Introduction

Role of Task Force

The Climate Resilience Zoning Task Force (CRZTF) was created to bring together diverse stakeholders to identify development standards that would increase the capacity of development in Cambridge to withstand and adapt to impacts from climate change. The Climate Change Vulnerability Assessment (CCVA) and ongoing Climate Change Preparedness and Resilience (CCPR) planning has been underway since 2012, and the Envision Cambridge comprehensive planning process (2019) began combining the City’s multidisciplinary work on climate change with a vision for the future growth and development of Cambridge. The Douglas Brown, et al. Zoning Petition (2017) also demonstrated citizens’ interest in this important issue. The City Council issued a Policy Order requesting the formation of an advisory committee to work through resiliency elements raised during the Envision process and through the Brown petition.

The City Manager appointed 20 members to the Task Force to ensure that a diversity of perspectives would be included in the discussions. The Task Force included residents from neighborhoods throughout the city, a union/trades representative, representatives from academic institutions, affordable housing builders, small business representatives, property owners, subject matter experts, and City staff. By bringing together stakeholders from across the Cambridge community, the vision was that the Task Force would reach consensus around an effective approach to regulating urban development in a way that would mitigate the identified impacts and risks of on-going climate change.

Task Force members were supported by staff in the Community Development Department (specializing in Zoning and Development and Environmental Planning) and Department of Public Works, and by consultants who were also involved in the CCVA, CCPR, and Urban Forest Master Plan.

The purpose of the Task Force was to discuss the specific climate change vulnerabilities identified in the CCVA, review recommendations from the ongoing CCPR planning effort and other related initiatives including the Urban Forest Master Plan, and recommend development standards to incorporate into Cambridge’s Zoning Ordinance. The Task Force focused on two specific impacts of climate change: flooding from sea level rise, storm surge, and precipitation, and rising temperatures exacerbated by the urban heat island effect.

The goal of the Task Force was to recommend zoning amendments that could be translated into a formal zoning petition by City staff and be presented to the City Council for consideration and adoption. The Task Force considered all types of development and all parts of the city. The final zoning recommendations are citywide in scope and would create standards for all new development, large and small, and specific types of additions and alterations to existing buildings and uses. The Task Force also considered both prescriptive- and performance-based approaches to creating new zoning standards,
ultimately gravitating toward performance-based standards. The Task Force also provided recommendations for actions that the City could pursue separately in the future.

**Process and Work Plan**

The Task Force met 19 times between January 2019 and March 2021. All meetings were open to the public and a website with information about the Task Force was actively maintained to ensure transparency. The City Council, through its Health and Environment Committee, had an active and ongoing role in shaping the work of the Task Force. Throughout the course of its discussions, the Task Force held two joint meetings with the Committee to provide updates on its progress and solicit feedback.

The work plan was as follows:

<table>
<thead>
<tr>
<th>Period</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>January – March 2019</td>
<td>Review climate resilience plans &amp; studies, understand zoning basics</td>
</tr>
<tr>
<td>April – September 2019</td>
<td>Examine flooding &amp; heat impacts, formulate principles &amp; objectives</td>
</tr>
<tr>
<td>October 2019 – March 2020</td>
<td>Discuss potential range of zoning strategies</td>
</tr>
<tr>
<td>October 2020 – January 2021</td>
<td>Formulate draft recommendations</td>
</tr>
<tr>
<td>February – March 2021</td>
<td>Come to consensus on final recommendations</td>
</tr>
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</table>

Note that meetings were suspended between March and October 2020, due to City policy on non-essential public meetings during the COVID-19 State of Emergency.

**Background Information and Resources**

After establishing its work plan and ground rules, the Task Force spent the first phase of its process reviewing and discussing information relevant to its work. These included City-led climate change initiatives, other planning studies, and community-based initiatives. Members also learned about what can and can’t be effectively regulated through zoning and the types of zoning strategies used in Cambridge. This phase included a tour of the Alewife area to see in-person examples of older and more recent development and to identify and discuss resilience issues in the context of buildings and sites.

**City’s Climate Planning Initiatives**

Since it joined ICLEI – Local Governments for Sustainability in 1999, Cambridge has taken an active role in both preparing for climate change and reducing its causes. The following recent planning efforts were the most relevant to the Task Force’s work:

- **Climate Change Vulnerability Assessment (CCVA):** Completed in 2017, this technical study explored Cambridge’s physical and social vulnerabilities to increasing temperatures, more intense storms, and storm surge flooding associated with sea level rise. Part 1 of the CCVA Report focused on risks posed by ever-increasing temperatures and precipitation while Part 2 focused on risks from rising sea levels and coastal storm surges. The CCVA serves as the technical foundation for the City’s other climate-related work, and its findings will be updated over time as climate change models evolve.
Resilient Cambridge Plan: This ongoing initiative is a roadmap for the City government, its residents, businesses, institutions, and key stakeholders to implement strategies in response to climate change threats. The City completed two area-specific CCPR plans, one with a focus on the Alewife area and the other on the Port neighborhood. These area-specific studies inform an upcoming citywide plan called Resilient Cambridge to be issued by June 2021. CCPR work products that were particularly helpful for the Task Force’s work included the four categories of strategies and the “Better Buildings” strategies developed for a “Preparedness Handbook” for the Alewife area. The Task Force shared the same team of consultants and City staff, so was able to benefit from this collaboration.

Net Zero Action Plan: Completed in 2015, this plan sets a roadmap for neutralizing greenhouse gas emissions from Cambridge. While the CCVA and CCPR focus on how to prepare the city for impacts from climate change, the Net Zero Action Plan focuses on reducing the city’s contribution to the climate crisis. Some recommendations from this initiative have already been adopted into the Zoning Ordinance. The City is currently conducting a comprehensive 5-Year Review of the Plan in order to evaluate the program impact to date, consider options to adjust the Net Zero Action Plan framework, and adopt an updated framework that reflects current climate science, policy, technology, and equity considerations.

