

# TOWN OF BROOKLINE, MASSACHUSETTS CLIMATE RESILIENCE PLANNING TOOLS



OPPORTUNITIES WITHIN THE TOWN OF BROOKLINE'S BYLAWS AND  
REGULATIONS TO INCORPORATE CLIMATE RESILIENCE AND ADAPTATION



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The Climate Change Adaptation Resiliency Gap and Opportunity Analysis revealed there are places within the Town of Brookline's regulations and by-laws to incorporate climate adaptation and resilience. The findings of the analysis are provided in this report. Chapter 1 provides information about climate change and its impacts, specific to Brookline. In addition, Chapter 1 outlines the methodology used to assess Brookline's regulatory framework, the goals of the project, general recommendations, and the jurisdiction of the regulations that were analyzed in depth. Chapter 2 through Chapter 6 provides recommendations for specific regulations and by-laws:

Chapter 2. Town of Brookline Wetland Regulations (2009)  
Chapter 3. Article 8.26 Stormwater Management By-Law  
Chapter 4. Zoning By-Law: Article IV Use Regulations, Article V Dimensional Requirements, and Article VI Vehicular Service Uses Requirements

Chapter 7 introduces several additional sustainable design standard options. Chapter 8 concludes the report with a summary of the gap and opportunities analysis.





## Chapter 1. Background

Investments and decision-making about the natural and built environment have long legacies and must consider a future that will be vulnerable to climate change. The Town of Brookline completed a Climate Vulnerability Assessment and Action Plan in 2017 that extensively details the climate change projections and associated vulnerabilities in Brookline (Metropolitan Area Planning Council (MAPC), 2017). In reaction to and utilizing the Town's Municipal Vulnerability Preparedness (MVP) Action Grant, Brookline set out to assess the gaps and opportunities to incorporate climate adaptation and resilience within local by-laws and regulations. The gaps and opportunities analysis resulted in numerous recommendations to ensure Brookline is prepared to adapt to climate change. The analysis primarily focuses on utilizing natural resources and the built environment to build climate resilience. Climate resilience refers to the ability of a community to thrive despite the impacts of climate change and climate adaptation means anticipating and preparing for the impacts of climate change.

The Climate Vulnerability Assessment and Action Plan (MAPC, 2017) details the key climate hazards in Brookline: increase in temperature, precipitation, and sea level rise. A summary of the historic trends, projected changes, and potential impacts are provided below. Temperatures in the Northeast United States have increased by almost two degrees Fahrenheit between 1895 and 2011 (Horton et al., 2014). Data from the Blue Hill Observatory in Milton (Massachusetts Executive Office of Energy and Environmental Affairs and Massachusetts Adaptation Advisory Committee, 2011) located less than ten miles from Brookline, reflects this trend. A significant portion of north Brookline is within the hottest 5% of land area in the 101-municipality MAPC region (MAPC, 2017). The increased temperatures will be apparent as heat waves and days over 90 degrees Fahrenheit become more frequent. At the beginning of this century, Brookline experienced 11-12 days above 90 degrees F, and by mid-century this is projected to increase to 32-33 days above 90 degrees F (Massachusetts Executive Office of Energy and Environmental Affairs and the Department of Energy Resources, 2018). The increased temperature will also impact the experience of a New England winter. Climate projections predict more precipitation will be falling as rain rather than snow and there will be fewer days under 32 degrees F. Rising temperatures will impact natural systems and the built environment. Increased temperatures could result in changes in species and composition of forest and wetland habitats, an increase in invasive species and pests, and a longer growing season (MAPC, 2017). Infrastructure can overheat or malfunction under extreme heat. Heat is also the number one weather-related killer. Young children and the elderly are the most vulnerable to heat stress.

As the atmosphere warms, it can hold more water; this leads to an increase in large rainfall events and fewer, smaller periodic rainfall events. This can also lead to longer periods of drought. Precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (Massachusetts Executive Office of Energy and Environmental Affairs, 2011). During this same time period, there has been a 71% increase in the amount of rain that falls in the top 1% of storm events (Horton et al., 2014). Under climate change precipitation is predicted to further intensify, following these historic trends. Moreover, more intense rainfall may result in more frequent riverine (out of banks) and stormwater flooding (when drainage infrastructure becomes overwhelmed). Increased stormwater can increase the amount of pollutants washed into water bodies.

Although Brookline has no coastal shoreline, modeling utilized in the CVAAP projected that later in the century, storm surge could travel up the Muddy River from the Charles River and impact the Brookline shoreline. The Boston Tide Station records show nearly one foot of sea level rise in the past century (MAPC, 2017). The Massachusetts State Hazard Mitigation and Climate Adaptation Plan (Massachusetts Executive Office of Energy and Environmental Affairs and Executive Office of Public Safety and Security, 2018) predicts a sea level rise around 2.4 ft by 2050 and 7.6 feet by 2100 (high scenario). Inundation from sea level rise could cause costly damage to infrastructure.

Through a Municipal Vulnerability Preparedness (MVP) Action Grant, the Town of Brookline set out to assess local by-laws and regulations for opportunities to incorporate climate adaptation and resilience to these hazards. Weston & Sampson reviewed the Town's existing by-laws to identify gaps and opportunities to introduce language to strengthen the resilience of residents, infrastructure and the built environment, and the natural environment.



Twenty-five guidelines, plans, regulations, and by-laws were reviewed for any current requirements, incentives, and authority to implement climate adaptation goals (see Appendix B for a list of documents and the screening criteria). The climate adaptation goals were identified after conducting an extensive literature review search and reviewing relevant documents to this project. See Appendix C for an annotated bibliography of measures, guidance, policies, and other planning tools that have been developed for use in Massachusetts and many other areas throughout the country.

All twenty-five reviewed guidance documents, plans, regulations, and by-laws have areas where climate adaptation goals could be incorporated. However, several regulatory mechanisms rose to the top as the primary avenues for implementing climate adaptation and resilience:

- Article 8.27 Brookline Wetlands By-Law and Regulations
- Article 8.26 Brookline Stormwater Management By-Law
- Brookline Zoning By-Law Sections:
  - 4.10 Floodplain Overlay District
  - 4.11 Land Disturbing Activities and Stormwater Management
  - Article V Dimensional Requirements
  - Article VI Vehicular Service Uses Requirements

These regulations went under further analysis, and the recommendations for their future amendments are included within this memo. The recommendations are based on technical expertise and local and national examples.

Each regulatory mechanism identified as a primary outlet with maximum potential for climate adaptation and resilience was assessed for opportunities to incorporate several climate adaptation and resilience goals (see the box to the right). Several of the goals are complementary to each other. For example, protection against construction impacts may also protect against stormwater impacts. In addition to the goal assessment, best practices and examples from an extensive literature review and technical expertise were used to provide specific recommendations for each regulatory mechanism.

Furthermore, focusing on specific planning tools, with the objective of proposing language to increase the Town's resilience to climate change will promote the use of consistent data sources and definitions, this increasing continuity across committees, planning tools, departments, and boards. Therefore, a description of the various data sources related to climate change hazards and definitions that can be used consistently across planning and policy is provided in the List of References, below.

### CLIMATE RESILIENCE GOALS

- Incorporate climate change into planning and decision-making
- Protect against stormwater impacts
- Protect against riverine impacts/impacts in the floodplain
- Protect against construction impacts
- Reduce demand on water supply during drought
- Minimize impact on streamflow
- Minimize increasing ambient outdoor temperature
- Protect buildings and occupants from the effects of climate change
- Protect against invasive species and promote ecosystem health



Low impact development (LID) techniques can be categorized as a “no regrets” strategy because they result in numerous benefits regardless of climate change. For example, green infrastructure and LID reduce stormwater runoff, decrease the costs associated with cooling buildings, and provide recharge to groundwater aquifers. They also provide residents with additional green space and provide habitat for pollinators and other beneficial animal species.

A regulation or by-law can be amended to change the extent of the land area or activities regulated or the review process. Table 1 details how each reviewed regulation and by-law regulates activities within specific jurisdictional land areas or above specific thresholds of activity. The regulated activities are subject to the approval of an application, permit, or plan, which is reviewed by a specific municipal department, board, or commission.

## “NO REGRETS” STRATEGIES

“No regrets” strategies enhance the living conditions of people in the present in addition to building climate resilience. “No regrets” strategies can be taken today without being certain about all the details of climate change because the strategies provide social, economic, and environmental benefits regardless.

Table 1. Regulatory Jurisdiction and Review Body

Regulation/ By-Law	Jurisdiction and Regulated Activities	Permit/ Approval	Review Body
Wetland Regulations for Article 8.27 Wetlands Protection	Wetlands, rivers, streams, ponds, and reservoirs and the land bordering these (buffer zones or 150 feet surrounding resource areas), and riverfront areas and land subject to flooding	Application and Permit	Conservation Commission
Article 8.26 Stormwater By-Law	Removal of a tree 32" or an aggregate of trees greater than 8" diameter at breast height (DBH)	Erosion Control Plan	Department of Public Works
	Land disturbing activities that: <ul style="list-style-type: none"> <li>Remove vegetation or change the slope on more than 2500 sq. ft.</li> <li>Store more than 100 cubic yards of excavate</li> </ul> Land disturbing activities greater than 2500 sq. ft. that increase stormwater runoff  Activity that would increase flow to municipal storm or sanitary sewer system  Alterations to the existing drainage system	Stormwater Management Plan	
Article 4.10 Floodplain Overlay District	Structures constructed or expanded and activities moving earth or other materials within special flood hazard areas Zone A or AE.	Special Permit	Board of Appeals



Table 1. Regulatory Jurisdiction and Review Body

Regulation/ By-Law	Jurisdiction and Regulated Activities	Permit/ Approval	Review Body
Article 4.11 Cluster Subdivisions, Groups of Single-Family Dwellings and Estate Conversions	Designed single-family dwellings or the conversion of an existing structures in S (single family) and SC (single family converted for two-family) Districts	Special Permit	Board of Appeals
Article 5.09(a) Community and Environmental Design Standards	All new structures and exterior modifications, which require a building permit.	Special Permit and Site Plan	<p>Planning Board Board of Appeals</p> <p><i>Involved:</i> Building Commissioner Planning Director</p> <p><i>Can be Appointed:</i> Design Advisory Team</p>



## Chapter 2. Town of Brookline Wetlands Regulation (2009)

The Town of Brookline Article 8.27 Wetlands Protection gives the Conservation Commission the authority to protect Resource Areas (like wetlands and buffers) and Resource Area Values (like flood control and storm damage prevention) through the Brookline Wetlands Regulations (see Text Box 1 for definitions of Resource Areas and Resource Area Values).

Article 8.27.9 Wetlands Protection authorizes the Conservation Commission to promulgate regulations. Therefore, amending the Wetlands Regulations by the Conservation Commission, rather than the by-law by a vote of Brookline's Town Meeting, will provide more flexibility, which will be important as new best practices and climate data become available. Wetlands soak up and store stormwater, which will be essential to Brookline's climate resilience. Trees and vegetated surfaces also soak up stormwater and reduce urban heat island. Therefore, the following Chapter recommends amendments to the Wetlands Regulations to extensively protect Resource Areas, as defined by the current by-law and regulation, under current and future climate change conditions. The amendments will:

1. Add definitions to include climate resilience terminology
2. Update the definition of the "Land Area Subject to Flooding" to be based on the most recently available climate data and predictions. Alternatively, consider using events with longer return periods (e.g., 500-year event). Allow the Commission to update data and statistics used as needed.
3. Expand performance standards to ensure that design considerations
  - Require adequate flood storage in Land Area Subject to Flooding
  - Limit storm and flood damage associated with climate change hazards
  - Protect structures and minimize damage to structures on site
  - Maximize water quality treatment or require stormwater treatment onsite
  - Create an option to require further analysis of stormwater impacts
  - Protect vegetation and limit site disturbance

### 1. & 2. Adding and Updating Definitions

Article 8.27.2 states, "Except as otherwise provided in this by-law **or in regulations of the Commission**, [emphasis added] the definitions of terms in this by-law shall be as set forth in the Wetlands Protection Act (G.L. c. 131, § 40) and Regulations (310 CMR 10.00)," which provides the Conservation Commission authority to alter and add definitions in the Wetland Regulations.

The Wetlands Regulations should be updated with climate adaptation related definitions to accompany any amendments related to climate resilience. For example, if the consideration of climate change impacts is instituted as a new performance standard, a definition of "climate change impacts" should be added to the regulation. The following definitions should be added:

- Adaptation
- Climate Change Hazards
- Flood Control
- Extreme Weather Event
- Resilience
- Storm Damage Prevention

Two existing definitions should be updated to improve climate resilience. The first update is to the "Wetland Resource Area Values" definition to include adaptation and resilience to climate change. Although many of the resource area values already contribute to climate adaptation, like flood control and storm damage, this will emphasize that wetlands are also valuable in future climate conditions. By adding climate adaptation and resilience to the Wetland Resource Area Values, the Commission will also recognize the value of wetlands under extreme heat, like cooling of stormwater prior to reaching streams.





The second definition update is to expand the definition of the “Land Subject to Flooding.” The current definition does not define the reoccurrence interval of the floodplain area. Defining the floodplain area to be that of a 500-year event will minimize confusion, while likely expanding the area covered under the current definition which may be assumed to cover the 100-year floodplain. Where National Flood Insurance Program data are unavailable or deemed by the Commission to be outdated or inaccurate, the boundary of said land may be based on the maximum lateral extent of flood water which has been observed or recorded, or other evidence presented and considered by the Commission, such as credible climate change projections. Such areas may or may not be characterized by wetland vegetation or soil characteristics.

#### Text Box 1. Article 8.27.2 Current Definitions

**RESOURCE AREAS** - Land under lakes, ponds, rivers or streams; any bank, marsh, wet meadow, bog or swamp bordering on any lake, pond, river or stream; land subject to flooding bordering on any lake, pond, river or stream; isolated land subject to flooding; isolated vegetated wetlands; riverfront areas; and vernal pools.

**RESOURCE AREA VALUES** – Without limitation, public or private water supply, groundwater, flood control, erosion and sedimentation control, storm damage prevention, water quality, water pollution control, wildlife habitat, rare species habitat including rare plant species, and recreation values.

### 3. Performance Standards

The Conservation Commission is given authority to create design specifications, performance standards, and other requirements to which permit applicants must abide. Article 8.27.8(b) states “The Commission is empowered to deny a permit for failure to meet the requirements of this by-law; for failure to submit necessary information and plans requested by the Commission; **for failure to meet the design specifications, performance standards, and other requirements in regulations of the Commission** [emphasis added]; for failure to avoid or prevent unacceptable significant or cumulative effects upon the resource area values protected by this by-law; and where no conditions are adequate to protect those values.” After reviewing the current performance standards, there is an opportunity to amend existing standards and add three new performance standards to improve adaptation and resilience.

#### Existing Performance Standards

The Land Subject to Flooding Performance Standard language should be updated to require flood storage or additional flood storage on site. Flood storage is compensatory within the 100-year floodplain through 310 CMR 10.00 Wetlands Protection. If the Town of Brookline’s Wetland Regulation is amended to the 500-year floodplain in the definition of land subject to flooding, the regulation should expand the requirement of compensatory flood storage beyond the State’s regulation.

Another option would be to require compensatory flood storage in excess of the flood storage lost (2:1 ratio). The Town may wish to model the effect of this approach to demonstrate that it is practicable. The compensatory flood storage may or may not restrict parking areas and garages as allowed flood storage. In areas of high density, utilizing parking areas and garages as flood storage is a useful tool. However, the storm runoff from these facilities may pollute Resource Areas and may result in damage to vehicles and property. Water quality best management practices will capture and manage the first inch of runoff.

#### New Performance Standards

The three areas where new performance standards can improve resilience are below:

##### **1) Climate Change Adaptation and Resilience Standard**

Although climate change is likely to result in somewhat more annual precipitation, the most effect will be on the intensity of rain events. Increased intensity will make events more likely to overwhelm drainage systems. As a result, flood control and storm damage prevention, among other Resource Area Values, offered by wetlands and other Resource Areas will be an even greater asset to the community (see Text Box 1 for definitions of Resource Areas and Resource Area Values). In addition, extreme weather events (including drought and heat) pose a threat to Resource Areas. Introduction of a Climate Change Adaptation



and Resilience Standard will protect Resource Area Values and Resource Areas under these future conditions.

Authority: The authority of the Wetland By-Law and Regulations to institute a Climate Change Adaptation and Resilience Standard is within the purpose “to protect the wetlands, water resources, and adjoining land areas in the Town of Brookline by controlling activities deemed by the Conservation Commission likely to have a significant or cumulative effect upon resource area values” (Article 8.27.1).

Recommendations: Applicants should be required to describe how a project design will limit storm and flood damage during extended periods of intense rainfall under future climate conditions. Applicants should also be required to describe how Resource Area health will not be cumulatively affected by the proposed alterations and under changing climate conditions. The Town may wish to increase the depth of rain events to be managed or require future-year projections of rain events that match the design life of proposed projects (e.g., statistical projections of the 10-year storm event in 30 – 50 years). The Climate Change Adaptation and Resilience Standard should also require applicants to describe measures to protect and minimize damage to proposed structures from the impacts of climate change. This standard will protect Resource Areas from rehabilitation construction impacts and potential pollution from storm debris.

## **2) Stormwater Management Review-Threshold Standard**

The Wetland Regulations Stormwater Management Standard would require approved alternations of 1,000 square feet or more to the site to adhere to the requirements set forth in Article 8.26 Stormwater Management By-Law even when the alterations do not meet other jurisdictional thresholds. Such alterations would require an Erosion and Sediment Control Plan and a Stormwater Management Plan. If the proposed amendments to the Stormwater Management By-Law are not updated as recommended in this memo, the Stormwater Management Performance Standard of the Wetlands Regulations should incorporate some of the language recommend for Article 8.26.

The Town may wish to add language that exempts other projects that cause land disturbance from regulatory review but require that these projects adhere to soil erosion and sediment control standards. This approach limits the application burden on reviewers and the regulated community while ensuring the Town’s authority to protect the environment. Alternatively, the Town may choose to continue with a threshold of 2,500 square feet or disturbance and offer an exemption from review provided the project meets the soil erosion standards.

Authority: The Wetland By-Law purpose is to ensure activities within Resource Areas do not have a significant or cumulative effect upon Resource Area Values. The Stormwater Management Standard will control stormwater activities that are likely to impact Resource Areas Values such as, groundwater supply, flood control, erosion and sedimentation control, storm damage prevention, water quality, and water pollution control.

Recommendations: The proposed recommendations for Stormwater Management By-Law define the areas protected under the Wetland Regulations as environmentally sensitive and will be expected to manage stormwater with LID techniques. More specifically, the performance standard should establish limits on the allowable site disturbance and set requirements for restoring disturbed vegetation and replacing disturbed soils to ensure predevelopment infiltration rates. These recommendations are presented in Chapter 3 of this document.



The Stormwater Management Standard should require the permit applicant to describe:

- How stormwater surface runoff and pollution will be mitigated during extreme weather events, including those under climate change.
- The extent to which stormwater management shall treat and infiltrate stormwater on site to mimic predevelopment conditions.
- How best management practices from Article 8.26 Stormwater Management or Stormwater Management Standards of the Massachusetts Department of Environmental Protection (MassDEP) have been applied.
- If there would be alteration to flood storage capacity on the site.

The regulations should also allow the Commission to require runoff calculations using current and projected precipitation duration and frequency data at their discretion and commensurate with the scope of the proposed project.

### **3) Vegetation Removal and Replacement and Wildlife Protection Standard**

The proposed Vegetation Removal and Replacement and Wildlife Protection Standard would require permit applicants to adhere to performance standards that eliminate vegetation removal without a rationale and require in-kind replacements.

Authority: Vegetation is important to several Resource Area Values defined in Article 8.27 (see Text Box 1) including flood control, erosion and sedimentation, wildlife habitat and recreation values. Vegetation will be essential to maintaining these Resource Area Values under projected climate conditions. Vegetation can also provide urban cooling when shade trees are protected, and impervious surfaces are minimized.

Recommendations: The Vegetation Removal and Replacement and Wildlife Protection Standard will require a vegetation / planting plans that improve the resiliency of the wildlife habitat of the Resource Area to withstand potential temperature and rainfall changes (drought and excess) due to climate change. The new standard will require in-kind replacements, which are not to be invasive. Native species are encouraged. Vegetation removal will be approved if specific criteria have been met or specific reasons apply. Reasons for removal would include categories such as the health of vegetation, ecological restoration, or vegetation will be replaced on site.

Note, this standard will incorporate the current language on protecting animal and plant species listed as rare, threatened, endangered, or of special concern by the Massachusetts Natural Heritage Program.



### *Application to Climate Adaptation and Resilience Goals*

The opportunities for amendments to the Wetlands Regulations and how they align with climate adaptation goals are shown in Table 2. See Appendix D for example language for each amendment.

