant or High Hazard.

A flood control dike runs along the Connecticut River from just south of the I-391 Bridge to south of Springdale Park. Without the dike, much of the area behind the dike would be subject to periodic flooding.

Energy Infrastructure

Energy-related infrastructure is located throughout Holyoke that not only serves the City but is also critical to the region:

- Electric transmission lines over Water Street from Chicopee
- Three solar fields (Springdale Road and County Road)
- Water Street Substation
- Tannery Brook Substation
- Liquified Natural Gas storage (Mueller Road)
- Water Street server "farm"

[2] PVPC Climate Vulnerability Map (under development as of October 2015) is available at: http://pvpc.maps.arcgis.com/apps/Viewer/index.html?appid=1b548206b7664404b094719310ada273

- Computer Center (downtown)
- ISO New England Electric Control Center (near I-91; of regional importance)

Flood control barriers surround the substations and server farm on Water Street, replacing the previous stop-log structures that were more time-consuming to install in the event of a flood.

Natural Resources

The following is an excerpt from the *City of Holyoke Open Space and Recreation Plan* (2012), which describes the settlement patterns in Holyoke:

> The City of Holyoke's growth and development has been shaped by the regional environmental resources that it shares with surrounding communities. The Connecticut River provided the City with an abundant source of power to fuel its growth in the 19th and 20th Centuries. The gently sloping alluvial plains of the River provided land for factories and homes. East Mountain and Mount Tom provided both a scenic backdrop and a de facto urban growth boundary for the City, as the slopes and soils of these two mountains were not conducive to largescale commercial and residential development. Mount Tom, which the City shares with Easthampton, was once located in Easthampton and Northampton, but the land was transferred incorporated into Holyoke's municipal boundaries when the Mount Tom State Reservation was created in 1902.

Water Resources

Holyoke's plentiful water resources include numerous rivers and streams, extensive wetlands, and reservoirs. The abundance of water resources is also reflected in the reliable surplus of surface water for private and public water supplies and also in the number of mills that use the Connecticut River as a source of power. Holyoke has twelve miles of riverfront along the Connecticut River. Much of the riverfront in the downtown area once was densely developed by historic mill complexes and industrial buildings.

Holyoke has an extensive system of reservoirs, as listed in the next section. The City owns much of the watershed lands of these reservoirs and these areas are often used, unofficially, for walking, hiking, nature study, and other relatively benign activities. Officially, these watershed lands are closed to the public, to protect the quality of the drinking water. With the construction of the pipelines from the city-owned Tighe-Carmody Reservoir in Southampton, the Whiting Street Reservoir is scheduled to go off-line soon, but remain as a back-up water supply.

Classification of Water Bodies and Access Status

Table 1 lists all the major water bodies and waterways in Holyoke, their classification as to water quality, and their accessibility from the city.

Table1: Waterbodies and Waterways in Holyoke

Name	*Classification	Public Access
Connecticut River	B (does not meet the standards below the dam)	public access at Jones Ferry River Access Center; one private canoe club; many informal, illegal access points
Bray Brook	unclassified	access through Mt. Tom State Reservation
Lake Bray	unclassified	access through Mt. Tom State Reservation
Zenner Pond (also called Wright Pond)	unclassified	no public access
Mountain Park Reservoir	unclassified	public access from adjacent United States Fish and Wildlife land
Kennedy Brook	unclassified	no public access
Whiting Street Reservoir	A	no public access
Broad Brook	unclassified	access through Conn. River Watershed Council parcel off Mountain Rd. and through Conservation Commission parcel on Rock Valley Road
Tannery Brook	unclassified	access at Holyoke Community College
Ashley Reservoir (including O'Connor and Wright Reservoirs)	A	no public access
McLean Reservoir	A	no public access
Spies Pond	unclassified	no public access
Snake Pond	unclassified	no public access

Berkshire Street Pond	unclassified	no public access
Green Brook	unclassified	no public access

* Classification refers to the quality of the water, as determined by the state. "A" is very high quality, suitable for drinking water. "B" is water that is not drinking water quality, but is fishable and swimmable.

There are several other small, unnamed streams in the City, such as the one draining the Whiting Street Reservoir.

Wetlands

The City contains approximately 605.16 acres of bordering vegetated wetlands according to the October 2004 release from the Commonwealth of Massachusetts Department of Environmental Protection. There are 1,140 acres of surface water in the city. Combined, these two features make up 9% of the City's landform.

Beaver Dams and Ponds

Beaver activity has been increasing over the past decade. Several wetland areas have been flooded by beaver dam construction. As a result, their vegetation has changed from forested wetland to marshy habitat. Sometimes beaver activity is detrimental to property, causing problems for local land owners (e.g., flooding of wells, septic systems, lawns, out-buildings, and roadways). Affected individuals must contact the Board of Health and Conservation Commission for advice and permission to alleviate the beaver problem.

The City of Holyoke has worked with property owners to address beaver-related concerns at the O'Connell/Kelly Way area; in the area of Peoples Bank on Whitneys Avenue; and on Kelly Way near Broad Brook.

Holyoke Reservoirs

Holyoke's drinking water sources are located in the west of the city and in Southampton. The City's water supply comes exclusively from these sources, and the City's zoning ordinance was amended to limit development in these areas in 2002.

Aquifers

The Barnes Aquifer, a regionally significant source of municipal and private water, is located, in part, beneath Holyoke. While the city does not rely on this resource as a water supply point for its citizens, there are eleven municipal wells connected to the Barnes Aquifer. Some communities rely solely on the Barnes Aquifer for their water needs.

Floodways

Water levels in Holyoke's rivers, streams, and wetlands rise and fall seasonally and during high rainfall events. High water levels are typical in spring, due to snow melt and ground thaw. This is the period when flood hazards are normally expected. Low water levels occur in summer due to high evaporation and plant uptake (transpiration). At any time, heavy rainfall may create conditions that raise water levels in rivers and streams above bank full stage, which then overflow adjacent lands.

Floodways include the watercourses (rivers and streams) and adjacent relatively low-lying areas subject to periodic flooding (the 100-year flood zone and the area between the 100-year flood zone and the 500-year flood zone). These adjoining lands are flood hazard zones and they vary in their predicted flood frequency. The 100-year flood zone has a one in 100 statistical probability (or one percent chance) of being flooded in a single year or is predicted to be flooded one year out of a 100-year period; while the 500-year flood zone is based on a 500-year period. Most of the floodways in Holyoke are narrow, fewer than 400 feet wide, because the City's hilly topography and rocky terrain do not permit the formation of broad floodplains. Holyoke's floodways are corridors that pass flowing water downstream, eventually into the Connecticut River.

The National Flood Insurance Program has produced maps that identify floodways across America. These maps were updated in 2013 and resulted in new floodplain boundaries. The following areas have been designated as floodways in Holyoke:

- Connecticut River—Log Pond Cove and McNulty Park Area, Northern Town Boundary from Easthampton Line to the first sharp bend in the River, eastern sections of Main Street, portions of downtown between Riverside Park and the Willimanset Bridge;
- Tannery Brook along Homestead Avenue;
- Broad Brook—along portions of Rock Valley Road and Mountain Road
- Whiting Street Brook-south of the reservoir down to Old Bassett Road

A flood control system consisting of concrete flood walls and earthen dikes extends from the Holyoke Dam south along the Connecticut River to the south end of Springdale Park. Without the flood control system, much of the area behind these structures would be subject to periodic flooding. The flood control system is maintained by the City of Holyoke Department of Public Works in accordance with its Flood Control Plan.

Forests

Holyoke has approximately 7,163 (50% of the city) acres of forest along the Mt. Tom/East Mountain range and into West Holyoke. The forest is predominantly deciduous, typical of Western Massachusetts. The mountain range has been extensively logged, with the exception of the steepest slopes, and logging continues on large tracts of land. The forests are therefore secondary growth of varying heights.

3 – HAZARD IDENTIFICATION & RISK ASSESSMENT

The following section includes a summary of disasters that have affected or could affect Holyoke. Historical research, conversations with local officials and emergency management personnel, available hazard mapping and other weather-related databases were used to develop this list. Identified hazards are the following:

- Floods
- Severe snowstorms / ice storms
- Hurricanes
- Severe thunderstorms / wind / tornadoes
- Wildfires / brush fires
- Earthquakes
- Dam failure
- Drought
- Extreme Temperatures

Natural Hazard Analysis Methodology

This chapter examines all hazards identified by the Massachusetts State Hazard Mitigation Plan. The analysis is organized into the following sections: Hazard Description, Location, Extent, Previous Occurrences, Probability of Future Events, Impact, and Vulnerability. A description of each of these analysis categories is provided below.

Hazard Description

The natural hazards identified for Holyoke are: floods, severe snowstorms/ice storms, hurricanes, severe thunderstorms / wind / tornadoes, wildfire/brushfire, earthquakes, dam failure, drought, and extreme temperatures. Many of these hazards result in similar impacts to a community. For example, hurricanes, tornadoes and severe snowstorms may cause wind-related damage.

Location

Location refers to the geographic areas within the planning area that are affected by the hazard. Some hazards affect the entire planning area universally, while others apply to a specific portion, such as a floodplain or area that is susceptible to wild fires. Classifications are based on the area that would potentially be affected by the hazard, on the following scale:

Location of Occurrence, Percentage of City Impacted by Given Natural Hazard	
Location of Occurrence	Percentage of City Impacted
Large	More than 50% of the City affected

Medium	10 to 50% of the City affected
Small	Less than 10% of the City affected

Extent

Extent describes the strength or magnitude of a hazard. Where appropriate, extent is described using an established scientific scale or measurement system. Other descriptions of extent include water depth, wind speed, and duration.

Previous Occurrences

Previous hazard events that have occurred are described. Depending on the nature of the hazard, events listed may have occurred on a local, state-wide, or regional level.

Probability of Future Events

The likelihood of a future event for each natural hazard was classified according to the following scale:

Frequency of Occurrence and Annual Probability of Given Natural Hazard	
Frequency of Occurrence	Probability of Future Events
Very High	70-100% probability in the next year
High	40-70% probability in the next year
Moderate	10-40% probability in the next year
Low	1-10% probability in the next year
Very Low	Less than 1% probability in the next year

Impact

Impact refers to the effect that a hazard may have on the people and property in the community, based on the assessment of extent described above. Impacts are classified according to the following scale:

Extent of Impacts, Magnitude of Multiple Impacts of Given Natural Hazard	
Extent of Impacts	Magnitude of Multiple Impacts
Catastrophic	Multiple deaths and injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.

Critical	Multiple injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 week.
Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 day.
Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.

Vulnerability

Based on the above metrics, a hazard index rating was determined for each hazard. The hazard index ratings are based on a scale of 1 (highest risk) through 5 (lowest risk). The ranking is qualitative and is based, in part, on local knowledge of past experiences with each type of hazard. The size and impacts of a natural hazard can be unpredictable. However; many of the mitigation strategies currently in place and many of those proposed for implementation can be applied to the expected natural hazards, regardless of their unpredictability.

Hazard Identification and Analysis Worksheet for Holyoke

Type of Hazard	Location of Occurrence	Probability of Future Events	Impact	Vulnerability
Floods	Large	Moderate	Critical	1
Severe snowstorms / Ice storms	Large	High	Critical	3
Hurricanes	Large	Low	Limited/Critical	3
Severe thunderstorms / wind / tornadoes	Medium	High	Limited/Critical	3
Wildfires / brushfires	Medium	Low	Minor	3
Earthquakes	Large	Low	Critical	4
Dam Failures	Medium	Low	Minor/Critical	4
Drought	Large	Medium	Minor	5
Extreme Temperatures	Large	High	Critical	2

Source: Adapted from FEMA Local Hazard Mitigation Planning Handbook (March 2013) Worksheet 5.1; City of Holden Beach North Carolina Community-Based Hazard Mitigation Plan, July 15, 2003 and the Massachusetts Emergency Management Agency (MEMA).

Floods

Hazard Description

There are three major types of storms that can generate flooding in Holyoke:

- Continental storms are typically low-pressure systems that can be either slow or fast moving. These storms originate from the west and occur throughout the year.

- Coastal storms, also known as nor'easters, usually occur in late summer or early fall and originate from the south. The most severe coastal storms, hurricanes, occasionally reach Massachusetts and generate very large amounts of rainfall.

- Thunderstorms form on warm, humid summer days and cause locally significant rainfall, usually over the course of several hours. These storms can form quickly and are more difficult to predict than continental and coastal storms.

A floodplain is the relatively flat, lowland area adjacent to a river, lake or stream. Floodplains serve an important function, acting like large "sponges" to absorb and slowly release flood waters back to surface waters and groundwater. Over time, sediments that are deposited in floodplains develop into fertile, productive farmland like that found in the Connecticut River valley. In the past, floodplain areas were also often seen as prime locations for development. Industries were located on the banks of rivers for access to hydro-power. Residential and commercial development occurred in floodplains because of their scenic qualities and proximity to the water. Although periodic flooding of a floodplain area is a natural occurrence, past and current development and alteration of these areas will result in flooding that is a costly and frequent hazard.

Location

According to the recently updated (2013) FEMA FIRM Maps some areas of Holyoke are located within the 100 year floodplain and thus susceptible to general flooding. The 100-year floodplain covers about 8.6 percent, or approximately 1,682 acres of the City, including an estimated 18 acres of developed residential land. The update to the map resulted in an addition of 23 parcels and the removal of 246 parcels from the flood zone.