Other City-Led Planning Initiatives

In addition to its climate-specific planning efforts, other recent studies have addressed the need to understand and respond to a changing climate:

- **Envision Cambridge**: Completed in 2019, the City’s most recent citywide, long-range comprehensive planning study sets broad goals and recommendations on the topics of climate and the environment, community wellbeing, the economy, mobility, housing, mobility, and urban form. In addition to the citywide plan, the Envision planning process also produced the Alewife District Plan in 2019, which focused on an area that is especially vulnerable to flooding and heat and suggested some ways to incorporate climate resilience into urban design.

- **Urban Forest Master Plan**: From 2018 to 2020, the Department of Public Works led a task force that focused on creating a strategic plan to evaluate, maintain and expand the urban forest canopy in Cambridge. The work is particularly relevant to the Task Force because trees contribute to climate resilience by reducing the urban heat island effect and mitigating stormwater runoff. The Cambridge Urban Forest Master Plan Technical Report was released in November 2019 and the City of Cambridge Urban Forest Report: Healthy Forest, Healthy City was published in September 2020. The lead consultant for the Urban Forest Master Plan also advised the Climate Resilience Zoning Task Force and one representative serves on the task forces for both initiatives. The Health Forest Healthy City initiative has been formally launched.

**Ten Year Sewer and Drain Infrastructure Plan**: The City has developed a strategic plan to manage the infrastructure improvements of the sewer and storm water mains, manholes, catch basins, pumping stations and Combined Sewer Overflow (CSO) outfalls that carry waste and storm water to treatment plants and discharge locations. This 10-year plan serves as a guidance document to prioritize construction and rehabilitation of these complex systems. The goals of the Plan include addressing high-risk infrastructure conditions, managing stormwater quality and quantity, reducing flooding, and
protecting neighborhoods, among others. These various planning initiatives work together to maximize co-benefits to Cantabrigians.

**Douglas Brown, et al., Zoning Petition**

In 2017, a group of residents (including Task Force members Doug Brown and Mike Nakagawa) proposed a zoning amendment based in part on the CCVA work. The amendment would have expanded the current Flood Plain Overlay District to include areas projected to be vulnerable to future flooding. All development or site work in that district would be subject to new requirements outlined in the petition, in addition to the existing requirements. The petition also proposed a “Green Factor” scoring system for all development subject to the Project Review Special Permit requirements.

There was broad agreement on the goals of this petition, which sought to use development standards in the Zoning Ordinance to build a more resilient Cambridge. While there were concerns raised about how to ensure effective implementation of some of the proposed standards, the performance-based approach of the proposed Green Factor was positively received by City staff, the Planning Board, and the City Council, with suggestions for further study and testing. This petition catalyzed support for the creation of a multi-stakeholder task force to study potential zoning standards that would complement the City’s suite of climate resilience initiatives. As a result, the City Manager created the Climate Resilience Zoning Task Force.

**Task Force Study and Findings**

The following section summarizes information that was presented to and discussed by the Task Force, along with some of the key points that emerged from the Task Force’s discussion.

**Overall Climate Impacts and Climate Planning**

The CCVA used global climate model simulations to generate temperature, humidity, precipitation, and sea level rise projections specifically for the city. The scenarios were developed using the best available science with the understanding that assumptions, methodologies, and resultant projections will need to be revised over time in light of new data or technologies, or changes in the environment itself. The CCVA projections are not intended to be a precise prediction of future conditions but are more of a “climate stress test” to understand how people and the built environment would be impacted by these changes.

The CCVA developed projections for two planning horizons, 2030 and 2070, and two categories of impacts, heat and flooding. City staff recommended that the Task Force focus on 2070 projections since buildings constructed today are expected to have at least a 50-year lifespan.

Drawing on the findings of the CCVA, the CCPR is focused on both reducing risks and preparing for unavoidable risks. It takes a multipronged but coordinated approach that focuses on performance. As a result, the project team identified four key categories of resilience strategies:

- **A. Closer Neighborhoods**: Strategies to strengthen community, social, and economic resilience;
- **B. Better Buildings**: Strategies to protect buildings against projected climate change impacts;
- **C. Resilient Infrastructure**: Strategies to ensure continued service or a speedy recovery from community-wide infrastructure systems;
D. Greener City: An enhanced living environment integrating air quality, waterways, green infrastructure, and the urban forest as a system resilient to climate impacts.

The Task Force focused exclusively on zoning mechanisms to complement other actions recommended in the CCPR. Task Force members recognized that zoning could help the City achieve its goals but cannot resolve every issue identified in the CCPR.

Flooding

Climate Projections, Risks, and Outcomes

The Task Force reviewed key impacts associated with the two main kinds of flooding that Cambridge faces: precipitation-driven flooding and flooding from a combination of sea level rise and storm surge (SLR/SS). Overall, the CCVA found that Cambridge will face increasing rates of precipitation and a greater frequency of larger storms.

Precipitation: Currently, flooding in Cambridge is driven by precipitation, which causes rivers to overtop their banks and streets to fill with water when drainage infrastructure is unable to immediately discharge floodwaters. According to CCVA projections, precipitation-driven flooding in Cambridge will become more frequent, cover broader areas of the city (including areas where it has not frequently occurred in the past), and have a greater depth. However, this type of flooding is mostly short-term in nature, and generally does not last for more than a day.