Table 2. Climate Resilience and Adaptation Goals and the Wetlands Regulations

Goals	How to Incorporate Goals into Wetlands Regulations
Incorporate climate change into planning and decision-making	Update language with definitions related to climate adaptation and resilience that can be used across planning and regulatory tools where applicable.
Protect against stormwater impacts	Add performance standards that can be updated to include a: <ul style="list-style-type: none"> <li>• Climate Change Adaptation and Resilience Standard</li> <li>• Stormwater Management Standard</li> <li>• Vegetation Removal and Replacement Standard</li> </ul>
Protect against riverine impacts/impacts in the floodplain	Protected by current buffer zone and riverfront area, which are considered resource areas.  Expand definition of “Land Subject to Flooding” and require compensatory flood storage within the 500-year floodplain and/or require 2:1 compensatory flood storage
Reduce demand on water supply during drought	Add a Vegetation Removal and Replacement Standard
Minimize impact on stream flow	Add performance standards can be updated to include a: <ul style="list-style-type: none"> <li>• Stormwater Management Standard.</li> <li>• Vegetation Removal and Replacement and Wildlife Protection</li> </ul>
Minimize increasing ambient outdoor temperature	Add performance standards can be updated to include a: <ul style="list-style-type: none"> <li>• Climate Change Adaptation and Resilience Standard</li> <li>• Stormwater Management Standard</li> <li>• Vegetation Removal and Replacement and Wildlife Protection</li> </ul>
Protect buildings and occupants from the effects of climate change	Add performance standards can be updated to include a: Climate Change Adaptation and Resilience Standard
Protect against invasive species and promote ecosystem health	Add a Vegetation Removal and Replacement Standard and Wildlife Protection Standard





## Chapter 3. Article 8.26 Stormwater Management By-Law

Ideally, stormwater management slows the flow of direct runoff so that rainfall can infiltrate into the ground. This can reduce erosion and the amount of pollutants washed into waterways. By retaining stormwater runoff on site, stormwater systems are less likely to become overwhelmed. Stormwater system performance will be challenged as precipitation increases in intensity. Nature-based solutions, like green infrastructure and low-impact development, are considered as best practices to address the impacts of climate change.

The recommendations in this report utilize the existing regulatory tool, the Stormwater Management By-Law, with Town-wide jurisdiction, to take advantage of opportunities to utilize stormwater management as a climate adaptation tool. The Stormwater Management By-Law Article 8.26 has three sections. The first section discusses discharge to the municipal drain system (8.26.1), which is further regulated in the Regulations Governing the Use of Storm Drains. The second section is about erosion and sediment control during land disturbances, like new building construction (8.26.2). The final section addresses post construction stormwater management (8.26.3). The second and third sections provide the greatest opportunity to use the Stormwater By-Law as a climate resilience tool.

The current Stormwater Management By-Law encourages stormwater management onsite and addresses several climate adaptation goals including minimizing stormwater runoff, reducing potential negative impacts of runoff, like erosion and pollution. In addition, the By-Law seeks to provide groundwater recharge. The Stormwater Management By-Law can further incorporate climate adaptation and resilience goals in several sections (Table 3).

Table 3. Climate Resilience and Adaptation Goals and Stormwater Management By-Law

Goals	How to Incorporate Goals into the Stormwater Management By-Law
Incorporate Climate Change into Planning and Decision-Making	Update with new definitions related to climate adaptation and resilience that can be used across planning and regulatory tools where applicable.  Required to meet MassDEP Stormwater Management Standards  Land Use Regulations align
Protect Against Stormwater Impacts	Add language in Section 8.26.1 to ensure: <ul style="list-style-type: none"><li>Storm drain capacity can accommodate projected rainfall amounts</li></ul> Add language to 8.26.3 to ensure: <ul style="list-style-type: none"><li>Post construction stormwater management accounts for impacts of climate change.</li><li>Stormwater infiltration is maximized onsite by preserving/planting vegetation, using BMPs, and reducing impervious surfaces</li></ul>
Protect Against Construction Impacts	Add language to Section 8.26.2 that has the authority to regulate managed construction and other activities that alter the earth to ensure erosion control measures account for projected impacts of climate change through the Erosion and Sediment Control Plan.
Minimize Increasing Ambient Outdoor Temperature	Add language to 8.26.2 and 8.26.3 that requires applicants to keep impervious surfaces to a minimum, to account for climate change impacts in erosion control measures, and to preserve/plant vegetation.

### 8.26.1 Discharges to the Municipal Storm Drain System Section

One of the objectives of section 8.26.1 is “to prevent pollutants from entering the storm drain.” Climate change is anticipated to increase the intensity and duration of rain events. These intense rainfall events, especially after periods of drought, may result in more flow to the storm drain system. Section 8.26. objectives can be updated to include a provision ensuring the impacts of climate change are taken into consideration.



### 8.26.2 Erosion and Sediment Control

The Erosion and Sediment Control section (8.26.1) of the Stormwater By-Law gives the Department of Public Works jurisdiction over land-disturbing activities above minimum thresholds that change the existing grade, remove existing vegetation, remove protected trees, and store excavate or fill. Land-disturbing activities that fall within the specified limits are required to complete an Erosion and Sediment Control Plan (8.26.2 paragraph 4) and to meet performance standards (8.26.2 paragraph 5). Intense rainfall events associated with climate change can cause high runoff rates could that lead to more erosion. Section 8.26.2 should anticipate projected climate conditions. At a minimum, performance standards should be updated to require that all permit applicants adhere to the Massachusetts Stormwater Handbook and Stormwater Standards (as amended) and to the requirements set forth in this by-law.

Either Section 8.26.2(4) Erosion and Sediment Control Plan or Section 8.26.2(5) Performance Standards should be updated with the recommendations in Table 3.

The following is a list of Stormwater Management Standards from the Massachusetts Stormwater Handbook applicable to the table that follows. It specifically includes standards 2, 3, 8 and 9. This listing is provided for reference.

2. Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.
3. Loss of annual recharge to groundwater shall be eliminated or minimized using infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.
8. A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.
9. A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.



Table 4. Recommendations for Article 8.26.2 Erosion and Sediment Control paragraph 4 or 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Prohibit/limit clear-cutting of construction site or set limits on allowable disturbance of existing vegetation	Limiting clear cutting reduces potential soil erosion.	Option 1: Prohibit clear-cutting of construction site. Option 2: Require a percentage of canopy to be retained during and after construction. Option 3: Establish limits on the allowable disturbance of existing vegetated areas in open space.	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Requirements for protecting % of existing trees	In part, tree protection is a technique to reduce soil erosion and sedimentation. The by-law currently requires an Erosion and Sediment Control Plan upon removal of protected tree(s) 32" diameter at breast height (DBH) or greater, either in the aggregate or a single tree. The current Erosion and Sediment Control Plan requires all trees 8" DBH or greater be identified and categorized as trees to be saved or removed.	Language in the Erosion and Sediment Control Plan standards could be more specific to protect trees or provide suitable replacements: - Require a rationale for how the removal will not lead to soil erosion.	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Reestablish vegetation in disturbed areas	Vegetation and trees reduce soil erosion.	Set requirements for re-establishing vegetation in disturbed areas dedicated to open space.	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Identify and protect environmentally sensitive areas as part of existing conditions	The purpose of the Erosion and Sediment Control Plan is to protect the environment from adverse impacts of erosion and sedimentation. Special attention should be paid to portions of the environment that are more vulnerable to adverse impacts.	Add definition of environmentally sensitive areas, include areas protected under the Wetland Regulations.  Set a limit of disturbance and identify limit on grading plans.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.

Table 4. Recommendations for Article 8.26.2 Erosion and Sediment Control paragraph 4 or 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Require minimization of site disturbance or disturbance of vegetated areas to be phased	The current Erosion and Sediment Control Plan requires "A sequence of construction of the development site, including stripping and clearing; protective measures for the trees to remain, rough grading; construction of utilities; infrastructure, and buildings; and final grading and landscaping. Sequencing shall identify the expected date on which clearing will begin, the estimated duration of exposure of cleared areas, areas of clearing, and establishment of permanent vegetation."	Add language to require minimization of site disturbance, including vegetation removal and replacement be phased.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Soils managed for revegetation	Vegetation reduces soil erosion.	In areas where topsoil is clean, consider limiting or prohibiting removal of topsoil from site. If soils are contaminated, this should not be enforced. Topsoil should be utilized in areas that have insufficient depth or to improve planting areas' ability to intercept runoff. Recommend or require rototilling and other prep of soils that are compacted during construction.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Set limits on allowable impervious cover or require minimization of impervious cover	High volumes of runoff increase the risk of erosion and sedimentation.	Establish maximum allowable impervious cover limits or require a description of how impervious cover will not lead to erosion and sedimentation. Limits of impervious cover between 10-15% are recommended.	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require developers to disconnect impervious surfaces where possible	High volumes of runoff increase the risk of erosion and sedimentation. Connected impervious surfaces can aggregate runoff leading to greater stormwater runoff volume compared to disconnected impervious surfaces.	Require the employment of low impact development best management practices to disconnect impervious area.	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.



Table 4. Recommendations for Article 8.26.2 Erosion and Sediment Control paragraph 4 or 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Limit site designs to areas of lesser slope and farther from watercourse/ Protect slopes on the construction site	Higher slopes are more vulnerable to soil erosion and sedimentation.	Add language about limiting or restricting development on areas with slopes higher than 25 or 30% without obtaining special permissions after an assessment made by a professional.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require/ encourage building footprints to avoid highly erodible high permeability (Soil Groups A and B).	The purpose of the Erosion and Sediment Control Plan is to protect the environment from adverse impacts of erosion and sedimentation. Special attention should be paid to highly erodible soils.	Include a description and identifying matrix to qualify hydrologic soil groups and limit or prohibit development on soil types deemed unstable and erodible.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require weather-based irrigation controls	Over-irrigation can lead to increased stormwater runoff and soil erosion.	Require weather- based irrigation controls.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require outfalls to be stabilized to reduce erosion	The purpose of the Erosion and Sediment Control Plan is to protect the environment from adverse impacts of erosion and sedimentation.	At drainage discharge points, provision shall be made for velocity reduction using appropriate technologies to prevent erosion at the point of discharge and down gradient.	<b>Standard #8</b> Plan to control construction related impacts  <b>Standard #9</b> Long-term O&M plan
Use perimeter controls at the site	Perimeter controls keep sediment on site.	Require perimeter controls.	<b>Standard #8</b> Plan to control construction related impacts
Stabilize construction site	The purpose of the Erosion and Sediment Control Plan is to protect the environment from adverse impacts of erosion and sedimentation.	Stabilize entrances and exits to prevent off-site tracking.  Stabilize sites when projects are complete or operations have temporarily ceased.	<b>Standard #8</b> Plan to control construction related impacts
Require restoration of compacted areas	The purpose of the Erosion and Sediment Control Plan is to protect the environment from adverse impacts of erosion and sedimentation. Soil compaction can result in increased soil erosion.	Add language to restore overall soil conditions at construction sites after construction is completed.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.  <b>Standard #8</b> Plan to control construction related impacts

Table 4. Recommendations for Article 8.26.2 Erosion and Sediment Control paragraph 4 or 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Limit traffic of heavy construction vehicles to specific areas to avoid soil compaction	The purpose of the Erosion and Sediment Control Plan is to protect the environment from adverse impacts of erosion and sedimentation. Soil compaction can result in increased soil erosion.	Limit traffic of heavy construction vehicles to specific areas by identifying and preventing soil compaction of soils with the highest infiltration capacity. Require the identification and use of specified travel paths for heavy construction equipment to limit overall site compaction, in addition to preventing and controlling soil erosion and sedimentation. Require the placement of temporary construction trailers to be shown on plans to ensure they are placed outside of environmentally sensitive areas and off soils with the highest infiltration capacity.	<b>Standard #8</b> Plan to control construction related impacts

Inspection and maintenance of erosion and sediment controls should also be considered to ensure that erosion control systems can efficiently operate under intense rainfall conditions. The purpose of 8.26.2 should be updated to explicitly state that adverse impacts from soil erosion to the environment may result from improper inspection and maintenance post-construction to provide authority to manage permanent features. The Review and Approval (6), Inspections (7), and Enforcement (8) sections should consider the following recommendations:

Table 5. Recommendations for Article 8.26.2 Erosion and Sediment Control paragraph 6, 7, 8

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Require as-built inspections before issuance of occupancy that includes identification of compacted areas	The Commissioner of Public works or designated agent shall make inspections to ensure implementation of the Erosion and Sediment Control Plan.	Revise inspection process to ensure that soil compaction is addressed and mediated prior to the issuance of occupancy.  Consider making a checklist of site inspection criteria.	<b>Standard #8</b> Plan to control construction related impacts  <b>Standard #9</b> Long-term O&M plan
Require inspections during and routinely after construction	Inspections are only required during construction. However, some erosion control measures use life extends beyond construction.	Add annual inspections to verify Erosion and Sediment Control Plan's overall effectiveness.	<b>Standard #8</b> Plan to control construction related impacts



Table 5. Recommendations for Article 8.26.2 Erosion and Sediment Control paragraph 6, 7, 8

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Require inspectors to be trained and certified	Currently, the person responsible for the implementation for the plan shall make regular inspections of all control measures. A trained, third party professional would likely increase enforcement and successful implementation.	Consider adding in language that any owner or developer must appoint a state licensed professional engineer or equivalent to sign all reports and conduct all inspections. Clarify any necessary training requirements and the aspects that an inspection would be verifying.	<b>Standard #8</b> Plan to control construction related impacts  <b>Standard #9</b> Long-term O&M plan

### 8.26.3 Post Construction Stormwater Management Section

The Post Construction Stormwater Management section of the by-law establishes minimum requirements and controls to protect the environment, natural resources, and general health and welfare of the Town from stormwater runoff. This includes the management of permanent features and maintenance. Land disturbances that increase stormwater runoff above a minimum threshold, increase flow to the municipal storm or sanitary sewer systems, or an activity that would alter or modify an existing drainage system must complete a Stormwater Management Plan (8.26.3-4) in addition to meeting performance standards (8.26.3-5a).

Intense rainfall events associated with climate change will push the capacity of current stormwater management systems. Stormwater Management Plans can mitigate climate change impacts by utilizing nature-based techniques and vegetative cover. By taking climate change into account and maximizing filtration on site with natural solutions, the Post Construction Stormwater Management By-Law will also better meet its objectives of ensuring:

- The municipal storm drain will not become overwhelmed.
- Non-point source pollutants will be filtered.
- Localize flooding from impervious surfaces will be minimized.

Therefore, the purpose of Post Construction Stormwater Management section could be updated to include “to reduce the impacts of climate change.” In addition, the jurisdiction of this section could be amended to cover vegetation removal and the addition of impervious surface as land disturbances.

Post Construction Stormwater Management has established objectives to minimize stormwater runoff from any development and to provide for groundwater recharge when appropriate. The recommended additions within this section use these pre-existing objectives to justify new detailed amendments which specify how these objectives will be met.



Table 6. Recommendations for Article 8.26.3 Post Construction Stormwater Management paragraph 4 and 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Requirements for protecting % of existing trees	Trees can be used as a stormwater runoff control	Language in the Erosion and Sediment Control Plan could be more specific to protect trees or provide suitable replacements <ul style="list-style-type: none"> <li>- Require a rationale for how the removal will not lead to soil erosion</li> <li>- Require a % of trees/% of canopy to be protected</li> </ul>	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Prohibit clear-cutting of construction site or set limits on allowable disturbance of existing vegetation	Vegetation can be used as a stormwater runoff control. Currently required to provide location of areas to be cleared of more than 50% of vegetation.	Option 1: Prohibit clear-cutting of construction site Option 2: Require a percentage of canopy to be retained during and after construction Option 3: Establish limits on the allowable disturbance of existing vegetated areas in open space	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Reestablish vegetation in disturbed areas	Vegetation can be used as a stormwater runoff control	Set requirements for re-establishing vegetation in disturbed areas dedicated to open space	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Set limits on allowable impervious cover or require minimization of impervious cover	Section objective to minimize stormwater runoff and provide groundwater recharge	Option 1: Establish maximum allowable impervious cover limits Option 2: Encourage permeable surfaces and require a description how impervious cover was minimized Option 3: Limit impervious area by requiring infiltration that is greater than or equal to predevelopment.	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.



Table 6. Recommendations for Article 8.26.3 Post Construction Stormwater Management paragraph 4 and 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Identify and protect environmentally sensitive areas as part of existing conditions	Must identify watercourses, wetlands, floodplains. Must provide existing and proposed locations, cross sections, and profiles of all brooks, streams, drainage swells and the method of stabilization (precedence). The purpose is to protect the environment from stormwater runoff and special requirements should be developed to protect sensitive environmental areas.	Add definition of environmentally sensitive areas  Set a limit of disturbance stricter near environmentally sensitive areas	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require developers to disconnect impervious surfaces where possible	Section objective to minimize stormwater runoff and provide groundwater recharge	Require the employment of non-structural BMPs to disconnect impervious area on completed construction sites	<b>Standard #2</b> Match pre- and post-development discharge rates  <b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require/encourage building footprints to avoid high permeability (Soil Groups A and B).	Section objective to minimize stormwater runoff and provide groundwater recharge	Include a description and identifying matrix to qualify hydrologic soil groups and limit or prohibit development on soil types deemed unstable and erodible.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require weather-based irrigation controls	Section objective to minimize stormwater runoff	Require weather- based irrigation controls	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Require inspectors during and routinely after construction	Section objective to properly operate and maintain controls that minimize stormwater runoff	Add annual inspections to verify stormwater management plan's overall effectiveness.	<b>Standard #8</b> Plan to control construction related impacts  <b>Standard #9</b> Long-term O&M plan

Table 6. Recommendations for Article 8.26.3 Post Construction Stormwater Management paragraph 4 and 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Require inspectors to be trained and certified	A licensed professional engineer must prepare the Stormwater Management Plan. DPW reviews the plan, inspects the site, and enforces the maintenance.	Consider adding in language that any owner or developer must appoint a state licensed professional engineer or equivalent to sign all reports and conduct all inspections. Clarify any necessary training requirements and the aspects that an inspection would be verifying	<b>Standard #8</b> Plan to control construction related impacts
LID site planning and design strategies must be used	Section objective to minimize stormwater runoff and provide groundwater recharge	Option 1: Use the LID By-Law as an example to expand the requirements of the Stormwater Management Plan or Post Construction Stormwater Management Performance Standards Option 2: Provide a stormwater management hierarchy (see Portland example) and require an explanation for choice of stormwater technique	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Roof runoff	Section objective to minimize stormwater runoff and provide groundwater recharge	Require directing clean roof runoff to landscaped or naturally vegetated areas capable of absorbing, or infiltration. Can be waived upon justification.	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.
Impacts of climate change are considered	Climate change will impact two of the objectives in this section: stormwater runoff and groundwater recharge. Considering the lifespan of improvements and the impacts of climate change during that time is critical to meeting these objectives in the future.	Update the purpose of Post Construction Stormwater Management section to include climate change	<b>Standard #3</b> Limit loss of recharge using sensitive site design, LID, etc.

Table 6. Recommendations for Article 8.26.3 Post Construction Stormwater Management paragraph 4 and 5

Best Practice	Authority	Action	Crosswalk with MA Stormwater Handbook
Strengthen Operation and Maintenance Plan requirements and inspections.	Section objective to properly operate and maintain controls that minimize stormwater runoff	MSA Permit requires “Inspect all stormwater treatment structures (excluding catch basins) at least annually and conduct maintenance as necessary.” Develop and implement a catch basin cleaning schedule with a goal of ensuring no catch basin is more than 50% full. Document catch basins inspected and cleaned, including total mass removed and proper disposal.	<b>Standard #9</b> Long-term O&M plan



### Align with Federal and State Standards

Many of amendments to the Stormwater Management By-Law will also coincide with the Federal Municipal Separate Storm Sewer System Permit (MS4) requirements.

The current Performance Standards already refer to the Massachusetts Stormwater Management Policy of 1997 or as amended. The Massachusetts Stormwater Handbook is the replacement policy. By explicitly stating the standards in the by-law it will emphasize the importance of meeting the criteria. Reference to the Massachusetts Department of Environmental Protection Stormwater Management Standards will also further climate resiliency and adaptation goals. A few examples are provided below.

1. *All new development should be designed to:*

- *Not allow new stormwater conveyances to discharge untreated stormwater*
- *Control peak runoff rates*
- *Recharge groundwater*
- *Eliminate or reduce the discharge of pollutants from land uses with higher pollutant loads*
- *Implement long term maintenance practices*

2. *Redevelopment shall be designed to:*

- *Not allow new stormwater conveyances to discharge untreated stormwater*
- *Control peak runoff rates*
- *Recharge groundwater*
- *Not allow new stormwater conveyances to discharge untreated stormwater*
- *Control peak runoff rates*
- *Recharge groundwater*
- *Improve existing conditions*
- *Retain the volume of runoff equivalent to, or greater than, 0.80 inch multiplied by the total post-construction impervious surface area on the site AND/OR 2) Remove 80% of the average annual post-construction load of Total Suspended Solids (TSS) generated from the total post-construction impervious area on the site AND 50% of the average annual load of Total Phosphorus (TP) generated from the total postconstruction impervious surface area on the site.*

The Massachusetts Model Low Impact Development (LID) By-law of the Smart Growth/Smart Energy Toolkit should be used as a resource when updating the Stormwater Management By-Law.





