Disaster Preparedness and Planning Project (DP3)

Baltimore is highly vulnerable to many natural hazards, ranging from coastal storms and flooding to extreme heat and high winds. There is strong consensus that these types of extreme events will increase, both in frequency and intensity, over the coming years. Furthermore, Baltimore's climate is changing. In the past century, the City has observed shifting trends in weather patterns and climate conditions. Projected changes in the local climate, such as relative seal level rise, combined with impacts from natural hazards events will affect larger areas of the City and threaten regionally significant assets.

Recognizing the City's current vulnerability to the impacts of severe hazard events, Baltimore has undertaken a thorough, forward-thinking approach to the hazard mitigation planning process. Baltimore's Disaster Preparedness and Planning Project (DP3) was created by the Department of Planning as an effort to address existing hazards while simultaneously preparing for predicted hazards due to climate change. This project develops a program that integrates hazards mitigation planning, floodplain mapping, and climate adaptation planning. DP3 links research, outreach, and actions to assure implementation of a comprehensive and new risk-preparedness system for addressing existing and future impacts.

Integrating hazard mitigation planning, which focuses on past events, with climate adaptation planning, which focuses on what will likely happen in the future, offers an innovative solution for Baltimore City. Completing a detailed inventory of natural hazards, a risk assessment, and a vulnerability analysis, informs actions to mitigate hazards and adapt to predicted climate impacts. This provides clear guidance and a unified strategy that supports Baltimore's sustainability and resilience.

In 2000, the President signed into law the Disaster Mitigation Act of 2000 (DMA 2000) in order to reduce the damages associated with natural hazards. The Federal Emergency Management Agency (FEMA) requires that every local jurisdiction in the United States develop and adopt an All Hazards Mitigation Plan (AHMP) as a condition to be eligible for disaster-related assistance. While FEMA requires that local governments update their AHMPs every five years, this plan is much more than a routine update.

An Advisory Committee consisting of representatives from environmental, non-profit, labor, business, community, and developer groups as well as local, state and federal government was developed to advise and provide expertise throughout the process. The charge to the committee was to develop recommendations to the Mayor on set of goals, strategies and actions the City of Baltimore should implement to reduce risk and increase resiliency. The entire Committee met four times and six times as subcommittees (infrastructure, buildings, natural systems, and public services) throughout the process.

Document Approval Timeline

Disaster Preparedness and Planning Project kickoff	October 1, 2012
Town Hall Meeting I	April 30, 2013
Vision, Goals, Strategies and Actions Draft online	July 18, 2013
Town Hall Meeting II	July 30, 2013
Draft Plan online	August 21, 2013

Proposed Plan presentation and adoption by Sustainability Commission	August 27, 2013
Proposed Public Hearing and Plan adoption by Planning Commission	September 19, 2013

Our Process:

The DP3 project will utilize the following process for plan development:

1. Identify and profile existing hazards.
2. Conduct an inventory that identifies all assets such as hospitals, schools, etc.
3. Utilize modeling to identify risk from existing hazards and predicted climate impacts.
4. Complete a vulnerability analysis of identified assets and critical facilities. Identify exposure, sensitivity and adaptive capacity.
5. Identify actions and recommendations to deal with existing hazards and predicted impacts.
6. Develop implementation plans for these actions, as well as recommendations for stakeholder involvement and funding strategies.

In order to determine the most feasible and effective mitigation and adaptation recommendations for Baltimore, natural hazards which threaten the City had to be identified and defined, and their impacts analyzed. In Baltimore, the following hazards were considered to pose a significant threat:

- Flooding
- Coastal Hazards- Tropical Storms and Hurricanes, Nor'easter, Sea Level Rise, and Storm Surge & Coastal Inundation
- Precipitation Variability- Precipitation, Winter Storms, Drought, Dam Failure
- Extreme Wind- Associated with Storms, Derechos, Tornados
- Extreme Heat
- Air Quality
- Additional Hazards- Earthquakes, Lightning and Hail, Tsunamis

The Impact Assessment not only identifies those hazards which are likely to affect Baltimore, but also notes the extent and severity of historic events as well as identifies potential changes in the severity of each hazard due scientific climate change projections.

Following the Impact Assessment, the Risk and Vulnerability Assessment chapter describes the risk and vulnerability associated with each type of hazard, including any higher risks associated with increased severity under future climate conditions. Furthermore, it notes specific community assets or critical facilities which may be threatened more than others.

The following goals, strategies and actions are a comprehensive list drafted by the Advisory Committee of experts and advisors. It is a framework document that will be used to draft the content for our entire plan. **Keep in mind, while looking at the goals, strategies and actions, there will be a significant amount of content added to provide clarity and further explain the purpose of the recommendation.**

The goal of the Disaster Preparedness and Planning Project is to provide clear guidance to city government and our citizens to develop a unified strategy for both hazard mitigation and climate adaptation that supports Baltimore's sustainability and resilience.