Sea Level Rise/Storm Surge: Flooding caused by rising ocean levels, both long-term sea level rise and water surges during storm events, does not currently impact Cambridge because it is protected by the Amelia Earhart Dam and the Charles River Dam. CCVA projections show that this regional infrastructure will likely protect Cambridge through 2030; however, projected 2070 SLR/SS levels have the potential to overtop the Amelia Earhart Dam in Medford if it is not raised, which would result in storm surges affecting the Alewife-Fresh Pond area. This type of saltwater flooding could last for more than a day and could impact buildings differently than freshwater flooding.

Projected Flood Elevations: The CCVA determined the elevation of projected flooding for locations throughout the city based on three sets of variables: the nature of flooding (precipitation driven or SLR/SS), the probability of flooding (10% probability of occurring within a year, sometimes called a “10-year flood,” or 1% probability of occurring within a year, sometimes called a “100-year flood”), and the timeframe of the projection (2030 or 2070). While these probabilities appear low, the cumulative risk is significant. For instance, a 10% annual probability event has a 96% probability of occurring within a 30-year period, and a 1% annual probability event has a 26% probability of occurring within a 30-year period.

To communicate the CCVA flooding projections in a useful way, the City created an online, interactive tool called the FloodViewer where users can select land parcels on a map and view all projected flooding elevations.

Flooding Impacts

Based on the findings of the CCVA, increased flooding will impact buildings and sites (such as houses, office buildings, and parks); infrastructure (such as roads, electricity, and water and stormwater systems); and critical services facilities (such as hospitals, fire stations, and community centers). The
Task Force focused most of its discussion on how zoning standards can mitigate these risks, including the following:

- Structural damage to buildings requiring remediation or replacement.
- Disruption to the habitability of the housing stock, since flooding can result in public health and safety concerns due to mold, contamination, and other consequences. These impacts can be more severe in basement-level living spaces, which can be more difficult to keep dry after a flooding event. The risks can also be more severe for lower-income households with fewer housing options and less ability to repair or replace damaged property.
- Economic disruption due to business closures and property needing to be replaced. These disruptions could disproportionately impact small businesses without the financial resources to withstand sudden losses.
- Social disruption caused by damage to community resources such as public schools, daycare and youth centers, pharmacies, food pantries, social service centers, and municipal resources that are relied upon by vulnerable populations.

**Mitigation Strategies**

While Cambridge cannot reduce its flood risk through City-led actions alone, changing how the City regulates development will improve citywide resilience. The CCPR planning process promotes a set of mitigation strategies in the Better Buildings category, including the following:

- Design new buildings using 2070 flood projections, given that buildings are likely to last for 50+ years.
- Elevate the grade surrounding the building or the building itself above the 10% probability flood elevation.
- Protect all usable spaces below the 10% probability flood elevation (with exceptions) so that will not be flooded (i.e. “dry floodproof” using barriers).
- Design all usable spaces (with exceptions) in a building that are below the 1% probability flood elevation to experience flooding but recover from any impacts (i.e. “wet floodproofing” using certain materials).
- Elevate vulnerable utilities, such as electrical boxes and shut-offs, above the 1% probability flood elevation where possible or protect them if below that elevation.

City staff have already begun to incorporate CCVA projections and some of the above-mentioned CCPR strategies into its review of development proposals. For example, applicants for special permits from the Planning Board are asked to study and mitigate future flood risks based on CCVA projections identified in the FloodViewer. Outside of zoning, the Department of Public Works (DPW), which is responsible for applying stormwater management standards and other regulations that control impacts of development on public infrastructure and resources, now relies on 2070 projections to inform its review. While this guidance has improved the resiliency of new development to flood risks, these standards are not codified in the Zoning Ordinance.

**Key Points in Task Force Discussions**

Over the course of several months, the Task Force discussed the benefits, costs, and challenges of different development strategies as framed by the City’s current climate planning efforts. Some key considerations that helped focus which strategies to prioritize to relative to flooding included:
Basements and low-level first floors are the most vulnerable parts of buildings to flooding; flooding in these living spaces can lead to mold, poor indoor air quality, and contaminated water.

Certain types of habitable uses should not be allowed below a certain flood elevation.

It is easier to regulate new construction than it is to regulate renovations to existing buildings.

Regulations could pose a financial burden that would make renovations cost-prohibitive for some residents; as a result, property owners need some flexibility to be able to make their own choices about how to weigh the costs and benefits of different mitigation options.

Development standards can have an impact on stormwater management, but zoning regulates land use and development, not larger infrastructure systems, which limits the nature of the interventions.

Since flood projections are subject to change and the impacts from precipitation and SLR/SS flooding varies throughout Cambridge, it is important to match the zoning requirements to the level of risk and give property owners some flexibility to choose how to protect against or recover from flooding.

Incremental solutions, such as solar-ready roofs, and strategies that provide co-benefits, including a pathway to net zero renewable energy, improve future resiliency while acknowledging current standards.

Heat

Climate Projections, Risks, and Outcomes

The Task Force also reviewed key impacts associated with heat and humidity. According to CCVA projections, the average ambient air temperature will be warmer, but will also fluctuate between greater extremes of heat and cold. Heat waves will be more frequent and longer in duration, which means that building energy use will shift from predominantly heating to predominantly cooling by mid-century. Each year, Cambridge currently experiences less than two weeks’ worth of days over 90°F, known as high heat days. The CCVA found that by 2070, there may be nearly three months’ worth of high heat days. In addition, the heat index, which is a function of temperature and relative humidity, is projected to increase significantly. This will make hot temperatures feel even hotter and could exacerbate the likelihood of heat exhaustion and heat stroke. Heat waves and poor indoor air quality will become increasingly challenging public health concerns and high heat days will place stress on infrastructure, such as roads and utilities.