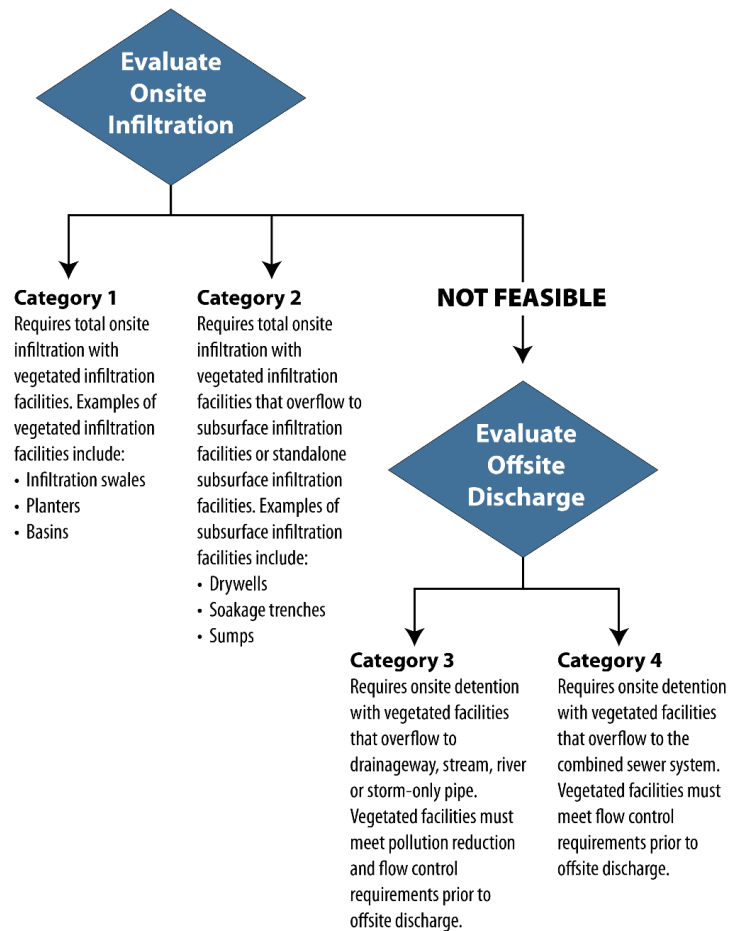
## Stormwater Management Case Study

### *City of Portland, Oregon- Stormwater Management Manual*

The City of Portland uses a stormwater hierarchy that prioritizes onsite infiltration. The highest technical feasible category (Category 1) must be used unless project designer's provide an analysis and evaluation to demonstrate the need to use techniques lower in the hierarchy.

## Impervious Area Reduction Techniques

Using impervious area reduction techniques can reduce the amount of impervious area that requires stormwater management. Examples of impervious area reduction techniques include ecoroofs, trees, and pervious pavement.



City of Portland Environmental Services ES1604



## Chapter 4. Zoning By-Law

The purpose of the Zoning By-law is consistent with the overall objectives of climate actions, specifically:

- encouraging the most appropriate use of land;
- reducing the hazards from fire and other danger;
- Providing public services related to transportation, water, sewerage, schools, and parks among others; and
- providing for adequate open space, including landscaped and usable open space, public shade trees and other landscape and natural features.

The following analysis primarily focus on areas of the zoning code where there is the greatest opportunity to incorporate climate adaptation and resilience. Section 4.10 Floodplain Overlay District and Section 4.11 Land Disturbing Activities and Stormwater Management both address the climate impact of intense rainfall. Article 5 Dimensional Requirements is another section filled with opportunity to incorporate low-impact development criteria, which will reduce Brookline's vulnerability to urban heat, intense rainfall and associated flooding.

Table 7. Climate Resilience and Adaptation Goals and the Zoning By-Law

Goals	Recommendations to Incorporate Goals into Zoning By-laws
Incorporate climate change into planning and decision-making	<ul style="list-style-type: none"> <li>• Consider expanding Section 4.10 Floodplain Overlay District and protections.</li> <li>• Incorporate climate resilience measures into Section 5.09 paragraph 4 Community and Environmental Design Standards.</li> <li>• Require Section 5.11 Cluster Subdivisions, Design Groups of Single-Family Dwellings, and Estate Conversions to consider other Town plans.</li> </ul>
Protect against stormwater impacts	<ul style="list-style-type: none"> <li>• Designs with the Section 4.10 Floodplain Overlay District should maximize stormwater absorption and compensatory storage.</li> <li>• Explicitly state and encourage stormwater best management practices in Section 4.11 Land Disturbing Activities and Stormwater Management.</li> <li>• Remove design criteria to carry all stormwater away in underground drainage systems and encourage stormwater best management practices in Section 5.09 paragraph 4 Community and Environmental Design Standards.</li> <li>• Promote the use of green infrastructure and impervious surface reductions through flexible yard requirements.</li> <li>• Allow green roofs to be counted as open space under specific circumstances and place limits on turf grass in Section 5.90 Minimum Landscaped Open Space and 5.91 Minimum Usable Open Space.</li> <li>• Update public and private off-street parking and streets, setbacks, and sidewalk requirements to reduce impervious cover and encourage use of stormwater best management practices.</li> </ul>
Protect against riverine impacts/impacts in the floodplain	<ul style="list-style-type: none"> <li>• Expand Section 4.10 Floodplain Overlay District to include additional flood protections.</li> </ul>
Reduce demand on water supply during drought	<ul style="list-style-type: none"> <li>• Encourage or require indoor and outdoor water conservation be considered in Section 5.09 paragraph 4 Community and Environmental Design Standards.</li> </ul>
Minimize increasing ambient outdoor temperature	<ul style="list-style-type: none"> <li>• Add building color and green/cool roofs as energy-conscious and microclimate cooling features in Section 5.09 paragraph 4 Community and Environmental Design Standards.</li> </ul>



Table 7. Climate Resilience and Adaptation Goals and the Zoning By-Law

Goals	Recommendations to Incorporate Goals into Zoning By-laws
Protect buildings and occupants from the effects of climate change	<ul style="list-style-type: none"> <li>Place limits on the type of activity that is permissible with the Section 4.10 Floodplain Overlay District and expand emergency site accessibility requirements.</li> </ul>
Protect against invasive species and promote ecosystem health	<ul style="list-style-type: none"> <li>Emphasize the importance of maintaining native tree species in Section 5.09 paragraph 4 Community and Environmental Design Standards.</li> <li>Increase open space requirements in Section 4.10 Floodplain Overlay District</li> <li>Provide guidance and preference for continuous and high-quality open space in Section 5.11 Cluster Subdivisions, Design Groups of Single-Family Dwellings, and Estate Conversions.</li> <li>Promote open space through flexible yard requirements.</li> </ul>

## Zoning By-Law Article IV. Use Regulations

### 4.10 Floodplain Overlay District

The Floodplain Overlay District covers land within Zone A or AE of the Norfolk County Flood Insurance Rate Maps (FIRM) issued by the National Federal Insurance Program. Zone A or AE are areas subject to flooding during a storm that has a 1% chance of occurring on an annual basis (see Text Box 2 for Flood Zone Definitions).

#### Text Box 2. FEMA Flood Insurance Rate Map Zone Definitions

**Zone A** (1% annual chance): Zone A is the flood insurance rate zone corresponding to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Detailed hydraulic analyses are not performed for such areas, therefore, no BFEs (base flood elevations) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

**Zone AE and A1-A30** (1% annual chance): Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

**Zone X** (0.2% annual chance): Zone X is the flood insurance rate zone that corresponds to the 500-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

Source: <https://www.fema.gov/flood-zones>

The purpose of the Floodplain Overlay District is to:

- Ensure public safety through reducing the threats to life and possibility of personal injury;
- Eliminate hazards to emergency response officials;
- Prevent the occurrence of public emergencies resulting from water quality contamination and pollution due to flooding;
- Avoid the loss of utility services, which if damaged by flooding, would disrupt or shut down the utility network and impact regions of the community beyond the site of flooding;
- Eliminate costs associated with the response to and cleanup of flooding conditions;
- Reduce damage to public and private property resulting from flooding waters;
- Preserve and maintain the ground water recharge areas within the floodplain;
- Preserve the natural flood control recharge areas within the flood plain.



Climate change, with more rainfall and storm surge, has already changed the way Brookline experiences flooding. As further explained in Appendix A, historic precipitation frequency was first delineated by Technical Paper 40 (TP-40) in 1961 by the National Oceanic and Atmospheric Administration (NOAA) and have since been updated by NOAA in 2015 (Atlas 14, Volume 10). The 100-year design storm from TP-40 is now approximately equal to a 30-year storm as calculated by NRCC and NOAA Atlas 14 (MAPC, 2017). Design storm figures from Atlas 14 for the 10-year, 24-hour storm are 15% higher than those issued by TP-40. Utilizing updated data to model floodplains or using bigger design storms will ensure the Floodplain Overlay District's purpose is accomplished.

The Floodplain Overlay District's recommended additions that account for climate change fall into three categories: flood protection, permitted uses in the floodplain, and design standards in the floodplain.

The Floodplain Overlay District can be amended to maximize flood protection, increase public safety, and improve recovery. The first recommendation expands the boundaries of the Floodplain Overlay District (4.10 paragraph 4). The other recommendations could be included under 4.10-9 as criteria to be met prior to receiving a special permit.

Table 8. Recommendations to Maximize Flood Protection and Alignment with Purpose

Recommendation	Meets Purpose*	Action
Expand boundary of Floodplain Overlay District	a-h	Include areas with a 0.2% annual chance of flood or the "500-year flood zone. (The 500-year flood zone, as defined by FEMA, is available in the 2017 Climate Vulnerability Assessment and Action Plan (MAPC, 2017).
Building access	a, b, e, f	Consider elevated public and private sidewalks, pathways, and connecting structures to improve accessibility during a flood.
Freeboard criteria	a, b, e, f	Lowest floor must be elevated two feet above the 500-year floodplain and critical facilities must be elevated three feet above the 500-year floodplain.
Flood marker requirement	b	The exterior of buildings should show the depth of inundation during a 100-year and 500-year flood.
Flood barrier restriction	a, e, f	Flood barriers are allowed under the condition that they will not adversely impact neighboring properties.
Flood protective design	e, f	All new construction should be designed to recover (ASCE Flood Resistant Design; residential units on second floor or higher; ceiling heights should be 15 feet or higher; onsite energy).
Emergency plans	a, b, e	Require public emergency plans that include warning and notification protocols, evacuation/access plans, shelter in place options, and procedures for deployment of flood protection measures.
Stormwater	a, b, e, f, g, h	Designs should maximize stormwater absorption areas and implement compensatory measures to accommodate floodwaters. All applicants must have an approved stormwater management permit and plan and a site hydrology report detailing the impacts on surrounding properties.

\*Letters correspond to paragraph above outlining the purpose of the Floodplain Overlay District

The Floodplain Overlay District currently defers to state regulations for uses permitted on site in 4.10-6 and encourages specific uses in 4.10-7. The following recommendations place limits on the type of activity that is permissible within the floodplain and expand the accessibility of the site.



Table 9. Floodplain Overlay District Allowed Use Recommendations

Recommendation	Meets Purpose	Action
Hazardous materials	a-d	Prohibit hazardous material storage without a permit.
Critical facilities	a, b, e, f	Permit critical facilities upon meeting criteria from the American Society of Civil Engineers Flood Resistant Design and Construction (ASCE 24-14) by Flood Design Class. Require Flood Design Class 3 structures be elevated above the 0.2% annual flood elevation. Prohibit Flood Design Class 4 structures from the district.
Site access	a, b	No new development shall be permitted on dead-end roads. Access shall be provided to land outside of the floodplain district on contiguous dryland from the site. Rescue services should provide written assurance that wheeled vehicles will be able to provide rescue and relief, or adequate shelter-in-place options are available in residential buildings.

Design standards that do not directly increase flood protection, but still improve the resilience of developments within the floodplain are expanded upon in the table below. The design standards increase the permeability of the site and consider the Floodplain Overlay District as a critical environmental area.

Table 10. Floodplain Overlay District Design Standard Recommendations

Recommendation	Meets Purpose	Action
Open space/permeability	g, h	The open space requirement for the Floodplain Overlay District shall meet a minimum 30% of gross lot area or the underlying zoning requirement for open space, whichever is greater.
Tree canopy	g, h	The Floodplain Overlay District should require minimum 30% tree canopy cover of the gross lot area or a description for why the standard cannot be met.
Cool/Green roof requirement	g	Use the Solar Reflectance Index (SRI) to mitigate heat island of all roof surfaces dependent upon the slope of the roof. Allow solar energy systems. Promote green roofs to contain stormwater runoff onsite.
Parking requirements	g, h	Limit surface parking to 10% of gross lot area. Set a parking maximum and no minimum (allow for more open space) for residential and commercial space.
Dimension setback requirements	h	Set a minimum front yard or setback requirement of 25 feet to allow adequate space for mature shade trees. Front yard is defined within the Zoning By-Law as "An open space extending across the full width of the lot and lying between the front lot line or lines and the nearest point of the building."

#### 4.11- Land Disturbing Activities and Stormwater Management

The Zoning By-Law Section 4.11 refers to the Stormwater Management By-Law for performance standards. For consistency, the second sentence in this section should be updated to reflect the correct section numbers of the Stormwater By-Law from 8.25 to 8.26. For clarity, the Zoning By-law could explicitly state the following are allowed and encouraged:

- Bioretention areas, swales, rain barrels, & cisterns near building foundations if properly designed.
- Green infrastructures techniques to replace grass strips between the public or private sidewalk and curb.
- Interior and exterior cisterns.
- Design criteria for vegetated channels and other stormwater best management practices.
- Disconnected downspouts into a rain barrel or yard.
- Cisterns to be placed on rooftops for rainwater harvesting.



## [Zoning By-Law Article V, Dimensional Requirements](#)

### [5.01 Table of Dimensional Requirement](#)

The Table of Dimensional Requirements provide the minimum lot size, required yard sizes, and open space minimums. The Table could be updated to include an impervious surface maximum. A maximum of 10% would be best on new development, and re-development infiltrations must be equal or greater to predevelopment.

### [5.09 paragraph 4 Community and Environmental Impact Design Standards](#)

Section 5.09 requires “all new structures and outdoor uses, exterior alterations, exterior additions, and exterior modifications or changes, including exterior demolitions, which require a building permit from the building department under the Building Code” to apply for a special permit subject to the community and environmental impact and design review procedures and standards (Section 5.09 paragraph 2). The special permit application requires submittal of a model (with abutting buildings, proposed contours, proposed buildings, and massing of abutting buildings), drawing of existing conditions (trees and other natural features), drawing of features and details, photographs of site, transportation studies, and an impact statement of how the community and environmental impact standards have been met. In addition to the current required material, the site review could also require that environmentally critical areas are identified as part of existing conditions.

The Community and Environmental Impact Design Standards are currently regarded as flexible requirements. The following recommendations are for existing Community and Environmental Impact Design Standards.

Table 11. Recommendations for Resilience Language in Zoning By-Law 5.09 (Paragraph 4)

Existing Design Standard Category	Recommendation
a. Preservation of Trees and Landscape	Emphasize the importance of maintaining native species
b. Relation of Buildings to Environment	Utilize natural features or vegetation for screening in lieu of walls
c. Relation of Buildings to the Form of the Streetscape and Neighborhood	Encourage street level parking be screened by view with vegetated walls. Allow exceptions to setbacks as described in 5.50, 5.60, 5.61
d. Open Space	Add stormwater management or flood storage as a design consideration
e. Circulation	Add a preference for green infrastructure for stormwater capture for public or private sidewalks, parking lots, and streets. Encourage the use of permeable paving for residential lots, patios, etc.
f. Stormwater Drainage	Remove requirement to carry all stormwater away in underground drainage systems. Require the use of low-impact development and green infrastructure.
g. Utility Service	Add a requirement that indoor and outdoor water conservation shall be considered.
l. Microclimate	Require the use of Cool/Green roofs to minimize urban heat island.
m. Energy Efficiency	Add building color as an energy-conscious design feature

A checklist or quantitative scoring system of design considerations could be used to guide review of proposed development. Developments that complete the checklist or that receive a score deemed appropriate could be permitted for expedited review as an incentive for adopting climate resilience and adaptation measures.

### [Section 5.11 Cluster Subdivisions, Designed Groups of Single-Family Dwellings, and Estate Conversions](#)

Typically, cluster subdivisions are characterized as several houses grouped together in a subdivision and arranged in a way that consolidates and reduces the building envelop so that undeveloped land remains available as common space. The set aside of undeveloped land that is permanently protected (as is the case for Brookline) can





be a tool for climate adaptation. Preserved vegetation and trees absorb both stormwater and heat, which are expected to increase with climate change.

The cluster subdivisions section (5.11-1) of the Zoning By-law describes how parcels can be divided into subdivisions. The designed groups of single-family dwellings (5.11-2) and estate conversions (5.11-3) sections describe how the land can be developed. Both types of developments are subject to review under Section 5.09(4) Community and Environmental Impact Design Standards. Therefore, only recommendations that apply specifically to designed groups of single-family homes and estate conversion are provided in this section. General design standards that should be applied to all development are provide in the recommendations for Section 5.09(4).

The Massachusetts Model Open Space Design/ NRPZ By-Law of the Smart Growth/Smart Energy Toolkit was used as the primary resource for the language amendments.

Table 12. Recommendations for Zoning By-law Section 5.11 Cluster Subdivisions, Designed Groups of Single-Family Dwellings, and Estate Conversions

Recommendations	Current Regulation	Action
Minimum Open Space	Minimum set in Table 5.01 Open Space is specified as the percent of gross floor space and divided between landscaped and usable.	Ensure calculations meet a minimum of 50-75% or more.
Dimensional Standards; area, frontage, etc.	The dimensional standards are specified for attached single-family home. The dimensional standards would be less than conventional zoning if more than two houses are grouped together. For detached single-family dwelling, the yard areas shall match the underlying zoning.	Reduce or remove minimum dimensional standards.
Quality of open space conserved; specificity of local priorities for natural, cultural, and historic resource conservation	The Board of Appeals shall find that the design is in harmony with prevailing character of neighborhood and the site's location, topography, and natural features make it particularly suitable for development. No indication of local conservation priorities, or language that refers only to regulated resource areas.	Clearly state local priorities. Require they be considered and mapped for use in the site design.
Contiguity of open space; relationship to previously protected open space	No contiguity requirement.	Contiguity require; adjacent land considered.
Quality of open space conserved; allowed uses of open space	Open space is subject to underlying zoning. A percentage of an open space must be landscaped, and a percentage must be usable.	Clear list of allowed uses consistent with conservation and recreation goals.
Quality of open space conserved; submission requirements - GIS maps, data, etc. to inform the review process	Vague or no language regarding submission of information on site resources and no specified process for the use of the data submitted.	Specific plans, maps, & comprehensive data regarding natural, cultural, and historic resources required and used as the basis for open space conservation.

Table 12. Recommendations for Zoning By-law Section 5.11 Cluster Subdivisions, Designed Groups of Single-Family Dwellings, and Estate Conversions

Recommendations	Current Regulation	Action
Relationship to plans	Relationship to open space goals of OSRP, master plan, and/or regional policy plans not discussed.	Required consideration of open space goals of OSRP, master plan, and/or regional policy plan.
Monitoring of open space	Open space shall be conveyed to the Town, a non-profit organization, a corporation/trust or owners of the dwelling units to conserve the open space. No specified monitoring requirements and no requirements that would assist the party responsible for monitoring.	Specific provisions to aid endowed monitoring by a conservation organization at stated intervals.
Density bonus-parking	1% bonus per 5% of required parking concealed below grade, within or under a residential structure.	Add a bonus for parking that incorporates green infrastructure to reduce run-off or utilizes permeable pavement.
Density bonus-superior site design	Up to 10% bonus for superior site design.	<p>Add the following as superior site design techniques:</p> <ul style="list-style-type: none"> <li>• Use of native plantings</li> <li>• Use of green infrastructure</li> <li>• Use of pervious pavement</li> <li>• Contiguity of open space</li> </ul> <p>Remove the "sidewalk and street improvements" such as wider sidewalks.</p>

#### *§5.50; §5.60; and §5.70 – Yard Requirements*

To promote green infrastructure and open space in yard requirements:

- Allow for flexibility, and in some cases elimination, of yard requirements if it promotes public or private open space open to the public, open space contiguity, and shared driveways.
- Allow exemptions for smaller front yards on curved streets and cul-de-sacs.

#### *§5.51; §5.61; and §5.71 – Projections into Yards*

To promote green infrastructure and open space in yard requirements:

- Allow the use of bioretention islands and other stormwater practices within landscaped areas or setbacks.
- Allow rain barrels to be placed within standard zoning setbacks.
- Set a maximum amount of or prohibit turf grass in setbacks.
- Set a maximum amount of impervious cover limits in setbacks.

#### *§5.90 – Minimum Landscaped Open Space and §5.91 –Minimum Usable Open Space*

Clarify what constitutes an open space by:

- Allowing green roofs to be counted as usable open space up to 50%, provided that every two percent of green roof counted toward the open space requirement an additional one percent of landscaped open space is added.
- Placing limits on (or incentivizing reductions of) the percentage of landscapable area that can be in turf grass. [EPA's Watersense](#) program recommends 40%.



### Zoning By-Law Article VI, Vehicular Service Uses Requirements

Streets, parking lots, roadways, and sidewalks make up a substantial portion of impervious surfaces in urban environments. Large swaths of impervious surfaces can cause flash floods in areas with inadequate storm drainage capacity. To protect such areas and to reduce strain on the municipal storm drain, future updates to the zoning code should consider the recommendations in Table 14 and Table 15 in addition to:

- Counting impervious public and private parking against allowable lot coverage.
- Providing an example of a [shared parking agreement](#).
- Examination of public and private streets, sidewalk, and right-of-way design.