Sectors

One of the most pressing challenges facing municipalities today is the quality and capacity of built public **infrastructure**—the water systems, schools and municipal buildings, transit systems, and other core assets upon which we all depend. Inadequate or failing public infrastructure will negatively impact the City's growth. Already, infrastructure in Baltimore has been proven vulnerable to unpredictable, extreme weather events. Extreme heat, and cold, for instance, leads to breaks in the water main system, causing localized flooding that damages surrounding buildings and roadways. Preparing infrastructure for these changes will not only minimize Baltimore's risk and vulnerability, it will also establish a resilient infrastructure network that is able to endure or adapt to the impacts of climate change.

Baltimore's **buildings**, some of which have been significant features in their communities for decades or even centuries, add vibrant charm to the City. In the past, Baltimore's building stock has been subject to weather-related risks, such as flooding associated with extreme precipitation events. Flooding has caused a great deal of damage, buildings may be destroyed — entirely or in part — or rendered unstable. Resilience of Baltimore's building stock is particularly important considering that many structures serve as refuge for City residents during severe storms and other extreme weather events. Similarly, critical emergency facilities — hospitals, fire stations, police stations, government buildings— perform essential functions during these events and increase the City's capacity to respond to, and alleviate, the impacts of a hazard. Additionally, the recommended actions intend to mitigate climate change impacts *from* buildings by improving energy and resource conservation. The strategies within this plan aim to protect buildings from current and future climate risks by increasing their resiliency.

Although **natural systems** will indeed suffer adverse consequences as a result of climate change, this plan primarily embraces nature for its potential as a hazard mitigation and climate adaptation tool. In many cases, natural features are capable of offsetting greenhouse gases and alleviating the severity of weather events, effectively reducing long-term risks from climate change and hazards. On the other hand, if not properly maintained, natural elements may themselves become a danger during an extreme weather event. The strategies proposed in this plan aim to identify how and where nature may be managed to the City's benefit, and what actions must be taken to eliminate all avoidable risks associated with neglected natural systems.

A major role of this plan is to expand Baltimore's preparedness for future hazards. Without a strategy for conveying information about the risks and vulnerabilities associated with these hazards, its message will fall on deaf ears. Therefore, strategies relating to **public health and human services** are concerned with distributing information, building resources, improving communication, and establishing response plans. Additionally, strategies are set in place that will prevent or limit health risks — including disease outbreak, physical exhaustion, and respiratory conditions, to name a few — that are triggered by extreme events. Effective public health strategies will ensure that all of Baltimore's population is prepared, well-informed and able to safely respond to hazards.

VISION

Baltimore will be a city whose daily activities reflect a commitment shared by government, business, and citizens to reduce or eliminate impacts from current and future natural hazards.

GOALS

Goal 1 Protect the health, safety and welfare of Baltimore City residents and visitors

Goal 2 Prevent damage to structures, infrastructure, and critical facilities

Goal 3 Build resilience and disaster prevention and planning into all programs, policies, and infrastructure (public and private)

Goal 4 Enhance the City of Baltimore's adaptive capacity and build institutional structures that can cope with future conditions that are beyond past experience

Goal 5 Promote hazard mitigation and climate adaptation awareness and education throughout the City of Baltimore

Goal 6 Become a Community Rating System (CRS) classified community

STRATEGIES AND ACTIONS (BY SECTOR)

Infrastructure:

One of the most pressing challenges facing municipalities today is the quality and capacity of built public **infrastructure**—the water systems, schools and municipal buildings, transit systems, and other core assets upon which we all depend. Inadequate or failing public infrastructure will negatively impact the City's growth. Already, infrastructure in Baltimore has been proven vulnerable to unpredictable, extreme weather events. Extreme heat, and cold, for instance, leads to breaks in the water main system, causing localized flooding that damages surrounding buildings and roadways. Preparing infrastructure for these changes will not only minimize Baltimore's risk and vulnerability, it will also establish a resilient infrastructure network that is able to endure or adapt to the impacts of climate change.

ENERGY

Strategy IN-1: Protect and enhance the resiliency and redundancy of electricity system

Action1: Work with the Maryland Public Service Commission (PSC) to minimize power outages from the local utility during extreme weather events by identifying and protecting critical energy facilities located within the City

Action 2: Evaluate the City of Baltimore utility distribution system, and identify "underground utility districts" using BGE's May 2013 short term reliability improvement plan

Action 3: Support BGE's collaboration with the Maryland Public Service Commission to implement various smart grid solutions that will provide the City with real-time access to data during events

Action 4: Identify, harden and water seal critical infrastructure relative to electrical, heating, and ventilation hardware within the flood plain

Action 5: Increase resiliency in our energy generation system by encouraging the development of decentralized power generation and developing fuel flexibility capabilities

Action 6: Develop a comprehensive maintenance and training program for City employees at facilities with backup generators to ensure proper placement, hook-up and ability to use during hazard events
Action 7: Install external generator hookups for critical City facilities that depend on mobile generators for backup power
Action 8: Partner with the Public Service Commission and the local electric utility to evaluate protecting power and utility lines from all hazards
Action 9: Determine low-laying substation vulnerability and outline options for adaptation and mitigation
Action 10: Evaluate and protect low laying infrastructure - switching vaults, conduit and transformers

Strategy IN-2: Increase energy conservation efforts
Action 1: Increase energy efficiency across all public and private sectors through education, efficiency retrofits, and building management systems
Action 2: Encourage critical facilities and institutions to connect to existing cogeneration systems, or develop new cogeneration systems
Action 3: Continue the City's electricity demand-response program during peak usage or pre-blackout periods

Strategy IN-3: Ensure backup power generation for critical facilities and identified key infrastructure during power outages
Action 1: Investigate off-grid, on-site renewable energy systems, generators, and technologies for critical facilities to ensure redundancy of energy systems
Action 2: Seek funding to purchase and install generators for all city building designated as critical to agency functions
Action 3: Develop Combined Heat and Power (CHP) co-generation plants at identified critical facilities
Action 4: Evaluate and ensure backup power generation is available to healthcare facilities (nursing homes, critical care facilities, hospitals, etc.)