While heat is an issue citywide, its impacts vary throughout the city due to the urban heat island effect, which magnifies ambient air temperature, making the air feel hotter than it would be otherwise. Areas in Cambridge with minimal tree canopy and large amounts of impervious surfaces, such as pavement and dark roofs, tend to capture and retain heat. This is especially prevalent in the Alewife Quadrangle and East Cambridge, but heat islands exist throughout the city. Climate projections show that the urban heat island effect will expand in area and become more intense over time.

Mitigation Strategies

Through CCPR, the City has identified three significant strategies to mitigate the impacts of rising temperatures by reducing heat island effects: using high solar reflective index (SRI) building envelopes and roofs, increasing vegetation while decreasing impervious surfaces, and promoting shade by expanding the urban forest canopy and using non-vegetative shade structures.
• **High-SRI building envelopes and roofs:** One study done in the area near Alewife and North Cambridge shows that if 50% of roofs were painted white to have a high SRI, the average ambient air temperature could decrease by 2.4°F with a maximum temperature reduction of 4.5°F;

• **Vegetation and impervious surfaces:** Converting impervious surfaces to vegetation using green infrastructure techniques also reduces ambient air temperature since reducing impervious area decreases air temperature and green infrastructure effectively reduces impervious area. Testing the maximum extent practicable of this conversion in the same area near Alewife and North Cambridge demonstrates that there could be an average temperature decrease of 1.7°F with a temperature reduction in the range of 0.1-6°F;

• **Shade:** The CCPR plans found that a 1% increase in the tree canopy relates to 0.12°F of cooling. It also found that increasing canopy cover to 30% citywide would lead to significant cooling of 38% of the city land area and that tree canopy provides the most significant cooling effects above 60% coverage. The UFMP acknowledges that while trees are more effective than shade structures, shade structures can provide shade immediately while new tree plantings require many years to achieve significant shade. As a result, shade structures act as a complementary heat reduction strategy to trees.

**Key Points in Task Force Discussion**

The Task Force discussed how Cambridge’s urban form influences temperatures and how it could be modified to promote cooling. Some key considerations that helped focus which strategies to prioritize for heat mitigation included:

• All areas of the city will experience an increase in the ambient air temperature, so cooling strategies should provide citywide benefits in addition to targeting priority areas;

• A performance-based requirement for heat resilience that gives a property owner a menu of options from which to choose allows for the most flexibility and choice;

• Vegetation is not always a feasible way to provide shade, so structures such as overhangs and canopies should be considered;

• The City should promote tree maintenance and encourage contiguous canopy coverage;

• Standards adopted into the Zoning Ordinance should strive to meet the goal of the UFMP to increase tree canopy coverage citywide, though they will need to balance other City priorities such as urban design guidelines, housing affordability, and the city’s historic character.

**Other Aspects of Resilience**

The Task Force focused primarily on urban development strategies to mitigate flooding and heat, as they are the source of the most significant impacts from climate change that Cambridge will face, and they can be addressed directly through development standards. However, the Task Force also discussed other planning strategies that could be referenced in zoning.

**Emergency Planning**

Emergency planning involves better preparing residents for emergency scenarios by providing resources that educate them and connect them with their community in the instance of an emergency event. It is distinct from emergency response, which provides immediate services to those impacted by disaster or
trauma to limit the negative impacts they experience. The goal of emergency planning is to improve human comfort and safety during an emergency with stand-alone or passive life support systems.

Task Force members agreed that new construction or substantial investments in renovations should incorporate emergency planning to help residents—particularly vulnerable residents—shelter in place. For instance, these projects could include a resilient community room that is elevated above potential flooding and has a backup energy supply, food and water, and a communication system. They could also have emergency egress and programming that enhances social resilience. Task Force members also discussed how emergency planning requires thinking about sharing resources and shelter among buildings.

While emergency planning falls outside the scope of development standards that can be mandated through zoning, it could be included as a topic to be discussed when development proposals are required to undergo a holistic design review process, such as a Planning Board special permit or an advisory development consultation.

Passive Resilience

The concept of “passive design,” encourages buildings to be designed to maximize interior comfort while requiring minimal energy use. This is effective as a climate change mitigation strategy because it reduces greenhouse gas emissions, but also promotes climate resilience because it increases a building’s ability to withstand heat and to keep occupants safe in the event of power outages or extreme weather events.

Passive design strategies involve careful attention to building envelope assemblies, building systems, and materials, which are regulated by the building code and generally outside the scope of zoning. However, there are ways that such approaches can be encouraged. For example, the “Passive House” rating system is incorporated into the city’s Green Building Requirements as an alternative to the LEED rating system. As above, passive design strategies could be a consideration for developments that undergo a holistic design review process.

Zoning Approaches

Zoning is a form of land use regulation that controls the type and intensity of land use, including the size and scale of buildings, as well as site and building characteristics such as setbacks and open space. Along with other regulations such as building codes, stormwater regulations, and historic preservation reviews, zoning is a key aspect of how Cambridge shapes its built environment. Far from being a rigid, one-size-fits-all tool, zoning offers municipalities different approaches to land use regulation. How zoning is crafted depends on the outcomes that Cambridge wants to achieve, including the types of projects that it wants to encourage or discourage.

Zoning mainly controls new development and alterations to existing development. Existing uses and buildings may be maintained even if the zoning is changed, but would have to conform with new zoning standards if they are modified or expanded, with a presumption that development will transition from less-conforming to more-conforming over time. While zoning may influence the choices that a property owner makes, it only regulates and does not dictate change. As mentioned above, there are many other regulations and factors that influence development. In addition, zoning is more effective when it sets
specific, quantifiable standards that are easy to measure and do not change. Zoning is less effective at regulating more qualitative standards and criteria that involve changes over time.