Many of the street and sidewalk recommendations may be most applicable to larger cluster developments.

Table 13. Off-Street Parking Recommendations

Recommendation	Section	Current Language	Action
Require landscaping in parking lots	<b>6.04</b>	<b>5.b and 5.c:</b> Set back areas must be landscaped and maintained <b>13:</b> At least 5% of the interior of the parking lot with 21 or more parking spaces shall be landscaped	<b>5.b and 5.c:</b> add language that landscaped areas may be utilized for stormwater management using LID/green infrastructure techniques <b>13:</b> Consider increasing landscaping to 10% of the interior of large parking lots and encourage the landscaped areas be used for stormwater management using LID/green infrastructure techniques
Encourage screening from adjoining properties to use vegetation in lieu of walls and berms	<b>6.04-6.b</b>	Adjoining properties must be protected from headlight glare using densely planted shrubs or trees or a wall.	Require vegetated walls or add language to encourage vegetated screens
Ability to reduce parking ratios	<b>6.02-1</b>	Special permits are available for changes or expansion of a non-residential use in a business district within an existing building	Expand the special permit for reduced parking ratios to new developments and redevelopments of all land use types near transit facilities
Establish maximum parking requirements	<b>6.02-1.a and 6.02 Table</b>	<b>6.02-1.a:</b> When required parking spaces results in a fractional number, only the fraction of one-half or more shall be counted as one. <b>6.02 Table:</b> Required spaces by land use <b>6.02-2.e:</b> Units occupied by three or more unrelated persons must have twice the parking requirements indicated in 6.02 Table	<b>6.02-1.a:</b> Allow all fractional numbers to round down upon the Board of Appeal's approval <b>6.02 Table:</b> Change the requirement to a maximum number of allowed parking spaces. Consider Setting parking or impervious cover requirements to 10% of gross lot area. <b>6.02-2.e:</b> Remove requirement to double parking requirements for this land use  Consider re-examining parking demand in urban areas where transportation alternatives exist in order to determine whether minimum parking standards can either be reduced or eliminated completely.



Table 13. Off-Street Parking Recommendations

Recommendation	Section	Current Language	Action
Reduce parking ratios	<b>6.02 Table</b>	Required spaces by land use	Reevaluate minimum parking standards, where utilized, to ensure that standards are not higher than necessary.
Provide incentives to reduce impervious cover in parking	<b>6.04-9.b</b>	Lot and driveways shall be surfaced with asphalt or other suitable material and drained to the satisfaction of the Building Commissioner	The Town may want to investigate creating an incentives system to encourage commercial and private dwellings to employ BMPs.
Allow for minimum stall width of 9 ft and length of 18 ft	<b>6.04-2.c</b>	Meets recommendation	-
Allow parking lot drive aisles to be 22 feet or less	<b>6.04-2.c</b>	Meets recommendation for most designs	Assess feasibility of reducing minimum aisle width of 90-degree parking for 8.5-foot stalls
Allow travel lanes to be from 10 to 12 ft for two-way travel with curb pullouts for passing	<b>6.04-2.d</b>	Minimum width of aisles providing access to stalls for two-way traffic shall be 20 feet or the aisle width required, whichever is greater	Add an exception for reduced aisle widths when curb pullouts are used in the design
Allow reduction in stall lengths for vehicle overhang in vegetated areas	<b>6.04-2.b</b>	Meets recommendation	-
Allow for permeable materials for overflow parking	<b>6.04-9.b</b>	Lot and driveways shall be surfaced with asphalt or other suitable material and drained to the satisfaction of the Building Commissioner	Consider encouraging the use of pervious parking lot surfaces by allowing the majority of the pervious parking surfaces provided to be excluded when calculating allowable lot coverage. This allows a developer to increase a proposed building footprint because when less of the parking area is counted towards allowable lot coverage, more of that coverage becomes available for building space. See <a href="http://northwesthillscog.org/PDF/Parking-report-phase-2-final-2003.pdf">http://northwesthillscog.org/PDF/Parking-report-phase-2-final-2003.pdf</a> for some possible ideas.
Allow multi-level parking	<b>5.06-4.c (1.b)</b>	For multiple or attached dwelling developments in an S-0.5P District, at least seventy-five percent (75%) of all parking spaces required by the Zoning By-law will be located in a subsurface parking garage.	Create Language to directly address and encourage multi-level parking.

Table 13. Off-Street Parking Recommendations

Recommendation	Section	Current Language	Action
Allow for shared parking arrangements and residential driveways	<b>6.02-1.c</b>	<p><b>6.02-1.c:</b> Two or more uses may provide for required parking in a common parking lot and a special permit is available to reduce parking requirements</p> <p><b>6.03-1.b:</b> By special permit the required parking can be within 400 ft of the principal use on a lot of the same ownership</p> <p><b>6.04-5.e:</b> Under special permit, owners of adjoining properties can establish common driveways under mutual easements</p>	<p><b>6.03-1. b:</b> Expand distance to within a 10-minute walk and remove restriction of ownership to promote shared parking</p> <p>6.04-5.e: Allow for up to 4 residential units</p>

Table 14. Streets, Setbacks, and Sidewalks Recommendations

Recommendation	Section	Current Language	Action
Allow flush curbs and/or curb cuts to allow for sheet flow discharge	6.04-5.d	<b>6.04-5.d:</b> In all districts, curbs shall be provided to prevent motor vehicles from being parked within required setback areas, or beyond the boundaries of the lot where no setback is required.	Revise curbing standards to allow curb cuts or flush curbs with curb stops to be utilized as an alternative to raised curbs, as well as grass swales or bioretention swales instead of curb or gutter.
Allow the use of curb bump outs for traffic calming and bioretention		No Zoning Regulation	Consider allowing curb bump outs/extensions near intersections and mid-block for traffic calming and bioretention opportunities.
Allow pervious parking for alleyways and on-street parking		No Zoning Regulation	Include language to specify where of pervious materials are allowed (such as sidewalks, alleyways, on-street parking, bikeways, trails and walkways). Require those applying for development or redevelopment to investigate the possibility of employing such measures and include the investigation as part of the application to the Planning Board to encourage their installation.

Table 14. Streets, Setbacks, and Sidewalks Recommendations

Recommendation	Section	Current Language	Action
Allow minimum driveway widths to be reduced		No Zoning Regulation	Consider adding language that allows for the reducing of the width of driveways. Single car driveways can be as narrow as 9 feet, or as wide as 12 feet. Double car driveways can be between 20 and 24 feet wide. To allow for door swing and area for passengers to step onto hard surfaces, consider encouraging decorative, permeable bands of 2 ft. in width where absolute minimum driveway widths are utilized (e.g., 9 feet may mean that guests are stepping in grass or dirt as they exit their vehicles). Allow for use of pervious materials at full width.
Allow for pervious sidewalks		No Zoning Regulation	The Town may want to consider requiring public and private sidewalks to be permeable, or, take a less prescriptive approach and just require a certain percentage of surfaces in front yards be permeable (for example, 50%) by using porous asphalt, porous concrete, interlocking pavers, bricks, or landscaping. Areas counted towards the landscaping requirement could also be credited towards the permeability requirement. The City of San Francisco has some good ordinance language for the latter here: <a href="http://www.sf-planning.org/ftp/files/publications_reports/Guide_to_SF_Green_Landscaping_Ordinance.pdf">http://www.sf-planning.org/ftp/files/publications_reports/Guide_to_SF_Green_Landscaping_Ordinance.pdf</a>
Allow green infrastructure techniques to replace grass strips between sidewalk and curb		No Zoning Regulation	In addition to modifying the by-law to allow for curb cuts, also consider placing emphasis on the use of bioretention, swales, and other green infrastructure practices between the curb and public and private sidewalks, and to incorporate specific design specs for doing so (see <a href="https://watershedmg.org/sites/default/files/documents/city-of-tucson-green-streets-active-practice-guidelines.pdf">https://watershedmg.org/sites/default/files/documents/city-of-tucson-green-streets-active-practice-guidelines.pdf</a> as an example).
Allow alternate pedestrian networks to be substituted for public and private sidewalks		There is no mention of trails and paths and links to be used between properties to serve as pedestrian networks	Provide detailed alternatives to sidewalks that can be used



Table 14. Streets, Setbacks, and Sidewalks Recommendations

Recommendation	Section	Current Language	Action
Give preference to sidewalks that follow natural land contours and for best pedestrian utility. Allow sidewalks on just 1 side of road in low-density neighborhoods		No Zoning Regulation	Give preference to sidewalks that follow natural land contours and for best pedestrian utility. Allow sidewalks on just 1 side of road in low-density neighborhoods
Require site design to reduce overall street length		No Zoning Regulation	Encourage site designers to analyze different layouts to see if they can reduce street length and submit multiple alternatives to the Planning Board for review.
Set wide, medium, narrow, and alley road width categories		No Zoning Regulation	20-24' widest for 2 lanes of travel, 18-20' for low traffic residential neighborhoods plus 2' shoulders
Road right-of-way widths		No Zoning Regulation	20-50' depending on road type
Cul-de-sacs and dead ends		No Zoning Regulation	Require center landscaping with bioretention in cul-de-sacs and allow hammerhead turnarounds.
Allow roadside swales		No Zoning Regulation	

## Chapter 5. Sustainable Design Standards

In addition to the amendments above, the Town of Brookline should consider adding the following “Sustainable Design Standards.” The techniques below could replace or complement the current Community and Environmental Impact Design Standards.

### Green Roof

Large developments or developments within specified zoning districts could be required to have a green roof. Green roofs should include roofs that are vegetated, use solar, or have a low “reflectiveness.” Sustainable Land Design and Development (SITES) provides an example of [how to calculate reflectiveness](#) (p.49). Other developments should be encouraged to use green roofs by ensuring the use of the roof is not included in the Floor to Area Ratio or Gross Floor Area calculation.

### Green Factor

The Green Factor or Green Area Ratios of a property is measured as a ratio of the square footage of the landscaped element and multiplied by a weighted factor compared to the total square feet. The required Green Factor could vary depending upon the size of the development or zone. The Green Factor requires sustainable and resilient landscaping but provides flexibility in how it is achieved. A Green Factor has been used in Seattle, WA (based on the land use) and Washington, DC. A very similar zoning by-law has been proposed in Cambridge, MA for large developments and the Floodplain Overlay District.

Table 15. Example of Green Factor Criteria and Weighted Multiplier

Green Factor	Multiplier	Notes
<b>Ground/Underground</b>		
Green space with new & uncompacted topsoil of less than 24”	0.3	
Green space with new & uncompacted topsoil of 24” or more	0.6	
Pervious Paving (more than 6” but less than 24” of soil or gravel)	0.2	
Pervious Paving (more than 24” of soil or gravel)	0.5	
Bio-swale / Bio-retention / Rain garden	0.8	
<b>Vegetation/Green Space</b>		
Grass, mulch, and other organic and inorganic plant or earthen material ground covers; plants less than 2’ tall at maturity	0.1	
Large shrubs or large perennials at least 2’ tall at maturity	0.3	Multiply by 9 square feet per plant
New Tree, Small (less than 40-foot canopy spread at maturity)	0.5	Multiply by 50 square feet per tree
New Tree, Large (greater than 40-foot canopy spread at maturity)	0.6	Multiply by 250 square feet per tree
Preserved Tree (must be greater than 6” diameter at breast height (DBH) to qualify)	0.8	Multiply as follows based on current diameter at breast height (DBH): 6-12” DBH: 250 square feet per tree 12-18” DBH: 600 square feet per tree 18-24” DBH: 1300 square feet per tree >24” DBH: 2000 square feet per tree



## Green Developments

Large developments or developments within certain zoning districts could be required to meet trademark design standards or equivalent. For example, the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Neighborhood Development or the U.S. Green Building Council's Sustainable Land Design and Development (SITES). SITES scorecard more closely aligns with the recommendations in this memo pertaining to climate adaptation. LEED Neighborhood Development would incorporate climate mitigation, or greenhouse gas reduction potential, in addition to climate adaptation. Equivalents would be acceptable upon a submittal showing how the two standards align.

**Table 16. Design Standards and Overlap with Climate Adaptation Recommendations**

<b>LEED Neighborhood Development Plan</b>	<b>SITES</b>
<ul style="list-style-type: none"> <li>• Imperiled Species and Ecological Community Protection</li> <li>• Wetland and Water Body Conservation</li> <li>• Floodplain Avoidance</li> <li>• Steep Slope Protection</li> <li>• Reduced Parking Footprint</li> <li>• Tree-lined and Shaded Streetscapes</li> <li>• Indoor Water Use Reduction</li> <li>• Outdoor Water Use Reduction</li> <li>• Minimized Site Disturbance</li> <li>• Rainwater Management</li> <li>• Heat Island Reduction</li> </ul>	<ul style="list-style-type: none"> <li>• Protect floodplain functions</li> <li>• Conserve aquatic ecosystems</li> <li>• Conserve habitats for threatened or endangered species</li> <li>• Conduct a pre-design assessment</li> <li>• Designate and communicate vegetation and soil protection zones</li> <li>• Manage precipitation on site</li> <li>• Reduce water use for landscaped irrigation</li> <li>• Manage precipitation beyond baseline</li> <li>• Reduce outdoor water use</li> <li>• Design functional stormwater features as amenities</li> <li>• Create or communicate a soil management plan</li> <li>• Control and manage invasive species</li> <li>• Use appropriate plants</li> <li>• Conserve health soils and appropriate vegetation</li> <li>• Conserve and use native plants</li> <li>• Reduce urban heat island effects</li> <li>• Use vegetation to minimize building energy use</li> <li>• Reduce the risk of catastrophic wildfire</li> <li>• Provide optimum site accessibility, safety and wayfinding</li> <li>• Restore soils disturbed by construction</li> <li>• Plan for sustainable site maintenance</li> <li>• Plan to monitor and report site performance</li> </ul>



## Chapter 6. Summary

The Town of Brookline has many opportunities to incorporate climate adaptation into its by-laws and regulations. The implementation of the recommendations presented in this report can be completed in piecemeal or adapted all together. The recommendations are often suggesting changes to the greatest extent possible. The recommendations can be tapered to fit the needs of Brookline. For example, requirements could be lessened to incentives or preferences. Removing the Community and Environmental Impact Design Standard in the Zoning By-law 5.09-4.f that states “all stormwater shall be carried away in underground drainage system” is the largest impediment within the regulations to carry out climate adaptation and resilience. Future next steps include conducting a similar analysis for opportunities to implement climate mitigation.



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## Appendix A

### Climate Data Sources and Other Resources





### Precipitation Duration and Frequency

Regulations, design, and construction often rely on historic precipitation and frequency data to make decisions. Technical Paper No. 40 or TP-40 was used to derive design storm standards from 1961 onwards until more recent data became available in 2014. Recent data is available from the National Oceanic and Atmospheric Administration (NOAA Atlas 14) and the Northeast Regional Climate Center (NRCC) at Cornell University. Atlas 14 was the official dataset to supersede TP-40.

In Massachusetts, the frequency or likelihood of intense precipitation has increased the 1960s due to climate change. This can be demonstrated by comparing NOAA Atlas 14 and NRCC data to TP-40. Recently released design storm figures (NOAA 14) for the 10-year, 24-hour storm are 15% higher than those issued in 1961. The TP-40 100-year storm calculated in 1961 is now approximately equal to a 30-year storm as calculated by NRCC and NOAA Atlas 14 (MWRA p.63). The NOAA 14 and NRCC figures specific to Brookline are available in Table 18. The Town of Braintree references NOAA 14 in regulations. The Town of Arlington and the Town of Natick reference the NRCC or “Cornell” numbers in regulations. The methodologies used by NOAA and NRCC differed somewhat, which is why the numbers are slightly higher. The Town should use and recommend using the latest rainfall frequency data from national, state, or local sources.

Table 17. Comparison of Past and Current Precipitation Frequencies Estimates

Brookline	TP-40	NOAA Atlas 14	NRCC
10-year, 24-hour storm	4.5"	5.16"	4.90"
100-year, 24-hour storm	6.5"	8.16"	8.88"
500-year 24-hour storm		11.3	13.38

The cities of Boston and Cambridge included future projections for the 10-year, 24-hour design storm as part of their climate vulnerability assessments. Their projections for increased precipitation are shown in Table 19. The Town could recommend projected design storms be used for stormwater management projects.

Table 18. Comparison of Projected Precipitation Frequencies Under Climate Change  
(10-year, 24-hour design storm)

Boston Water and Sewer Commission	Baseline 1948-2012	2035	2060	2100
Medium emissions	5.24"	5.55"	5.76"	6.08"
High emission		5.6"	6.03"	6.65"
Cambridge	Baseline (1971-2000)	2015-2044	2055-2084	
Climate model	4.9"	5.6"	6.4"	

Source: Climate Ready Boston, Boston Research Advisory Group Report, 2016

### Flood Hazard Mapping

Floods can be modelled based on precipitation data in addition to other localized characteristic such as soil conditions, slope, and drainage. The Federal Emergency Management Agency (FEMA) works with local and state agencies to map these characteristics. FEMA maps are based on historic data and were last updated in Brookline in 2012 with 2002 LiDAR topographic data.



## Appendix B

### List of Reviewed Brookline Planning Documents Reviewed and Screening Criteria



## List of Reviewed Brookline Policy Documents

### General Bylaws

Article 3.7 Building Commission  
Article 3.12 Dept Planning & Community Development  
Article 3.16 Park and Recreation Commission  
Article 3.17 Public Works, Department Organization  
Article 3.19 Community Preservation Committee  
Article 5.3 Demolition  
Article 8.26 Stormwater Management  
Article 8.26.2 Erosion and Sediment Control (amendment adopted in 2017)  
Article 8. 27 Wetlands

### Regulations

DRAFT Use of Sanitary Sewers  
DRAFT Use of Water Supply  
DRAFT Use of Storm Drains  
Wetlands Regulations  
Subdivisions

### Zoning Bylaws

Article IV, Section 4.10 Floodplain Overlay District  
Article IV, Section 4.11 Land Disturbing Activities and Stormwater Management  
Article V Dimensional Requirements  
Article V, Section 5.09(4) Community Design and Environmental Impact Standards  
Article V, Section 5.11 Cluster Subdivisions, Designed Groups of Single-Family Dwelling, and Estate Conversions

### Comprehensive Plans

DRAFT Open Space Plan 2018 Goals and Action Items  
Climate Action Plan 2018  
Brookline Housing Production Plan 2016  
Complete Streets Presentation, August 2018  
DRAFT Complete Streets Prioritization Plan (spreadsheet)

### Design Guidelines

DPW Public Way Guidelines  
Proposed Planning Board Public Way Design Guidelines

### Checklist

DPW Site Plan Review

### Public Information

Brookline Webpage: Stormwater Division: Commercial - Construction - Household



Objective	Policy Change Actions	Type of Policy Change
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## OVERALL STRATEGIES

### Goal: Incorporate Climate Change into Planning and Decision-Making

Assess Projected Impacts	Establish Baseline Conditions	Map “hot spots.” Identify flood-prone areas.
Assess Projected Impacts	Identify Hazards and Risks	Identify secondary impacts including interruptions to electrical, gas, telecommunication, and transportation systems.  Use regional climate change, population demographics, transportation demand, and related projections to understand where community assets could be vulnerable.  Update land use maps to identify vulnerable lands. Designate less-vulnerable areas and encourage development there.  Mainstream climate change projections and smart growth into comprehensive, master, capital improvement, and hazard mitigation plans.
Assess Projected Impacts	Assess Predicted Future Conditions	Use scenario planning to inform local planning and policies.  Estimate or use credible estimates of sea-level rise, higher annual temperatures, more frequent and longer extreme heat events, increased precipitation, more severe rain events, and increased greenhouse gas concentrations.
Planning	Consistent Planning	Align land use, hazard mitigation, transportation, capital improvement, and other plans so all plans are working toward the same climate change goals.
Land Use and Development	Landscape and Design	Adapt a rating system (i.e. Green Area Ratio) that addresses soil depth, bioretention, plants, vegetated walls, permeable paving, trees, water and renewable energy.
Land Use and Development	Defining Desired Outcomes	Evaluate development incentives to see if they encourage development in particularly vulnerable areas. Create a list of desired development elements in more-vulnerable areas and encourage or require developers to implement a certain number of them  Encourage compact development policies such as walkable block sizes, transit-supportive density, and high intersection connectivity.
Zoning	Zoning that Accommodates Climate Change	Adopt flexible zoning.  Adopt elements of dynamic zoning or building flexibility into codes.  Adopt a floating zone or overlay zone.
Energy	Renewable Energy	Encourage on-site renewable energy and storage:  Amend codes or adopt ordinances to allow renewable energy on individual properties and in communal installations.  Use public-private partnerships to promote renewable energy.