LIQUID FUELS:

Strategy IN-4: Protect and manage liquefied natural gas sites and (City) fueling stations before and during hazard events
Action 1: Work with BGE to ensure existing preparedness plans for Spring Gardens liquefied natural gas site incorporate its vulnerability to present and predicted flooding, storm surge and sea level rise
Action 2: Adopt building code that requires anchoring of 50 gallon storage tanks or larger
Action 3: Work with BEG to monitor efforts to protect the natural gas system against flooding

Strategy IN-5: Evaluate and improve resiliency of liquid fuels infrastructure
Action 1: Design and implement a generator program that assists private gas stations in securing backup generators, especially those stations along major evacuation routes
Action 2: Increase and ensure fuel availability during distribution disruptions
Action 3: Ensure fuel for generators and delivery priority is given to critical facilities and emergency responders

COMMUNICATION SYSTEMS

Strategy IN-6: Evaluate and improve resiliency of communication systems that are in place for sudden extreme weather events

- Action 1: Utilize new technologies such as fiber optics, external hook-ups, and mobile generators to improve resiliency
- Action 2: Build redundancy into all public and inter-agency warning and communication systems
- Action 3: Identify best practices for the installation and management of flood proofing of all communications infrastructure at risk of water damage
- Action 4: Implement additional nurse triage phone lines at community health centers to reduce medical surge on hospitals
- Action 5: Evaluate and improve early warning systems for hazard events
- Action 6: Ensure continued operation of city governments various computer mainframes for email, control systems, and internet service during a hazard event
- Action 7: Identify shared communication technology for emergency responders and government agencies to ensure continued and coordinated communication during emergency events

TRANSPORTATION

Strategy IN-7: Integrate climate change into transportation design, building and maintenance

- Action 1: Determine the coastal storm vulnerability and complete an exposure assessment of City transportation assets
- Action 2: Improve stormwater management, operations and maintenance for stream flooding that erodes away bridge supports
- Action 3: Incorporate compliance with earthquake standards to withstand a magnitude eight earthquake for all new, improved and rebuilt bridges
- Action 4: Design bridge expansion joints for longer periods of high heat and develop a more robust inspection and maintenance process
- Action 5: Research utilizing the Envision Rating System and Greenroads Rating System for all new infrastructure and road projects
- Action 6: Identify, investigate, and incorporate Best Management Practices related to transportation design, construction and maintenance

Strategy IN-8: Identify additional alternative routes and modes for effective transport and evacuation efforts during emergency situations

- Action 1: Evaluate existing evacuation systems and develop a comprehensive evacuation plan
- Action 2: Coordinate evacuation plans with regional partners
- Action 3: Develop and prioritize clearance of specified transportation routes for delivery of emergency response supplies
- Action 4: Educate the public on the dangers of driving through flooded roads

Strategy IN-9: Alter transportation systems in flood-prone areas in order to effectively manage stormwater

- Action 1: Prioritize infrastructure upgrades for roads identified at risk of flooding through the use of elevation data and Sea, Lake and Overland Surges from Hurricanes (SLOSH) model results

Action 2: Raise streets in identified flood prone areas as they are redeveloped
Action 3: Encourage development of Green Streets in flood prone areas and throughout the city
Action 4: Encourage use of permeable pavement in non-critical areas – low-use roadways, sidewalks, parking lots and alleys
Action 5: Add pumps or other mitigation alternatives to streets as they are redeveloped (if needed)
Action 6: Assess need for new culvert capacity and identify where upgrades are needed
Action 7: Conduct an in-depth analysis of the impacts of drain fields that feed the harbor
Action 8: Expand and reinforce existing stormwater education programs
Action 9: Design and implement floodgates and barriers in transportation tunnels
Action 10: Encourage Federal and State Government to design and install floodgates and barriers at vulnerable transportation tunnels
Action 11: Upgrade floodgate hardware and mechanisms to control rate of water into all city tunnels

Strategy IN-10: Ensure structural stability of all transportation tunnels to reduce impact from seismic activity

Action 1: Repair cracks and leaks in all tunnels to reduce impact of seismic activity
Action 2: Follow Federal, State and Local criteria for the stabilization of Historic transportation tunnels (e.g. Howard Street)
Action 3: Install a seismically resistant fire standpipe, air monitoring, and automatic valve system in all City tunnels to provide a fully automated and monitored fire suppression system

Strategy IN-11: Evaluate changes to road maintenance and construction materials based on anticipated changes in climate