How Zoning Works

Cambridge is divided into base zoning districts that regulate basic aspects of development, such as use, building height, floor area, number of housing units, open space, setbacks, and parking. Each district has a set of uniform rules that correspond to its unique development characteristics. Some districts are more permissive – allowing a wider range of uses, or larger buildings – while others are more restrictive. Any new development standards would need to interact with existing standards in a logical way.

In addition to base zoning, there are citywide development standards that apply all (or most) base zoning districts as well as area-specific overlay districts that overlap with all or parts of base zoning districts. Citywide rules serve particular policy objectives, and include Green Building Requirements (Section 22.20), Inclusionary Housing and Incentive Zoning (Section 11.203), and Project Review (Article 19.000). Area-specific overlay districts modify the base zoning in locations that are subject to particular planning concerns, and include Planned Unit Development (PUD) districts, mixed-use overlay districts (e.g., Central Square and Harvard Square), and the Flood Plain Overlay District. Each approach to applying development standards has benefits and drawbacks (see Table 1).

Types of Development Standards

The following are some general approaches to crafting development standards that were discussed by the Task Force:

- Prescriptive approaches create precise rules that can be simply and straightforwardly applied with administrative review. Maximum building height or minimum parking requirements are some examples. These approaches do not offer flexibility – they are either met or not met.
- Performance standards require a specific outcome that could be met through different means, without mandating a single way of achieving that outcome. The Green Building Requirements, which are based on holistic design rating systems, are an example. These approaches offer some flexibility, but usually require an analysis or study to demonstrate compliance, which can be an additional burden for smaller-scale development.
- Some zoning requirements mandate a review process by which a City body, such as the Planning Board or Board of Zoning Appeal, determines whether particular criteria are met. The main example of this in Cambridge’s zoning is the Project Review Special Permit (Section 19.20).
- Some zoning requirements incorporate incentives, which allow some additional flexibility beyond the base zoning requirements to serve some public objective. A large-scale example is PUD overlay zoning, which allows increased height and density in a particular area but requires a more intensive Planning Board review and approval process and the incorporation of public benefits, such as open space, identified in plans for the area. At a smaller scale, the incentive approach is used to relax setback requirements to install insulation on an existing building to improve energy performance (Section 5.24.2.1).

See Table 2 for a direct comparison of the benefits and drawbacks of each of these types of development standards.
### Table 1.
Each approach to zoning has its benefits and drawbacks.

<table>
<thead>
<tr>
<th></th>
<th>Benefits</th>
<th>Drawbacks</th>
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</thead>
<tbody>
<tr>
<td><strong>Base Zoning Districts</strong></td>
<td>Tailored to the land use character of the district (height, scale, density); uniformity across a district</td>
<td>Might not be consistent throughout the city; current district boundaries might not be ideal for a particular standard</td>
</tr>
<tr>
<td><strong>Citywide Rules</strong></td>
<td>Consistent application of a citywide standard; uniformity across multiple zoning districts</td>
<td>Can create widespread non-conformity issues; must be compatible with underlying district regulations</td>
</tr>
<tr>
<td><strong>Area-Specific Overlays</strong></td>
<td>Same as citywide overlay, but more customizable/targeted</td>
<td>Confusing to interpret/apply in combination with base zoning; must be compatible with underlying district regulations; fragmentation creates tension with uniformity</td>
</tr>
</tbody>
</table>

### Table 2.
There are advantages and disadvantages to the different types of development standards.

<table>
<thead>
<tr>
<th></th>
<th>Benefits</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prescriptive</strong></td>
<td>Easily understandable; straightforward to apply/enforce</td>
<td>No allowance for flexibility; some issues can’t be expressed as simple standards</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td>More direct in addressing some issues/impacts; opportunity to meet standards in different ways</td>
<td>Requires more professional expertise; potential for ambiguity, unforeseen consequences</td>
</tr>
<tr>
<td><strong>Discretionary</strong></td>
<td>Case-by-case review allows for input, improvement, mitigation; relies on good judgment</td>
<td>Discretionary decisions can be challenged; relies on good judgment</td>
</tr>
<tr>
<td><strong>Incentives</strong></td>
<td>Easily understandable; encourages “better than the minimum” approach</td>
<td>Challenge to agree on balance between incentive and benefit; doesn’t guarantee a particular outcome</td>
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### Guiding Principles and Objectives