Objective	Policy Change Actions	Type of Policy Change
ADAPTING TO FLOODING AND EXTREME PRECIPITATION		
Goal: Protect Against Stormwater Impacts		
Vegetation and Landscaping	Preservation of natural areas	<p>Site plan applicants required to provide layout of existing vegetated areas;</p> <p>Presence of maximum as well as minimum yard sizing ordinance;</p> <p>Residential restrictions for enlarging existing turf lawn areas;</p> <p>Provides incentives for using vegetation to filter stormwater runoff;</p> <p>Require a specific percentage of permanently protected open space for cluster development;</p> <p>Limit site designs to areas of lesser slope and farther from watercourse</p>
Vegetation and Landscaping	Tree Planting and Protection	<p>Existence of a tree protection ordinance.</p> <p>Existence of a forest protection ordinance.</p> <p>Requirements for protecting % of existing forest.</p> <p>Requirements for unpaved area around tree.</p> <p>Restrictions on trimming or pruning.</p> <p>Require shade trees in all municipal projects and private parking lots.</p> <p>Adopt a tree canopy or urban forest master plan and implementing ordinances.</p> <p>Allow the use of raingardens, tree boxes, &amp; other low impact development (LID) best management practices (BMPs) for tree planting requirements.</p> <p>Offer incentives to plant and protect trees.</p> <p>Require tree or shrub planting on parkways, parking lots, and other impervious areas (Chicago).</p>
Vegetation and Landscaping	Landscaping Island and Screening	<p>Require landscaping in parking lots.</p> <p>Allow the use of bioretention islands and other stormwater practices within landscaped areas or Setbacks.</p> <p>Require screening from adjoining properties to encourage using vegetation in lieu of walls and berms.</p> <p>Allow Green Infrastructure techniques to replace grass strips between sidewalk and curb.</p> <p>Give bioretention areas "credit" as landscape areas to count as a percent of required landscaping.</p> <p>Require landscaping plans to include less water-intensive, native vegetation.</p> <p>Require weather- based irrigation controls.</p> <p>Allow bioretention areas, swales, rain barrels &amp; cisterns near building foundations, if properly designed.</p>
Vegetation and Landscaping	Invasive Plant Species Control	Require the removal of any invasive plants on the work site.
Vegetation and Landscaping	Altered Topography	<p>Elevate site.</p> <p>Balance cut and fill.</p> <p>Remove soil and increase floodplain.</p>
Vegetation and Landscaping	Grey and Green Walls and Barriers	<p>Construct berm as a natural flood barrier.</p> <p>Construct floodwall.</p> <p>Construct a living shoreline.</p>

Objective	Policy Change Actions	Type of Policy Change
Impervious Area Management	Streets and Driveways	<p>Evaluate minimum widths of streets to ensure narrowest possible.</p> <p>Allow/require street features to receive runoff.</p> <p>Allow the use of curb cuts or flush curbs.</p> <p>Reduce minimum cul-de-sac radius or require center island landscaped.</p> <p>Allow alternative turnarounds for low-density residential streets.</p> <p>Allow minimum driveway widths to be reduced.</p> <p>Permit shared driveways in residential developments.</p> <p>Allow travel lanes travel lanes to be from 12 to 10 ft. (or less) with curb pullouts for passing.</p> <p>Allow the use of curb bump-outs for traffic calming and bioretention.</p> <p>Allow pervious parking for alleyways &amp; on-street parking.</p> <p>Require site designs to reduce overall street length.</p>
Impervious Area Management	Parking Areas and Sidewalks	<p>Ability to reduce parking ratios.</p> <p>Establish maximum parking requirements.</p> <p>Allow for the use of shared parking arrangements.</p> <p>Provide a model shared parking agreement.</p> <p>Allow for reduced parking ratios where mass transit exists.</p> <p>Allow minimum stall width of 9 ft.</p> <p>Allow minimum stall length of 18 ft.</p> <p>Allow reduction in stall lengths for vehicle overhang in vegetated areas.</p> <p>Allow/encourage permeable materials for overflow parking.</p> <p>Allow for multi-level parking.</p> <p>Provide incentives to reduce impervious cover in parking.</p> <p>Allow for pervious sidewalks.</p> <p>Allow alternate pedestrian networks to be substituted for sidewalks.</p> <p>Allow parking lot drive aisles to be 22 ft.</p> <p>Reduced parking ratio of 3.0 spaces per 1,000 sq. ft. gross floor area</p> <p>Reduced parking ratio of 2 to 4.5 spaces for 1,000 sq. ft. gross floor area for commercial centers.</p>
Impervious Area Management	Buildings	<p>Requirements for rooftop structures &amp; materials allow/encourage green roofs.</p> <p>Use “blue” roofs (cool roofs that can also store rainwater) to release the water slowly.</p>
Impervious Area Management	Disconnect Impervious Areas	<p>Require developers to disconnect impervious surfaces.</p> <p>Allow runoff volumes to be reduced when re-infiltrated into vegetated areas.</p> <p>Allow flush curbs and/or curb cuts to allow for sheet flow discharge.</p> <p>Distinguish between connected &amp; disconnected impervious.</p>
Vegetated Open Channels	Vegetated Channels	<p>Allow/require vegetated open channel conveyance.</p> <p>Establish design criteria for vegetated channels.</p>
Stormwater Management	Education and Guidance	<p>Help private property owners better manage stormwater through education and incentives.</p> <p>Develop a municipal stormwater design manual that illustrates context-appropriate green infrastructure.</p>
Stormwater Management	Capture and Retain Stormwater	<p>Adopt a site plan requirement that requires all new development to retain all stormwater on-site.</p> <p>Require new development or redevelopment to capture and infiltrate the first 1 or 1.5 inches of rain.</p>



Objective	Policy Change Actions	Type of Policy Change
Stormwater Management	Funding Mechanisms	Create sustainable funding for stormwater infrastructure.
<b>Goal: Protect Against Riverine Impacts/Impacts in the Floodplain</b>		
Vegetation and Landscaping	Riparian Buffers	<p>Presence of a stream buffer or floodplain ordinance.</p> <p>Consistency of stream/riparian requirements with state regulatory requirements.</p> <p>Buffer areas protected by conservation easement or other permanent restrictions.</p> <p>Ordinance identifies or limits when storm-water outfall structures can cross the buffer.</p> <p>Specify what maintenance /activities are allowed within the buffer.</p> <p>Require/encourage a 50 ft. min wetland buffer.</p>
Vegetation and Landscaping	Wetlands	Adopt local wetlands protection ordinance.
Land Use and Development	Floodplain Management	<p>Design open space in flood plains for multiple amenities.</p> <p>Adopt “no adverse impact” flood plain regulations.</p> <p>Acquire flood-prone lands.</p> <p>Determine whether to relocate structures that have been repeatedly flooded including identifying an equitable approach for relocation decisions and potential funding sources.</p> <p>Adopt the 500-year flood plain as the “locally regulated floodplain.”</p> <p>Rolling easements</p>
Land Use and Development	Directed Development Patterns	<p>Transfer of development rights or purchase of development rights</p> <p>Conservation overlay district or cluster development</p> <p>Buyouts of vulnerable properties</p>
<b>Goal: Protect Against Construction Impacts</b>		
Minimize Land Disturbances	Limits of Disturbance	<p>Identify environmentally critical/constrained areas as part of existing conditions;</p> <p>Ability to reduce setbacks Include maximum turf grass or impervious cover limits in setbacks;</p> <p>Prohibit clear-cutting of construction project site;</p> <p>Limit traffic of heavy construction vehicles to specific areas;</p> <p>Require identification of specific areas that provide significant hydrologic functions;</p> <p>Require as-built inspections before issuance of occupancy that includes id of compacted areas;</p> <p>Require restoration of compacted areas in accordance with soil erosion and sediment plan;</p> <p>Require disturbance of vegetated areas to be phased;</p> <p>Minimize hydrologic alterations to existing wetlands.</p> <p>Require/encourage building footprints to avoid highly erodible high permeability (Soil Groups A and B).</p>
Land Use and Development	Transit Oriented Development	Encourage higher density development to be centered around transportation corridors

Objective	Policy Change Actions	Type of Policy Change
Land Use and Development	Open Space and Cluster Development	<p>Allow open space or cluster developments.</p> <p>Allow for flexible site design incentives for open space or cluster design.</p> <p>Set limits on allowable disturbance of existing vegetation.</p> <p>Reestablish vegetated areas in disturbed open space.</p> <p>Set limits on allowable impervious cover in open space.</p> <p>Develop an open space plan</p> <p>Zoning for open or recreational space</p>
Land Use and Development	Wetlands Protection	Restrict development in areas buffering water bodies or wetlands.
Impervious Area Management	Roadways	<p>Pilot a sustainable streetscape program with green infrastructure features.</p> <p>Adopt green and complete streets design standards.</p> <p>Establish elevation requirements with design guidelines for streets and infrastructure.</p>

Objective	Policy Change Actions	Type of Policy Change
<b>ADAPTING TO DROUGHT</b>		
<b>Goal: Reduce Demand on Water Supply</b>		
Water Conservation	Residential and Commercial Development	<p>Implement water conservation incentives; offer rebates or other incentives to encourage drought-tolerant plants, residential rainwater harvesting, water-efficient fixtures, or other water-saving practices.</p> <p>Determine water conservation goals.</p> <p>Require non-water efficient fixtures be upgraded and replaced.</p>
Water Conservation	Rainwater Harvesting	<p>Require BMP maintenance plan for cisterns.</p> <p>Allow harvested rainwater to be used for non-potable interior uses (e.g., toilet flushing.;</p> <p>Allow personal treatment systems to be used for potable water supplies.</p> <p>Mandate rainwater harvesting for all new commercial construction.</p>
Water Conservation	Ordinances and Building & Zoning Codes	<p>Allow downspouts to be disconnected into a rain barrel or yard;</p> <p>Allow interior or exterior cisterns;</p> <p>Allow rain barrels to be placed within standard zoning setback areas;</p> <p>Allow cisterns to be placed on rooftops for rainwater harvesting.</p> <p>Promote the use of WaterSense-rated plumbing fixtures through incentives.</p> <p>Recommend the use of drought-tolerant plants or xeriscaping as part of water conservation, landscaping, and water waste ordinances.</p>
<b>Goal: Minimize Impact on Streamflow</b>		
Manage Stormwater to Sustain Stream Function	Performance Standards	<p>Require stormwater to be retained/ infiltrated onsite (bioretention, natural areas, and swale infiltration) where possible.</p> <p>Provide sufficient storage volume via stormwater management practice standards &amp; sizing requirements.</p> <p>Ensure adequate water quality, channel protection, and flood control performance.</p> <p>Ensure adequate applicability thresholds for performance standards.</p> <p>Require outfalls to be stabilized to reduce erosion.</p>

Objective	Policy Change Actions	Type of Policy Change
<b>ADAPTING TO EXTREME HEAT</b>		
<b>Goal: Minimize Increasing Ambient Outdoor Temperature</b>		
Increase Cooling	Education and Guidance	Conduct pilot programs to reduce heat. Include heat maps in plans; make heat maps available to public
Decrease Heat Absorption	Reduce Waste Heat	Retrofit buildings and utilities for higher energy efficiency. Install energy-efficient appliances. Install energy-efficient windows, and shades. Insulate ceilings, walls, basement, crawlspaces, and water system. Adopt anti-idling bylaws.
Decrease Heat Absorption	Roadways	Include reducing heat island effects as an objective in complete streets projects.
Vegetation and Landscaping	Tree Planting and Protection	Existence of a tree protection ordinance. Existence of a forest protection ordinance. Requirements for protecting % of existing forest. Requirements for unpaved area around tree. Restrictions on trimming or pruning. Require shade trees in all municipal projects and private parking lots. Adopt a tree canopy or urban forest master plan and implementing ordinances. Allow the use of raingardens, tree boxes, & other low impact development (LID) best management practices (BMPs) for tree planting requirements. Offer incentives to plant and protect trees. Require tree or shrub planting on parkways, parking lots, and other impervious areas (Chicago).
Vegetation and Landscaping	Landscaping Island and Screening	Require landscaping in parking lots. Allow the use of bioretention islands and other stormwater practices within landscaped areas or Setbacks. Require screening from adjoining properties to encourage using vegetation in lieu of walls and berms.
Impervious Area Management	Streets and Driveways	Evaluate minimum widths of streets to ensure narrowest possible. Reduce minimum cul-de-sac radius or require center island landscaped. Allow alternative turnarounds for low-density residential streets. Allow minimum driveway widths to be reduced. Permit shared driveways in residential developments. Allow travel lanes travel lanes to be from 12 to 10 ft. (or less) with curb pullouts for passing. Allow the use of curb bump-outs for traffic calming and bioretention. Require site designs to reduce overall street length.

Objective	Policy Change Actions	Type of Policy Change
Impervious Area Management	Parking Areas and Sidewalks	<p>Ability to reduce parking ratios.</p> <p>Establish maximum parking requirements.</p> <p>Allow for the use of shared parking arrangements.</p> <p>Provide a model shared parking agreement.</p> <p>Allow for reduced parking ratios where mass transit exists.</p> <p>Allow minimum stall width of 9 ft.</p> <p>Allow minimum stall length of 18 ft.</p> <p>Allow reduction in stall lengths for vehicle overhang in vegetated areas.</p> <p>Allow for multi-level parking.</p> <p>Provide incentives to reduce impervious cover in parking.</p> <p>Allow for pervious sidewalks.</p> <p>Allow alternate pedestrian networks to be substituted for sidewalks.</p> <p>Allow parking lot drive aisles to be 22 ft.</p> <p>Reduced parking ratio of 3.0 spaces per 1,000 sq. ft. gross floor area</p> <p>Reduced parking ratio of 2 to 4.5 spaces for 1,000 sq. ft. gross floor area for commercial centers.</p>
Impervious Area Management	Cool Transit Pathways	Develop cool corridors aligned with bike and pedestrian routes (Chicago Green Alleys)
<b>Goal: Minimize Increasing Ambient Indoor Temperature</b>		
Increase Cooling	Tree Cover and Vegetation	Promote shade trees along buildings and in public spaces.
Increase Cooling	Buildings	<p>Green Roofs</p> <p>Adopt a green roof ordinance.</p> <p>Remove impediments to development of green roofs</p> <p>Green Walls</p>
Decrease Heat Absorption	Building Materials	<p>Promote cool pavements, cool roofs, high albedo materials</p> <p>Incentivize materials, colors, or roofs either with a minimum Solar Reflectance Index rating of 78</p>
Impervious Area Management	Buildings	Requirements for rooftop structures & materials allow/encourage green roofs.

Objective	Policy Change Actions	Type of Policy Change
<b>PROTECTING BUILDINGS THROUGH DEVELOPMENT AND REDEVELOPMENT</b>		
<b>Goal:</b>		
Protect Against Flooding	Manage Development near Floodplain	Retrofit public buildings, critical facilities, and other infrastructure to withstand flood. Incentivize elevation of buildings above base flood elevation.
Protect Against Flooding	Wet Floodproofing	Wet floodproofed spaces can only be used for parking, access, and storage. Elevate mechanical, electrical, and internet systems to an upper level, roof, or above Design Flood Elevation. Separate electrical circuits between under and above expected flood levels. Allow water to move into enclosed parts of building's lower area and to move out when water recedes. Select materials for their ability to become wet, sustain minimal damage, dry and be restored. Consider incorporating modular components that can be replaced into the design.
Protect Against Flooding	Dry Floodproofing	Design buildings with shield tracks that allow flood shields to slide into place. Design buildings with temporary flood walls can be placed along the perimeter of a property.
Protect Against Flooding	Elevate Buildings	Elevated building Urban design strategies may be needed to connect an elevated building with the public realm.
Prevent Contamination	Manage Systems and Facilities	Install backflow prevention hardware to protect potable water from contamination Safeguard toxic materials (in labs, hospitals, schools, universities, DPW facilities).
Protect Against Heat	Ventilation and Circulation	Use cross-ventilation for passive cooling. Enable windows to be opened. Install ceiling fans.
Protect Against Loss of Power	Renewable Energy	Renewable energy systems, including solar and wind, should be paired with energy storage to facilitate islanding, especially at critical facilities. Buildings can be equipped with emergency generators.
Protect Against Loss of Use	Passive Survivability	Develop a program to enable building residents and occupants to effectively manage and operate resilient buildings. Low Power Occupancy Mode: this could include enough power for an elevator, water and waste water systems, some LED lighting, fridges, and a conditioned community room Incentivize passive survivability (the ability of a building to continue to offer basic function and habitability after loss of infrastructure) into building development/redevelopment. Supply drinking water without power; designate one or more common areas on lower floor for potable water distribution. Ensure toilets and sinks work without power; use at least one non-electric toilet and sink per bathroom. Keep residential stairwells and hallways lit during blackouts. Add backup wireless fire communication systems.

Objective	Policy Change Actions	Type of Policy Change
Protect Against Wind	Materials and Construction	<p>Improve wall and roof coverings (i.e. reinforce or secure roof deck, install new roof covering)</p> <p>Protect openings such as windows, doors, skylights, soffits, vents) by installing impact--resistant coverings (i.e. storm shutter) and impact-resistant products (window or door).</p> <p>Use a continuous load path in construction; a continuous load path in construction resists all loads – such as lateral and uplift wind pressures. A continuous load path starts at the point or surface where loads are applied, moves through the framing, continues to the foundation, and transfers the loads to the soils that support the building. To be effective, each link in the load path – from the roof to the foundation – must transfer loads without failure. Continuous load path design typically involves a series of approved connections, such as the roof sheathing to roof framing, roof framing to wall, wall to floor, and floor to foundation.</p>



Objective	Policy Change Actions	Type of Policy Change
<b>EMERGENCY PREPAREDNESS AND RECOVERY</b>		
<b>Goal: Prepare for Emergencies and Educate Public</b>		
Public Outreach		
	Public Communication s and Warning Systems	General emergency warning system Flood-warning system Heat warning system; develop various levels of heat advisories (i.e. for heat over 95 degrees F, over 100 degrees F, or three or more days over 90 degrees F) Air quality warning/rating system Develop neighborhood-scale communication systems that are redundant to normal communications systems as back-up to telephone, cellular, cable and internet services. Provide emergency information to tenants.
	Emergency Shelter	Consider providing an emergency sheltering area in your project design. Familiarize residents with emergency shelter locations.
Preparedness		
	Emergency Plan	Develop an emergency operations plan. Ensure that there is an accessible route for the residents to the emergency shelter and hospital, and for evacuation. Include the issue of climate change in the town's emergency plan.
	Cooling Centers	Establish one or more "cool" cooling centers for short periods of heat emergencies.
	Vulnerable Populations	Establish a program to pre-identify and support individuals who are more vulnerable due to health conditions, addiction, homelessness or social isolation, and develop community support and emergency response systems to ensure their safety and well-being.
	Businesses and Organizations	Work with businesses and organizations to ensure they plan for continuity of critical services. Work with key healthcare service providers and the regional health and medical coalition to ensure capacity, continuity and access to medical services including pharmacies, dialysis, mental health, and addiction treatment.

#### DEFINITIONS:

##### Sea Level Rise - Planning Flood Elevation

The height that floodwaters are projected to reach with 3.2' of Sea Level Rise and 2.5" for subsidence during a 1% chance annual flood. (SLR-PFE equals 40" above 1% chance annual flood waters.)

##### Sea Level Rise - Design Flood Elevation

The height of the lowest occupiable floor (when wet floodproofing), or the height of the lowest structural member of an inhabitable floor (when elevating a building) with 40" of SLR. SLR-DFE is typically 12"-24" above the SLR-PFE.

#### Questions:

Wind and MA Building Code, in general

Water

## Appendix C

### Annotated Bibliography



## Annotated Bibliography

### 1 - Charles River Basin Climate Projections

[http://sococlimate.org/images/articles/MA\\_StatewideandMajorBasins\\_Climate%20Projections\\_Final.pdf](http://sococlimate.org/images/articles/MA_StatewideandMajorBasins_Climate%20Projections_Final.pdf)

Northeast Climate Science Center Climate Change Projections. These projections can help identify future precipitation and temperature scenarios in Brookline under climate change.

### 2- Town of Brookline Vulnerability Assessment and Action Plan

<https://www.brooklinema.gov/1463/Vulnerability-Assessment>

The Vulnerability Assessment includes a lot of great information on the risks that Brookline specifically faces (from flooding, heating, etc.) It may be useful to utilize some of the studies included in this literature review to compile a concentrated breakdown of the economic and safety risks associated with inaction.

### 3- UMass Amherst study - Climate Change and Flood Risk: Evidence from New York real estate

<https://www.umass.edu/economics/sites/default/files/Mullins.pdf>

This study demonstrates how property values in New York City declined in response to three different flood risk indicators (the Biggert-Waters Flood Insurance Reform Act, Hurricane Sandy, and the release of new FEMA floodplain maps). This demonstrates the financial incentive to increase resilience of existing buildings that face high flood risk, and to avoid building new properties in areas with high flood risk (or ensure that resilience to flooding is central to their design).

### 4 - The Effects of Urban Trees on Air Quality

[https://www.nrs.fs.fed.us/units/urban/local-resources/downloads/Tree\\_Air\\_Qual.pdf](https://www.nrs.fs.fed.us/units/urban/local-resources/downloads/Tree_Air_Qual.pdf)

This study from the USDA Forest Service is useful in support of taking measures to increase tree coverage/urban vegetation in cities. It explains how urban trees affect air quality by reducing temperature, removing air pollutants, emitting volatile organic compounds, and affecting the energy use of buildings. (Interestingly, this study claims that placement of trees around buildings is important in determining if energy consumption is increased or decreased, because for example both blocking summer breezes and shading the building in the winter can actually increase energy demand.)