Action 1: Develop a repaving strategy that reduces damage to asphalt and incorporates better maintenance and operations
Action 2: Develop a reconstruction and repair strategy that reduces damage to concrete and incorporates better maintenance and operations
Action 3: Develop deicing strategies and materials that are effective in extreme cold temperatures and prolonged events to stabilize roadway and bridge surfaces
Action 4: Design pavement sections and materials that withstand longer periods of extreme heat events

WATERFRONT

Strategy IN-12: Enhance the resiliency of the City's waterfront to better adapt to impacts from hazard events and climate change

Action 1: Raise bulkhead height along shoreline areas most at risk
Action 2: Stabilize and armor unprotected shorelines with vegetation and/or stone
Action 3: Encourage the development of integrated flood protection systems that use structural (engineering) and non-structural (wetlands) measures
Action 4: Review and enhance coastal area design guidelines to better mitigate the impacts of flooding
Action 5: Enhance and strengthen waterfront zoning and permitting

WASTEWATER

Strategy IN-13: Increase the resilience of all wastewater systems and protect them from current and projected extreme weather events

- Action 1: Ensure all water and wastewater pumping stations have off-grid, on-site energy sources and/or reliable backup power sources by increasing the number of backups and pulling from different grids
- Action 2: Evaluate the sewer system to identify and develop key areas for disinfection of raw sewage overflows
- Action 3: Develop and adopt increased level of protection for construction, redevelopment, and design of all water and wastewater facilities to account for future climate projections
- Action 4: Retrofit and harden low-laying pumping stations and treatment plants
- Action 5: Ensure effective operations and security for wastewater treatment plants if facilities are overwhelmed by hazard event
- Action 6: Establish protocols and capability for disinfecting raw sewage if treatment is not possible
- Action 7: Improve stormwater and waste water infrastructure to prevent flooding from overflows
- Action 8: Conduct an assessment of the City's current water and wastewater system to identify age, condition of infrastructure, capacity, weaknesses and areas for priority upgrades
- Action 9: Conduct and utilize a detailed risk assessment to determine vulnerability of the City's sewage treatment plants
- Action 10: Determine how high the sewage treatment buildings are, what the tanks are made of, and if the plant is at risk of back flow
- Action 11: Retrofit wastewater treatment facility and methane gas storage system to withstand seismic activity. Design facility to exceed current building codes

Strategy IN-14: Integrate resiliency, redundancy, and structural stability into the City's drinking water system to ensure safe and reliable water storage and distribution

- Action 1: Repair leaks and improve connection from all City reservoirs and the Susquehanna River
- Action 2: Provide water conservation education, and continue to protect our watersheds to assist in maintaining water quality
- Action 3**:** Ensure dam emergency plans account for impacts of climate change, including changes in the intensity and duration or precipitation events
- Action 4: Identify and document post damage responsibilities in memorandums of understanding as addendums to reservoir watershed management agreement
- Action 5**:** Review dam capacity, load and failure points and review them against 1,000 year and 10,000 year precipitation events
- Action 6: Conduct a study to determine seismic design standards and seismic resiliency of drinking water distribution system (tunnels, piping, clean water pump stations, dams, shafts, and tanks)
- Action 7: Increase stormwater recharge areas and quantity management
- Action 8: Evaluate the impacts of sediment loading on reservoir capacity
- Action 9 Manage watershed forests to provide maximum benefits for water quality and to maintain resiliency during extreme weather events

Action 10: Adopt new policies on salt application and storage to prevent high salinization on drinking water supplies and into nearby water bodies
Action 11: Establish a structured Firming Program to maintain adequate storage and water quality in the source-water reservoirs during drought conditions
Action 12: Maintain appropriate agreements with Susquehanna River Basin Commission (SRBC) and the Exelon Power Company to ensure adequate water withdraws from the Susquehanna River during drought emergency

Strategy IN-15: Conduct an assessment that evaluates and improves all underground utilities ability to withstand extreme heat and cold and higher water tables
Action 1: Replace old and malfunctioning pipes with new pipes or retrofit existing pipes with new lining
Action 2: Evaluate and utilize new technology that allows for greater flexibility in pipes as they are replaced

STORMWATER

Strategy IN-16: Enhance and expand stormwater infrastructure and systems
Action 1: Implement the requirements of Baltimore's MS4 (separate stormwater and sewer system) permit
Action 2: Prioritize storm drain upgrades and replacement in areas with reoccurring flooding
Action 3: Install backflow-prevention devices or other appropriate technology along waterfront to reduce flood risk
Action 4: Preserve and protect natural drainage corridors
Action 5: Review and revise storm drain design on a continuous basis, to accommodate projected changes in intense rainfall

Strategy IN-17: Modify urban landscaping requirements and increase permeable surfaces to reduce stormwater runoff
Action 1: Evaluate existing stormwater requirements and increase them to incorporate Environmental Site Design (ESD) regulations
Action 2: Incorporate urban landscaping requirements and permeable surfaces into community managed open spaces
Action 3: Increase green building requirements for all new construction
Action 4: Require vegetative roofs for all new commercial, industrial, multifamily, and city-owned development
Action 5: Utilize vegetative roofs, rain gardens and bioswales to capture water
Action 6: Require water conservation requirements such as rain barrels and cisterns on City-owned properties, and residential, commercial and industrial properties
Action 7: Require permeable paving on low-use pathways