After reviewing and discussing the background information described above, but before developing zoning recommendations, the Task Force discussed and reached consensus around a set of principles and factors to guide its discussions. With this framework in mind, it then identified more specific land use and development objectives that the final recommendations would aim to achieve.
<table>
<thead>
<tr>
<th>Principle</th>
<th>Factors</th>
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</table>
| 1. **Focus on people, communities, and equity** | • Consider human needs in relation to the physical environment;  
  • For residential development, focus on health, safety, and livability of people’s homes;  
  • For commercial development, focus on economic impacts that broadly affect people’s lives;  
  • Acknowledge the differing capacities for risk of people across the income spectrum;  
  • Foster greater social connectiveness and mutual support. |
| 2. **Account for differentiation and choice**  | • *Differentiation*: Apply different strategies to different land use scenarios (e.g., new buildings can be elevated while elevating existing buildings or systems is more difficult; open space and tree plantings will have different effects in areas with different prevailing patterns of development);  
  • *Choice*: Provide options to allow for economic choices (e.g., cost of floodproofing to withstand damage vs. cost of replacement; installation of structural sun-shading devices vs. green infrastructure). |
| 3. **Balance strategies to address new construction and existing development** | • Target policies to new construction or existing development depending on how much of the population will be affected;  
  • Evaluate what changes to existing buildings can reasonably be expected if they are incentivized and what changes are less likely to be feasible;  
  • Assess implications of the recent trend toward more intensive use of basement space in existing buildings. |
| 4. **Use performance-based standards as well as prescriptive standards**  | • Adopt standards that allow for a range of possible solutions;  
  • Set performance standards for larger development that undergoes a higher level of review;  
  • Set prescriptive standards where they can be applied universally across a broad range of land use and development scenarios;  
  • Use tested and established frameworks where possible (e.g., LEED resilience credits as a starting point);  
  • Incorporate programmatic approaches (e.g., emergency preparedness plans) where practical. |
<p>| 5. <strong>Allow flexibility in changing circumstances</strong> | • <em>Incrementalism</em>: Promote present actions that can lead to future improvements (e.g., designing roofs to anticipate the future installation of green infrastructure), mindful of the balance of risks and costs; |</p>
<table>
<thead>
<tr>
<th>Land Use and Development Objectives to Mitigate Flooding and Heat Impacts</th>
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<tbody>
<tr>
<td><strong>1. Elevate and Floodproof</strong></td>
</tr>
<tr>
<td>Protect flood-sensitive uses such as residential units and critical building systems by elevating above future design flood elevations or dry floodproofing where below future design flood elevations</td>
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<tr>
<th>6. Support actions with co-benefits</th>
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<tr>
<td>Implement strategies that mitigate both flooding and heat;</td>
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<tr>
<td>Prioritize strategies that have other benefits such as reduced energy demand (e.g., passive livability), improved water quality (e.g. increased pervious surface), air quality, open space, habitat, or recreation when possible;</td>
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<tr>
<td>Balance strategies that improve flooding and heat resilience with other city priorities.</td>
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<th>7. Seek effectiveness</th>
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<tr>
<td>Choose strategies that are the best suited to address the issue or impact;</td>
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<tr>
<td>Use zoning to complement non-zoning tools and other actions the City is undertaking (e.g. CCPR);</td>
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<tr>
<td>Affect enough sustainable development to have a meaningful impact on residents and the built environment;</td>
</tr>
<tr>
<td>Aim for benefits at the individual property, abutter, neighborhood, and city scale that will exceed costs over the life of a structure.</td>
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<tr>
<th>8. Make decisions based on best available data and science</th>
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<tbody>
<tr>
<td>Build a base of knowledge for future decision-making by continuing to collect and evaluate information about climate change and its impacts;</td>
</tr>
<tr>
<td>Plan for climate science to evolve and our understanding of impacts to become clearer with time;</td>
</tr>
<tr>
<td>Use forward-looking data, acknowledging uncertainties while anticipating that future climate conditions will be warmer and wetter.</td>
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</table>
2. Design to Recover
   Design buildings to withstand or recover from projected flooding (e.g. wet floodproofing, temporary barriers, water-resistant or replaceable materials)

3. Green Infrastructure
   Use green infrastructure (e.g., swales, wetlands, green roofs) in addition to gray infrastructure (e.g. storage tanks) to manage stormwater on-site

4. Preserve Vegetation
   Preserve existing vegetation (e.g. trees, ground cover, planted roofs)

5. Create Vegetation
   Create new vegetated areas (e.g. trees, ground cover, planted roofs) and design so that plantings can thrive over time

6. Limit Paved Areas
   Limit amount of paved area, increase permeable area

7. Provide Shading
   Provide shade with trees or structural shading where trees are infeasible, especially over paved areas

8. Use Reflective Surfaces
   Use solar-reflective surface materials for roofs, buildings, and paved surfaces to the extent possible

9. Promote Passive Resilience
   Incorporate “passive resilience” features including high performance building envelope, shading, natural ventilation, and limit air leakage

10. Shelter in Emergencies
    Provide spaces for sheltering and services during extreme events

11. Create Emergency Plans
    Create emergency plans with protocols to implement during an extreme weather event, where practical

12. Implement Area-Wide Strategies
    Achieve the above results across larger areas (e.g., protective berms, elevated infrastructure, larger-scale green infrastructure, pooled open space, neighborhood preparedness plans)

13. Produce Co-Benefits
    Promote objectives with other environmental benefits, such as reducing energy demand, greenhouse gas emissions, and auto trip generation; and increasing renewable energy production
Recommendations

The final phase of the Task Force’s process involved working to develop recommended changes to the Cambridge Zoning Ordinance that are informed by the Principles and Factors described above and would achieve the Land Use and Development Objectives described above. The recommendations are grouped in the following categories:

- **Category 1: Flood Resilience** – Codification of standards based on 2070 projected flooding elevations that are consistent with current City practices.
- **Category 2: Heat Resilience** – Creation of the performance-based Cool Factor and establishment of new standards based on City plans.
- **Category 3: Adjust Current Zoning Standards** – Removing obstacles in current base zoning standards that prevent or discourage resilience measures that are recommended in the City’s Climate Change Preparedness and Resilience planning.
- **Category 4: Planning Board Review** – Addition of new standards that are applicable to major new development regulated by Article 19.000 (including Green Building Requirements in Section 22.20), generally developments of 25,000+ square feet.
- **Category 5: Future Study** – Other initiatives that could directly or indirectly advance resilience planning, and efforts to undertake as new zoning is implemented.

The consensus of the Task Force was to set new flood resilience and heat resilience standards in the case of new buildings, but not to impose requirements that could be burdensome to owners of smaller sites making alterations or additions to existing buildings. Task Force members recognized the importance of promoting climate resilience citywide through zoning; however, they believed that the City needs to further study how requirements could be tailored to smaller parcels to ensure that they do not place undue burdens on small property owners.

