

City of Cambridge  
Climate Protection Action Committee

**Recommendations for Adaptation to Climate Change**

Purpose

The Climate Protection Action Committee (CPAC) is an advisory body to the City Manager on the implementation of the Climate Protection Plan. CPAC has been reviewing information about the projected impacts of climate change in the Northeast and Boston area. Organizations and leaders on climate change have begun to advocate that planning and action needs to focus both on mitigating greenhouse gas emissions to help reduce the extent of climate change and on adaptation to the impacts of climate change.

CPAC believes there likely are steps that would be prudent for the City and the community to consider to make Cambridge more resilient to climate change and that the risks and the possible responses should be studied. This document is not intended to be comprehensive or final, nor are the recommendations it contains viewed as a substitute for action related to mitigation. The document outlines the basis for the committee's sense that 1) there are risks related to climate change that the city may face and that 2) these risks are sufficiently plausible, although uncertain, that the city should begin to identify the range of potential risks, study their likelihood, timing and consequences, and, for some, develop and prioritize strategies for addressing them and/or their consequences. In short, the Committee suggests that the City assess our vulnerabilities.

Findings

**AT LEAST SOME DEGREE OF CLIMATE CHANGE IS UNAVOIDABLE.**

- Since Cambridge joined ICLEI in 1999, climate protection efforts have focused on mitigating greenhouse gas emissions. This focus was consciously emphasized by the Climate Protection Task Force that developed the Cambridge Climate Protection Plan with City staff on the grounds that efforts on adapting to climate change would detract from mitigation.
- Since the Climate Protection Plan was approved in 2002, science has progressed and many scientists believe that some degree of climate change is now unavoidable no matter how successful GHG mitigation efforts are. Various studies have indicated that even after excess GHG emissions cease, the planet will continue to warm for a thousand years.
- Several studies and advisory bodies have recommended that governments aim to prevent future warming beyond 2 degrees Celsius (3.6 degrees Fahrenheit) in order to prevent catastrophic climate change. However, most authorities believe this will be extremely challenging to achieve.

**CAMBRIDGE IS VULNERABLE TO SEA LEVEL RISE AND STORM SURGE FLOODING.**

- Scientists' projections of future sea level rise have been increasing in elevation as new studies have been completed. Many scientists acknowledge that the IPCC Fourth Assessment Report underestimated sea level rise because the projections were largely

based on thermal expansion of the oceans. Due to the limits of scientific understanding when the report was prepared, the IPCC report did not account for melting of glaciers and ice sheets. Recent scientific reports that take melting of glaciers and ice sheets into account indicate average sea level could rise between 2.5 feet to over 6 feet by the end of the century.

- Cambridge appears to be vulnerable to sea level rise. The city is located on what were, once, the banks of a tidal Charles River, and large areas of Cambridge were once tidal mud flats. These low-lying areas were filled in over time. In the early 1900s, the Charles River Dam was built to protect the areas adjacent to the lower Charles River, including East Cambridge and Cambridgeport, from tidal flooding and storm surges coming up from Boston Harbor. With sufficient sea level rise, the existing flood protection provided by the Charles River Dam will be overwhelmed.
- Paul Kirshen, a hydrologist at Battelle and author of climate impact studies on the Boston area and other areas, informed the CPAC that under current conditions the Charles River Dam will protect Cambridge against a flood surge coming up from the harbor in a 100-year event (i.e., a storm of severity that data predicts is likely to occur only once every 100 years). Given the height of the dam and the estimates of the surge from a 100-year event, he notes that today the maximum height of the sea would reach within 8 inches of the top of the dam.
- Any increase in sea level increases the likelihood that a surge will overtop the dam. Rises in sea level between 1 to 1.6 feet by 2050 and 1.6 to 4.5 feet by 2100 fall in the middle of the range of the recent projections. Therefore, even estimates of sea-level change in the lower range of today's models predict a rise sufficient to make the surge from a 100-year event overtop the dam.
- If a storm surge exceeds the elevation of the dam, sea water will flow into the lower Charles River basin and with sufficient time will flood areas of Cambridge and Boston. Kendall Square, most of the MIT campus, Cambridgeport, East Cambridge, North Point, and even the southern portion of Harvard Square would be at risk. Dr. Kirshen's scenarios are conservative in the sense that they do not factor in additional sources of floodwater from stormwater runoff from precipitation or two potential routes for sea water that could short circuit the Charles River Dam through Boston and Somerville/Cambridge. An image depicting the extent of flooding in Cambridge under the 2050 storm surge scenario is attached (note: the image omits flooding in the Alewife Brook/Fresh Pond watershed that would be associated with the Mystic River).
- Storm surge flooding would have a catastrophic impact on structures in the flood areas. Lower levels of buildings would suffer water damage and subsequent problems with mold could result. We note that in residential areas, there are many buildings with basement apartments. Flooding would also severely affect underground infrastructure, including transportation, electrical, communications, stormwater, and sewer systems. Oil and other toxic materials may also be transported to buildings and properties.
- The economic and social consequences of storm surge flooding breaching our current flood defenses would be catastrophic.
- It is not possible for the City on its own to implement measures to fully protect Cambridge against future storm surge flooding. Because sea water would come from the harbor and there are routes through Boston and Somerville that will contribute flood water, a regional response is required. The committee believes that state and federal agencies are critical players in any response to this problem.

