**Climate Readiness Training Module Outline**

**Module Name: Flooding**

**Total run time:**

In-Person Session: 70 minutes

**Module Objectives:**

1. Define riverine, coastal, and inland flooding
2. Understand how climate change is impacting flooding
3. Understand flooding vulnerability
4. Identify flood mitigation efforts that can be done by homeowners and the city
5. Understand what a wetland is and the ramifications of building on former wetlands

**In-Person Session Agenda:**

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| **Section** | **Details** | **Facilitator/ Materials** | **Timing** (Total: 135 Minutes) |
| **Welcome** | Provide a formal welcome and review the goals of the day.* Pause for questions/clarifications.
 | Facilitator leads | **2 mins** |
| **Pair & Share-**  | * **\*\*Per the slide What’s the Flooding Story, please take a moment to describe:**

**Wetlands** are submerged or permeated by water -- either permanently or temporarily -- and are characterized by plants adapted to saturated soil conditions. Wetlands include fresh and salt water marshes, wooded swamps, bogs, seasonally flooded forest, sloughs -- any land area that can keep water long enough to let wetland plants and soils develop.Wetlands are extremely valuable because:* they absorb the impact of hydrologic events such as large waves or floods;
* they filter sediments and toxic substances;
* they supply food and essential habitat for many species of fish, shellfish, shorebirds, waterfowl, and furbearing mammals;
* they also provide products for food (wild rice, cranberries, fish, wildfowl), energy (peat, wood, charcoal), and building material (lumber); and
* they are valuable recreational areas for activities such as hunting, fishing, and birdwatching.

In the past, wetlands were considered wasteland, and many of Massachusetts’ wetlands were drained or filled in so that they could be farmed or built upon. Recently the value of wetlands has been recognized and efforts have been made to protect these ecosystems. However, they are still disappearing under the pressure of human activity, and are being threatened by air pollution and climate change.From the diagram, you can see that wetlands in upper watershed areas capture and slowly release snowmelt and spring rainfall. When these wetlands are removed, more water moves more quickly downstream, causing flood waters to rise higher and flow faster. |  | **5 mins** |
| **Climate Change & Watersheds 101****(Lesson)** | In this section the facilitator presents on:* Effects of Climate Change
* Definition of watershed
* Impacts of flooding on health

**Effects of Climate Change?**Climate change is making the world warmer, wetter, and weirder, and today we are focusing on the wetter part and why its getting weirded from climate change. The impacts of these changes will be felt directly in the moment and indirectly, after the event or over time. Climate will impact everything from health to housing. From increases in heat illnesses and diseases from ticks due to heat, damaged roads/housing from storms or heat, disruptions to essential services and power or communication networks. Economy and mental health impacts that radiate out from that.Today we are going to focus on the wetter part of warmer, wetter, and weirder**Impacts of Flooding**Climate change will worsen the impacts of flooding by intensifying heavy precipitation events, sea level rise, and become more destructive and dangerous**Impacts of flooding on health:*** **During flooding events,** you are at risk for drowning, injury, and accidents as well as exposure to water-borne diseases
* Water-borne infectious diseases – FLOOD WATER IS NOT CLEAN WATER. All flood waters contain pathogens. This is dangerous if you are in the flood water, but it can also be dangerous if you swim or fish in rivers, lakes, ponds after. Drain water is not cleaned before moving it to the river.
* **After the floods,** you may suffer from displacement, financial instability, mental health toll from the trauma
* The displacement that occurs – financial implications, disruptions to routine, need to pull heavily on resources (this is particularly complicated in renter situations)
* Longer term health impacts - Trauma and mental health impacts. Floods create conditions for indoor mold growth, negatively impacting air quality and respiratory illnesses.
* **Damage to infrastructure** includes road closures, flooded buildings/train stations, basement flooding in homes and potential septic backflow
* **Disruption to essential services** includes constrained utility, medical services, emergency response.
* Constrained utility, medical services, emergency response
* **Economy impacts from flooding** includes property damage to local businesses, supply chain interruptions
 |  | **10 mins** |
| **Watersheds** | **What is a watershed?**A watershed is an area of land that drains water into a common body of water. For example, if we are in the Charles River watershed, and you are washing your car in the street, that water will go from the street into the storm drain to the Charles River* Watersheds are more than just drainage areas in and around our communities. They are necessary to support habitat for plants and animals, and they provide drinking water for people and wildlife. They also provide the opportunity for recreation and enjoyment of nature.

Healthy watersheds provide many ecosystem services including, but not limited to: nutrient cycling, carbon storage, erosion/sedimentation control, increased biodiversity, soil formation, wildlife movement corridors, water storage, water filtration, flood control, food, timber and recreation, as well as reduced vulnerability to invasive species, the effects of climate change and other natural disasters. These goods and services are essential to our social, environmental and economic well-being.Watersheds in areas with lots of concrete, pavement, and roofs, shed water quickly, while forested and grassy rural areas absorb more water.When water enters the watershed too quickly for the land to absorb it, flooding can occur. During a downpour, rainwater hits pavement and flows into drains, picking up pollutants like oil, fertilizers, and road salts along the way. These pollutants can flow into nearby water bodies, where they can harm wildlife, make swimming and boating unsafe, or even contaminate drinking water. |  | **10 minutes** |
| **Types of flooding**  | Facilitator notes that while there are many types of flooding, we will be focusing on three:**What are the three main types of flooding?*** **Coastal flooding, inland flooding, and riverine flooding**
* Cambridge is most likely to experience extreme precipitation or inland flooding, riverine flooding, and coastal flooding
* Cambridge has not experienced coastal flooding, yet. These others we are experiencing already.