**Category 1: Flood Resilience**

**Overview**

To address the impacts of flooding on Cambridge, the Task Force identified development standards based on the Long-Term Flood Elevations (LTFE) identified in the Cambridge FloodViewer. By using future projections rather than flood risk maps prepared by the Federal Emergency Management Agency (FEMA), the City will be able to protect buildings and sites that experience riverine flooding, localized flooding, and flooding due to sea level rise and storm surge (SLR/SS). The Task Force decided to use the LTFE projections because most buildings built today are designed to last for 50 years, which is in alignment with the timeframe of the projections. The Task Force recommends that these standards are updated at regular intervals as the science evolves and projections change, as long as there is advance notice before they become effective.

**Standards and Application**

The Task Force recommends requiring flood protection for all new construction occurring on sites below the projected flood elevations as identified in the Cambridge FloodViewer. Flood protection is defined differently for different uses and is based around the build/protect/recover standards identified in CCPR. Alterations to non-conforming buildings would be allowed per Article 8.000, but some cases would
require a special permit or variance. For buildings that are below the 1%-probability LTFE, the following standards apply:

- Protect vulnerable residential living space and critical building systems by elevating vulnerable uses above the 2070 1%-LTFE;
- Design other built spaces to recover without irreparable damage by dry-floodproofing vulnerable uses between the 2070 10%- and 1%-LTFE.

For buildings that are below the 10%-probability LTFE, the following standards apply:

- Protect principal-use spaces intended for regular active use by elevating buildings or grade above the 2070 10%-LTFE and dry-floodproofing most usable spaces below the 2070 10%-LTFE;
- Design other accessory spaces (e.g., storage) to recover without irreparable damage by wet-floodproofing most usable spaces between the 2070 10% and 1%-LTFE.

The Task Force is recommending these standards because they will codify existing City-recommended practices and because they give property owners greater flexibility while still protecting buildings and people.

Task Force Comments

The Task Force was supportive of these standards because they are targeted to areas that are projected to experience flooding and because they offer a certain amount of flexibility and choice. Some Task Force members suggested that the City establish a mechanism for property owners to appeal the FloodViewer projections. Other Task Force members suggested that historic structures may need special considerations and that it would be useful to allow modifications through a Planning Board special permit process. Some Task Force members asked that language be added to Article 19.000 that encourages developers of large projects to protect to the 1%-LTFE where possible, since the higher standard increases a building’s flood resilience.

The Task Force seeks to ensure that the goals of the Affordable Housing Overlay (AHO) are not compromised by these standards. Since the AHO does not currently allow development to proceed as-of-right if it requires a zoning variance, some Task Force members suggested allowing modifications for projects that are developed under the AHO.

Category 2: Heat Resilience

Overview

A key component of the Task Force’s recommendations is the use of the performance-based Cool Factor to measure the heat resilience of a development proposal. The Cool Factor is a Cambridge-specific alternative to popular green area ratios, such as Seattle’s Green Factor and Somerville’s Green Score. It calculates a weighted score based on site features including mature tree preservation, new tree planting, ground-level vegetation coverage, green roofs, shade structures, and the use of high-solar-reflectivity paving materials. Property owners are given the flexibility to choose which Cool Factor strategies are most appropriate for their project, as long as they meet the minimum weighted score requirement. The Task Force is recommending this strategy because traditional zoning does not adequately encourage overall cooling performance of buildings and sites. In addition, members
acknowledged that Cambridge already has strong, performance-based regulations for stormwater management that combines green and grey infrastructure, so a combined approach to managing flooding and heat is not necessary.

Standards and Application

The Task Force recommends adopting the Cool Factor as the City’s primary standard for measuring the heat resilience of development projects. The Cool Factor would be applied in the following ways:

- For new construction of 25,000+ square feet, the Cool Factor shall apply to Project Review projects through the Section 19.50 Building and Site Plan Requirements. The open space requirement identified in Section 5.30 of the Zoning Ordinance will serve as the multiplier; if that requirement is less than 20%, then 20% will be used instead.
- For alterations of 25,000+ square feet, the Cool Factor shall apply to Project Review projects through the Section 19.50 Building and Site Plan Requirements. The open space requirement identified in Section 5.30 of the Zoning Ordinance will serve as the multiplier; if that requirement is less than 20%, then 20% will be used instead. If the existing condition is non-conforming, the property owner may compensate for any reduction to the existing Cool Factor score instead of meeting the requirement to have a score of 1 or above.
- For new construction that is less than 25,000 square feet, the Cool Factor shall apply through base zoning. The open space requirement identified in Section 5.30 of the Zoning Ordinance will serve as the multiplier; if that requirement is less than 20%, then 20% will be used instead. Special permits may be allowed for specific scenarios.

There was interest among some Task Force members to apply the Cool Factor to alterations and renovations that are under 25,000 square feet; however, the Task Force decided that more analysis was needed to understand the impacts of doing so. Overall, Task Force members supported having all properties in Cambridge contribute to cooling but thought that the City needed to conduct additional research to identify an appropriate citywide standard that acknowledges different zoning scales and contexts.

Task Force Comments

Task Force members suggested establishing a process to revisit the Cool Factor scoring in a few years after the City and property owners have had experience implementing the standard. Some Task Force members preferred setting a minimum cooling multiplier of 25% but were able to agree to a 20% minimum. They suggested that it might be appropriate to increase the cooling multiplier in the future. Task Force members also noted that the City needed to work out the specifics for how property owners could compensate for a reduction in their existing Cool Factor score.