### 5 - EPA Green Infrastructure Cost-Benefit Resources

<https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources>

This webpage is host to a long list of reports and case studies exemplifying how green infrastructure has saved communities money in various ways. Below are some particularly interesting, relevant, or otherwise broadly-encompassing examples, but many more can be found on the webpage.



## **6 - ECONorthwest - Low Impact Development at the Local Level: Developers' Experiences and City and County Support**

<https://s3-us-west-2.amazonaws.com/econw-publications/2009-Clackamas-County-Low-Impact-Development.pdf>

Subsection II of this report prepared by ECONorthwest for The Rock Creek Sustainability Initiative summarizes an analysis of the challenges and benefits of LID, from a developer's perspective. This includes the challenges developers often face in implementation, as well as the economic benefits developers have found result from LID. Subsection III of the report summarizes steps that local jurisdictions in the US have taken to promote LID, including modification of building and inspection codes and offering incentives.

## **7- EPA – Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices**

[https://www.epa.gov/sites/production/files/2015-10/documents/2008\\_01\\_02\\_nps\\_lid\\_costs07uments\\_reducingstormwatercosts-2.pdf](https://www.epa.gov/sites/production/files/2015-10/documents/2008_01_02_nps_lid_costs07uments_reducingstormwatercosts-2.pdf)

This report is a summary of 17 case studies - in Washington, Wisconsin, Virginia, British Columbia, Arkansas, Illinois, North Carolina, Oregon, and Maryland - exemplifying how LID design principles lowered the cost of developments by 15% to 80% from the conventional development cost. The section "Evaluation of Benefits and Costs" also outlines and describes many of the environmental and quality of life benefits of LID.

## **8 - EPA – Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs**

[https://www.epa.gov/sites/production/files/2015-10/documents/lid-gi-programs\\_report\\_8-6-13\\_combined.pdf](https://www.epa.gov/sites/production/files/2015-10/documents/lid-gi-programs_report_8-6-13_combined.pdf)

This report is similar to the above report, in that it summarizes 13 different case studies of Low Impact Development programs in communities across the US. However, these case studies focus on the communities' experience with the economic evaluations that they performed themselves, rather than cost analyses performed by a third party after the fact. Further, the cases were selected to represent a broad range of different LID programs and different methods for analyzing cost. This report would be useful in gaining a more holistic picture of the potential economic and community benefits of LID, as well as in determining how best to evaluate the benefits and costs of LID programs considered for Brookline specifically.

## **9 - Georgetown Climate Center – Green Infrastructure Toolkit**

<http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/introduction.html>

"The purpose of this toolkit is to analyze common trends in the approaches various cities are taking to planning, implementing, and funding green infrastructure to manage stormwater. The toolkit is intended to aid local governments nationwide in comparing best practices across cities, drawing lessons from different approaches, and crafting similar policies for their own jurisdictions." This toolkit would be very useful in an effort to create a green infrastructure policy in Brookline, because it



provides resources geared specifically towards various phases of the process, from pilot projects to funding and communication.

#### **10 - Center for Neighborhood Technology – The Value of Green Infrastructure**

[http://www.cnt.org/sites/default/files/publications/CNT\\_Value-of-Green-Infrastructure.pdf](http://www.cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf)

This comprehensive guide seeks to help communities and planners evaluate the numerous benefits of LID practices including green roofs, tree planting, bioretention and infiltration, permeable pavement, and water harvesting. This guide is simple and very easily digestible.

#### **11 - American Society of Landscape Architects – Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide.**

<https://www.asla.org/ContentDetail.aspx?id=31301>

Another report featuring case studies to exemplify the benefits that green infrastructure can have for a community. This report puts greatest emphasis on cost reduction as a result of reduced demand for stormwater treatment/management, reduced energy costs, reduced flood damage and improved public health. The American Society of Landscape Architects Website also provides a list of green infrastructure stormwater management case studies in Massachusetts: <https://www.asla.org/stormwatercasestudies.aspx#massachusetts>

#### **12 - National Institute of Building Sciences – Natural Hazard Mitigation 2017 Interim Report**

<https://www.fema.gov/natural-hazard-mitigation-saves-2017-interim-report>

This report updates the previous study of the same nature to say that “society saves \$6 for every \$1 spent through mitigation grants funded through select federal agencies and a corresponding benefit-cost ratio of 4:1 for investments to exceed select provisions of the 2015 model building codes.” Though the exact figures in this report are not widely generalizable, it is a compelling example of how investment in mitigation does in fact have a huge payoff. Section 2.2.1 details the findings of the report specific to flood mitigation; designing new homes to exceed 2015 I-Code Requirements for Riverine Flood saves \$5 for every \$1 spent to build new buildings higher out of the floodplain.

#### **13 - Parks and the Urban Heat Island: A Longitudinal Study in Westfield, Massachusetts**

<https://www.nrs.fs.fed.us/pubs/gtr/gtr-p-94papers/32bristow-p94.pdf>

This study compares temperatures across Westfield, Massachusetts, across both spatial and temporal ranges, to determine the extent to which the city’s parks and protected areas were able to mitigate urban heat island effect. The study found both that urban heat islands had grown in Westfield between 1993 and 2009, and that urban parks and protected areas were in fact effective in keeping air temperatures cooler.



#### **14 - Seattle Stormwater Ordinance**

[www.seattle.gov/dpd/codesrules/codes/stormwater/default.htm](http://www.seattle.gov/dpd/codesrules/codes/stormwater/default.htm)

Comprehensive control of all runoff, drainage, erosion and grading. Incorporates the City's multivolume Stormwater Manual as the required basis for project design. Scope and approach may serve useful for discharge control to flood prone areas.

#### **15 - Washington, DC Stormwater Ordinance**

<https://doee.dc.gov/swregs>

Comprehensive control of all runoff, drainage, erosion and grading. Incorporates the City's multivolume Stormwater Manual as the required basis for project design. Scope and approach may serve useful for discharge control to flood prone areas. Fee or purchase of stormwater credits (Sections 527, 531, 532, 533, 534). May be a useful concept in an urban environment.

#### **16 - Braintree's Wetlands and Floodplain Protection Districts Zoning Bylaw**

<https://www.braintreema.gov/DocumentCenter/View/1411/Article-VI---Permitted-Uses-in-Districts-PDF>

Provides for inclusion of documented areas of flooding outside of FEMA flood zones. (Article VI section 135-608). Incorporates building code. Useful model for inclusion of areas beyond FEMA designations and incorporation of State codes and regulations.

#### **17 - Georgetown Climate Center-Analysis of Biggert-Waters Flood Insurance Reform Act of 2012**

<http://www.georgetownclimate.org/reports/analysis-of-the-flood-insurance-reauthorization-and-reform-law-2012.html>

A summary and analysis of the Federal Act and its implications for states and local governments looking to adopt policies to help them adapt to flooding and related impacts. The following topics relate indirectly to land use: increase insurance for multifamily residences (5 or more), phases out subsidies for repetitive loss properties, allows 100% grants for relocating or removing repetitive loss structures, and provides incentives for construction of flood control structures. These changes should be reflected in language in local flood control regulation.

#### **18 - Massachusetts Stormwater Handbook**

<https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards>

Multi-volume series of comprehensive and technical documents used as a regulatory tool and/or standard. Useful for a reference or standard in new/revised by-laws and other regulations. Includes management standards, best management practices, and a redevelopment checklist.

#### **19 - Cambridge Zoning Ordinance Article 22 (Green Building Requirements)**

[https://www.cambridgema.gov/~media/Files/CDD/ZoningDevel/Ordinance/zo\\_article22\\_1397.ashx](https://www.cambridgema.gov/~media/Files/CDD/ZoningDevel/Ordinance/zo_article22_1397.ashx)

This ordinance requires new and substantially renovated buildings in Cambridge to be constructed sustainably, with construction over 25,000 sq ft requiring a LEED 'Certified' rating or better, and construction over 50,000 sq ft requiring a LEED 'Silver' rating or better. The ordinance also contains



modifications to other zoning regulations to encourage sustainable/energy-efficient design features. This is a useful example of how to remove impediments to sustainable design from pre-existing zoning regulations.

## **20 - Boston Zoning Code Article 37 – Green Buildings**

<http://www.bostonplans.org/planning/planning-initiatives/article-37-green-building-guidelines>

Article 37 is a 2007 addition to Boston’s Zoning Code requiring major building projects (projects subject to Boston Zoning Article 80B) to be LEED Certifiable. This zoning code article isn’t quite as broadly-encompassing as Cambridge’s, and the requirements are less stringent. However, the Boston Planning and Development Agency has other project performance and documentation requirements for large construction project that impose more progressive sustainability requirements, including the Climate Resiliency Policy (described below). Article 37 established the Interagency Green Building Committee to help ensure compliance to both the Article 37 Green Building Requirement, and the Climate Resiliency Policy. The combination of the zoning code article and the resiliency policy is an alternative method that Brookline could consider for achieving more sustainable development requirements/incentives.

## **21 - Boston Planning and Development Agency: Climate Resiliency Review Policy and Climate Resiliency Guidance**

<http://www.bostonplans.org/getattachment/5d668310-ffd1-4104-98fa-eef30424a9b3> The Climate Resiliency Review Policy requires all building projects subject to Boston Zoning Code Article 80 Large Project, Planned Development Area, and Institutional Master Plan review to “analyze near and long-term project impacts on the surrounding environment and Boston’s greenhouse gas inventory, including consideration of future climate conditions” (including sea-level rise, higher annual temperatures, more frequent and longer extreme heat events, increased precipitation, more severe rain events, and increased greenhouse gas concentrations, as well as secondary impacts including interruptions to electrical, gas, telecommunication, and transportation systems). The Policy includes requirements for each stage of the project process, including which filings the Climate Change Checklist must be submitted with. Brookline could consider implementing a modified version of this checklist; in fact, doing so is an action item proposed within Brookline’s Vulnerability Assessment.

The Boston Planning and Development Agency’s Climate Resiliency Design Reference Guide for New Developments (<http://www.bostonplans.org/getattachment/13ad8744-411f-45fd-8b08-809787d37900>) provides guidance to developers on how to complete of the Article 37 Climate Resiliency Checklist. Proposed projects should incorporate strategies for both reducing energy consumption to mitigate the negative effects of climate change, and increasing resilience by reducing the impacts of flooding, storm events, and increasing temperatures.





## **22 - Boston Planning and Development Agency Smart Utilities Policy:**

<http://www.bostonplans.org/news-calendar/news-updates/2018/6/14/bpda-passes-smart-utilities-policy>.

Boston Planning and Development Agency has begun implementation of the Smart Utilities Policy. Among its requirements are hardening of infrastructure against climate change factors and application of Green Infrastructure standards (storm water infiltration) to projects with over 100,000 square feet. May be a useful policy to consider in Brookline.

## **23 - Cambridge Zoning Amendment Petition**

[http://www.cambridgema.gov/~media/Files/CDD/ZoningDevel/Amendments/2018/BrownFloodPlain/zngamend\\_brown\\_petitiontext.pdf?la=en](http://www.cambridgema.gov/~media/Files/CDD/ZoningDevel/Amendments/2018/BrownFloodPlain/zngamend_brown_petitiontext.pdf?la=en)

Recent (2018) proposed zoning amendment to create a new Section 22.80-Green Factor to address community health and safety citywide to address extreme heat and to improve open space, infrastructure, and stormwater management. It is also intended to expand the applicable zoning requirements within the existing Section 20.70-Floodplain Overlay District of the Cambridge Zoning Ordinance. Cites Cambridge Climate Change Vulnerability Assessment as basis of proposed changes. Would require City to establish “Green Factor” evaluation process and development standards to minimize heat island effects and stormwater runoff effects of new development. Would establish Flood Plain Overlay District and establish strict development standards within FEMA flood zones and areas identified in the 2017 Climate Change Vulnerability Assessment. Example of comprehensive regulation update.

## **24 - Municipal Climate Adaptation Guidance Series: Site Plan Review Ordinances, Maine**

[https://www.maine.gov/dacf/municipalplanning/docs/CAGS\\_08\\_Site\\_Plan\\_Review.pdf](https://www.maine.gov/dacf/municipalplanning/docs/CAGS_08_Site_Plan_Review.pdf)

A guide for establishing site plan review and using it to promote climate resilience. Regulatory language provided that is specific to Maine. Language may be instructive for Brookline, however, 2018 petition to City of Cambridge may be more conformed to Massachusetts land use regulations.

## **25 - NIST Community Resilience Planning Guide**

<https://www.nist.gov/topics/community-resilience/community-resilience-planning-guide>

Volume 2 of the Community Resilience Planning Guide analyzes the dependencies that social and economic structures in a community have on the built environment and physical infrastructure. The guide aims to help communities identify ways to align community goals with developing resilience in the face of future potential climate disasters. What is especially useful about this guide is the fact that in each chapter related to infrastructure (buildings, transportation systems, energy systems, communications systems, water and wastewater systems), there is a section that specifically addresses how to work within existing regulatory conditions to increase resilience within that system. The guide also provides suggestions for adjusting regulations for both new and existing infrastructure to increase resilience with respect to specific hazards that infrastructural system may face (snow, flood, etc.)



## **26 - EPA Green Infrastructure Municipal Handbook**

[https://www.epa.gov/green-infrastructure/policy-guides#Municipal Handbook](https://www.epa.gov/green-infrastructure/policy-guides#Municipal%20Handbook)

Five editions of this municipal handbook are broken up to cover funding options, retrofit policies, green streets, rainwater harvesting policies, and incentive mechanisms, all of which are intended to help local governments to increase incorporation of green infrastructure into their communities.

## **27 - MA Smart Growth/Smart Energy Toolkit Model Low Impact Development Bylaw**

<https://www.mass.gov/files/documents/2017/11/03/Low%20Impact%20Development%20%28LID%29%20bylaw%20with%20regulation.pdf>

This model LID Bylaw from the Massachusetts Smart Growth/Smart Energy Toolkit is intended for use in Massachusetts localities to enforce minimum LID standards and incentivize maximum inclusion of LID design principles in new development or redevelopment projects. Appendix A includes example LID credits and incentives.

A handful of cities in the US have begun to implement urban landscaping standards to promote green infrastructure. Precedent for such programs was established in Europe, with Berlin often cited as the first city to incorporate green infrastructure into urban planning and design. Cities have since taken inspiration and molded the basic principle – establishing minimum green infrastructure requirements into zoning regulations – into policies that suit their city’s contexts and needs.

## **28 - Seattle Green Factor**

<http://www.seattle.gov/dpd/codesrules/codes/greenfactor/default.htm>

The Seattle Green Factor is a code requirement in the Seattle Municipal Code (Article 23.85.019) that requires projects to earn a certain minimum amount of credits (established by the property’s zoning). Credits are earned through incorporation of various landscape features that are designed to help reduce stormwater runoff, cool the area during a heat wave, provide habitats for birds and insects, decrease crime, support nearby businesses, etc. The crediting system is outlined in the Seattle Green Factor Score Sheet.

## **29 - Washington D.C. Green Area Ratio**

<https://doee.dc.gov/service/green-area-ratio-overview>

Washington DC’s GAR zoning regulation sets minimum lot-coverage standards and site design features required for development, based on zoning district. A GAR scoresheet is used to help developers meet the minimum required score for their project. The goal of the Green Area Ratio is to reduce stormwater runoff, cool the urban landscape, and improve air quality. Landscaping features that count towards the overall GAR score include tree canopies, vegetative ground cover, bioretention facilities, permeable paving, renewable energy generation, among many others.



### **30 - San Francisco Green Landscaping Ordinance**

[http://default.sfplanning.org/publications\\_reports/Guide\\_to\\_SF\\_Green\\_Landscaping\\_Ordinance.pdf](http://default.sfplanning.org/publications_reports/Guide_to_SF_Green_Landscaping_Ordinance.pdf)

San Francisco's Green Landscaping Ordinance was adopted on Earth Day of 2010 and requires that new development and significant alteration projects adhere to requirements regarding: greening of front setback areas; screening of parking areas; street trees; parking lots, vehicular use area, and permeable surfaces; and climate appropriate plants. A guide to the ordinance makes the requirements accessible and comprehensible and helps residents/property owners understand its benefits.

### **31 - Sacramento Parking Lot Tree Shading Guidelines**

<http://www.cityofsacramento.org/~media/Corporate/Files/Public-Works/Publications/Maintenance/Urban%20Forestry/ShadingGuidelines2003.pdf>

Contains requirements for shading paved areas. Specific guidelines for placement of trees for parking lots and for planting techniques. May serve as example for Brookline guidance manual for urban tree plantings.

### **32 - Cambridge Climate Change Preparedness & Resilience – Alewife Preparedness Plan**

<http://www.cambridgema.gov/CDD/Projects/Climate/climatechangeresilienceandadaptation.aspx>

Part of Cambridge's Climate Change Preparedness and Resilience Plan is the development of neighborhood-specific adaptation/preparedness plans. Alewife's is the first of those to be drafted, given that it is the neighborhood found to be most vulnerable to heat and flooding. The strategies included in the plan are divided into four categories: Prepared Community, Adapted Buildings, Resilient Infrastructure, and Resilient Ecosystems. There is a table of strategies for each category. The plan includes a "qualities of resiliency" metric that allows the strategies to be compared to one another, and thus prioritized (however this is not done in the draft of the plan as it stands now). The plan seems similar to the Action Plan included in Brookline's vulnerability assessment, but it does also suggest a method for prioritization of action items that may be helpful to Brookline. The idea of having neighborhood-specific action plans may also be worth borrowing.

### **33 - FEMA Floodplain Management Requirements Unit 6: Additional Regulatory Measures**

<https://www.fema.gov/floodplain-management-requirements>

This document may be a useful resource in trying to more restrictively regulate development in the floodplain. The introduction states that "the NFIP regulatory standards are minimums. They may not be appropriate for every local situation or unique circumstances. Therefore, states and communities are encouraged to enact more restrictive requirements where needed to better protect people and properties from the local flood hazard." The document goes on to explain how a restrictive regulation can be viewed as "taking" in the eyes of the Court, in which case the provision could be overturned (per the 5<sup>th</sup> amendment). Section C of the document provides a table of regulatory measures that go beyond federal and state regulations that flood-prone areas are required by the National Flood Insurance Program (NFIP) to consider. The document outlines common approaches to regulating floodplain development, including location restrictions, building requirements, safety requirements,



encroachment standards, compensatory storage, stormwater management, and temporary moratoriums. Section E goes on to further explain ways to “package” proposals for stricter floodplain management in such a way that also supports other community goals, particularly if the community is having a hard time recognizing flood as a real risk that they should be concerned about.

### **34 - Model Zoning Regulations for Parking for Northwestern Connecticut**

<http://northwesthillscog.org/PDF/Parking-report-phase-2-final-2003.pdf>

A model of practical zoning regulations for parking to minimize impervious services and the negative effects of paved parking surfaces on the water quality. The study was conducted specifically for the northwest CT region, which is largely rural and sparsely populated, and this model reflects that. However, many of the guidelines and fundamental concepts for parking regulation may be relevant to Brookline (see pg. 5).

### **35 - MA Smart Growth/Smart Energy Toolkit Smart Parking Model Bylaw**

<https://www.mass.gov/files/documents/2017/11/03/Smart%20Parking.pdf>

From the Massachusetts Smart Growth/Smart Energy Toolkit: <https://www.mass.gov/smart-growth-smart-energy-toolkit-module-bylaws>. “The following bylaw provisions for implementing smart parking strategies are designed to address three distinct issues relative to off-street parking: 1) Reducing standards for required parking; 2) Providing innovative solutions for shared and off-site parking; and 3) Parking area design.”

### **36 - Sacramento Zoning Code Parking Regulations**

<https://www.cityofsacramento.org/Community-Development/Planning/Current-Planning/Zoning/Zoning-Code-Parking-Regulations>

Parking regulations are specific to land use zones. Include adjustment for projects including certified transportation plans. Planters required for larger lots; separate areas for bicycles required. Concepts and language may be applicable to Brookline.

### **37 - EPA Heat Island Community Action Database**

<https://www.epa.gov/heat-islands/heat-island-community-actions-database>

This is a comprehensive database compiled by the EPA, summarizing the techniques used by various municipalities across the United States to minimize the Heat Island Effect. The database is organized by state, locality, mechanism, and mitigation strategy, and includes links to access more information about each program. Includes Cal Green (<https://codes.iccsafe.org/public/document/details/toc/657>), the 2016 California Green Building Standards Code, Part 11.



### **38 - Cool Policies for Cool Cities: Best Practices for Mitigating Urban Heat Islands in North American Cities**

<https://aceee.org/files/proceedings/2014/data/papers/10-356.pdf>

This study by the American Council for an Energy Efficient Economy and the Global Cool Cities Alliance discusses the threat Urban Heat Island Effect and reviews the mitigation strategies in place in 26 North American cities. The findings of the study are organized by city and have been leveraged to create a comprehensive list of actionable recommendations for other municipalities seeking to address Urban Heat Island Effect and its adverse impacts on public health.

### **39 - Measures to Reduce the Urban Heat Island Effect in Rosemont – La Petite-Patrie**

[https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/mun/pdf/13-0616-Rosemont%20Case%20Study\\_e.pdf](https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/mun/pdf/13-0616-Rosemont%20Case%20Study_e.pdf)

This source discusses the experience of a Montreal borough – Rosemont-La Petite-Patrie – with Urban Heat Island Effect and the legislative actions the borough took to mitigate it and its effect on public health. Revisions to their zoning bylaw included a mandate to install a green, white, or highly reflective roof on all new buildings or in any roof replacement; a mandate for minimum landscaping requirements for new parking areas; a paving material requirement for new parking and storage areas; and a landscaping requirement for new buildings.