Strategy IN-18: Evaluate and support DPW's stream maintenance program
Action 1: Review and improve status of standing maintenance requirements
Action 2: Review maintenance funding opportunities to ensure adequate funding
Action 3: Identify opportunities where stream restoration efforts will off-set maintenance costs
Action 4: Identify interdependencies and benefits of the stream maintenance program with other transportation programs

Action 5: Clear streams on a regular basis, prioritize dredging the stream beds, and increase inspection and cleaning of culverts and storm drains to prevent flooding

Action 6: Develop interagency cooperation and cross functional teams to develop and implement stream maintenance and restoration

Strategy IN-19: Support and increase coordination and information sharing across jurisdictions to better enable mitigation of cross-border impacts on the regions' watersheds (e.g., understanding flood conditions upstream in the County)

Action 1: Partner with local counties to evaluate major tributaries in all watersheds to determine best management practices for capturing run-off and slowly releasing it (stormwater quantity management)

Action 2: Encourage information sharing within the Chesapeake Bay community to assist in developing best management practices

SOLID WASTE

Strategy IN-20: Reevaluate and support a comprehensive debris management plan for hazard events

Action 1: Investigate best practices and establish interagency cooperative relationships for efficient and cost effective disposal of downed trees, yard waste, building debris, hazardous waste and household garbage

Action 2: Expand and integrate existing programs to reduce or intercept debris before it gets into the streams and harbor

Action 3: Develop and promote solid waste management actions for citizens to implement before a hazard event

POLICY AND GOVERNMENT DECISION-MAKING

Strategy IN-21: Encourage the integration of climate change and natural hazards into private and State planning documents, systems, operations, and maintenance

Action 1: Incorporate consideration of hazards and climate adaptation measures or planning principles into all plans, systems, operations, and maintenance

Action 2: Ensure Red Line planning incorporates adaptation and transportation strategies outlined in the DP3 Plan

Action 3: Ensure hazard scenarios and projected climate impacts, utilized in vulnerability assessments, are at a minimum 25% greater in intensity and impact than historical record events to date

Action 4: Develop resiliency planning guidelines for public and private hospital, health care facilities and other institutional entities (e.g. Universities)

Action 5: Identify and partner with regional air quality institutions to integrate air quality measures and messaging into City policy efforts

Strategy IN-22: Develop City policy which requires new city government capital improvement projects incorporate hazard mitigation principles

Action 1: Discourage new projects in hazard-prone areas such as floodplains or the coastal high hazard area

Action 2: Require that critical facilities be designed and constructed to withstand the 500-year flood projections

Action 3: Use comprehensive infrastructure assessments to identify infrastructure in need of replacement and prioritize funding for those projects

Buildings:

Baltimore's **buildings**, some of which have been significant features in their communities for decades or even centuries, add vibrant charm to the City. In the past, Baltimore's building stock has been subject to weather-related risks, such as flooding associated with extreme precipitation events. Flooding has caused a great deal of damage, buildings may be destroyed — entirely or in part — or rendered unstable. Resilience of Baltimore's building stock is particularly important considering that many structures serve as refuge for City residents during severe storms and other extreme weather events. Similarly, critical emergency facilities — hospitals, fire stations, police stations, government buildings— perform essential functions during these events and increase the City's capacity to respond to, and alleviate, the impacts of a hazard. Additionally, the recommended actions intend to mitigate climate change impacts *from* buildings by improving energy and resource conservation. The strategies within this plan aim to protect buildings from current and future climate risks by increasing their resiliency.

CITY CODES & DESIGN GUIDELINES

Strategy B-1: Develop and implement hazard resilience measures for critical facilities including hospitals, fire stations, police stations, hazardous material storage sites, etc.

Action 1: Require all hazardous materials within the floodplain to be elevated a minimum of three feet above the Base Flood Elevation (BFE)
Action 2: Require new critical facilities to be designed with redundant operating systems
Action 3: Require pre-wiring for generators at all facilities designated critical to agency operations and hazard response
Action 4: Develop stricter resiliency measures or flood mitigation practices for critical facilities
Action 5: Develop partnership with private fueling stations to provide backup generators in exchange for a commitment to fueling emergency response vehicles during a hazard event
Action 6: Ensure storage of and access to diesel fuel for generators in critical facilities
Action 7: Require backup solar powered street lights and signals are integrated along evacuation routes and high traffic areas

Strategy B-2: Enhance building codes that regulate building within a floodplain or near the waterfront

Action 1: Design projects to be resilient to a mid-century sea level rise projection and adaptable to longer-term impacts
Action 2: Incorporate climate change and coastal hazard considerations into building codes by increasing freeboard requirements to two feet as buildings are redeveloped and renovated
Action 3: Continue to regulate to the existing tidal floodplain delineation
Action 4: Incorporate outfall elevation regulations into buildings and natural resource codes
Action 5: Develop Construction Best Practices for development within floodplains
Action 6: Train all code enforcement and building inspectors about flood proofing techniques and the local floodplain ordinance