Outside of the 100-year floodplain, there are few areas of the city that experience chronic flooding due to flash floods:

- Green Brook- particularly at Green Lane and Longfellow Drive;
- Portions of the Great Lakes neighborhood
- Tannery Brook- between Meadowbrook Road and Whiting Estate on Homestead Avenue;
- unnamed stream at Mt. Tom Avenue at Wyckoff Country Club pond;
- land along the Connecticut River frontage in Smith's Ferry above the Holyoke Dam including areas of the Mt. Tom Power Plant;

- a wide strip along the Connecticut River east of Route 5 in the southeastern corners of the city;
- some stretches of Broad Brook in West Holyoke;
- Southampton Road, due to an undersized culvert.

There are a few roadways that are subject to flooding due to poor drainage during heavy rain storms and flash flooding events, including Fairmont Street, Skyview Street, West Franklin Street, and Cabot Street next to the First Level Canal. In addition, underpasses at Mosier, Cabot, Sargeant, Jackson, and Appleton Streets are known to flood after storm events.

The Holyoke Canal System and adjacent lands are also subject to flooding in the event of a catastrophic failure of the controls of the Canal System.

Extent

Floods can be classified as one of two types: flash floods and general floods.

- **Flash floods** are the product of heavy, localized precipitation in a short time period over a given location. Flash flooding events typically occur within minutes or hours after a period of heavy precipitation, after a dam or levee failure, or from a sudden release of water from an ice jam. Most often, flash flooding is the result of a slow-moving thunderstorm or the heavy rains from a hurricane. In rural areas, flash flooding often occurs when small streams spill over their banks. However, in urbanized areas, flash flooding is often the result of clogged storm drains (leaves and other debris) and the higher amount of impervious surface area (roadways, parking lots, roof tops).
- **General floods** may last for several days or weeks and are caused by precipitation over a longer time period in a particular river basin. Excessive precipitation within a watershed of a stream or river can result in flooding particularly when development in the floodplain has obstructed the natural flow of the water and/or decreased the natural ability of the ground-cover to absorb and retain surface water runoff (e.g., the loss of wetlands and the higher amounts of impervious surface area in urban areas).

The average annual precipitation for Holyoke and surrounding areas in western Massachusetts is 46 inches.

Previous Occurrences

The Hazard Mitigation Workgroup identified the locations listed under the “location” section as where previous occurrences of localized flash flooding have occurred.

In addition, during Tropical Storm Irene in 2011, stoplog structures needed to be added to ___.

Probability of Future Events

It is likely that Holyoke will experience three or four flash flooding events each calendar year. Newly developed areas of the City are less vulnerable to the effects of flash flooding because of the presence of modern storm water management systems.

Impact

According to the National Flood Insurance Program, there are 29 active policies within the Special Flood Hazard Area in Holyoke. Accordibg to the NFIP, these policies insure $8,451,600 of property. Utilizing median home value of $189,300, and an average household size of 2.56 people, an estimated 20 percent of damage to each structure in the 100-year flood plain would result in a total of $530,040 worth of damage and 36 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above analysis, Holyoke faces a high vulnerability from flooding.

Severe Snowstorms / Ice Storms

Hazard Description

Severe winter storms can pose a significant risk to property and human life. The rain, freezing rain, ice, snow, cold temperatures and wind associated with these storms can cause the following hazards:

- Disrupted power and phone service
- Unsafe roadways and increased traffic accidents
- Infrastructure and other property are also at risk from severe winter storms and the associated flooding that can occur following heavy snow melt.
- Tree damage and fallen branches that cause utility line damage and roadway blockages
- Damage to telecommunications structures
- Reduced ability of emergency officials to respond promptly to medical emergencies or fires.

Location

The entire City of Holyoke is susceptible to severe snowstorms. Because these storms occur regionally, they would impact the entire City.

Extent

The Northeast Snowfall Impact Scale (NESIS) developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (Kocin and Uccellini, 2004) characterizes and ranks high-impact Northeast snowstorms. These storms have large areas of 10-inch snowfall accumulations and greater. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus NESIS gives an indication of a storm's societal impacts.

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. The aerial 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 ten for extreme storms. The raw score is then converted into one of the five NESIS categories. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers.

Northeast Snowfall Impact Scale Categories		
Category	**NESIS Value**	**Description**
1	1—2.499	Notable
2	2.5—3.99	Significant

3	4—5.99	Major
4	6—9.99	Crippling
5	10.0+	Extreme

Source: http://www.ncdc.noaa.gov/snow-and-ice/rsi/nesis

Previous Occurrences

New England generally experiences at least one or two severe winter storms each year with varying degrees of severity. Severe winter storms typically occur during January and February; however, they can occur from late September through late April.

Based on data available from the National Oceanic and Atmospheric Administration, there are 47 winter storms since 1958 that have registered on the NESIS scale. Of these, approximately 26 storms resulted in snow falls in the Pioneer Valley of at least 10 inches. These storms are listed in the table on the next page, in order of their NESIS severity.

A particular storm of note was the October 2011 snowstorm, which resulted in significant damage to trees and power lines. Though accumulations were under 10 inches, damage was caused due to the weight of snow on trees still with full foliage.

Winter Storms Producing Over 10 inches of Snow in the Pioneer Valley, 1958-2015			
Date	**NESIS Value**	**NASIS Category**	**NESIS Classification**
1958-02-14	6.25	4	Crippling
1958-03-18	3.51	2	Significant
1960-03-02	8.77	4	Crippling
1960-12-11	4.53	3	Major
1961-01-18	4.04	3	Major
1961-02-02	7.06	4	Crippling
1964-01-11	6.91	4	Crippling
1966-01-29	5.93	3	Major
1966-12-23	3.81	2	Significant
1967-02-05	3.50	2	Significant

1969-02-08	3.51	2	Significant
1969-02-22	4.29	3	Major
1969-12-25	6.29	4	Crippling
1972-02-18	4.77	3	Major
1978-01-19	6.53	4	Crippling
1978-02-05	5.78	3	Major
1982-04-06	3.35	2	Significant
1983-02-10	6.25	4	Crippling
1987-01-21	5.40	3	Major
1993-03-12	13.20	5	Extreme
1994-02-08	5.39	3	Major
1995-02-02	1.43	1	Notable
1996-01-06	11.78	5	Extreme
1997-03-31	2.29	1	Notable
2000-01-24	2.52	2	Significant
2000-12-30	2.37	1	Notable
2003-02-15	7.50	4	Crippling
2005-01-21	6.80	4	Crippling
2006-02-12	4.10	3	Major
2007-02-12	5.63	3	Major
2007-03-15	2.54	2	Significant
2009-03-01	1.59	1	Notable
2010-02-23	5.46	3	Major
2010-12-24	4.92	3	Major
2011-01-09	5.31	3	Major
2011-01-26	2.17	1	Notable
2011-02-01	5.30	3	Major
2011-10-29	1.75	1	Notable
2013-02-07	4.35	3	Major
2013-03-04	3.05	2	Significant
2013-12-13	2.95	2	Significant
2013-12-30	3.31	2	Significant
2014-02-11	5.28	3	Major
2014-11-26	1.56	1	Notable
2014-12-09	1.49	1	Notable
2015-01-25	2.62	2	Significant
2015-01-29	5.42	3	Major
2015-02-08	1.32	1	Notable

Source: http://www.ncdc.noaa.gov/snow-and-ice/rsi/nesis

Probability of Future Events
Based upon the availability of records for Hampden County, the likelihood that a severe snow storm will hit Holyoke in any given year is greater than 50 percent.

Research on climate change indicates that there is great potential for stronger, more frequent storms as the global temperature increases. More information about the effect of Climate Change can be found in the Pioneer Valley Planning Commission's Climate Action Plan, available at www.sustainableknowledgecorridor.org.

The Massachusetts State Climate Change Adaptation Report has additional information about the impact of climate change and can be accessed at www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html.

Impact

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all residential property in City, $3,222,075,300 is used. An estimated 20 percent of damage would occur to 10 percent of structures, resulting in a total of $64,441,506 worth of damage. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability
Based on the above assessment, Holyoke faces a medium risk from severe snowstorms and ice storms.

Hurricanes

Hazard Description

Hurricanes are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. The primary damaging forces associated with these storms are high-level sustained winds and heavy precipitation. Hurricanes are violent rainstorms with strong winds that can reach speeds of up to 200 miles per hour and which generate large amounts of precipitation. Hurricanes generally occur between June and November and can result in flooding and wind damage to structures and above-ground utilities.

Location

Because of the hazard's regional nature, all of Holyoke is at risk from hurricanes. Ridge tops are more susceptible to wind damage.

Extent

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Hurricane Wind Scale, which rates hurricane wind intensity on a scale of 1 to 5, with 5 being the most intense.

Saffir-Simpson Scale	
Category	**Maximum Sustained Wind Speed (MPH)**
1	74–95
2	96–110
3	111–129
4	130–156
5	157 +

Source: National Hurricane Center, 2012

Previous Occurrences

Hurricanes that have affected the Pioneer Valley are shown in the following table.

Major Hurricanes in the Pioneer Valley		
Hurricane/Storm Name	**Year**	Saffir/Simpson Category (when reached MA)
Great Hurricane of 1938	1938	**3**
Great Atlantic Hurricane	1944	**1**
Carol	1954	**3**
Edna	1954	**1**
Diane	1955	**Tropical Storm**
Donna	1960	**Unclear, 1 or 2**
Groundhog Day Gale	1976	**Not Applicable**
Gloria	1985	**1**
Bob	1991	**2**
Floyd	1999	**Tropical Storm**
Irene	2011	**Tropical Storm**
Sandy	2012	**Super Storm**

Probability of Future Events

Holyoke's location in Western Massachusetts reduces the risk of extremely high winds that are associated with hurricanes, although it can experience some high wind events. Based upon past occurrences, it is reasonable to say that there is a low probability of hurricanes in Holyoke in any given year.

Impact

A description of the damages that could occur due to a hurricane is described by the Saffir-Simpson scale, as shown below.

Hurricane Damage Classifications			
Storm Category	**Damage Level**	**Description of Damages**	**Wind Speed (MPH)**
1	MINIMAL	No real damage to building structures.	74-95

		Damage primarily to un-anchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. An example of a Category 1 hurricane is Hurricane Dolly (2008).	
	Very dangerous winds will produce some damage		
2	MODERATE	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. An example of a Category 2 hurricane is Hurricane Francis in 2004.	96-110
	Extremely dangerous winds will cause extensive damage		
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtain wall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. An example of a Category 3 hurricane is Hurricane Ivan (2004).	111-129
	Devastating damage will occur		
4	EXTREME	More extensive curtain wall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. An example of a Category 4 hurricane is Hurricane Charley (2004).	130-156
	Catastrophic damage will occur		
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major	157+

		damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. An example of a Category 5 hurricane is Hurricane Andrew (1992).	
	Catastrophic damage will occur		

In the event of a tropical storm or hurricane, the greatest risk to Holyoke will be flooding of underpasses and in areas not protected by levees. Wind damage will be limited, but widely spread, perhaps including downed power and communications lines, but flooding damage will be more severe and focused on residential properties; the City's transportation infrastructure and evacuation routes could also be impacted, especially Route 5. Flooding of this and surrounding areas could result in difficulty moving populations out of harm's way.

For most hurricanes or severe wind events, the City has experienced small blocks of downed timber and uprooting of trees onto structures. Using a total a value of all structures in City of $3,222,075,300, wind damage of 5 percent with 10 percent of structures damaged would result in an estimated $16,110,377 of damage. Estimated flood damage to 10 percent of the structures with 20 percent damage to each structure would result in $64,441,506 of damage. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above analysis, Holyoke faces a medium-low risk from hurricanes.

Severe Thunderstorms / Wind / Tornadoes

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain, and sometimes hail. Effective January 5, 2010, the National Weather Service (NWS) modified the hail size criterion to classify a thunderstorm as 'severe' when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Wind is air in motion relative to surface of the earth. For non-tropical events over land, the NWS issues a Wind Advisory (sustained winds of 31 to 39 mph for at least 1 hour or any gusts 46 to 57 mph) or a High Wind Warning (sustained winds 40+ mph or any gusts 58+ mph). For non-tropical events over water, the NWS issues a small craft advisory (sustained winds 25-33 knots), a gale warning (sustained winds 34-47 knots), a storm warning (sustained winds 48 to 63 knots), or a hurricane force wind warning (sustained winds 64+ knots). For tropical systems, the NWS issues a tropical storm warning for any areas (inland or coastal) that are expecting sustained winds from 39 to 73 mph. A hurricane warning is issued for any areas (inland or coastal) that are expecting sustained winds of 74 mph. Effects from high winds can include downed trees and/or power lines and damage to roofs, windows, etc. High winds can cause scattered power outages. High winds are also a hazard for the boating, shipping, and aviation industry sectors.

Tornadoes are swirling columns of air that typically form in the spring and summer during severe thunderstorm events. In a relatively short period of time and with little or no advance warning, a tornado can attain rotational wind speeds in excess of 250 miles per hour and can cause severe devastation along a path that ranges from a few dozen yards to over a mile in width. The path of a tornado may be hard to predict because they can stall or change direction abruptly. Within Massachusetts, tornadoes have occurred most frequently in Worcester County and in communities west of Worcester, including communities in eastern Hampshire County. High wind speeds, hail, and debris generated by tornadoes can result in loss of life, downed trees and power lines, and damage to structures and other personal property (cars, etc.).