Category 3: Adjust Current Zoning Standards

Overview

New zoning requirements should work in tandem with development standards that are already in place. Therefore, in addition to creating additional requirements that development must meet, it is important to ensure that other zoning requirements do not constrain or discourage the outcomes that are desired. There are certain standards in the current Zoning Ordinance that could be revised or removed because
they create impediments to achieving the Task Force’s Principles and Objectives. Removing these requirements would provide incentives for property owners to change buildings and sites to be more resilient without imposing new regulatory burdens.

Standards and Application

The Task Force recommends the following changes to the Zoning Ordinance:

- Exempt outdoor shade canopies from GFA, height, setback, and open space limitations. This would apply to new construction or alterations where shade canopies are proposed.
- Exempt exterior flood-resilience measures (e.g., stairs, ramps) from GFA, setback, and open space limitations. This would apply to new construction or alterations where site flood protection measures are proposed.
- Exempt usable green roof areas and rooftop access headhouses from GFA and height limitations as-of-right. This would apply to new construction or alterations where green roofs are proposed.
- Allow a compensating increase in height limit (up to 4’) if the ground story is elevated up to the 2070 1%-LTFE. This would apply to new construction or alterations where site flood protection measures are proposed.
- Exempt basement area from GFA limitations as-of-right, if protected from flooding below 2070 1%-LTFE. This would apply to new construction or alterations where site flood protection measures are proposed.

Task Force Comments

The Task Force was very supportive of these five recommendations. One Task Force member expressed concern with exempting shade structures from height and setback requirements, but ultimately all Task Force members agreed to these recommendations.

Category 4: Planning Board Review

Overview

Section 19.20 of the Zoning Ordinance establishes a process by which the Planning Board reviews major development for consistency with the urban design objectives of the City and to mitigate adverse impacts on city traffic. Typically, the special permit only applies to buildings equal to or greater than 50,000 gross square feet, though in some districts review is required for projects equal to or greater than 20,000 gross square feet. Applicants are required to submit a variety of studies, plans, and narratives, and the Planning Board is required to make specific findings based on criteria stated in the Zoning Ordinance. These Special Permits only apply to a limited number of developments, but most new development in Cambridge (by floor area) falls into this large project category. The holistic review process, with public input and approval based on a set of established criteria, provides an opportunity to conduct site-specific review of how a development is planned and designed for resilience.

Standards and Application

The Task Force recommends adding two standards to Article 19.000 that would apply to projects applying for a special permit from the Planning Board:
• Require applicants for a Project Review Special Permit to submit a Resilience Narrative with their application that includes projections for flood risk and heat risk as well as a description of mitigation strategies, including flood protection, heat island mitigation, passive resilience measures, and operational preparedness.

• Add a Resilience Objective to the Citywide Urban Design Objectives in Section 19.30 that notes that development should be planned to respond to anticipated effects of climate change, with indicators related to flood protection, heat island mitigation, passive resilience measures, and operational preparedness. This objective would be used by the Planning Board in its review of all applications for a special permit.

The goal of the Resilience Narrative recommendation is that it would require applicants to consider resilience measures early in the development of their projects. It also ties into the Task Force’s recommendations for flood resilience and heat resilience. Similarly, the Resilience Objective gives City staff and Planning Board members a specific standard by which to measure applications for a special permit.

Task Force Comments

The Task Force supported these recommendations because they prioritize resilience and create consistency in how the Planning Board reviews special permit applications with respect to resilience priorities. Some Task Force members noted that the indicators will need to be specific and fact-based in order to improve the resilience of projects. They suggested including drawing sheets in the submission package and requiring applicants to identify a full range of resiliency measures for all of the key aspects identified of both the Resilience Narrative and the Resilience Objective. Some Task Force members also suggested that applicants are required to reference how their projects conform with specific City plans and goals outlined in policies such as the UFMP and the CCPR.

Category 5: Future Study

The Task Force acknowledged that climate science is dynamic, so members suggested that these amendments to the zoning ordinance are evaluated for their performance at a future date. In particular, they recommended studying the success of these amendments in meeting the Task Force’s Principles and Objectives, with a focus on climate resilience effects as well as impacts on housing production, historic preservation, and small business viability. Task Force members also suggested revisiting climate projections and recommendations from CCPR to determine if additional approaches should be considered, such as expanding the Cool Factor as mentioned above.

As the Task Force discussed possible recommendations to the Zoning Ordinance, members also acknowledged that there were related issues that needed to be addressed but were outside of the scope of zoning. For example, Task Force members discussed the importance of preserving Cambridge’s built cultural heritage through standards that balance historic preservation with resiliency. Members also noted the role that urban design guidelines could play to guide climate-resilient development in the city.

In addition, the Task Force discussed how revising the City’s parking requirements in Article 6.000 of the Zoning Ordinance would also make Cambridge more resilient to climate change. By taking such steps as eliminating minimum parking requirements, lowering maximum parking requirements, and reducing
parking ratios, the City would decrease the amount of land used for the storage of vehicles. This would likely reduce the amount of impervious surface and create more opportunities for green infrastructure, which would improve the City’s ability to withstand the impacts of increased flooding and increased heat. However, the Task Force decided not to include these strategies in its final recommendations because members chose to focus more specifically on buildings and sites.

Implementation and Next Steps

The Charge and Operating Procedures that have guided the Climate Resilience Zoning Task Force set an expectation that City staff would translate these recommendations into a zoning petition. City staff intends to provide opportunities for Task Force to provide input when the zoning language is drafted. Since amending the Zoning Ordinance requires the Planning Board, Ordinance Committee, and City Council to hold public hearings, there will also be opportunities for continued public comment and involvement. In addition, updated science and the City’s experience implementing these recommendations could drive a need for revising any zoning provisions recommended by the Task Force.
Appendix

- Charge and Operating Procedures
- Cool Factor score sheet
- Cool Factor guidance document