### **40 - Environmental Defense Fund - “Green, Clean, and Dollar Smart: Ecosystem Restoration in Cities and Countryside.”**

[http://actrees.org/files/Research/edf\\_scarlett.pdf](http://actrees.org/files/Research/edf_scarlett.pdf)

“This guidebook offers cities, counties, states and stakeholders some discussion, examples, and a summary of tools and policy recommendations that may stimulate further interest in expanding, integrating, and refining the greening of urban infrastructure using an ecosystem services framework.” (iii) The latter section of the guidebook offers Toolkit Sections containing specific recommendations for enabling and promoting urban greening initiatives through use of existing legislation and development of new, integrated metrics.

- US Forest Service i-Tree: Free software programs that analyze ecosystem services and cost-estimates of the value of trees and vegetation <https://www.itreetools.org/>
- Green Service Utility Fees, such as utility “treebate” programs that give residents utility rebates based on tree planting on private property and stormwater utility fees that can be rebated based on implementation of stormwater management infrastructure
- Leverage existing federal regulations to promote urban greening, such as provisions in the Clean Air Act that may permit tree planting to count towards ozone-reduction credit, and grant provisions in the Clean Water Act and Safe Drinking Water Act that can be used for green infrastructure or land acquisition with the purpose of protecting water supply (many more examples and discussion of opportunities and challenges in guidebook)
- Develop bylaws that “support ecosystem services evaluation and investments” (example: Oregon’s Ecosystem Services Bill)



#### **41 - EPA: “Reducing Urban Heat Islands: Compendium of Strategies”**

[https://www.epa.gov/sites/production/files/2017-05/documents/reducing\\_urban\\_heat\\_islands\\_ch\\_6.pdf](https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_6.pdf)

This EPA report assembles examples of heat island mitigation activities from engaged stakeholders around the country and organizes them into the categories of either “voluntary efforts” or “policy efforts.” For each mitigation technique or activity, examples of municipalities putting it into action are provided. Voluntary efforts include demonstration projects, incentive programs, urban forestry programs, weatherization, outreach and education, and awards. Policy efforts include procurement, resolutions, tree and landscape ordinances, comprehensive plans and design guidelines, zoning codes, green building standards, building codes, and air quality standards. Some notable examples:

- Grant programs for green roofs, green walls, and cool roofs (examples: Chicago, Houston, Pennsylvania DEP)
- Incorporate cool roof coatings in weatherization projects to protect low-income households from urban heat island and to help reduce energy costs of cooling the living space. This has been done by the Energy Coordinating Agency of Philadelphia
- Tree protection ordinances (requiring a permit for tree removal); Atlanta, Annapolis, and San Antonio all have tree protection ordinances
- Amend the zoning code to include floor area ratio bonuses (or other bonuses) for developments that incorporate certain heat island mitigation strategies, such as green roofs. Both Chicago, Illinois and Portland, Oregon have incorporated such bonuses into their zoning codes

#### **42 - Philadelphia Stormwater Management Incentives Program**

<http://www.phila.gov/water/wu/stormwater/Pages/Grants.aspx>

Owners of non-residential properties (or anyone with the permission of the property owner) can apply for a grant from the City of Philadelphia to cover up to 100% of the cost of design and construction of a stormwater management project on the property. Stormwater management projects are additionally incentivized by the fact that Philadelphia’s stormwater utility fees are based on the amount of impervious surfaces on the property, so properties that incorporate more pervious surfaces and landscaping to help manage stormwater runoff thereby see reduced stormwater fees.

#### **43 - Portland, OR – Ecoroofs Program**

<https://www.portlandoregon.gov/bes/44422>

From 2008 to 2012 Portland ran an ecoroofs incentive program, providing a construction incentive of \$5 per square foot. Portland recognized many benefits of ecoroofs, including saving energy, cooling urban heat islands, decreasing stormwater runoff, filtering air pollutants, absorbing carbon dioxide, providing habitats for birds and insects and providing urban green spaces for the enjoyment of community members. The result of Portland’s incentive program was 130 projects with over 8 acres of ecoroofs, managing 4.4 million gallons of stormwater annually. The site includes a description of the program, the cost analysis of the program, and more resources about ecoroofs. Below is the link to the cost benefit evaluation report prepared for this program in 2008:

<https://www.portlandoregon.gov/bes/article/261053>





#### **44 - Town of Littleton Low Impact Design/Best Management Practices Manual**

<http://littletonma.qscend.com/reports-plans>

This document serves to support the development of a stormwater management program by helping developers understand the best management practices that can be employed to reduce the impact of development quality and quantity of stormwater runoff. The document provides a brief description of the BMPs relevant to Littleton, in the categories of Infiltration, Attenuation, and Treatment. It also includes a matrix designed to help developers select the BMPs that are best suited to their particular projects. A similar (Brookline-specific) document would be a useful supplement to any LID bylaw that Brookline might pass and would help to make the incorporation of LID methods as simple and streamlined as possible for developers (thereby removing implementation barriers).

#### **45 - MAPC Low Impact Development Toolkit**

<https://www.mapc.org/resource-library/low-impact-development-toolkit/>

LID Factsheets cover the following methods: Low-Impact Site Design, Roadway and Parking Lot Design, Permeable Paving, Bioretention Areas, Vegetated Swales, Grass Filter Strips, Infiltration Trenches and Dry Wells, Cisterns and Rain Barrels, and Green Roofs. Although many of these methods are covered elsewhere in the reviewed literature, this resource may be particularly useful as they are MA specific and very comprehensive; there is a fact sheet for each method, and each fact sheet includes sections on: applications/design principles, limitations, benefits and effectiveness, maintenance, and cost.

#### **46 - Green Streets Guidebook for Holyoke, Massachusetts**

<https://www.holyoke.org/wp-content/uploads/2012/10/Final-Cover-Page-LowRes-w-Cover.pdf>

This guidebook was prepared by The Conway School for Holyoke to promote the use of Green Streets principles as a mechanism by which to address Holyoke's combined sewer overflow problem. Though the guidebook was written for Holyoke's specific context and conditions, many of the tools provided would be useful to Brookline were the city to wish to incorporate Green Streets into their action plan for bolstering climate resilience.

Interestingly, Green Streets have not taken off in popularity in New England to the same extent as other LID and Green Infrastructure principles/programs have. Green Street design principles have begun to be utilized in Philadelphia, Tucson, and Baltimore, but implementation of Green Streets in Brookline may make the Town something of a pioneer in New England.

#### **47 - City of Tucson Department of Transportation Green Streets Active Practice Guidelines**

<https://watershedmg.org/document/city-tucson-green-streets-active-practice-guidelines>

Guidelines for incorporating green infrastructure features into all new construction/reconstruction of publicly funded roadways and all drainage projects (that include a landscaping element). Document includes description of which projects these guidelines apply to, performance goals for Green Streets, requirements for each phase of Green Street Projects, principles, and a Green Infrastructure Planning Procedure.





#### **48 - EPA Green Reserve – Green Streets Conceptual Guide**

<https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockkey=P10059Y4.txt>

This guide, produced by the EPA Green Reserve, provides an outline of the various strategies that can be utilized to create city streets that are greener, safer, more attractive, reduce carbon footprint, reduce urban heating, and reduce stormwater pollution and runoff into waterways. The guide discusses strategies that are useful for residential streets, commercial streets, arterial streets, and alleys.

#### **49 - Green Alley Initiative, Chicago**

[https://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green\\_alleys.html](https://www.cityofchicago.org/city/en/depts/cdot/provdrs/street/svcs/green_alleys.html)

Chicago began a Green Alley initiative (and developed a handbook) that encourages use of porous paving, recycled and light-colored paving materials, and retention/infiltration systems whenever an alley needs to be re-paved. Forty-six alleys were renovated under this initiative in 2007, and ultimately, almost 2,000 miles of alleyways will be made permeable. This approach may be of use in some Brookline areas.

#### **50 - National Wildlife Federation – Green Works for Climate Resilience**

<https://www.nwf.org/Our-Work/Environmental-Threats/Climate-Change/Climate-Smart-Conservation/Climate-Smart-Communities/Green-Works-Guide>

This is a guide to nature-based approaches for managing the effects of climate change in an urban environment. It is divided up into impact categories: sea-level rise, coastal flooding, and erosion; drought and increasing aridity; extreme heat and the Urban Heat Island Effect; inland flooding and stormwater management; and changes to the natural landscape. This guide is great in that it includes not only strategies for managing different hazard risks, but also provides examples of cities implementing those strategies successfully, ways to update existing programs and policies to support those strategies, and cost-benefit information about the strategies.

#### **51 – TreePhilly**

<http://treephilly.org/>

TreePhilly is an outreach program put on by the Philadelphia Parks and Recreation Department to promote urban tree planting on private property, in support of their urban reforestation efforts (which have included extensive tree planting on public lands). TreePhilly offered educational outreach programs, and a year-long free tree giveaway for property owners.

#### **52 - DC RiverSmart Rooftops Green Roof Rebate Program**

<https://doee.dc.gov/greenroofs>

In order to promote the installation of green roofs on properties throughout the city, the Department of Energy and Environment offers a rebate of \$10 to \$15 dollars per square foot for green roof installations.



### **53 - Montgomery County RainScape Program**

<https://www.montgomerycountymd.gov/water/rainscapes/index.html>

The Department of Environmental Protection of Montgomery County offers rebates to eligible property owners who install certain RainScape landscape or design systems on their property. “RainScapes” include rain gardens, conservation landscapes, green roofs, rain barrels, permeable pavement, and pavement removal. The rebates are scaled to provide the greatest incentive for the best RainScape techniques.

### **54 - Annapolis Maryland StormWater Utility Fee Credit Program**

<https://www.annapolis.gov/446/Stormwater-Fee-Credit-Program>

In order to incentivize the installation of stormwater management structures on private properties, the City of Annapolis raised the Stormwater Utility Fee and began offering a 50% fee reduction to property owners who have installed on-site stormwater management infrastructure.

### **55 - Building Resilience in Boston – “Best Practices” for Climate Change Adaptation and Resilience for Existing Buildings**

[http://www.greenribboncommission.org/archive/downloads/Building\\_Resilience\\_in\\_Boston\\_SML.pdf](http://www.greenribboncommission.org/archive/downloads/Building_Resilience_in_Boston_SML.pdf)

This report was prepared on behalf of the Boston Green Ribbon Commission Climate Preparedness Working Group by Linnean Solutions, the Built Environment Coalition, and The Resilient Design Institute. The 117-page report reviews a broad range of projects and research at the national and international level, to identify best practices for improving the climate resilience of existing buildings. While the report was written with an eye to Boston’s specific circumstances and challenges, many of the conclusions drawn and recommendations made would be applicable to Brookline, and warrant consideration. This report touches on an important point in its focus on improving resilience of existing buildings rather than new developments, acknowledging that “newly designed buildings can easily adapt to new building standards, but adapting existing buildings takes more effort and different strategies.” Sections 3 and 4 will likely be the most useful; Section 3 covers the “best practices” identified by the report, and Section 4 discusses municipal actions that can be taken to promote resilience.

### **56 - New Orleans Gentilly Resilience District**

<https://www.nola.gov/resilience/resilience-projects/gentilly-resilience-district/>

With funding from the National Disaster Resilience Competition, The City of New Orleans has launched a project to create the first “resilience district” in the district of Gentilly. The creation of the resilience district entails twelve different projects and programs, developing resilience in various aspects of the district from stormwater and flooding management infrastructure to workforce development, smart energy systems to wetland revitalization. This project is particularly inspiring because it demonstrates how green infrastructure and the development of resilience can help a community recover from a natural disaster and build resilience to future disasters, all while bolstering the morale and quality of life of a neighborhood’s residents. It is also a good example of the importance project coordination and a comprehensive plan; rather than developing isolated solutions



to complex problems, the Gentilly Resilience District addresses the fact that the nature of the issues it faces requires a wide variety of closely coordinated solutions.

### **57 - EPA City Green: Innovative Green Infrastructure Solutions for Downtowns and Infill Locations**

<https://www.epa.gov/smartgrowth/city-green-innovative-green-infrastructure-solutions-downtowns-and-infill-locations>

*“City Green: Innovative Green Infrastructure Solutions for Downtowns and Infill Locations (2016) is for local governments, private developers, and other stakeholders who help shape redevelopment projects in downtowns and infill locations where development has already occurred. It provides inspiration and helps identify successful strategies and lessons learned for overcoming common barriers to using green infrastructure in these contexts. The examples could encourage cities to adopt policies that would expand the number of projects incorporating similar green infrastructure approaches.”* This report is essentially a case study of twelve different communities and how they overcame challenges to green infrastructure in developed areas (of which limited space and unknown soil quality are prominent). A strength of this document is that it addresses both the why and how questions of Green Infrastructure: Section D is specifically about how municipalities remove regulatory obstacles to allow green infrastructure projects, and Section F is full of examples of Green Infrastructure bringing up property value.

### **58 - City Lab – A Guidebook for City Planners on Green Infrastructure**

<https://www.citylab.com/solutions/2017/04/a-guidebook-for-city-planners-on-green-infrastructure/522396/>

This online resource displays 30 nature-based solutions (and 23 case studies exemplifying what these solutions might look like in practice) for reducing the threat of climate hazards.

- Otter Creek Floodplain Restoration – to protect downstream communities such as Rutland and Middlebury, conservation easements were bought to restore and protect the floodplain and wetland ecosystems that protect communities from flooding when Otter Creek overruns its bank due to storms or yearly snow melt. The benefits of the project were hundreds of thousands of dollars’ worth of flood damage reduction, and improved water quality of in the Lake Champlain watershed.
- Lick Run Watershed in Cincinnati – to address Cincinnati’s major combined sewer overflow problem, a massive 6-component project was undertaken to reduce the amount of stormwater entering the sewers. A main component of this effort was the daylighting of three streams, including Lick Run.

### **59 - American Society of Landscape Architects website**

<https://www.asla.org/greeninfrastructure.aspx>

The American Society of Landscape Architects has compiled a whole database of organizations, resources, government resources, research, and projects associated with various Green Infrastructure in the contexts of Forests & Nature Reserves, Wildlife Habitat & Corridors, Cities, Constructed Wetlands, Green Street, and Green Roofs & Walls. Some of these resources or



examples are covered in this literature review, but there are many more that could be useful to various resilience initiatives!

#### **60 - Resilient by Design; Bay Area Challenge; Meet the Projects**

<http://www.resilientbayarea.org/meetprojects/>

Final design concepts presented for nine project sites throughout San Francisco Bay. Projects and “a roadmap” presented to the Resilient Bay Summit; these are top projects from Resilient by Design competition, similar to the previous Boston competition. Projects integrate concepts of elevation of urban areas, expanded wetlands (for flood retention), replacement of aging infrastructure, stream restoration, and development of a social design process. These projects generally focus on rising sea level, but the social design process may provide useful concepts for the community outreach process.

#### **61 - Gloucester Coastal Climate Change Vulnerability Assessment and Adaptation Plan**

<http://www.gloucester-ma.gov/DocumentCenter/View/3416>

Focuses on flooding and sea level rise. The “Adaptation Strategies” section includes general recommendations for changes to local policies and regulations that may serve as a conceptual checklist for modification of Brookline by-laws and regulations. The few recommendations for acquisition of property in flood-prone areas may be applicable.

#### **62 - Hull Freeboard Incentive Program**

[http://www.town.hull.ma.us/Public\\_Documents/HullMA\\_conservation/permitfeefinal.pdf](http://www.town.hull.ma.us/Public_Documents/HullMA_conservation/permitfeefinal.pdf)

In 2009, Hull enacted the state's first freeboard incentive program to encourage the elevation of flood-prone buildings above currently predicted floodwater levels to account for future coastal storm events and sea level rise. Through this freeboard incentive program, the town seeks to protect the health and safety of citizens, prevent property damage, and reduce costly emergency services. Hull's Conservation Agent worked with the Massachusetts Office of Coastal Zone Management and the town's Building Commissioner to develop the freeboard incentive, which enables the Building Department to offer a credit up to \$500 for permit fees to builders and homeowners who elevate new and renovated structures at least two feet above the highest federal or state requirement. (Buildings in A and V zones need to be elevated at least two to four feet above the base flood elevation, respectively, to meet the freeboard requirements.) An added benefit for property owners is significant discounts to flood insurance premiums. As of 2015, owners of 42 properties have applied for permits for new construction or existing homes that included two or more feet of freeboard.

#### **63 - China and US Case Studies Georgetown Climate**

<http://www.georgetownclimate.org/articles/case-studies-in-building-community-resilience.html>

Center case study on climate change adaptation strategies in 6 US or China municipalities: 2 focus on sea level rise and flooding, Two on water supply and 2 on urban heat island effects. Relevant urban heat island efforts include adoption of a green building code (Washington DC) and



Expansion of the urban tree canopy (Hong Kong, China). Reports on each area descriptive and contain no specific measures applicable to Brookline. Examples include use of GIS to prioritize use of resources, use of an umbrella plan to integrate measures into applicable programs.

**64 - Greening Your Community presentation for Worcester by MassAudubon**

[https://www.massaudubon.org/content/download/16085/238473/file/GreeningYourCommunity\\_Presentation\\_Worcester\\_093015%20sml.pdf](https://www.massaudubon.org/content/download/16085/238473/file/GreeningYourCommunity_Presentation_Worcester_093015%20sml.pdf)

Powerpoint presentation for Worcester by MassAudubon on cost-effective LID strategies. Good presentation of LID measures that may be incorporated into a wide range of redevelopment and new projects. Useful concepts for implementing LID requirements, but limited guidance for specific by-laws or regulations. May contain examples for workshops during development and adoption of stormwater regulations.

**65 - MassAudubon Bylaw Review**

<https://www.massaudubon.org/our-conservation-work/advocacy/shaping-the-future-of-your-community/publications-community-resources/bylaw-review>

Excel based framework for comparing local land use regulations to state-wide best practices, to better support implementation of Green Infrastructure and LID strategies. Could be useful step in developing scope of regulatory changes.

**66 - EPA Case Study: Planning for Climate Change - Manchester-by-the-Sea**

[https://toolkit.climate.gov/sites/default/files/Manchester-by-the-Sea\\_March\\_2016.pdf](https://toolkit.climate.gov/sites/default/files/Manchester-by-the-Sea_March_2016.pdf)

Brief overview of vulnerability assessment and use of EPA evaluation tool applied to municipal waste water treatment facility in a coastal flood zone. Not applicable to the Brookline scope of work.

**67 - Mattapoissett Coastal Resilience –Water and Sewer Infrastructure**

[https://www.mattapoissett.net/sites/mattapoissettma/files/uploads/mattapoissett\\_coastalresilience\\_finalreport\\_06302016.pdf](https://www.mattapoissett.net/sites/mattapoissettma/files/uploads/mattapoissett_coastalresilience_finalreport_06302016.pdf)

Consultant study identifies and prioritizes risk reduction strategies for infrastructure maintenance and to mitigate the short and long-term vulnerabilities of water supply and wastewater treatment facilities. Focuses on coastal flooding and storm surge, and suggests engineering solutions.

**68 - Adapting to Urban Heat: A Toolkit for Local Governments - Georgetown Climate Center**

<http://www.georgetownclimate.org/reports/adaptation-tool-kit-urban-heat.html>

Toolkit includes policy tools for increasing use of green roofs, cool roofs, cool pavements and urban forestry. General discussion of financial and policy incentives for these key urban island heat factors. May serve as a checklist for items to include in Bylaw and regulation updates.



### **69 - Virginia Case Study, Manage Rising Flood Risks –Georgetown Climate Center**

<http://www.georgetownclimate.org/files/report/Va%20Case%20Study%20Jan.%202013%20update.pdf>

Evaluation of what is within existing land-use powers to adapt manage flood risk and erosion along the Virginia coast. Comprehensive discussion of land use related mechanism that may be used to regulate activities and mitigate risk in flood prone areas. May be used as a checklist of methods to consider in By-law and regulation updates. Specific language examples not provided.

### **70 - Chula Vista Climate Adaptation Strategies, City of Chula Vista's Climate Change Working Group**

<https://www.chulavistaca.gov/home/showdocument?id=5443>

Planning document recommends 11 strategies to “adapt” the community to these impacts within energy and water supply, public health, wildfires, ecosystem management, coastal infrastructure, and the local economy sectors. The implementation plan for each strategy includes performance metrics, timeline, and budget/financing for each project. The strategies are: 1) Cool Paving, 2) Shade Trees, 3) Cool Roofs, 4) Local Water Supply & Reuse, 5) Storm Water Pollution Prevention & Reuse, 6) Education & Wildfires, 7) Extreme Heat Plans, 8) Open Space Management, 9) Wetlands Preservation, 10) Sea Level Rise & Land Development Codes, and 11) Green Economy. Focus and structure of plan limits its applicability to Brookline By-laws and regulations.