Location

As per the Massachusetts Hazard Mitigation Plan, the entire City is at risk of high winds, severe thunderstorms, and tornadoes.

Extent

An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. Southern New England typically experiences 10 to 15 days per year with severe thunderstorms. Thunderstorms can cause hail, wind, and flooding.

Tornadoes are measured using the enhanced F-Scale, shown with the following categories and corresponding descriptions of damage:

Enhanced Fujita Scale Levels and Descriptions of Damage			
EF-Scale Number	**Intensity Phrase**	**3-Second Gust (MPH)**	**Type of Damage Done**
EF0	Gale	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	Moderate	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	Significant	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	Severe	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	Devastating	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

Previous Occurrences

In western Massachusetts, the majority of sighted tornadoes have occurred in a swath east of Holyoke, known as "tornado alley." Sixteen incidents of tornado activity (all F2 or less) occurred in Hampden County between 1959 and 2014.

Because tornadoes rarely occur in this part of the country, assessing damages is difficult. Furthermore, buildings have not been built to Zone 2, Design Wind Speed Codes.

Severe thunderstorms are much more common. In 2013, a microburst blew down a large amount of trees on Mt. Tom. While most of the damage was within the City of Easthampton, the forest debris now serves as a potential source of fuel for wildfires that could impact Mt. Holyoke, including the telecommunications towers utilized by multiple emergency response units (such as state police) in the region.

Probability of Future Events

One measure of tornado activity is the tornado index value. It is calculated based on historical tornado events data using USA.com algorithms. It is an indicator of the tornado level in a region. A higher tornado index value means a higher chance of tornado events. Data was used for Hampden County to determine the Tornado Index Value as shown in the table below.

Tornado Index for Hampden County	
Hampden County	138.23
Massachusetts	87.60
United States	136.45

Source: USA.com
http://www.usa.com/hampden-county-ma-natural-disasters-extremes.htm

As per the Massachusetts Hazard Mitigation Plan, there are approximately 10 to 30 days of thunderstorm activity in the state each year.

Based upon the available historical record, as well as Holyoke's location in a high-density cluster of state-wide tornado activity, it is reasonable to estimate that there is a low frequency of tornado occurrence in Holyoke in any given year.

Impact

The potential for locally catastrophic damage is a factor in any tornado, severe thunderstorm, or wind event. Most buildings in the Holyoke have not been built to Zone 1, Design Wind Speed Codes. The first edition of the Massachusetts State Building Code went into effect on January 1, 1975, with most of the City's housing build before this date.

Using a total value of $3,222,075,300 of all residential units in Holyoke, and an estimated 10 percent of structures damaged each by 20 percent, yields a total damage of $64,441,506. This estimate does not include building contents, land values or damages to utilities.

Vulnerability

Based on the above assessment, Holyoke has a medium vulnerability to severe thunderstorms and wind and a low risk to tornadoes.

Wildfire / Brushfire

Hazard Description

Wildland fires are typically larger fires, involving full-sized trees as well as meadows and scrublands. Brushfires are uncontrolled fires that occur in meadows and scrublands, but do not involve full-sized trees. Both wildland fires and brushfires can consume homes, other buildings and/or agricultural resources. Typical causes of brushfires and wildfires are lightning strikes, human carelessness, and arson.

FEMA has classifications for 3 different classes of wildland fires:

- Surface fires – the most common type of wildland fire, surface fires burn slowly along the floor of a forest, killing or damaging trees.
- Ground fires burn on or below the forest floor and are usually started by lightening
- Crown fires move quickly by jumping along the tops of trees. A crown fire may spread rapidly, especially under windy conditions.

Location

Hampden County has approximately 273,000 acres of forested land, which accounts for 67 percent of total land area. Holyoke has approximately 7,000 (50% of the city) acres of forest along the Mt. Tom/East Mountain range and into West Holyoke. However, wildfire is unlikely to affect large areas of Holyoke east of Interstate 91 as most forest areas are fragmented. Large tracts of land west of Interstate Route 91 are heavily forested and more at risk for wildfires. Difficult access to remote areas due to topography and lack of roads are risks in this area. Brushfires frequently erupt along railroad tracks due to sparks from passing trains.

Extent

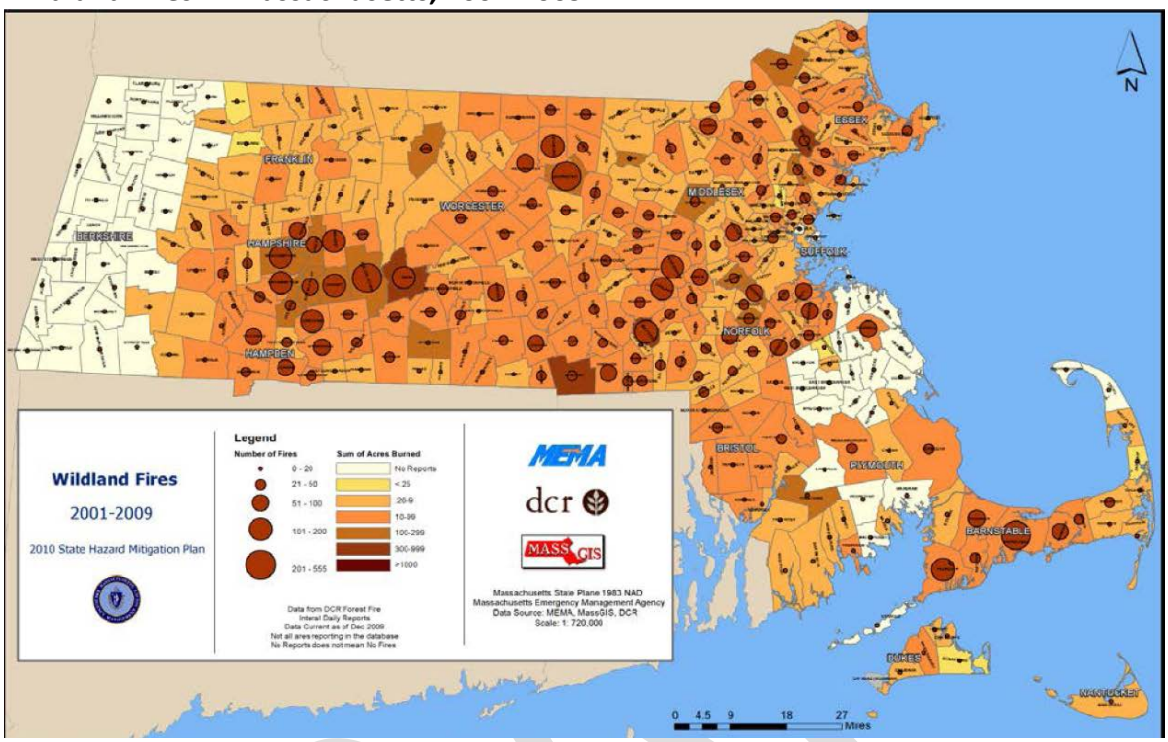
Wildfires can cause widespread damage to the areas that they affect. They can spread very rapidly, depending on local wind speeds and be very difficult to get under control. Fires can last for several hours up to several days.

Previous Occurrences

During the past 100 years, there have not been many wildfires occurring in the Pioneer Valley. However, several have occurred during the past 20 years, as shown in the list below:

- 1995 – Russell, 500 acres burned on Mt. Tekoa
- 2000 – South Hadley, 310 acres burned over 14 days in the Litihia Springs Watershed
- 2001 – Ware, 400 acres burned
- 2010 – Russell, 320 acres burned on Mt. Tekoa
- 2012 – Eastern Hampden County, dry conditions and wind gusts created a brush fire in Brimfield, and burned 50 acres

Wildland Fires in Massachusetts, 2001-2009



Source: Massachusetts Hazard Mitigation Plan

Probability of Future Events

In accordance with the Massachusetts Hazard Mitigation Plan, the City Hazard Mitigation Workgroup found it is difficult to predict the likelihood of wildfires in a probabilistic manner because the number of variables involved. However, given the proximity of previous wildfires, and their proximity to the City, the Hazard Mitigation Workgroup identified the likelihood of a future wildfire to be low. However, lightening and trains often result in annual fires that are quickly put under control, particularly at areas around Pleasant Street, Brown Avenue, and Mt. Tom.

Climate scenarios project summer temperature increases between 2ºC and 5ºC and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown.

Impact

Using a total value of $3,222,075,300 of all structures in Holyoke, and an estimated 1 percent of structures damaged each by 50 percent, an estimated damage due to wildfire is $16,110,377. This estimate does not include building contents, land values or damages to utilities.

Vulnerability

Based on the above assessment, Holyoke faces a medium vulnerability to wildfires.

Earthquakes

Hazard Description

An earthquake is a sudden, rapid shaking of the ground that is caused by the breaking and shifting of rock beneath the Earth's surface. Earthquakes can occur suddenly, without warning, at any time of the year. New England experiences an average of 30 to 40 earthquakes each year although most are not noticed by people.[3] Ground shaking from earthquakes can rupture gas mains and disrupt other utility service, damage buildings, bridges and roads, and trigger other hazardous events such as avalanches, flash floods (dam failure) and fires. Un-reinforced masonry buildings, buildings with foundations that rest on filled land or unconsolidated, unstable soil, and mobile homes not tied to their foundations are at risk during an earthquake.[4]

Location

Because of the regional nature of the hazard, the entire City is susceptible to earthquakes.

Extent

The magnitude of an earthquake is measured using the Richter Scale, which measures the energy of an earthquake by determining the size of the greatest vibrations recorded on the seismogram. On this scale, one step up in magnitude (from 5.0 to 6.0, for example) increases the energy more than 30 times. The intensity of an earthquake is measured using the Modified Mercalli Scale. This 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 denoting a earthquake that causes almost complete destruction.

Richter Scale Magnitudes and Effects	
Magnitude	Effects
< 3.5	Generally not felt, but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
5.4 - 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 up to about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers

[3] Northeast States Emergency Consortium Web site: *www.nesec.org/hazards/earthquakes.cfm.*

[4] Federal Emergency Management Agency Web site: *www.fema.gov/hazards/earthquakes/quake.shtm.*

	across.

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

Source: US Federal Emergency Management Agency

Previous Occurrences

The most recent earthquakes to affect New England are shown in the table below.

New England Earthquakes with a		

Magnitude of 4.2 or more, 1924 – 2012		
Location	**Date**	**Magnitude**
Ossipee, NH	December 20, 1940	5.5
Ossipee, NH	December 24, 1940	5.5
Dover-Foxcroft, ME	December 28, 1947	4.5
Kingston, RI	June 10, 1951	4.6
Portland, ME	April 26, 1957	4.7
Middlebury, VT	April 10, 1962	4.2
Near NH Quebec Border, NH	June 15, 1973	4.8
West of Laconia, NH	Jan. 19, 1982	4.5
Plattsburg, NY	April 20, 2002	5.1
Bar Harbor, NH	October 3, 2006	4.2
Hollis Center, ME	October 16, 2012	4.6

Source: Northeast States Emergency Consortium website, www.nesec.org/hazards/earthquakes.cfm

New England States Record of Historic Earthquakes		
State	**Years of Record**	**Number Of Earthquakes**
Connecticut	1668 - 2007	137
Maine	1766 - 2007	544
Massachusetts	1668 - 2007	355
New Hampshire	1638 - 2007	360
Rhode Island	1776 - 2007	38
Vermont	1843 - 2007	73
New York	1840 - 2007	755
Total Number of Earthquakes within the New England states between 1638 and 1989 is 2262.		

Source: Northeast States Emergency Consortium website, *www.nesec.org/hazards/earthquakes.cfm*

Probability of Future Events

One measure of earthquake activity is the Earthquake index value. It is calculated based on historical earthquake events data using USA.com algorithms. It is an indicator of the earthquake activity level in a region. A higher earthquake index value means a higher chance of earthquake events. Data was used for Hampden County to determine the Earthquake Index Value as shown in the table below.

Earthquake Index for Hampden County	
Hampden County	0.24
Massachusetts	0.70
United States	1.81

Based upon existing records, there is a low frequency of earthquakes in Holyoke with between a 1 percent and 2 percent chance of an earthquake occurring in any given year.

Impact

Massachusetts introduced earthquake design requirements into their building code in 1975 and improved building code for seismic reasons in the 1980s. The seismic standards have also been upgraded with the 1997 revision of the State Building Code. However, these specifications apply only to new buildings or to extensively-modified existing buildings. Holyoke has a considerable inventory of old buildings in the downtown area that have fallen into disrepair, leading to occasional building collapses. A significant earthquake would further destabilize these structures. Buildings, bridges, water supply lines, electrical power lines and facilities built before the 1980s may not have been designed to withstand the forces of an earthquake.

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all residential property in the City, $3,222,075,300 is used.

An estimated 100 percent of damage would occur to 20 percent of structures, resulting in a total of $644,415,060 worth of damage and 8,715 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above analysis, Holyoke faces a low risk from earthquakes.

Dam Failure

Hazard Description

Dams and their associated impoundments provide many benefits to a community, such as water supply, recreation, hydroelectric power generation, and flood control. However, they also pose a potential risk to lives and property. Dam failure is not a common occurrence, but dams do represent a potentially disastrous hazard. When a dam fails, the potential energy of the stored water behind the dam is released rapidly. Most dam failures occur when flood-waters above over top and erode the material components of the dam. Often dam breaches lead to catastrophic consequences as the water rushes in a torrent downstream flooding an area engineers refer to as an "inundation area." The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

Many dams in Massachusetts were built during the 19th Century without the benefit of modern engineering design and construction oversight. Dams of this age can fail because of structural problems due to age and/or lack of proper maintenance, as well as from structural damage caused by an earthquake or flooding.