## **A WIDE RANGE OF POTENTIAL PUBLIC HEALTH IMPACTS ARE POSED BY CLIMATE CHANGE.**

- A wide range of potential public health impacts are posed by increases in temperature, rainfall, and sea level rise. Because the determinants of public health are more varied, predicting public health impacts is more complicated than an issue like sea level rise.
- Within Cambridge, rising temperatures would cause more days of extreme heat resulting in increased incidences of heat stress and increased formation of ground level ozone (i.e., smog). Ozone formation is in part determined by temperatures which drive the chemical reaction. Increased air pollution would exacerbate respiratory and cardiac diseases.
- Increased temperatures would increase the use of air conditioning, which would in turn create more demand for electricity and produce more greenhouse gas emissions.
- Higher temperatures and rainfall would also increase the production of allergens such as pollen, which in turn would trigger more asthma and allergies.
- Increased temperatures and precipitation would create more favorable habitat for new vector organisms such as different species of mosquitoes and pathogens such as new viruses. Not only would new vectors extend their range to our area, but new pathogens would be carried by vectors that already inhabit our region. In recent years we have seen new diseases such as West Nile virus take hold in the Northeast as a result of changing conditions.
- Some populations will be more vulnerable to the increased risks, such as people with compromised immune systems and the elderly.

## **THERE IS A WIDE RANGE OF POTENTIAL IMPACTS IN ADDITION TO SEA LEVEL RISE AND PUBLIC HEALTH.**

- The committee has not examined the full range of potential impacts and instead chose to focus on sea level rise and public health as two areas that seem most likely to be locally significant. Nevertheless, there are potentially significant impacts involving water supply, food supply, energy system reliability, surface water quality, and transportation networks among others.
- The physical impacts caused by climate change on infrastructure and other systems would in turn cause social and economic impacts on the community. In addition to the cost of responding to the impacts, other effects may occur such as displacing residents from their homes and loss of businesses to safer areas.

## **OTHER LOCAL AND STATE GOVERNMENTS ARE PLANNING FOR CLIMATE CHANGE ADAPTATION.**

- ICLEI's Climate Resilient Communities program works with communities on planning for climate change adaptation. Keene, New Hampshire has been an early participant.
- The City of Boston is currently working with the Climate Action Leadership Committee appointed by the mayor. Among the committee's tasks is to evaluate the risks of sea level rise and develop recommendations on how to reduce those risks.
- Other cities, including New York, Seattle, Chicago, and London, and many agencies around the country involved in water management have developed plans or policies on climate change adaptation.

- Massachusetts has been developing a state plan on climate change adaptation, as required by the Global Warming Solutions Act. The plan is expected to be issued soon. California recently issued a statewide climate change adaptation plan.

### **UNCERTAINTY HINDERS PLANNING FOR CLIMATE CHANGE ADAPTATION.**

- While climate change is clearly coming down the road, the scale and pace is very uncertain. The amount and rate that climate factors such as temperature, precipitation, and sea level will change is dependent on the future rate of greenhouse gas emissions which in turn depend on the level of economic activity, future energy supply trends, government policy, and technology trends.
- Without reliable assumptions on sea level, precipitation, and temperature, it is very difficult to plan large-scale adaptation measures such as dam heights.
- It appears that in some cases at least ranges of climate-related changes can be defined. For example, sea level rise elevations might be bracketed. State and federal agencies need to provide guidance to local governments to facilitate planning.

### **IT'S IMPORTANT TO START PLANNING NOW TO MAKE CAMBRIDGE MORE RESILIENT TO CLIMATE CHANGE.**

- While uncertainties make planning for climate change adaptation very difficult, an approach for beginning to plan for adaptation is to identify “no or low regret” actions. These would be actions that may involve some investment of resources, but which yield benefits in addition to increasing the resilience of the community. An example would be to replace existing dark colored roofs with white roofs. White roofs absorb less heat and would mitigate the effect of rising temperatures. They also reduce energy costs related to cooling buildings in summer (and have much less of a winter heating penalty). Similarly, it may be possible to size stormwater conduits larger to convey larger volumes of stormwater runoff with little additional cost.
- Major infrastructure projects, such as raising the Charles River Dam and installing other flood defenses, can require decades of lead time to plan, design, and construct. The City will need to coordinate with other communities in the region in order to engage federal and state agencies in the necessary actions.
- Climate change impacts will be felt most acutely at the local level. Local governments are on the front lines in terms of responding to flooding, heat waves, public health threats, infrastructure damage, etc. Municipal budgets will likely be affected when climate change impacts begin to be felt.
- There are advantages in the long term to planning ahead, rather than reacting to climate change as it happens. Costs of responding to climate change impacts can be reduced with early planning.