Strategy B-3: Strengthen city codes to integrate anticipated changes in climate

Action 1: Review zoning code (floodplain, drainage, stormwater management, erosion control) and strengthen code (where necessary) in order to better protect citizens and increase resiliency in buildings
Action 2: Review and amend existing codes to require more flood structures in the floodplain
Action 3: Reduce development in 100-year flood plain
Action 4: Utilize open space category in zoning code to protect sensitive areas (e.g. stormwater sites, steep slopes, floodways, etc.)
Action 5: Review and increase Base Floodplain Elevation (BFE) standards to the highest available State, Federal or local elevation level
Action 6: Evaluate and update stormwater management regulations to avoid increases in downstream flooding
Action 7: Adopt design requirements that include wet and dry flood proofing techniques
Action 8: Review and consider adoption of the International Green Construction code
Action 9: Strengthen city codes to help reduce urban heat island impacts

Strategy B-4: Update a list of flood prone and repetitive loss buildings to consider for acquisition
Action 1: Continue to acquire property (including repetitive loss properties) in the special flood hazard areas where feasible and appropriate
Action 2: Prioritize Hazard Mitigation Assistance funding for mitigation of repetitive loss properties and severe repetitive loss properties
Action 3: Develop a creative financing program to increase the flood resiliency of industrial buildings

STRUCTURAL

Strategy B-5: Improve wind resiliency of new and existing structures
Action 1: Review local building codes to determine if revisions are needed to improve the structures ability to withstand greater wind velocities and storm impacts
Action 2: Retrofit windows in emergency shelter to withstand winds associated with coastal storm events

Strategy B-6: Evaluate various seismic design enhancements using prototypical Baltimore City building types
Action 1: Determine engineering effectiveness and cost-benefit of various earthquake mitigation measures using computer modeling

Strategy B-7: Retrofit existing buildings in the 100-yr floodplain to increase resiliency
Action 1: Develop a creative financing program for residential and commercial properties
Action 2: Encourage flood resiliency retrofits for buildings 25,000 square feet or larger in the 100-yr floodplain
Action 3: Study engineering alternatives where retreat and accommodation are not possible
Action 4: Prioritize retrofitting and increasing resiliency of public housing units in the 100-year floodplain and other high risk areas
Action5: Collaborate with building owners and developers within the floodplain to ensure all electrical, mechanical, and key building systems are above the base flood elevation and meet existing codes

NON-STRUCTURAL

Strategy B-8: Improve resource conservation opportunities in all city owned buildings

Action 1: Install energy-efficient and low-water-use equipment during renovations in all City-owned buildings

Action 2: Support energy efficiency and weatherization as part of Baltimore City schools ten-year plan

Action 3: Update Baltimore green building standards by offering multiple compliance paths for new and substantially renovated construction

Strategy B-9: Provide education about resource conservation within buildings

Action 1: Conduct educational outreach and provide information about savings related to reduced water use

Action 2: Educate and provide resources and information about utility rebate programs

Action 3: Conduct educational outreach and provide information about proper storage and disposal of hazardous materials and heating oil

Action 4: Provide energy efficiency education to include information on conserving electrical power with emphasis on reductions during summer peak demand hours

Strategy B-10: Use HAZUS-MH computer modeling to determine losses generated by coastal storms

Action 1: Utilize engineering studies and cost-benefit analyses to generate additional mitigation measures

Action 2: Evaluate various building design enhancements to reduce losses generated by earthquakes, floods, and storm surge

Natural Systems:

Although **natural systems** will indeed suffer adverse consequences as a result of climate change, this plan primarily embraces nature for its potential as a hazard mitigation and climate adaptation tool. In many cases, natural features are capable of offsetting greenhouse gases and alleviating the severity of weather events, effectively reducing long-term risks from climate change and hazards. On the other hand, if not properly maintained, natural elements may themselves become a danger during an extreme weather event. The strategies proposed in this plan aim to identify how and where nature may be managed to the City's benefit, and what actions must be taken to eliminate all avoidable risks associated with neglected natural systems.

URBAN PARKS AND FOREST

Strategy NS-1: Utilize green corridors and parks to help protect surrounding communities from the impacts of hazard events

- Action 1: Evaluate green corridors and parks for possible improvements for flood management and air quality improvement
- Action 2: Increase the resiliency of park facilities and buildings

Strategy NS-2: Increase and enhance the resilience and health of Baltimore's urban forest

- Action 1: Anticipate future changes in temperature and weather by developing a comprehensive list of plant and tree species or varieties known to have a broad range of environmental tolerances
- Action 2: Establish and routinely update a comprehensive tree inventory to anticipate insect and forest structural impacts of climate change
- Action 3: Establish a comprehensive maintenance program that includes pruning for sound structure and the removal of hazardous limbs and trees. First focus on vulnerable infrastructure nearby such as essential facilities and roads
- Action 4: Continually adjust and modify planting details and specifications to assure the health and longevity of trees
- Action 5: Increase the urban tree canopy and target areas with urban heat island impacts
- Action 6: Proactively communicate and collaborate with the City of Baltimore on the removal of trees around electric distribution lines to minimize power outages