The Massachusetts Department of Conservation and Recreation Office of Dam Safety is the agency responsible for regulating dams in the state (M.G.L. Chapter 253, Section 44 and the implementing regulations 302 CMR 10.00). To be regulated, these dams are in excess of 6 feet in height (regardless of storage capacity) and have more than 15 acre feet of storage capacity (regardless of height). Dam safety regulations enacted in 2005 transferred significant responsibilities for dams from the State of Massachusetts to dam owners, including the responsibility to conduct dam inspections.

Location

The Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Office of Dam Safety (a division of the Department of Conservation and Recreation) identifies 13 dams in Holyoke.

Status of Dams in Holyoke (as of Fall 2015)

Dam Name	Primary Owner	Hazard Potential	Most Recent Formal Phase I Inspection	Condition	Dam Purpose	EAP Status	Reg. Authority
Ashley Pond Dam	City of Holyoke, Water Works	Significant Hazard	10/30/2013	Satisfactory	Water Supply		Office of Dam Safety
Bobala Farm Rd. Dam	City of Holyoke, Office of the Mayor	N/A					Non-Jurisdictional
Clear Pond Dam	City of Holyoke, Water Works	Low Hazard	8/14/2009	Poor	earthen embankment		Office of Dam Safety
Clear Pond West Dike	City of Holyoke, Office of the Mayor	Low Hazard	8/14/2009	Poor	Previously water s		Office of Dam Safety
Holyoke Dam	FERC Regulated Dam, Contact FERC for up to date record information	Significant Hazard					FERC Jurisdiction
Lake	DCR -	Significa	6/2/2011	Fair	Recreation		Office of

Bray Dam	Dept. of Conservation & Recreation - MassParks	nt Hazard			al		Dam Safety
Mclean Reservoir Dam	City of Holyoke, Water Works	Significant Hazard	10/30/2013	Good	Water Supply		Office of Dam Safety
Neves (Bray) Dam	No Record for Privately Owned Non-Jurisdictional Dam	N/A					Non-Jurisdictional
Schaeffer Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam	N/A					Non-Jurisdictional
Whiting Street Reservoir Dam	City of Holyoke, Water Works	High Hazard	10/1/2014	Fair	Emergency water	Compliant Letter Sent	Office of Dam Safety
William Skinner Lower Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam	N/A					Non-Jurisdictional
William	No Record	N/A					Non-

Skinner Upper Pond Dam	for Privately Owned Non-Jurisdictional Dam						Jurisdictional
Zenner Pond Dam	No Record for Privately Owned Non-Jurisdictional Dam	N/A					Non-Jurisdictional

Source: Massachusetts Office of Dam Safety

Extent

Often dam breaches lead to catastrophic consequences as the water ultimately rushes in a torrent downstream flooding an area engineers refer to as an "inundation area." The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

Dams in Massachusetts are assessed according to their risk to life and property. The state has three hazard classifications for dams:

- *High Hazard*: Dams located where failure or improper operations will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways, or railroads.

- *Significant Hazard*: Dams located where failure or improper operation may cause loss of life and damage to homes, industrial or commercial facilities, secondary highways or railroads or cause interruption of use or service of relatively important facilities.

- *Low Hazard*: Dams located where failure or improper operation may cause minimal property damage to others. Loss of life is not expected.

Previous Occurrences

To date, there have been no dam failures in Holyoke.

Probability of Future Events

As Holyoke's high hazard dams age, and if maintenance is deferred, the likelihood of a dam failure will increase, but, currently the frequency of dam failures is very low with a less than one percent chance of a dam failing in any given year.

As described in the Massachusetts Hazard Mitigation Plan, dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hydrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams are already increases in stream flows from earlier releases from dams. Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Impact

A failure of Whiting Street Reservoir Dam, with a high hazard level, could result in an estimated 100 percent of damage to 20 percent of structures, resulting in a total of $644,415,060 worth of damage and 8,715 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Due to inspections and regular maintenance practices, Holyoke faces a very low risk from dam failure despite the number of dams in the city.

Drought

Hazard Description

Drought is a normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. In the most general sense, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. Reduced crop, range land, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of the direct impacts of drought. Of course, these impacts can have far-reaching effects throughout the region and even the country.

Location

Because of this hazard's regional nature, a drought would impact the entire City.

Extent

The severity of a drought would determine the scale of the event and would vary among City residents depending on whether the residents' water supply is derived from a private well or the public water system.

The U.S. Drought Monitor also records information on historical drought occurrence. Unfortunately, data could only be found at the state level. The U.S. Drought Monitor categorizes drought on a D0-D4 scale as shown below.

U.S. Drought Monitor		
Classification	**Category**	**Description**
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
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies

Source: US Drought Monitor, http://droughtmonitor.unl.edu/classify.htm

Previous Occurrences

In Massachusetts, six major droughts have occurred statewide since 1930.[5] They range in severity and length, from three to eight years. In many of these droughts, water-supply systems were found to be inadequate. Water was piped in to urban areas, and water-supply systems were modified to permit withdrawals at lower water levels. The following table indicates previous occurrences of drought since 2000, based on the US Drought Monitor:

Annual Drought Status	
Year	**Maximum Severity**
2000	No drought
2001	D2 conditions in 21% of the state
2002	D2 conditions in 99% of the state
2003	No drought
2004	D0 conditions in 44% of the state
2005	D1 conditions in 7% of the state
2006	D0 conditions in 98% of the state
2007	D1 conditions in 71% of the state
2008	D0 conditions in 57% of the state
2009	D0 conditions in 44% of the state
2010	D1 conditions in 27% of the state
2011	D0 conditions in 0.01% of the state
2012	D2 conditions in 51% of the state

Source: US Drought Monitor

Probability of Future Events

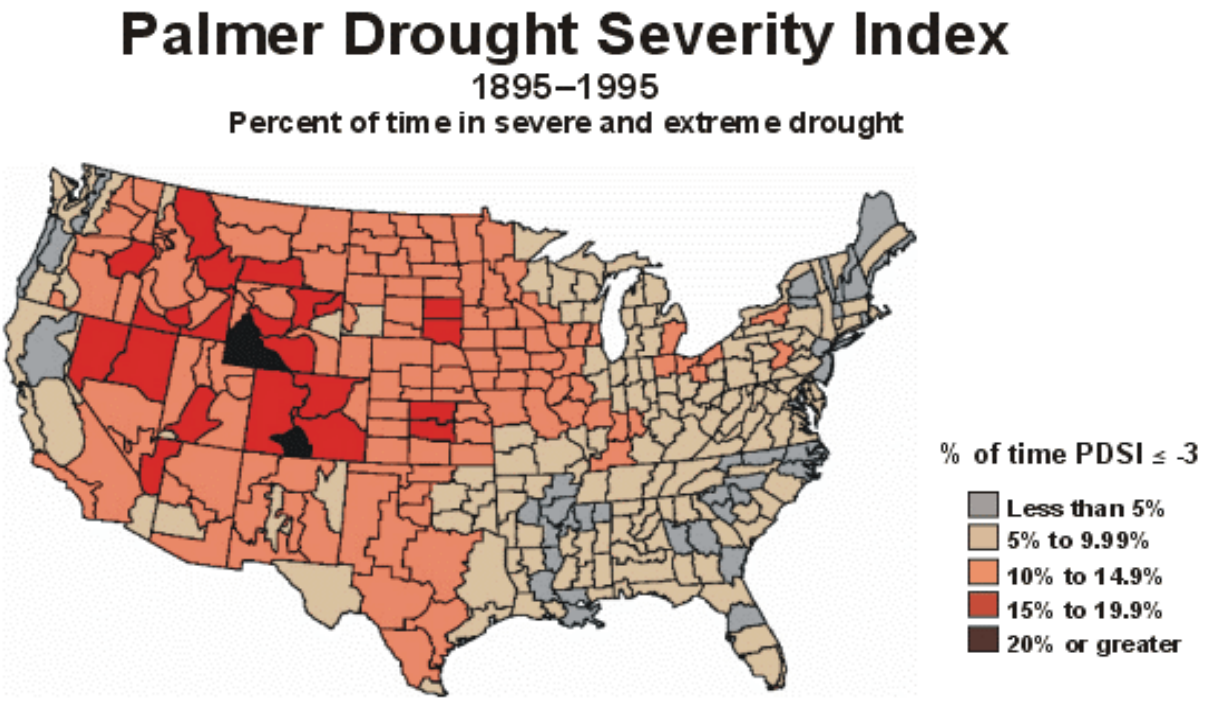
In Holyoke, as in the rest of the state, drought occurs at a rate of between 1 percent and 10 percent in a single given year.

Based on past events and current criteria outlined in the Massachusetts Drought Management Plan, it appears that western Massachusetts may be more vulnerable than eastern Massachusetts to severe drought conditions. However, many factors, such as water supply sources, population, economic factors (i.e., agriculture based economy), and infrastructure, may affect the severity and length of a drought event.

When evaluating the region's risk for drought on a national level, utilizing a measure called the Palmer Drought Severity Index, Massachusetts is historically in the lowest percentile for severity and risk of drought.[6] However, global warming and climate change may have an effect on drought risk in

[5] US Geological Survey Water-Supply Paper 2375. "National Water Summary 1989 – Floods and Droughts: Massachusetts." Prepared by S. William Wandle, Jr., US Geological Survey.
[6] National Drought Mitigation Center – http://drought.unl.edu

the region. With the projected temperature increases, some scientists think that the global hydrological cycle will also intensify. This would cause, among other effects, the potential for more severe, longer-lasting droughts.



1. Impact

Due to the water richness of Western Massachusetts, Holyoke is unlikely to be adversely affected by anything other than a major, extended drought. While such a drought would require water saving measures to be implemented, there would be no foreseeable damage to structures or loss of life resulting from the hazard.

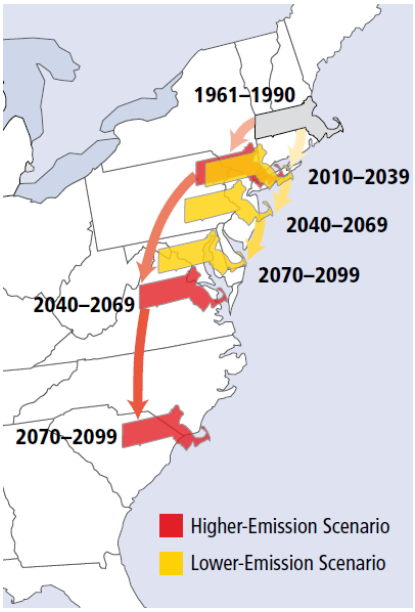
2. Vulnerability

Based on the above assessment, Holyoke faces a low risk of drought.

Extreme Temperatures

Hazard Description

Greater variation and extremes in local atmospheric temperatures due to global changes in climate are now among the natural hazards that this plan anticipates. Holyoke is likely to experience more instances of extreme and sustained heat and cold. And, because warmer air holds more moisture, higher temperatures will also bring wetter winters, more severe storms, and more frequent flooding. Locally, there will also be more single-day records highs, and more total days with highs above 90 degrees, and more heat waves with 3 or more days above 90 degrees. More extreme temperatures throughout Western Massachusetts and New England mean that there will be more floods, droughts, and tornados. There will also be more Atlantic hurricanes and nor'easters. Anticipated increases in extreme local temperatures is directly related to many of the previously described vulnerabilities, as well as increasing the risk of heat-related disease and injury, especially among senior citizens and residents unable to afford air conditioning.



At current rates of greenhouse gas accumulation and temperature increases, the climate of Massachusetts will become similar to those of present-day New Jersey or Virginia by 2040-2069, depending on future GHG emissions. *Source: NECIA 2006*

Anticipated Climatic Variation

In Western Massachusetts, annual precipitation is expected to increase by 14% by the end of the 21st century. However, most of this precipitation increase will come during the winter months – as much as 30% more than today – while summertime precipitation will actually decrease slightly. Also, most of the added winter precipitation is expected to be in the form of rain, rather than snow. This will mean a continuation of the current regional trend of a decreasing snowfall totals, as well as the number of days with snow cover on the ground, but more precipitation overall.
The increased amount of strong precipitation events and overall increase in rainfall, combined with the aging stormwater infrastructure in the region, will likely result in more flooding in the region.

Per the Massachusetts Hazard Mitigation Plan, extreme cold or heat is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. There is no universal definition for extreme temperatures, with the term relative to local weather conditions. For Massachusetts, extreme temperatures can be defined as those that are far outside the normal ranges. The average temperatures for Massachusetts are:

- Winter (Dec-Feb) Average = 27.51ºF
- Summer (Jun-Aug) Average = 68.15ºF

Criteria for issuing alerts for Massachusetts are provided on National Weather Service web pages: http://www.erh.noaa.gov/box/warningcriteria.shtml.