**Inland Flooding** * You experience this type of flooding when rainfall overwhelms the capacity of drainage systems, and you see flooding on streets and in basements.
* Climate change impacts stormwater flooding because with more frequent and intense downpours leads to sewer backups that cause localized flooding or lead to greater runoff of contaminants such as trash, nutrients, sediment or bacteria into local waterways.
* Primarily when you have these high precipitation short duration storm events. We've seen a lot this summer.

**Coastal Flooding*** **Coastal flooding** is when seawater covers land areas near the coast
* This flooding is common during a hurricane or tropical storm
* Climate change is increasing coastal flooding in several ways:
* Warmer temperatures are more favorable to hurricanes.
* Sea level rise creates favorable conditions for **storm surge**
* In the future, we expect the dams to breached (over top or flanked) first Alewife, then Charles

**Storm surge** is a rise in sea level that occurs during intense storms. It caused by the storm's winds pushing water onshore, leading to floodingPlay this 1 minute video describing storm surge: <https://youtu.be/an5uDl2ftb8>**Riverine Flooding*** **River (or Riverine) flooding** is when consistent rain or snow melt overwhelm the capacity of a river
* This type of flooding is common in late winter or early spring, when snow and ice melt
* River floods have become **larger and more frequent** in the Northeast due to climate change
* Additionally, riverine flooding also occurs with storm surge/sea level rise on tidally influenced rivers. The Charles/Mystic Rivers are tidally influenced rivers (or at least were before the dams).

**Climate Change, Coastal Flooding, & Watersheds: oh Dam!*** More frequent and intense downpours can also challenge cities with combined stormwater and wastewater drainage systems. These systems can be overwhelmed by large amounts of rainfall or snowmelt and lead to more combined sewer overflows (CSOs) into waterways. An increase in CSOs can reduce water quality and make meeting water quality standards more difficult.
* Stormwater runoff can also wash sediment, nutrients or other pollutants into water sources. Increased sediment, nutrients and other pollutants can diminish water quality, threaten drinking water sources, and complicate water treatment processes
 |  | **15 mins** |
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| **Flooding Vulnerability** | * Can either reduce exposure/sensitivity AND/OR increase adaptive capacity
* Who do we think are groups more sensitive to flooding and who would be the most exposed to flooding impacts?

**Light blue is sensitivity, dark blue is vulnerabilities** * We are all sensitive at certain times
* Go around the room and pick a box to explain why more flood sensitive
* For the people who live in floodplains - note the floodplains, as the US gov't defines it (FEMA), are not reflective of the entire area we expect future flooding in Cambridge

**Some areas are more exposed to flooding*** Natural landscape elements such as wetlands, forests, and grasslands, absorb rainwater and prevent flooding
* Increased urbanization adds pavement and other impermeable/impervious surfaces, which alters natural drainage systems, causing flooding in urbanized areas such as cities
* Development in floodplains and low-lying areas are more susceptible to riverine flooding
* Under-maintained infrastructure can also lead to stormwater flooding
* However, with many of these elements now gone due to development, there is no place for this rainwater to go, so instead of absorbing at the surface, the rainwater will run off impervious surfaces (such as roads) and lead to flooding conditions from extreme precipitation
* There are underground flows of water, Historic swamp, shallow water table.
 | Facilitator  | **10 mins** |
| **Intervention (Lesson)** | **Dos and Don'ts of Flooding*** Each group will receive an envelope, inside are the dos and don’ts of coping with flooding – but they’re all mixed up!
* Read each action and ask:
* *Before, during, or after a flood, is this something* ***to do*** *or* ***to avoid****?*
* The first to sort all actions correctly wins!

**What YOU Can Do to Reduce Flood Risk*** **Avoid contact with flood water due to potentially elevated levels of contamination** associated with raw sewage and other hazardous or toxic substances that may be in the flood water.
* Flood water may have high levels of raw sewage or other hazardous substances. Early symptoms from exposure to contaminated flood water may include upset stomach, intestinal problems, headache and other flu-like discomfort. Anyone experiencing these and any other problems should immediately seek medical attention.
* Do not use the sewage system until water in the soil absorption field is lower than the water level around the house. If you have a home-based or small business and your septic system has received chemicals, take extra precautions to prevent contact with water or inhaling fumes. Proper clean-up depends on the kinds of chemicals in the wastewater.
* Be sure children are protected from chemicals and diseases in flood water. Behavior such as crawling or placing objects in their mouths can increase a child's risk of exposure and sickness.
* **Mosquitos can sharply increase after a flood**, due to the sudden availability of standing water which they require for breeding -- even very small amounts of water. As flood waters recede be sure to drain, overturn, or empty areas -- no matter how small -- to reduce mosquito breeding areas and **help reduce the spread of mosquito-borne diseases.**
* **Mold can cause serious health problems. The key to mold control is moisture control.** After the flood, remove standing water and dry indoor areas. Remove and discard anything that has been wet for more than 24-48 hours.
 | Slides | **15 mins** |
| **Flooding Interventions** | **Flooding Interventions: Green and Gray Infrastructure**Green infrastructure are vegetated landscapes and other green spaces contributing to the reducing, slowing, and cleaning of stormwater and cooling urban heat island * Rain garden
* Bioswale
* Improvements to green spaces will help improve water quality in downstream water bodies

Gray Infrastructure is human-engineered infrastructure for water resources* Pipe upsizing
* Flow re-routing
* Storage tank installation
 |  | **5 mins** |
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