Strategy NS-3: Create an interconnected network of green spaces to support biodiversity and watershed based water quality management

- Action 1: Support the Growing Green Initiative to increase green space and pervious services in areas where there is significant abandonment and opportunities to reduce the urban heat island effect
- Action 2: Convert vacant and distressed row house lands into meaningful and connected space (parkland)
- Action 3: Complete a watershed based habitat analysis for the City
- Action 4: Create a strategic plan that identifies areas of focus for tree planting, stormwater management, and forest preservation
- Action 5: Certify Baltimore as a Community Wildlife Habitat through the National Wildlife Foundation (NWF)

Strategy NS-4: Expand, protect and restore riparian areas in the city

Action 1: Conduct regular maintenance of stream restoration projects and stormwater quality facilities
Action 2: Require riparian buffers with all new development and capital projects
Action 3: Evaluate current regulations regarding stream buffers and floodplains and modify them (if appropriate)

Strategy NS-5: Preserve and create new ecological buffer efforts and support creating more (e.g. wetlands) along coastal areas

Action 1: Integrate natural buffer requirements, such as wetlands and soft shorelines, into new development or redevelopment
Action 2: Complete stream restoration projects in Baltimore City and County stream valleys that lead into the coastal wetlands so as to increase habitat and reduce sedimentation
Action 3: Identify and evaluate areas in the Critical Area buffer to prioritize ecological buffer restoration efforts and areas that could be enhanced to serve as natural storm surge barriers

WATER SUPPLY AND MANAGEMENT

Strategy NS-6: Enhance and improve the resilience of Baltimore's water supply

Action 1: Work with the Counties that control land uses impacting the drinking water distribution system and reservoirs to minimize negative impacts to water quality
Action 2: Develop local alternatives to Susquehanna for emergency water supply sources and create additional redundant systems
Action 3: Identify facilities that could contaminate major drinking water sources if impacted by disaster (i.e., chemical spill due to flood) and work with them to ensure appropriate risk reduction measures are in place
Action 4: Maximize capture of rainwater to ensure recharge of groundwater systems and reduce extreme variability
Action 5: Encourage the use of grey water systems as water conservation and landscape maintenance resources
Action 6: Consider development of water conservation ordinances and measures and draft enforcement process and procedures
Action 7: Increase authority to implement water restrictions and other emergency measures as needed
Action 8: Research the use of water banks, water pools, and water markets to facilitate the reallocation of water resources
Action 9: Promote an increase in forest cover for the reservoir watersheds and encourage forest management practices that increase the vigor, diversity and sustainability of existing forest stands

Strategy NS-7: Require the City's drought management plan to account for changes in climate

Action 1: Map drought risks and water availability via climate change scenarios
Action 2: Update drought management plans to recognize changing conditions
Action 3: Partner with others in the region, to develop and participate in an early drought monitoring and warning system

Strategy NS-8: Integrate climate change and natural hazards planning into small watershed action plans (SWAPs)

Action 1: Review existing watershed management plans and identify future actions to address climate impacts

Strategy NS-9: Ensure that local flood damage prevention regulations account for changes in sea level rise and climate

Action 1: Expand the use of climate information (e.g. seasonal forecasts) in water resources planning and management.

Action 2: Research and actively monitor trends in storm events, stream flow and other conditions affecting hydrology and water

Action 3: Update flood maps to reflect changing risk associated with climate change.

Action 4: Continuously improve and enhance flood vulnerability data.

Action 5: Develop policy to keep existing tidal floodplain boundaries for regulating development purposes

Public Services:

A major role of this plan is to expand Baltimore's preparedness for future hazards. Without a strategy for conveying information about the risks and vulnerabilities associated with these hazards, its message will fall on deaf ears. Therefore, strategies relating to **public health and human services** are concerned with distributing information, building resources, improving communication, and establishing response plans. Additionally, strategies are set in place that will prevent or limit health risks — including disease outbreak, physical exhaustion, and respiratory conditions, to name a few — that are triggered by extreme events. Effective public health strategies will ensure that all of Baltimore's population is prepared, well-informed and able to safely respond to hazards.

EMERGENCY PREPAREDNESS& RESPONSE

Strategy PH-1: Strengthen emergency preparedness coordination between local government, NGOs, and private entities by updates to the City Emergency Operations Plan (EOP) and related Emergency Support Functions (ESF)

- Action1: Identify and develop a common database that all city government agencies and departments should utilize for hazard information, preparedness and response
- Action 2: Ensure consistency and integration with existing and future response plans within and between agencies
- Action 3: Continue to identify and improve coordination with Key Partners including private sector, State partners, Federal partners, community, universities and industry leaders through Local Emergency Planning Committee
- Action 4: Coordinate outreach efforts of the Mayor's Office of Emergency Management, Mayor's Office of Neighborhood and Constituent Services, Baltimore City Health Department and Maryland Emergency Management Agency (MEMA) to leverage messages related to all-hazards emergency preparedness
- Action 5: Develop strong working relationships with local experts to provide technical assistance to refine and improve city government emergency preparations
- Action 6: Review and improve specific response plans contained in the EOP and related ESFs that relate to extreme weather events (snow, heat, flood, wind, electrical outages, and other hazard events)
- Action 7: Ensure equipment purchases and communication systems are compatible across agencies and jurisdictions
- Action 8: Encourage all animal rescue and care shelters to further develop their internal plans for animal's health and safety during and after a hazard event
- Action 9: Ensure all animal rescue and care shelters located within the floodplain are provided the support to apply for and obtain funds to relocate
- Action10: Develop and implement a case study of hospital-based practices that foster community resilience to climate change