Anticipated Climatic Variations for Massachusetts Due to Climate Change

Category	Current (1961-1990 avg.)	Predicted Change 2040-2069	Predicted Change 2070-2099
Average Annual Temperature (°F)	46°	50°to 51°	51° to 56°
Average Winter Temperature (°F)	23°	25.5° to 27°	31° to 35°
Average Summer Temperature (°F)	68°	69.5° to 71.5°	74° to 82°
Days over 90 °F	5 to 20 days	-	30 to 60 days
Days over 100 °F	0 to 2 days	-	3 to 28 days
Annual Precipitation	41 inches	43 to 44 inches	44 to 47 inches
Winter Precipitation	8 inches	8.5 to 9 inches	9 to 10.4 inches
Summer Precipitation	11 inches	10.9 to 10.7 inches	10.9 to 11 inches

Sources: Massachusetts Climate Adaptation Report 2011, NECIA

Location

Any instances of extreme temperatures that have occurred in the past occurred throughout Holyoke. Extreme cold or heat usually requires the opening of shelters on a few occasions per year.

Extent

As per the Massachusetts Hazard Mitigation Plan, the extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature Index. Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. The chart shows three shaded areas of frostbite danger. Each shaded area shows how long a person can be exposed before frostbite develops. In Massachusetts, a wind chill warning is issued by the NWS Taunton Forecast Office when the Wind Chill Temperature Index, based on sustained wind, is –25ºF or lower for at least three hours.

Extreme temperatures would affect the whole community.

Wind Chills

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

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

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

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

For extremely hot temperatures, the heat index scale is used, which combines relative humidity with actual air temperature to determine the risk to humans. The NWS issues a Heat Advisory when the Heat Index is forecast to reach 100-104 degrees F for 2 or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105+ degrees F for 2 or more hours. The following chart indicates the relationship between heat index and relative humidity:

Heat Index

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										

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke or 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 exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Previous Occurrences

The following are some of the lowest temperatures recorded in parts of Massachusetts for the period from 1895 to present (Source: NOAA, www.ncdc.noaa.gov.):

- Blue Hills, MA- –21°F
- Boston, MA- –12°F
- Worcester, MA- –19°F

The following are some of the highest temperatures recorded for the period from 1895 to present (Source: NOAA, www.ncdc.noaa.gov.):

• Blue Hills, MA - 101°F
• Boston, MA - 102°F
• Worcester, MA - 96°F

Extreme heat usually requires the opening of shelters on a few occasions per year. In the winters of 2014 and 2015, warming centers were opened for extremely cold temperatures due to the “polar vortex.”

Probability of Future Events

The probability of future extreme heat and extreme cold is considered to be "high," or between 40 and 70 percent in any given year.

Impact

The impact of extreme heat or cold in Holyoke is considered to be "critical," with multiple injuries and significant property damage (due to Holyoke’s large stock of neglected/abandoned and old buildings).

Vulnerability

Holyoke’s vulnerability from extreme heat and cold is considered to be, "2 - High Risk."

Other Hazards

In addition to the hazards identified above, the Hazard Mitigation Team reviewed the full list of hazards listed in the Massachusetts Hazard Mitigation Plan. Due to the location and context of the City, coastal erosion, landslides, and tsunamis, were determined to not be a threat.

4 – CRITICAL FACILITIES

Facility Classification

A Critical Facility is defined as a building, structure, or location that:

- Is vital to the hazard response effort
- Maintains an existing level of protection from hazards for community residents and property
- Would create a secondary disaster if a hazard were to impact it

The Critical Facilities List for the City of Holyoke has been identified utilizing a Critical Facilities List provided by the State Hazard Mitigation Officer. Holyoke's Hazard Mitigation Workgroup has broken up this list of facilities into three categories:

- Facilities needed for emergency response in the event of a hazard event.

- Facilities identified as non-essential and not required in an emergency response event, but which are considered essential for the everyday operation of the City.

- Facilities or institutions that include special populations which would need additional attention in the event of a hazard event.

The critical facilities and evacuation routes potentially affected by hazard areas are identified following this list. The Past and Potential Hazards/Critical Facilities Map (Appendix D) also identifies these facilities.

Category 1 – Emergency Response Services

The City has identified the Emergency Response Facilities and Services as the highest priority in regards to protection from natural and man-made hazards.

1. Emergency Operations Center

Primary Location: Holyoke Fire Department Headquarters - 600 High Street
Secondary Location: City of Holyoke Senior Center (Sargeant Street)

2. Fire Station

Holyoke Fire Department Headquarters– 600 High Street
Fire Station #3 – 1591 Northampton Street
Fire Station #5 – 33 Whiting Farms
Fire Station #6 – 640 Homestead

3. Police Station

Holyoke Police Station – 130 Appleton Street

4. Highway Garage

Department of Public Works – 63 Canal Street

5. Water Department

Holyoke Water Works Main Office – 20 Commercial Street
Treatment Facility- Route 202 and remote pumping stations

6. Sewer Department

Holyoke Water Pollution Control Facility, (WPCF) and Combined Sewer Overflow, (CSO) Facility (1 Berkshire Street, remote CSO Facilities, Pump Stations and Flood Stations)

7. Emergency Fuel Stations

Holyoke Department of Public Works Central Fuel Depot- 24 Commercial Street

8. Emergency Electrical Power Facility -stationary

Generator X 3 – DPW
Generator X 10 – Holyoke Gas and Electric HG&E has more generators
Generator X 3 – Holyoke Water Works
Generator X 3 – Holyoke Sewer Department - WPCF, CSO Facility and Smith's Ferry Pump Station

Generators are located at each of the following locations: Dean Technical High School, Peck Middle School, Mater Dolorosa, Holyoke Community College, Mount Marie Nursing Home and Childcare Center, Loomis House Nursing, the former Geriatric Authority of Holyoke, Mount Saint Vincent Nursing Home, Renaissance Manor on Cabot, Buckley Nursing Home, Holyoke Soldiers Home, Sunbridge for Holyoke, Holyoke Medical Center, Providence Hospital of Holyoke, Pulaski Apartments, Elmwood Towers, Falcetti Towers, Fire Departments #1, #3, #5 and #6.

9. Emergency Shelters:

Maurice A Donahue Elementary – Whiting Farms Road (413)-534-2069
Holyoke Soldiers Home – 110 Cherry Street (413)-532-9475
Council on Aging – (413)-534-2208
Holyoke Fire Department - 600 High Street
Morgan Elementary – 596 South Bridge Street (413)-534-2083
White Elementary – 1 Jefferson Street (413)-534-2058
Marcella Kelly School – 216 West Street (413)-534-2500
Holyoke Medical Center – 575 Beech Street (413)-534-2500
Holyoke Community College – 303 Homestead Avenue (413)-533-8565
Sullivan School - 400 Jarvis Street (413)-534-2060
Pope John Paul II Center/Mater Dolorosa - 25 Maple Street (413)-532-7889
St. Peter's Lutheran Church - 34 Jarvis Avenue (413)-532-5060
United Congregational - 395 High Street (413)-532-1483
Holy Trinity Greek Orthodox **(Not ADA)** - 410 Main Street (413)-533-9880

Emergency Shelters (Red Cross Approved as of 2006)

Dean Technical High School – 1045 Main Street (413)-534-2071
Holyoke High School – 500 Beech Street (413)-534-2020
William Peck Middle School – 1916 Northampton Street (413)-534-2040
H.B. Lawrence School – 156 Cabot Street (413)-534-2075
War Memorial - 310 Appleton Street (413)-322-5628

Emergency Shelters (Red Cross Approved as of 2008)

First Lutheran Church - 1810 Northampton Street (413)-534-7071
St. Paul's Episcopal Church - 485 Appleton Street (413)-532-5060
YMCA - 171 Pine Street (413)-534-5631

9. Dry Hydrants - Fire Ponds - Water Sources

Canal System in the downtown sections.

10. Transfer Station

The City provides curb side refuse collection with direct delivery of the waste to a waste-to-energy facility in Springfield. The City operates a drop-off facility on Berkshire Street for waste materials such as tires, waste oil, appliances and bulky furniture that are banned from disposal with ordinary household refuse.

11. Utilities

Tennessee Natural Gas Pipeline
Canal System / Hadley Falls - Holyoke Gas & Electric
Water Pollution Control Facility - 1 Berkshire Street
Solar Fields - County Road, Muller Road, Coolidge Road

12. Heliports

Barnes Municipal Airport – Airport Road, Westfield
Roberts Field- Holyoke High School
Anniversary Field- Lynch Middle School
Crosier Field- Peck Middle School

13. Communications

Cell and Emergency Dispatch Towers - located on Mt. Tom, Cherry Street, Community Field, former Mt. Tom Coal Plant, D. Hotels, Holy Cross, Sargeant Street note: State police, FAA, FEMA, MEMA, and news organizations all have communications towers on Mt. Tom)
Telephone Cross boxes
Central Switching Office - located at Fire Department Headquarters, Soliders Home, City Hall, Holyoke Mall, Peoples Bank, St. Vincent Nursing Home

14. Primary Evacuation Routes

MA Route 202
MA Route 116

MA Route 5
MA Route 141
Interstate Route 391 Connector
Interstate Route 91

15. Bridges Located on Evacuation Routes

Vietnam Veterans Memorial Bridge
Mueller Bridge
Interstate Route 391 Connector
Multiple Bridges in canal district
Willimansett Bridge

Category 2 – Non Emergency Response Facilities

The City has identified these facilities as non-emergency facilities; however, they are considered essential for the everyday operation of Holyoke.

1. Water Supply

The City of Holyoke draws on surface water, exclusively, for its drinking water needs. There are four reservoirs, but only two are active currently (Manhan and McLean). The Manhan Reservoir (also known as Tighe-Carmody Reservoir), is located in the Town of Southampton and is the City's primary source. It has a storage capacity of 4.8 billion gallons and an estimated safe yield of 13 MGD. The McLean Reservoir serves the City's upper elevations; it has a storage capacity of 365 MG and an estimated safe yield of 0.5 MGD. Ashley Reservoir and Whiting Street Reservoir serve as reserve supplies. The city of Holyoke maintains 7 individual water storage facilities located at Jarvis Avenue (2 tanks with a total capacity of 3.25 MG), Rock Cut Road (2 tanks with a total capacity of 4.0 MG), Apremont Highway (1 tanks with a capacity of 0.5 MG) and Treatment Facility (2 tanks with a total capacity of 6.0 MG).

The Upland Road pumphouse is located in an area near Tannery Brook that regularly floods. Replacing culverts downstream would alleviate this problem.

2. Sewer and Storm-water Collection and Treatment Infrastructure

Holyoke WPCF and CSO Facility – One Berkshire Street
Holyoke support Facilities (noted on map), including:

Combined Sewer Overflow Facilities:
Multiple remote locations throughout the City

Flood Stations:
#1 - 100 Gatehouse Road
#2 - 3 Hadley Mills Road
#3 - 5 Water Street

#4 - 22 Water Street
#5 - 122 Middle Water Street
#6 - 204 South Water Street
#7 - 20 Jed Day's Landing

Wastewater Pumping Stations:
Jones Ferry - 33 Jones Ferry Road
Springdale - 18 Jed Day's Landing
Jackson Street - 206 South Water Street
Mosher Street - 115 Mosher Street
Highland Park - 33 St. Kolbe Drive
Smith's Ferry - 585 Northampton Street

3. Problem Culverts

Meadowbrook Road at Tannery Brook
Kane Road at Tannery Brook
Green Lane at Green Brook
Ross Road at Broad Brook
Upland Road at Tannery Brook
Keyes Rd. at Broad Brook
Longfellow Road (under I-91)
71 Southampton Road
100 Southampton Road
Fairmont Street (at the Soldiers' Home at Fairmont Street; culvert is too small)
Michigan Avenue

4. Problem Flood and Drainage Areas

Meadowbrook Road at Tannery Brook
Kane Road at Tannery Brook
Green Lane at Green Brook

Category 3 – Facilities/ Institutions with Special Populations

The third category contains people and facilities that need to be protected in event of a disaster.

1. Hospitals & Health Facilities

Holyoke Medical Center – 575 Beech St.
Holyoke Regional Medical Building – 10 Hospital Dr.
Holyoke Health Center – 230 Maple St.
Council on Aging – 291 Pine Street
Loomis House Nursing Center – 298 Jarvis Ave.
Sarawood Retirement Home – 1 Loomis Ave.
Beaven Kelly Nursing Home – Brightside Rd.
Mont Marie Child Care Center – 34 Lower Westfield Road

Mt. Saint Vincent Nursing Home – Holy Family Rd.
Renaissance Manor on Cabot – 279 Cabot St.
Buckley Nursing Home – 282 Cabot St.
Mary's Meadow at Providence - 13 Gamelin Rd
Providence Place -5 Gamelin Rd
Holyoke Rehabilitation Center - 230 Easthampton Road

2. Special Needs Population (s)

Falcetti Towers - 475 Maple St
Elmwood Towers - South St
Rosary Towers - 21 Bowers St
Holyoke Soldiers Home- 110 Cherry St
Childrens' House Child Care - 513 Beech Street
Holyoke Animal Hospital
Holyoke Community College Day Care Facility - 303 Homestead Ave
Square One Child Care - 133-243 High Street
Arbor House - 130 Pine Street
Jericho House - 537 Northampton Street

- Holyoke has a large Environmental Justice (EJ) population. The City of Holyoke's EJ community boundary covers approximately 3,368 acres (5.26 square miles) (source: MassGIS) of the City. Approximately ⅓ of the City's population resides in this boundary. Based upon the current accepted definition of Environmental Justice, residents of Environmental Justice Populations occupy neighborhoods with disproportionate concentrations of environmental pollutants and experience limited opportunities to participate in public decision making processes.