### **Recommendations for Next Steps**

#### **1. The City should conduct a vulnerability assessment.**

Relevant municipal departments could be convened to review existing information about climate change impacts and assess infrastructure, public health, environmental resources, and other systems that are vulnerable to the effects of climate change to better understand the range of issues and options for making Cambridge more resilient.

A vulnerability assessment is the process of identifying, quantifying, and prioritizing (or ranking) vulnerabilities, including the threats to the population and to infrastructure. It can be done from political, social, economic and environmental perspectives.

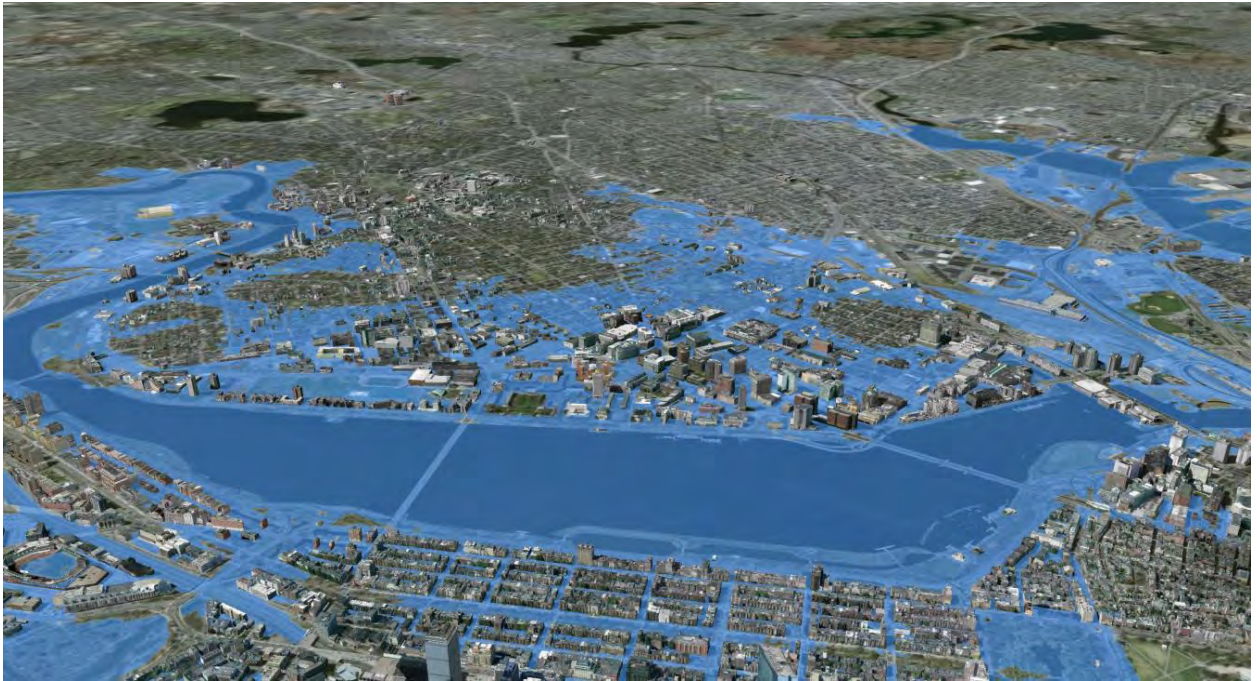
**2. Based on the vulnerability assessment, the City should review options to take early “no and low regret” actions to make Cambridge more resilient.**

City agencies could work with state and regional agencies, nearby communities, and significant community stakeholders to assess options to move forward with climate change adaptation measures.

**3. CPAC will continue to monitor and assess local government best practices on climate change adaptation.**

Activity on climate change adaptation appears to be gaining momentum. The state climate change adaptation advisory committee is expected to issue its report in the spring of 2010. The federal government has proposed establishing a climate service at NOAA, similar to the Weather Service. Outside resources may become available for work on this issue at the local level.

**Cambridge with 11.5 feet (NAVD) storm surge (does not include freshwater contributions) – flooded area in light blue**



- **2050; Very High 10 year storm, mid-range 100 year storm**
- **2100; Low 10 year storm, Very low 100 year storm**