Strategy PH-2: Develop a Hazard Awareness Program

- Action 1: Create a standardized early warning system for citizens, as well as visitors
- Action 2: Evaluate and improve community health center strategies for communicating with patients during an emergency
- Action 3: Educate citizens about the early warning system and actions to take when enacted
- Action 4: Prepare and integrate occupational health and safety message and instructions for first responders

Action 5: Hold climate specific seminars for hospital emergency and sustainability managers

Strategy PH-3: Designate community leaders and organizations that can assist and provide support during hazard events

Action 1: Prior to a hazard event, identify lead contacts serving vulnerable populations and coordinate actions to maximize safety and information sharing

Action 2: Develop a community group coordination plan and implementation guide

Action 3: Identify and evaluate plans already in place and work to improve utilization of community based leaders to assist in preparedness and response

Strategy PH-4: Integrate climate change and natural hazards planning into all City and community plans

Action 1: Develop guidelines to include proactive climate planning into plan development process

Action 2: Incorporate language that strengthens the ability of city government officials to enforce rules and restrictions that support public health, safety and welfare related to hazard events and conditions

Action 3: Partner with Maryland Department of Health and Mental Hygiene or other pertinent entity to develop institutional checklist and materials for health care specific resilience plans

Strategy PH-5: Better equip emergency workers for natural hazards

Action 1: Research and identify personal protective equipment (PPE) needs based on specific hazards

HEALTH

Strategy PH-6: Anticipate and address potential disease outbreaks caused by extreme weather events and changing climatic conditions

Action 1: Provide existing interagency data as needed to support studies of heat and flood related vector borne diseases in Baltimore City based on changing temperature and moisture

Action 2: Evaluate existing programs that detect disease outbreaks to determine their flexibility to respond to new conditions.

Strategy PH-7: Protect Baltimore residents from the effects of hazard events and plan for more frequent hazard occurrences

Action 1: Re-evaluate and update existing heat alerts, advisories, and updates to healthcare and emergency service providers

Action 2: Ensure that residents and visitors have access and transportation to cooling centers during extreme heat events

Action 3: Evaluate code red plans to ensure all agencies adequately protect their own workers

Action 4: Consider extending hours for public wading pools during extreme heat events

Action 5: Include information about Code Red in the event permitting process, and incorporate language that allows BCHD to cancel outdoor events

Action 6: Work with Regional, State and Local partners to improve air quality and reduce respiratory illnesses

Action 7: Create and implement programs to address combined health impacts of heat and air pollution

Action 8: Stay abreast of latest conduits for social media and capitalize on these methods to inform public during emergencies

EDUCATION AND OUTREACH

Strategy PH-8: Conduct climate, resiliency, and emergency planning education and outreach

Action 1: Incorporate environmental health and climate change into curriculum at schools, universities and health care facilities

Action 2: Educate communities on how city agencies respond to hazard events, their role in an event, and how agencies work together

Action 3: Educate and train community groups to participate in responding to hazards

Action 4: Generate a comprehensive community-specific all hazards outreach campaign

Action 5: Develop and communicate a simplified process for Baltimore residents to follow after a hazard event

Action 6: Support development of curriculum for institutions to teach community about climate change as part of their community benefits programs

Action 7: Utilize existing preparedness messaging to include information on universal precautions to insect-borne and other infectious diseases

Strategy PH-9: Improve awareness and education about the importance of flood insurance and preparation for Baltimore citizens

Action 1: Create an educational program centered on flood hazards, coastal construction practices and evacuation procedures

Action 2: Encourage owners of properties to purchase flood insurance and improve policyholder awareness at time of sale or renewal

Action 3: Inform property owners who have paid off their mortgage that flood insurance is still necessary

Action 4: Identify programs and grants that assist citizens in purchasing flood insurance and making flood proofing changes

Action 5: Develop an annual newsletter to inform and remind owners of property in the floodplain about flood insurance and flood proofing activities they should undertake

Action 6: Provide information on how to file for reimbursement for impacts of hazards

Action 7: Require a flood disclosure form, and educational information as part of lease agreements for commercial and residential properties

Action 8: Develop floodplain awareness information for rental tenants, including information on insuring personal property and housing contents against flood damage, and ensure distribution as tenants change

FOOD SYSTEM

Strategy PH-10: Increase Baltimore's Food Security

Action 1: Double the size and number of food producing community gardens by 2025

Action 2: Link Jessup, Maryland Food Hub, and regional/local food producers to local distributors

Action 3: Incorporate Baltimore’s food policy initiative into planning efforts

Action 4: Develop a food security plan for Baltimore

Action 5: Increase land under cultivation for commercial urban agriculture

Action 6: Launch a campaign to educate the public on risk of food borne illnesses during hazard events due to lack of proper cooling/heating of food