3. Recreation Areas

Holyoke Heritage State Park
Mt. Tom Reservation
Anniversary Field
Avery Field
Bennett Field
Bonin Field
Carlos Vega Park
Community Field
Crosier Field
Ely Court
Gloutak Park
Gramps Park
Hamilton St. Park
Ingleside Playground
Jackson Courts

John Young Field
Jones Pt. Park
Kennedy Park
Kenney Field
Kosciuszko Park
Laurel Park
Mackenzie Field
Mayer Field
McNally Field
McNulty Field
Mitchell Field
Morgan St. Park
Peasants Park
Pina Park
Pulaski Park
Roberts Field
Rohan Park
Roosevelt Park

4. Schools

E.N. White Elementary – 1 Jefferson St. (413)-534-2058
Holyoke High School – 500 Beech Street (413)-534-2020
Dean Technical High School – 1045 Main St. (413)-534-2071
William Peck Middle School – 1916 Northampton St. (413)-534-2040
Holyoke Day Nursery – 159 Chestnut St. (413)-538-8419
H.B. Lawrence School – 156 Cabot St. (413)-534-2075
Marcella Kelly School – 216 West St. (413)-534-2078
Mater Dolorosa – 25 Maple St. (413)-532-2831
First Lutheran School – 1810 Northampton St. (413)-532-4272
Metcalf School – 2019 Northampton St. (413)-534-2067
Maurice A Donahue Elementary – Whiting Farms Rd. (413)-534-2069
Elmer McMahon School – 75 Kane Rd. (413)-534-2062
Morgan Elementary – 596 South Bridge St. (413)-534-2083
Lt. Clayre Sullivan Elementary – 400 Jarvis Ave. (413)-534-2060
Holyoke Community College – 303 Homestead Ave. (413)-533-8565
Holyoke Head Start – 662 High St. (413)-536-0363
Heritage Child Development – 251 Appleton St. (413)-538-9441
Brighter Beginnings Day Care – 10 Laurel St. (413)-532-4280
Holyoke Community Charter School - 2200 Northampton Street
Paolo Friere Charter School - 161 Lower Westfield Rd.
Center School - 1913 Northampton St.
Holyoke Chicopee Springfield Head Start - 41 Commercial Street
Neari School - 70 North Summer Street
RFK Action Corps -

5. Churches

Blessed Sacrament – 21 Westfield Road
St. Paul's Episcopal Church – 485 Appleton St.
Ebenezer Assembly of God – 200 Main St.
Apostolic Christian Church – 456 Main St.
First Lutheran Church – 1810 Northampton St.
Livingstone Assembly of God – 478 Pleasant St.
Sisters of St. Joseph – 287 Essex St.
Bethlehem Baptist Community Church – 304 Elm St.
St. Peter's Lutheran Church – 34 Jarvis Ave.
Christian Pentecostal Church – 96 Cabot St.
First Baptist Church – South St.
Templo Pentacosta La Hermosa – 93 Pine St.
The Church of Rescuing Sheep – 345 High St.
Holy Tabernacle Church for all People – 56 Suffolk St.
Sacred Heart Church – 435 Maple St.
Perreault – 34 Lower Westfield Rd.
Blessed Sacrament – 1945 Northampton St.
Iglesia Pentecostal Jehovah Justicia Nuestra – 330 Maple St.
Iglesia Cristo Es El Camino – 109 High St.
Bible Baptist Church – 375 Elm St.
Our Lady of Guadalupe – 435 Maple St.
Springfield Chicopee Church – 41 Commercial St.
Iglesia Bautista – 440 High St.
Rosa De Saron Creation – 223 Maple St.
Iglesia Christiana Herederos De Christo – 85 Main St.
First Presbyterian Church – 300 Appleton St.
Casa Apostolica – 440 High St.
Holy Trinity Greek Orthodox – 410 Main St.
Seventh Day Adventist – 140 Suffolk St.
Mountain View Baptist Church – 310 Apremont Hwy.
Our Lady of the Cross – 23 Sycamore St.
Catholic Latino Ministry – 51 Hamilton St.

6. Historic Buildings/Sites

The City of Holyoke has numerous properties listed on its Historic Inventory. Larger historic properties in the downtown area include City Hall, the War Memorial, 1 Canal Street, W, Hadley Falls Company House, and the Wisteriahurst Museum.

7. Employment Centers

CareerPoint
Holyoke Works
361 Whitney Ave
Ingleside Mall

Peoples Bank Headquarters - 230 Whitney
Baystate Health Conference Center - 300 Whitney Street
Kelly Way (home of Honda Financial)
Holyoke Hospital
Holyoke Community College
All Holyoke public schools are large employment centers

Category 4 - Potential Resources

These facilities provide or contain potential resources for services and supplies.

1. Food/Water:
2. Hospital/Medical Supplies:
3. Heating Fuel:
4. Gas: LNG Storage Facility
5. Building Materials Suppliers:
6. Heavy and Small Equipment Suppliers: portable generators available at 600 High Street
7. Gravel Pits:
8. Emergency Companion Animal Care: DART Trailers, available from Western Region Homeland Security Advisory Council

Critical Facilities and Evacuation Routes Potentially Affected by Hazard Areas			
Hazard Type	**Hazard Area**	**Critical Facilities Affected**	**Evacuation Routes Affected**
Flooding	Lower Wards along CT River and Canal System below Holyoke Dam Below Whiting Street Reservoir Dam Below Holyoke Dam West Holyoke Rock Valley Area CT River above Holyoke Dam Broad Brook - along portions of Rock Valley and Mountain Roads (area with large amount of septic systems)	DPW- 63 N. Canal Street HWW - 20 Commercial Street WPCF and CSO Facility 1 Berkshire Street CSO Facilities Sewer Pump Stations Flood Control Stations Dean Tech High (in floodplain) Hydroelectric Facilities Gatehouse Road Canal Control Rail lines CSOs (Berkshire Avenue)	Route 5 - near power plant Bridges over Canal System (Cabot, North Bridge) Underpasses susceptible to flooding
Severe snowstorms / ice storms	Entire City (power-related issues) Drifts from Whiting Farms Rd. and Sullivan Rd. and at Exit 15 from Interstate 91 near intersection of Homestead and Westfield Rd.	Communication Towers Holyoke Mall Schools WPCF and CSO Facility 1 Berkshire Street CSO Facilities Sewer Pump Stations Flood Control Stations Water Treatment Facility and remote pump	Rt. 141 frequently closes during winter weather Rt. 202 closes occasionally due to winter weather

		stations	
Hurricanes	City-wide	Communication Towers WPCF and CSO Facility 1 Berkshire Street CSO Facilities Sewer Pump Stations Flood Control Stations	
Severe thunderstorms / wind / tornadoes	City-wide and localized areas	Communication Towers WPCF and CSO Facility 1 Berkshire Street CSO Facilities Sewer Pump Stations Flood Control Stations	
Wildfires / Brushfires	West of Interstate 91 Train Tracks	Storage Tanks LNG Facility – Mueller Road Mt. Tom	Interstate 91 Rt. 141 Rt. 202 Rt. 5
Earthquakes	N/A	N/A	
Dam failures	Lower Wards	WPCF and CSO Facility 1 Berkshire Street CSO Facilities Sewer Pump Stations Flood Control Stations	
Drought	N/A	N/A	N/A
Extreme Temperatures	N/A	N/A	N/A

5 – CURRENT MITIGATION STRATEGIES

One of the steps of this Hazard Mitigation Plan is to evaluate all of the City's existing policies and practices related to natural hazards and identify potential gaps in protection. After reviewing these policies and the hazard identification and assessment, the City Hazard Mitigation Workgroup developed a set of hazard mitigation strategies it would like to implement.

The City of Holyoke has developed the following goal to serve as a framework for mitigation of the hazards identified in this plan.

Goal Statement

To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to the following hazards: flooding, severe snowstorms/ice storms, severe thunderstorms, hurricanes, tornadoes, wildfires/brushfires, earthquakes, dam failures, drought, and extreme temperatures.

For the extent of this analysis, the Workgroup reviewed the following City documents:

- Zoning Ordinances
- Subdivision Rules and Regulations
- Comprehensive Emergency Management Plan
- City Open Space and Recreation Plan

Overview of Mitigation Strategies by Hazard

An overview of the general concepts underlying mitigation strategies for each of the hazards identified in this plan is as follows:

Flooding

The key factors in flooding are the water capacity of water bodies and waterways, the regulation of waterways by flood control structures, and the preservation of flood storage areas and wetlands. As more land is developed, more flood storage is demanded of the City's water bodies and waterways. The City currently addresses this problem with a variety of mitigation tools and strategies. Flood-related regulations and strategies are included in the City's general Ordinances, zoning by-law, and subdivision regulations. Infrastructure like dams and culverts are in place to manage the flow of water.

Severe Snowstorms / Ice Storms

Winter storms can be especially challenging for emergency management personnel. The Massachusetts Emergency Management Agency (MEMA) serves as the primary coordinating entity in the statewide management of all types of winter storms and monitors the National Weather Service (NWS) alerting systems during periods when winter storms are expected. Even though the storm has usually been forecast, there is no certain way for predicting its length, size or severity. Therefore, mitigation strategies must focus on preparedness prior to a severe snow/ice storm.

The City's current mitigation tools and strategies focus on preparedness, with many regulations and standards established based on safety during storm events. To the extent that some of the damages from a winter storm can be caused by flooding, flood protection mitigation measures also assist with severe snowstorms and ice storms.

Hurricanes

Hurricanes provide the most lead warning time of all identified hazards, because of the relative ease in predicting the storm's track and potential landfall. MEMA assumes "standby status" when a hurricane's location is 35 degrees North Latitude (Cape Hatteras) and "alert status" when the storm reaches 40 degrees North Latitude (Long Island). Even with significant warning, hurricanes can cause significant damage due to flooding and severe wind.

The flooding associated with hurricanes can be a major source of damage to buildings, infrastructure and a potential threat to human lives. Flood protection measures can thus also be considered hurricane mitigation measures. The high winds that often accompany hurricanes can also damage buildings and infrastructure, similar to tornadoes and other strong wind events.

Severe Thunderstorms / Winds / Tornadoes

Most damage from tornadoes and severe thunderstorms come from high winds that can fell trees and electrical wires, generate hurtling debris and, possibly, hail. According to the Institute for Business and Home Safety, the wind speeds in most tornadoes are at or below design speeds that are used in current building codes, making strict adherence to building codes a primary mitigation

strategy. In addition, current land development regulations, such as restrictions on the height of telecommunications towers, can also help prevent wind damages.

Wildfires / Brushfires

Wildfire and brushfire mitigation strategies involve educating people about how to prevent fires from starting, as well as controlling burns within the City.

Earthquakes

Although there are five mapped seismological faults in Massachusetts, there is no discernible pattern of previous earthquakes along these faults nor is there a reliable way to predict future earthquakes along these faults or in any other areas of the state. Consequently, earthquakes are arguably the most difficult natural hazard for which to plan.

Most buildings and structures in the state were constructed without specific earthquake resistant design features. In addition, earthquakes precipitate several potential devastating secondary effects such as building collapse, utility pipeline rupture, water contamination, and extended power outages. Therefore, many of the mitigation efforts for other natural hazards identified in this plan may be applicable during the City's recovery from an earthquake.

Dam Failure

Dam failure is a highly infrequent occurrence, but a severe incident could prove catastrophic. In addition, dam failure most often coincides with flooding, so its impacts can be multiplied, as the additional water has nowhere to flow. The only mitigation measures currently in place are the state regulations governing the construction, inspection, and maintenance of dams. This is managed through the Office of Dam Safety at the Department of Conservation and Recreation.

The Hadley Falls Dam is regulated by the Federal Energy Regulatory Committee.

Drought

Although Massachusetts does not face extreme droughts like many other places in the country, it is susceptible to dry spells and drought. Drought can most likely be effectively mitigated in regions like the Pioneer Valley if measures are put into place, such as ensuring that groundwater is recharged.

Existing Mitigation Strategies

The City of Holyoke has a list of existing mitigation strategies that were in place prior to the development of the first Hazard Mitigation Plan in 2007, as well as a set of prioritized mitigation strategies to be pursued in the future. Strategies that were previously completed prior to 2007, or completed between 2007 and 2014, are listed below and noted under the "effectiveness" column. Strategies that were completed since the last version of the plan are listed in bold.

As part of the development of this plan update in 2014, the Hazard Mitigation Workgroup evaluated each mitigation strategy to determine its effectiveness and whether any improvements could be made.

Existing Mitigation Strategies (2007)				
Capability	**Action Type**	**Area Covered**	**Hazards Mitigated**	**Effectiveness**
Shelter Identification	Identify existing shelters that are earthquake resistant as well as outside of floodplain and inundation areas. Disseminate this information to appropriate City departments.	Entire City	General	Somewhat effective
Shelter Inventory	Inventory supplies at existing shelters and develop a needs list and storage requirements. Establish arrangements with local or neighboring vendors for supplying shelters with food and first aid supplies in the event of a natural disaster.	Entire City	General	Effective (though not tested)

Existing Mitigation Strategies (2007)				
Capability	**Action Type**	**Area Covered**	**Hazards Mitigated**	**Effectiveness**
Evaluate Current Emergency Notification System	Examine current notification system including feasibility of Reverse 911. Develop a preliminary project proposal and cost estimate.	Entire City	General	Effective
Disseminate Public Safety Information	Collect, periodically update, and disseminate information on which local radio stations provide emergency information, what to include in a 'home survival kit,' how to prepare homes and other structures to withstand flooding and high winds, and the proper evacuation procedures to follow during a natural disaster.	Entire City	General	Somewhat Effective
Design Evacuation and Communication Systems	Design natural hazards evacuation and communication system to effectively communicate with residents about evacuation procedures, sheltering options, and emergency conditions including elderly, bi-lingual, bi-cultural, those	Entire City	General	Effective

Existing Mitigation Strategies (2007)				
Capability	**Action Type**	**Area Covered**	**Hazards Mitigated**	**Effectiveness**
	with limited means, and those with limited transportation.			
Revise subdivision rules and regulations	Consider adding flood prevention and mitigation to the purpose section of the Subdivision Rules and Regulations.	Floodplains	Flooding	Not effective (so few subdivisions)
Revise subdivision rules and regulations	Ensure that the Development Impact Statement identifies impacts of the proposed development could have on the potential for flooding, and include mitigation measures, if deemed necessary by the Planning Board.	Floodplains	Flooding	Not effective
Revise subdivision rules and regulations	Consider implementing standards in the Subdivision Rules and Regulations to require temporary and permanent erosion control measures for streams and surface water bodies.	Floodplains	Flooding	Not effective

Existing Mitigation Strategies (2007)				
Capability	**Action Type**	**Area Covered**	**Hazards Mitigated**	**Effectiveness**
Revise subdivision rules and regulations	Consider adding more specific impacts to address in the Special Permit process including topographic change, removal of cover vegetation, risk of erosion or siltation and increased stormwater runoff.	Floodplains	Flooding	Not effective
Implement OSRP	In regards to the Holyoke Open Space and Recreation Plan, consider implementing the Five-Year Action Plan strategies, particularly those dealing with protection of forests and farmland.	Floodplains	Flooding	Not effective
Community Rating System	The City should evaluate whether to become a part of FEMA's Community Rating System.	Floodplains	Flooding	Somewhat effective
Assess Loss of Enfield Dam	Review the effects of the loss of the Enfield Dam on flooding potential.	Floodplains	Flooding	Effective
Emergency Generators	Acquire emergency generators.	Floodplains	Flooding	Effective

Existing Mitigation Strategies (2007)				
Capability	**Action Type**	**Area Covered**	**Hazards Mitigated**	**Effectiveness**
Emergency Plan for Remote Areas	Develop a plan for providing access to water, information, shelter, and food stores to people in remote locations in City in the event of a severe winter storm.	West Holyoke	Severe Snow/Ice Storms	Not Effective
Acquire Snow Melter	Acquire Snow Melter.	City-wide	Severe Snow/Ice Storms	Effective
Update Zoning Regulations for Telecommunication Facilities	In the Zoning regulations for Telecommunication Facilities, consider adding safety and prevention of wind-related damage as a stated purpose.	City-wide	Hurricanes/Tornadoes / Wind	Not effective
Fire Prevention Awareness	Develop and distribute an educational pamphlet on fire safety and prevention.	City-wide	Wildfire/Brushfire	Effective
Require Underground Water Tanks	Consider revising the Subdivision Rules and Regulations Required Improvements section to include the construction of an underground water tank(s) (30,000 gal. minimum) in new subdivisions for fire suppression purposes.	West Holyoke	Wildfire/Brushfire	Not effective

Existing Mitigation Strategies (2007)				
Capability	**Action Type**	**Area Covered**	**Hazards Mitigated**	**Effectiveness**
Increase Response Mobility	Acquire additional off-road capable ATV and Brush Truck.	West of I-91	Wildfire/Brushfire	Effective
Evaluate Buildings	Evaluate the City Hall and other shelters to determine if they are earthquake resistant.	Shelter locations	Earthquakes	Effective
Shelter Back-up Power	Ensure that all identified shelters have sufficient back-up utility service in the event of primary power failure.	City-wide	Earthquakes	Effective
Dam Repair	Repair Whiting Street Reservoir Dam.	Whiting Street	Dam Failure	Effective
Dam Awareness	Notify downstream property owners of presence and condition of dam and emergency preparations.	Dam inundation zones	Dam Failure	Effective

Deleted Mitigation Strategies

Several mitigation strategies listed in the 2007 version of the Holyoke Hazard Mitigation Plan have been removed in this 5-year update. Strategies were deleted for one of two reasons: 1) they have been determined as no longer useful for mitigating a hazard (whether due to completion or ineffectiveness), or 2) They have been determined to be in need of replacement by a more specific mitigation strategy.

Deleted Mitigation Strategies				
Action	**Description**	**Hazards Mitigated**	**Responsible Agency**	**Reason for Deletion**
Conduct Shelter Identification	Identify existing shelters that are earthquake resistant as well as outside of floodplain and inundation areas. Disseminate this information to appropriate City departments.	General		Completed and repeated
Shelter Inventory	Inventory supplies at existing shelters and develop a needs list and storage requirements. Establish arrangements with local or neighboring vendors for supplying shelters with food and first aid supplies in the event of a natural disaster.	General		Complete – includes existing MOUs with suppliers and inventory of War Memorial Shelter
Evaluate Current Emergency Notification System	Examine current notification system including feasibility of Reverse 911. Develop a preliminary project proposal and cost estimate.	General		Completed and implemented
Disseminate Public	Collect, periodically update, and	General		Needs revision

Deleted Mitigation Strategies				
Action	**Description**	**Hazards Mitigated**	**Responsible Agency**	**Reason for Deletion**
Safety Information	disseminate information on which local radio stations provide emergency information, what to include in a 'home survival kit,' how to prepare homes and other structures to withstand flooding and high winds, and the proper evacuation procedures to follow during a natural disaster.			
Design Evacuation and Communications Systems	Design natural hazards evacuation and communication system to effectively communicate with residents about evacuation procedures, sheltering options, and emergency conditions including elderly, bi-lingual, bi-cultural, those with limited means, and those with limited transportation.	General		Complete – Reverse 911 and inter-operational communications system adopted
Revise Subdivision Rules and Regulations	Consider adding flood prevention and mitigation to the purpose section of the Subdivision Rules and Regulations.	Flooding		Not effective (very few subdivisions)
Revise Subdivision Rules and Regulations	Ensure that the Development Impact Statement identifies impacts of the proposed development could have on the potential for flooding, and include mitigation measures, if deemed	Flooding		Not effective (very few large developments)

Deleted Mitigation Strategies				
Action	**Description**	**Hazards Mitigated**	**Responsible Agency**	**Reason for Deletion**
	necessary by the Planning Board.			
Revise Subdivision Rules and Regulations	Consider implementing standards in the Subdivision Rules and Regulations to require temporary and permanent erosion control measures for streams and surface water bodies.	Flooding		Not effective
Revise Subdivision Rules and Regulations	Consider adding more specific impacts to address in the Special Permit process including topographic change, removal of cover vegetation, risk of erosion or siltation and increased stormwater runoff.	Flooding		Not effective
Implement OSRP	In regards to the Holyoke Open Space and Recreation Plan, consider implementing the Five-Year Action Plan strategies, particularly those dealing with protection of forests and farmland.	Flooding		Complete through other means
Assess Loss of Enfield Dam	Review the effects of the loss of the Enfield Dam on flooding potential.	Flooding		Complete – inundation maps updated
Emergency Generators	Acquire emergency generators.	Flooding		Complete
Emergency Plan for Remote Areas	Develop a plan for providing access to water, information,	West Holyoke	Severe Snow/Ice Storms	Not Effective

Deleted Mitigation Strategies				
Action	**Description**	**Hazards Mitigated**	**Responsible Agency**	**Reason for Deletion**
	shelter, and food stores to people in remote locations in City in the event of a severe winter storm.			
Fire Prevention Awareness	Develop and distribute an educational pamphlet on fire safety and prevention.	Wildfire/brushfire	Fire Dept.	Complete
Require Underground Water Tanks	Consider revising the Subdivision Rules and Regulations Required Improvements section to include the construction of an underground water tank(s) (30,000 gal. minimum) in new subdivisions for fire suppression purposes.	West Holyoke	Wildfire/ Brushfire	Not effective (very few subdivisions)
Increase Response Mobility	Acquire additional off-road capable ATV and Brush Truck.	Wildfire/brushfire		Complete
Shelter Back-up Power	Ensure that all identified shelters have sufficient back-up utility service in the event of primary power failure.	Earthquakes		Complete
Dam Awareness	Notify downstream property owners of presence and condition of dam and emergency preparations.	Dam failure		Complete – phone tree developed, drills practiced every year

Previously Identified and New Strategies

Several of the action items previously identified in the 2008 Hazard Mitigation Plan are currently continuing, either because they require more time to secure funding or their construction process is ongoing. In addition, the Hazard Mitigation Workgroup identified several new strategies that are also being pursued. These new strategies are based on experience with currently implemented strategies, as well as the hazard identification and risk assessment in this plan.

Prioritization Methodology

The Holyoke Hazard Mitigation Planning Workgroup reviewed and prioritized a list of previously identified and new mitigation strategies using the following criteria:

Application to multiple hazards – Strategies are given a higher priority if they assist in the mitigation of several natural hazards.

Time required for completion – Projects that are faster to implement, either due to the nature of the permitting process or other regulatory procedures, or because of the time it takes to secure funding, are given higher priority.

Estimated benefit – Strategies which would provide the highest degree of reduction in loss of property and life are given a higher priority. This estimate is based on the Hazard Identification and Analysis Chapter, particularly with regard to how much of each hazard's impact would be mitigated.

Cost effectiveness – in order to maximize the effect of mitigation efforts using limited funds, priority is given to low-cost strategies. For example, regular tree maintenance is a relatively low-cost operational strategy that can significantly reduce the length of time of power outages during a winter storm. Strategies that have identified potential funding streams, such as the Hazard Mitigation Grant Program, are also given higher priority.

Eligibility Under Hazard Mitigation Grant Program – The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. 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. Funding is made available through FEMA by the Massachusetts Emergency Management Agency. Municipalities apply for grants to fund specific mitigation projects under MEMA requirements.

The following categories are used to define the priority of each mitigation strategy:

Low – Strategies that would not have a significant benefit to property or people, address only one or two hazards, or would require funding and time resources that are impractical

Medium – Strategies that would have some benefit to people and property and are somewhat cost effective at reducing damage to property and people

High – Strategies that provide mitigation of several hazards and have a large benefit that warrants their cost and time to complete

Very High – extremely beneficial projects that will greatly contribute to mitigation of multiple hazards and the protection of people and property. These projects are also given a numeric ranking within the category.

Cost Estimates

Each of the following implementation strategies is provided with a cost estimate. Projects that already have secured funding are noted as such. Where precise financial estimates are not currently available, categories were used with the following assigned dollar ranges:

- **Low** – cost less than $50,000
- **Medium** – cost between $50,000 – $100,000
- **High** – cost over $100,000

Cost estimates take into account the following resources:

- City staff time for grant application and administration (at a rate of $25 per hour)
- Consultant design and construction cost (based on estimates for projects obtained from City and general knowledge of previous work in City)
- City staff time for construction, maintenance, and operation activities (at a rate of $25 per hour)

Project Timeline

Each strategy is provided with an estimated length of time it will take for implementation. Where funding has been secured for the project, a specific future date is provided for when completion will occur. However, some projects do not currently have funding and thus it is difficult to know exactly when they will be completed. For these projects, an estimate is

provided for the amount of time it will take to complete the project once funding becomes available.

Previously Identified and New Strategies Prioritized by Holyoke								
Action	**Description**	**Status**	**Hazards Mitigated**	**Responsible Agency**	**Priority**	**Cost**	**Funding Source**	**Timeframe**
Disseminate Public Safety Information	Disseminate literature about natural hazards – including a "home survival kit," how to prepare homes and structures for natural disasters, and proper evacuation procedures - through social media.	In progress	All	Fire Dept. / EMD	Medium	Low	EMPG grants	Under 6 months
Adopt Community Rating System	Evaluate whether to become a part of FEMA's Community Rating System.	Not started	Flooding		Low	Low		1-2 years
Acquire Snow Melter	Acquire snow melter.	In progress	Snowstorms	DPW	High	High	HMG	Under 6 months
Update Zoning Regulations for Telecommunications Facilities	In the zoning regulations for Telecommunications Facilities, consider adding safety and prevention of wind-related damage as a stated purpose. Mandate emergency equipment on telecommunication towers.	In progress	Snowstorms Ice storms Wind / tornadoes Severe thunderstorms		Medium	Low		1-2 years
Evaluate Buildings for Earthquake Resistance	Evaluate City Hall and other shelters to determine if they are earthquake resistant.	Not started	Earthquakes		Low	Low		1-2 years
Conduct Dam Repair	Repair Whiting Street Reservoir Dam.	Not started	Dam Failure Floods	HWW	High	High	HMG	2 years

Previously Identified and New Strategies Prioritized by Holyoke								
Action	**Description**	**Status**	**Hazards Mitigated**	**Responsible Agency**	**Priority**	**Cost**	**Funding Source**	**Timeframe**
			Hurricanes					
Modify stoplog structures	Modify/update flood control stoplog structures throughout city levee system (17), as listed in city flood plan.	Not started	Flooding	DPW	Very high	High	HMG	1-2 years
Update generator for War Memorial Shelter.	Modify/replace generator for War Memorial Shelter.	Not started	All	DPW	Very high	Medium	HMG, EMPG, Green Communities	1-2 years
Develop access agreement for Mt. Tom telecommunications	Develop an agreement with state police and other relevant landowners/agencies (such as DCR) for road or helicopter access to repair telecommunications towers as needed after natural hazards.	Not started	Wind Tornadoes Severe Thunderstorms Snowstorms Ice Storms Hurricanes	EMD/Fire Dept.	Medium	Low		Less than 6 months
Build flood barriers (1)	Build flood barriers around the computer center sever farm on Water Street.	Not started	Flooding	HG&E	High	High	HMG	1 year
Build flood barriers (2)	Build flood barriers at the North Canal substation.	Not started	Flooding	HG&E	High	High	HMG	1 year
Conduct community risk assessment	Create inspection positions to conduct a community risk assessment to assess	Not started	All hazards					

Previously Identified and New Strategies Prioritized by Holyoke								
Action	**Description**	**Status**	**Hazards Mitigated**	**Responsible Agency**	**Priority**	**Cost**	**Funding Source**	**Timeframe**
	deficient buildings and municipal inventory in natural hazards.							
Create multi-department plan	Develop a multi-departmental coordination plan for Reverse 911	Not started	All hazards	EMD		Low		

6 – PLAN REVIEW, EVALUATION, IMPLEMENTATION, AND ADOPTION

Plan Adoption

Upon completion of the draft Hazard Mitigation Plan, a public meeting was held on December 14, 2015, to request comments. The Hazard Mitigation Plan was then submitted to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency for their review. Upon receiving conditional approval of the plan by FEMA, the plan was presented to the City's City Council and adopted.

Plan Implementation

The implementation of this plan began upon its formal adoption by the City Council and approval by MEMA and FEMA. Those City departments and boards responsible for ensuring the development of policies, Ordinance revisions, and programs as described in Sections 5 and 6 of this plan will be notified of their responsibilities immediately following approval. The City's Hazard Mitigation Workgroup will oversee the implementation of the plan.

Incorporation with Other Planning Documents

Existing plans, studies, reports and technical information were incorporated throughout the planning process. This included a review and incorporation of significant information from the following key documents:

- *Holyoke Open Space and Recreation Plan* – this Plan was used to identify the natural context within which the Holyoke mitigation planning would take place. This proved useful insofar as it identified water bodies, rivers, streams, infrastructure components (i.e. water and sewer, or the lack thereof), as well as population trends. This was incorporated to ensure that the City's mitigation efforts would be sensitive to the surrounding environment. During the OSRP update, the City can use the work of the PDM Plan to incorporate identified hazard areas into open space and recreation planning. This could either take the form of acquiring parcels of land that are currently un-developed, but situated within an identified hazard area, as permanent open space, thereby minimizing the likelihood that critical infrastructure components will be constructed in an area prone to damage from natural hazards.

- *Holyoke Zoning Ordinance* - The City's Zoning Ordinance was used to gather identify those actions that the City is already taking that are reducing the potential impacts of a natural hazard (i.e. floodplain regulations) to avoid duplicating existing successful efforts.

- *State of Massachusetts -Hazard Mitigation Plan* - This plan was used to insure that the City's PDM was consistent with the State's Plan.

As the City of Holyoke creates new and updates existing planning documents, this plan and its implementation strategies will be incorporated as applicable. This process will be ongoing and part of the standard practice of reviewing other plans to ensure consistency between plans.

Plan Monitoring and Evaluation

The City's Emergency Management Director or his designee will call meetings of all responsible parties to review plan progress an annual basis in each of the following years: 2016, 2017, 2018, 2019, 2020 and as needed (*i.e.*, following a natural disaster). The public will be notified of these meetings in advance through a posting of the agenda at City Hall. Responsible parties identified for specific mitigation actions will be asked to submit their reports in advance of the meeting. Meetings will entail the following actions:

- Review events of the year to discuss and evaluate major issues, effectiveness of current mitigation, and possible mitigation for future events.
- Assess how the mitigation strategies of the plan can be integrated with other City plans and operational procedures, including the Zoning Ordinance and Emergency Management Plan.
- Review and evaluate progress toward implementation of the current mitigation plan based on reports from responsible parties.
- Amend current plan to improve mitigation practices.

Following these discussions, it is anticipated that the Workgroup may decide to reassign the roles and responsibilities for implementing mitigation strategies to different City departments and/or revise the goals and objectives contained in the plan. The Workgroup will review and update the Hazard Mitigation Plan every five years. The next updated plan will be submitted to MEMA and FEMA in the spring of 2020.

Appendix A – Technical Resources

1) Agencies

Massachusetts Emergency Management Agency
(MEMA)……..508/820-2000
Hazard Mitigation Section.....617/626-1356
Federal Emergency Management Agency (FEMA).....617/223-4175
MA Regional Planning Commissions:
Berkshire Regional Planning Commission (BRPC)…… ……..413/442-1521
Cape Cod Commission (CCC)…… ……...508/362-3828
Central Massachusetts Regional Planning Commission (CMRPC) …… 508/693-3453
Franklin Regional Council of Governments (FRCOG)…… ……..413/774-3167
Martha's Vineyard Commission (MVC)…… ……508/693-3453
Merrimack Valley Planning Commission (MVPC)…… ……..978/374-0519
Metropolitan Area Planning Council (MAPC)…….. ……..617/451-2770
Montachusett Regional Planning Commission (MRPC)…… ……978/345-7376
Nantucket Planning and Economic Development Commission (NP&EDC) …….508/228-7236
Northern Middlesex Council of Governments (NMCOG)……978/454-8021
Old Colony Planning Council (OCPC)…… ……..508/583-1833
Pioneer Valley Planning Commission (PVPC)…… ……..413/781-6045
Southeastern Regional Planning and Economic Development District (SRPED..508/823-1803
MA Board of Building Regulations & Standards (BBRS)…… ……617/227-1754
MA Coastal Zone Management (CZM)…… ……617/626-1200
DCR Water Supply Protection……617/626-1379
DCR Waterways……617/626-1371
DCR Office of Dam Safety……..508/792-7716
DFW Riverways……617/626-1540
MA Dept. of Housing & Community Development……617/573-1100
Woods Hole Oceanographic Institute……508/457-2180
UMass-Amherst Cooperative Extension……413/545-4800
National Fire Protection Association (NFPA)…… ……617/770-3000
New England Disaster Recovery Information X-Change (NEDRIX – an association of private companies & industries involved in disaster recovery planning)…… ……781/485-0279
MA Board of Library Commissioners……617/725-1860
MA Highway Dept, District 2……413/582-0599
MA Division of Marine Fisheries……617/626-1520
MA Division of Capital & Asset Management (DCAM)…… ……617/727-4050
University of Massachusetts/Amherst……413/545-0111
Natural Resources Conservation Services (NRCS)…… ……413/253-4350
MA Historical Commission……617/727-8470
U.S. Army Corps of Engineers……978/318-8502

Northeast States Emergency Consortium, Inc. (NESEC).....781/224-9876
National Oceanic and Atmospheric Administration: National Weather Service….508/824-5116
US Department of the Interior: US Fish and Wildlife Service 413/253-8200
US Geological Survey.....508/490-5000

2) Mitigation Funding Resources

404 Hazard Mitigation Grant Program (HMGP) ……..MEMA
406 Public Assistance and Hazard Mitigation .....MEMA
Community Development Block Grant (CDBG)……..DHCD, also refer to RPC
Dam Safety Program.....MA Division of Conservation and Recreation
Disaster Preparedness Improvement Grant (DPIG) ……..MEMA
Emergency Generators Program by NESEC‡ .....MEMA
Emergency Watershed Protection (EWP) Program.....USDA, Natural Resources Conservation
Service Flood Mitigation Assistance Program (FMAP)……..MEMA
Flood Plain Management Services (FPMS).....US Army Corps of Engineers
Mitigation Assistance Planning (MAP).....MA Emergency Management Agency
Mutual Aid for Public Works.....Western Massachusetts Regional Homeland Security Advisory Council
National Flood Insurance Program (NFIP) † ……..MA Emergency Management Agency
Power of Prevention Grant by NESEC‡ .....MA Emergency Management Agency
Roadway Repair & Maintenance Program(s).....MassDOT
Section 14 Emergency Stream Bank Erosion & Shoreline Protection .....US Army Corps of Engineers
Section 103 Beach Erosion……..US Army Corps of Engineers
Section 205 Flood Damage Reduction……..US Army Corps of Engineers
Section 208 Snagging and Clearing ……..US Army Corps of Engineers
Shoreline Protection Program……MA Department of Conservation and Recreation
Various Forest and Lands Program(s).....MA Department of Environmental Protection
Wetlands Programs .....MA Department of Environmental Protection

‡NESEC – Northeast States Emergency Consortium, Inc. is a 501(c)(3), not-for-profit natural disaster, multi-hazard mitigation and emergency management organization located in Wakefield, Massachusetts. Please, contact NESEC for more information.

† Note regarding National Flood Insurance Program (NFIP) and Community Rating System (CRS): The National Flood Insurance Program has developed suggested floodplain management activities for those communities who wish to more thoroughly manage or reduce the impact of flooding in their jurisdiction. Through use of a rating system (CRS rating), a community's floodplain management efforts can be evaluated for effectiveness. The rating, which indicates an above average floodplain management effort, is then factored into the premium cost for flood insurance policies sold in the community. The higher the rating achieved in that community, the greater the reduction in flood insurance premium costs for local property owners. MEMA can provide additional information regarding participation in the NFIP-CRS Program.

3.

3) Internet Resources

Sponsor	Internet Address	Summary of Contents
Natural Hazards Research Center, U. of Colorado	http://www.colorado.edu/litbase/hazards/	Searchable database of references and links to many disaster-related websites.
Atlantic Hurricane Tracking Data by Year	http://wxp.eas.purdue.edu/hurricane	Hurricane track maps for each year, 1886 – 1996
National Emergency Management Association	http://nemaweb.org	Association of state emergency management directors; list of mitigation projects.
NASA – Goddard Space Flight Center "Disaster Finder:	http://www.gsfc.nasa.gov/ndrd/dis aster/	Searchable database of sites that encompass a wide range of natural disasters.
NASA Natural Disaster Reference Database	http://ltpwww.gsfc.nasa.gov/ndrd/main/html	Searchable database of worldwide natural disasters.
U.S. State & Local Gateway	http://www.statelocal.gov/	General information through the federal-state partnership.
National Weather Service	http://nws.noaa.gov/	Central page for National Weather Warnings, updated every 60 seconds.
USGS Real Time Hydrologic Data	http://h20.usgs.gov/public/realtime.html	Provisional hydrological data
Dartmouth Flood Observatory	http://www.dartmouth.edu/artsci/geog/floods/	Observations of flooding situations.
FEMA, National Flood Insurance Program, Community Status Book	http://www.fema.gov/fema/csb.html	Searchable site for access of Community Status Books
Florida State University Atlantic Hurricane Site	http://www.met.fsu.edu/explores/tropical.html	Tracking and NWS warnings for Atlantic Hurricanes and other links
The Tornado Project Online	http://www.tornadoroject.com/	Information on tornadoes, including details of recent impacts.
National Severe Storms Laboratory	http://www.nssl.uoknor.edu/	Information about and tracking of severe storms.
Independent Insurance Agents of America IIAA Natural Disaster Risk Map	http://www.iiaa.iix.com/ndcmap.html	A multi-disaster risk map.
Earth Satellite Corporation	http://www.earthsat.com/	Flood risk maps searchable by state.
USDA Forest Service Web	http://www.fs.fed.us/land	Information on forest fires and land management.

4.

Appendix B – Documentation of the Planning Process

Appendix C – List of Acronyms

FEMA	Federal Emergency Management Agency
MEMA	Massachusetts Emergency Management Agency
PVPC	Pioneer Valley Planning Commission
EPA	Environmental Protection Agency
DEP	Massachusetts' Department of Environmental Protection
NWS	National Weather Service
HMGP	Hazard Mitigation Grant Program
FMA	Flood Mitigation Assistance Program
SFHA	Special Flood Hazard Area
CIS	Community Information System
DCR	Massachusetts Department of Conservation and Recreation
FERC	Federal Energy Regulatory Commission
TRI	Toxics Release Inventory
FIRM	Flood Insurance Rate Map
NFIP	National Flood Insurance Program
CRS	Community Rating System
BOS	Board of Selectmen
DPW	Department of Public Works
LEPC	Local Emergency Planning Committee
EMD	Emergency Management Director
Con Com	Conservation Commission
Ag Com	Agricultural Commission
EOC	Emergency Operations Center
CEM Plan	Comprehensive Emergency Management Plan
EMA	Emergency Management Agency
RACES	Radio Amateur Civil Emergency Service
WMECO	Western Massachusetts Electric Company
HAZMAT	Hazardous Material

Appendix D – Past and Potential Hazards/Critical Facilities Map

CERTIFICATE OF ADOPTION

City of Holyoke, Massachusetts

A RESOLUTION ADOPTING THE City of Holyoke Hazard Mitigation Plan Update

WHEREAS, the City of Holyoke established a Workgroup to update the City's Hazard Mitigation plan; and

WHEREAS, the City of Holyoke participated in the update of the Holyoke Hazard Mitigation Plan;

and WHEREAS, the City of Holyoke Hazard Mitigation Plan Update 2015 contains several potential future projects to mitigate potential impacts from natural hazards in the City of Holyoke, and

WHEREAS, a duly-noticed public meeting was held by the City Council on _____ for the public and municipality to review prior to consideration of this resolution; and

WHEREAS, the City of Holyoke authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Holyoke City Council (or Mayor--need to decide) formally approves and adopts the City of Holyoke Hazard Mitigation Plan Update 2015, in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this _____

ATTEST