### **71 - Massachusetts Smart Growth/Smart Energy Toolkit**

[http://www.mass.gov/envir/smart\\_growth\\_toolkit/bylaws/model-osd-nrpz-zoning-final.pdf](http://www.mass.gov/envir/smart_growth_toolkit/bylaws/model-osd-nrpz-zoning-final.pdf)

Model Open Space Design/Natural Resource Protection Zoning – model bylaw deals specifically with subdivision of land and/or the site design process to promote “open space design” or cluster development. This approach is typically applied to residential development on larger lots. Would apply to limited areas of Brookline.

### **72 - National Institute of Standards and Technology Community Resilience Planning Guide Briefs**

<https://www.nist.gov/topics/community-resilience/planning-guide-briefs>

A series of short discussions intended to supplement the NIST Planning Guide (already in Annotated Bibliography) but each can also stand alone. Focused on resilience evaluations and community actions to develop goals, objectives and plans. More applicable for earlier phases of MVP planning process. LEED Resources (particularly Climate Resilience Planning Tool).

### **73 - Climate Smart Cities Tool - Trust for Public Lands**

<https://www.tpl.org/how-we-work/climate-smart-cities#sm.00000vwzcr3qegefmbz6heak7rz34>

Website contains an overview of a 4-part strategy: connect, cool, absorb, protect. Four example “smart cities”, including Boston, are provided. Boston materials include Tufts heat island study and two urban farm examples. Heat island study is a well-researched evaluation of Boston existing conditions and a general discussion of potential mitigation.





**74 - New York Law Journal, March 13, 2014. Deluge of New York City Laws Guards Against Flooding, Protects Environment**

<http://wordpress.ei.columbia.edu/climate-change-law/files/2016/06/Gerrard-2014-03-NYC-Flood-Laws-Protect-Environment.pdf>

Thirty-one of the environmental laws enacted in 2013 relate to the post-Sandy recovery process resulting from the Building Resiliency Task Force recommendations. City enacted 17 laws that were designed to make buildings and infrastructure more resilient. Also, based on testimony at hearings on preparedness and response, the city enacted nine laws that focused on improving emergency preparedness and response, and laws that focused on making recovery easier for homeowners and businesses. Building code revisions of this type are usually enacted by the Commonwealth. (<https://www1.nyc.gov/site/buildings/codes/local-laws.page>)

**75 - Special Initiative for Rebuilding and Resiliency: A Stronger More Resilient New York**

<https://www1.nyc.gov/site/sirr/report/report.page>

Report details the impact of Hurricane Sandy, evaluates the potential for future damage given climate change impacts, and details the opportunities for improvement to the citywide infrastructure and built environment, specifically coastal protection, buildings, and critical services (including utilities, energy, telecommunications, transportation, water and wastewater) as well as healthcare, insurance, and natural environments such as parks. The final section of the report describes the community rebuilding and resilience plans for different neighborhoods in the city. Focuses on flooding and emergency response. Potentially useful example for evaluating infrastructure vulnerability and upgrades.

**76 = Building Resiliency Task Force Report by the New York City Building Resiliency Task Force**

<https://www.urbangreencouncil.org/content/projects/building-resiliency-task-force>

The report includes 33 proposals to improve disaster resiliency focusing on buildings and provides a costing methodology for new construction and existing buildings. Several implementation approaches are presented for the proposals, including: required upgrade, new code, remove barrier, recommended, and further actions, including expanded descriptions of the issues and benefits, specific actions on building systems (such as foundations, structure, windows and doors, and mechanical systems), cost estimates, and additional references. May be useful if Brookline evaluates incentives for reconstructing or relocating buildings.

**77 - Guidance Document for Incorporating Resiliency Concepts into NFPA Codes and Standards**

<https://www.nfpa.org/-/media/Files/News-and-Research/Resources/Research-Foundation/Research-Foundation-reports/Other-research-topics/RFGuidanceDocumentIncorporatingResiliencyConcepts.ashx?la=en&hash=E0C96325151640A1C6033DDDDCA4B98974D4DC69>

Make general recommendations to consider design that will minimize damage or design features to facilitate easy repair or replacement of fire protection systems after climate change related events. Addresses buildings and emergency preparedness. Provide engineered features for fire protection system resiliency, those features





related to fire prevention in hazard and occupancy guidance documents. Anticipates future NFPA work on specifics.

#### **78 – Massachusetts Climate Change Adaptation Report**

<https://www.mass.gov/files/documents/2017/11/29/Full%20report.pdf>

As directed by the Global Warming Solutions Act, the Massachusetts Executive Office of Energy & Environmental Affairs convened a group of advisors and prepared the first report on climate change for the state. Released in 2011, the report considers current and projected climate change impacts, vulnerabilities of key infrastructure, the natural environment, public health and welfare, communities, and the coastline, and strategies for adapting to predicted climate change.

#### **79 – EPA Smart Growth Fixes for Climate Adaptation and Resilience**

[https://www.epa.gov/sites/production/files/2017-01/documents/smart\\_growth\\_fixes\\_climate\\_adaptation\\_resilience.pdf](https://www.epa.gov/sites/production/files/2017-01/documents/smart_growth_fixes_climate_adaptation_resilience.pdf)

This EPA publication is intended to help communities address some of the expenses and political challenges of preparing for and adapting to climate change. The strategies outlined here can be worked into a community's regular processes and policies—for example, through scheduled updates to zoning and building codes. Options in each chapter are categorized as modest adjustments, major modifications, and wholesale changes. The report is divided by impacts that communities are likely to face as the climate continues to change, including strategies: that broadly address climate change (Chapter 3), adapting to flooding and extreme precipitation that include green infrastructure strategies also useful for addressing heat and sea level rise, (Chapter 4), for adapting to extreme heat (Chapter 6), and for adapting to drought (Chapter 7).

#### **80- Arlington's Regulations for Wetlands Protection and Bylaw**

Regulations: <https://www.arlingtonma.gov/home/showdocument?id=41320>

Bylaw: <https://www.arlingtonma.gov/town-governance/laws-and-regulations/town-bylaws/title-v-regulations-upon-the-use-of-private-property#A8>

Arlington's Regulations for Wetlands Protection is given authority by the bylaw to incorporate new definitions and permit considerations for the protection of wetlands. The Regulations incorporate definitions related to climate resilience. Climate adaptation, stormwater management, vegetation replacement, and flood management must be taken into account through the permitting process. The regulations use an 'Adjacent Upland Resource Area (AURA)' to expand protection beyond the typical resource area.



### **81- Unified Facilities Criteria: Low Impact Development**

[https://www.wbdg.org/FFC/DOD/UFC/ARCHIVES/ufc\\_3\\_210\\_10\\_2004.pdf](https://www.wbdg.org/FFC/DOD/UFC/ARCHIVES/ufc_3_210_10_2004.pdf)

The report provides an overview of low impact development techniques including design goals, design criteria, and site planning guidance. The report also provides information on how low impact development can contribute to meeting water related regulations, like the Clean Water Act, and the location of federal resources, like precipitation data. Thirteen best management practice are described in greater detail (the use-case, cost data, maintenance issues and the corrective actions that can be taken). There are examples of the best management practices with illustrative images.



Document Number	Geographical Area	Resource Title	Annotated Bibliography Page Number	Website	Argument for Action	Hazard(s) Addressed										Resource Type									
						Flooding and Extreme Precipitation		Drought	Extreme Heat	Air Quality	Buildings	Emergency Preparedness	Other	Report	Case Study	Guide	Database/ Further Reading	Model/ Example	Policy Action	Planning Strategy	Bylaw/Zoning/ Ordinance				
						Stormwater	Riverine and Floodplains																		
Massachusetts Cities																									
2	MA City	Town of Brookline Vulnerability Assessment and Action Plan	1	<a href="https://www.brooklinema.gov/1463/Vulnerability-Assessment">https://www.brooklinema.gov/1463/Vulnerability-Assessment</a>	x	x				x					x										
13	MA City	Parks and the Urban Heat Island: A Longitudinal Study in Westfield, MA	3	<a href="https://www.nrs.fs.fed.us/pubs/ot/ot-cp-44/papers/2002/low-uhl.pdf">https://www.nrs.fs.fed.us/pubs/ot/ot-cp-44/papers/2002/low-uhl.pdf</a>	x					x					x										
19	MA City	Cambridge Zoning Ordinance - Article 22	4	<a href="https://www.cambridgema.gov/~media/Files/CDD/Zoning/News/Ordinance/zo_article22_1397.pdf">https://www.cambridgema.gov/~media/Files/CDD/Zoning/News/Ordinance/zo_article22_1397.pdf</a>						x	x				x					x	x			x	
20	MA City	Boston Zoning Code - Article 37	5	<a href="http://www.bostonplans.org/planning/planning-relatives/article-37-green-building-guidelines">http://www.bostonplans.org/planning/planning-relatives/article-37-green-building-guidelines</a>		x	x		x						x					x	x				
21	MA City	Boston Planning and Development Agency Climate Resiliency Review Policy and Climate Resiliency Guidance	5	<a href="http://www.bostonplans.org/getattachment/5d695112-1e11-4100-989e-eaf9204a9b93">http://www.bostonplans.org/getattachment/5d695112-1e11-4100-989e-eaf9204a9b93</a>		x	x			x					x					x	x				
22	MA City	Boston Planning and Development Agency Smart Utilities Policy	6	<a href="http://www.bostonplans.org/news-calendar/news-updates/2018/6/14/bpda-passes-smart-utilities-policy">http://www.bostonplans.org/news-calendar/news-updates/2018/6/14/bpda-passes-smart-utilities-policy</a>		x					x				x					x	x				
23	MA City	Cambridge Zoning Amendment Petition	6	<a href="http://www.cambridgema.gov/~media/Files/CDD/Zoning/News/Amendments/2018/Brown/Plap/reqamend_brown_petitioned.pdf?__ga__">http://www.cambridgema.gov/~media/Files/CDD/Zoning/News/Amendments/2018/Brown/Plap/reqamend_brown_petitioned.pdf?__ga__</a>		x				x										x	x				
32	MA City	Cambridge Climate Change Preparedness & Resilience - Alewife Preparedness Plan	8	<a href="http://www.cambridgema.gov/CDD/Projects/CDD/ClimateChange/Resilience/alewife/alewife.pdf">http://www.cambridgema.gov/CDD/Projects/CDD/ClimateChange/Resilience/alewife/alewife.pdf</a>		x	x			x					x						x	x		x	
44	MA City	Town of Littleton Low Impact Design/Best Management Practices Manual	12	<a href="http://littletonma.gov/cdd/reports-plans-content/uploads/2012/10/Email-Cover-Page-LowRes-w-Cover.pdf">http://littletonma.gov/cdd/reports-plans-content/uploads/2012/10/Email-Cover-Page-LowRes-w-Cover.pdf</a>		x														x			x	x	
46	MA City	Green Streets Guidebook for Holyoke, MA	12	<a href="https://www.holyoke.org/lets-content/uploads/2012/10/Email-Cover-Page-LowRes-w-Cover.pdf">https://www.holyoke.org/lets-content/uploads/2012/10/Email-Cover-Page-LowRes-w-Cover.pdf</a>		x				x							x						x	x	
61	MA City	Gloucester Coastal Climate Change Vulnerability Assessment and Adaptation Plan	16	<a href="http://www.glocester.ma.gov/DocumentCenter/View/3416">http://www.glocester.ma.gov/DocumentCenter/View/3416</a>	x		x								x								x	x	
62	MA City	Hull Freeboard Incentive Program	16	<a href="http://www.town.hull.ma.us/Public_Documents/H/IMA_cddreservationfinal.pdf">http://www.town.hull.ma.us/Public_Documents/H/IMA_cddreservationfinal.pdf</a>	x		x								x								x	x	
64	MA City	Greening Your Community presentation for Worcester by MassAudubon	17	<a href="https://www.massaudubon.org/content/download/16085/238473/file/GoverningYourCommunityPresentation_Worcester_093015%20sm.pdf">https://www.massaudubon.org/content/download/16085/238473/file/GoverningYourCommunityPresentation_Worcester_093015%20sm.pdf</a>	x	x					x							x					x	x	
66	MA City	EPA Case Study: Planning for Climate Change - Manchester-by-the-Sea	17	<a href="https://booklet.climate.gov/sites/default/files/Manchester-by-the-Sea_March_2016.pdf">https://booklet.climate.gov/sites/default/files/Manchester-by-the-Sea_March_2016.pdf</a>	x										x										
67	MA City	Mattapoisett Coastal Resilience -Water and Sewer Infrastructure	17	<a href="https://www.mattapoisett.net/sites/mattapoisett/files/uploads/mattapoisett_coastalresilience_finalreport_06302016.pdf">https://www.mattapoisett.net/sites/mattapoisett/files/uploads/mattapoisett_coastalresilience_finalreport_06302016.pdf</a>	x		x								x										
80	MA	Arlington's Regulations for Wetlands Protection and Bylaw	20	<a href="https://www.arlingtonma.gov/home/showdocument?id=41300">https://www.arlingtonma.gov/home/showdocument?id=41300</a> Bylaw: <a href="https://www.arlingtonma.gov/download/2016/06/06/2014-02-NYC-Flood-Laws-Protect-Environment.pdf">https://www.arlingtonma.gov/download/2016/06/06/2014-02-NYC-Flood-Laws-Protect-Environment.pdf</a>		x		x		x				x										x	
New York City																									
3	NYC	Climate Change, Flood Risk and Property Values: Evidence from New York City	1	<a href="https://www.umass.edu/economics/sites/default/files/M414r.pdf">https://www.umass.edu/economics/sites/default/files/M414r.pdf</a>	x	x	x								x										
74	NYC	New York Law Journal, March 13, 2014. Deluge of New York City Laws Guards Against Flooding, Protects Environment	19	<a href="http://www.law.columbia.edu/climate-change-law/files/2016/06/Sept2014-02-NYC-Flood-Laws-Protect-Environment.pdf">http://www.law.columbia.edu/climate-change-law/files/2016/06/Sept2014-02-NYC-Flood-Laws-Protect-Environment.pdf</a>		x	x				x										x			x	
75	NYC	Special Initiative for Rebuilding and Resiliency: A Stronger More Resilient New York	19	<a href="https://www1.nyc.gov/sites/default/files/2016/06/06/2014-02-NYC-Flood-Laws-Protect-Environment.pdf">https://www1.nyc.gov/sites/default/files/2016/06/06/2014-02-NYC-Flood-Laws-Protect-Environment.pdf</a>		x	x				x				x	x					x				
76	NYC	Building Resiliency Task Force Report by the New York City Building Resiliency Task Force	19	<a href="https://www.urbanresiliencycouncil.org/content/for-rapids-building-resiliency-task-force">https://www.urbanresiliencycouncil.org/content/for-rapids-building-resiliency-task-force</a>		x	x								x	x						x			
Other Cities																									
14	Other City	Seattle Stormwater Ordinance	4	<a href="http://www.seattle.gov/cdd/codesrules/codes/stormwater/default.htm">http://www.seattle.gov/cdd/codesrules/codes/stormwater/default.htm</a>		x														x					x
15	Other City	Washington, DC Stormwater Ordinance	4	<a href="https://doh.dc.gov/news">https://doh.dc.gov/news</a>		x															x				x
24	Other State	Maine Municipal Climate Adaptation Guidance Series: Site Plan Review Ordinances	6	<a href="https://www.maine.gov/dacf/municipalplanning/docs/CAGS_08_Site_Plan_Review.pdf">https://www.maine.gov/dacf/municipalplanning/docs/CAGS_08_Site_Plan_Review.pdf</a>		x	x														x	x			
28	Other City	Seattle Green Factor	7	<a href="http://www.seattle.gov/cdd/codesrules/codes/greenfactor/default.htm">http://www.seattle.gov/cdd/codesrules/codes/greenfactor/default.htm</a>		x				x	x				x						x	x			
29	Other City	Washington D.C. Green Area Ratio	7	<a href="https://doh.dc.gov/service/green-area-ratio-overview">https://doh.dc.gov/service/green-area-ratio-overview</a>		x				x	x										x	x			
30	Other City	San Francisco Green Landscaping Ordinance	8	<a href="http://default.sfpplanning.org/publications_repo/sf/Guide_to_SF_Green_Landscaping_Ordinance.pdf">http://default.sfpplanning.org/publications_repo/sf/Guide_to_SF_Green_Landscaping_Ordinance.pdf</a>		x									x			x			x	x			
31	Other City	Sacramento Parking Lot Tree Shading Guidelines	8	<a href="http://www.cityofsacramento.org/~media/Cdd/cddrules/Files/Public-Works/Publications/Maintenance/Urban%20Parking%20Shading%20Guidelines2003.pdf">http://www.cityofsacramento.org/~media/Cdd/cddrules/Files/Public-Works/Publications/Maintenance/Urban%20Parking%20Shading%20Guidelines2003.pdf</a>						x											x	x			
36	Other City	Sacramento Zoning Code Parking Regulations	9	<a href="https://www.cityofsacramento.org/CommunityDevelopment/Planning/Current-Planning/Zoning/Zoning-Code/Parking-Regulations">https://www.cityofsacramento.org/CommunityDevelopment/Planning/Current-Planning/Zoning/Zoning-Code/Parking-Regulations</a>		x					x										x	x			
42	Other City	Philadelphia Stormwater Management Incentives Program	11	<a href="https://www.phila.gov/water/wu/stormwater/Pas/Guide.aspx">https://www.phila.gov/water/wu/stormwater/Pas/Guide.aspx</a>		x															x	x			
43	Other City	Portland Oregon Ecoroofs Program	11	<a href="https://www.portlandoregon.gov/bes/44492">https://www.portlandoregon.gov/bes/44492</a>		x				x	x				x						x	x			

## Annotated Bibliography Presented by Geography

Document Number	Geographical Area	Resource Title	Annotated Bibliography Page Number	Website	Argument for Action	Hazard(s) Addressed										Resource Type									
						Flooding and Extreme Precipitation		Drought	Extreme Heat	Air Quality	Buildings	Emergency Preparedness	Other	Report	Case Study	Guide	Database/ Further Reading	Model/ Example	Policy Action	Planning Strategy	Bylaw/Zoning/ Ordinance				
						Stormwater	Riverine and Floodplains																		
47	Other City	City of Tucson DOT Green Streets Active Practice Guidelines	12	<a href="https://watershedring.org/document/city-tucson-green-streets-active-practice-guidelines">https://watershedring.org/document/city-tucson-green-streets-active-practice-guidelines</a>		x				x						x					x	x			
49	Other City	Green Alley Initiative, Chicago	13	<a href="https://www.cityofchicago.org/city/en/depts/cd/cdprodivs/street/ucva/green_alleys.html">https://www.cityofchicago.org/city/en/depts/cd/cdprodivs/street/ucva/green_alleys.html</a>						x	x														
51	Other City	TreePhilly	13	<a href="http://treephilly.org/">http://treephilly.org/</a>						x	x						x	x							
52	Other City	DC RiverSmart Rooftops Green Roof Rebate Program	13	<a href="https://dkee.dc.gov/greenroofs">https://dkee.dc.gov/greenroofs</a>		x				x	x						x	x							
53	Other City	Montgomery County RainScape Program	14	<a href="https://www.montgomerycountymd.gov/water/anscapes/index.html">https://www.montgomerycountymd.gov/water/anscapes/index.html</a>		x											x	x							
54	Other City	Annapolis Maryland StormWater Utility Fee Credit Program	14	<a href="https://www.annapolis.gov/446/Stormwater-Fee-Credit-Program">https://www.annapolis.gov/446/Stormwater-Fee-Credit-Program</a>		x											x	x							
55	Other City	Building Resilience in Boston - Best Practices for Climate Change Adaptation and Resilience for Existing Buildings	14	<a href="https://www.greenribboncommission.org/learn/downloads/Building_Resilience_in_Boston_SML.pdf">https://www.greenribboncommission.org/learn/downloads/Building_Resilience_in_Boston_SML.pdf</a>									x	x					x	x	x				
56	Other City	New Orleans Gentrilly Resilience District	14	<a href="https://www.nola.gov/resilience/resilience-projects/gentrilly-resilience-district/">https://www.nola.gov/resilience/resilience-projects/gentrilly-resilience-district/</a>		x								x			x			x	x				
60	Other City	Resilient By Design Bay Area Challenge	16	<a href="http://www.resilientbayarea.org/meetprojects/">http://www.resilientbayarea.org/meetprojects/</a>		x	x							x			x			x	x				
70	Other City	Chula Vista Climate Adaptation Strategies, City of Chula Vista's Climate Change Working Group	18	<a href="https://www.chulavista.ca.gov/home/showdocument?id=5443">https://www.chulavista.ca.gov/home/showdocument?id=5443</a>	x	x				x	x					x					x	x			
Massachusetts																									
1	MA	Charles River Basin Climate Projections	1	<a href="http://apocclimate.org/images/articles/MA_StatewideandMajorBasins_Climate%20Projections_Final.pdf">http://apocclimate.org/images/articles/MA_StatewideandMajorBasins_Climate%20Projections_Final.pdf</a>	x	x	x			x				x											
18	MA	Massachusetts Stormwater Handbook	4	<a href="https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards">https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards</a>		x			x										x						
27	MA	MA Smart Growth/Smart Energy Model Low Impact Development Bylaw	7	<a href="https://www.mass.gov/files/documents/2017/11/03/Low%20Impact%20Development%20%28LID%29%20bylaw%20with%20regulation.pdf">https://www.mass.gov/files/documents/2017/11/03/Low%20Impact%20Development%20%28LID%29%20bylaw%20with%20regulation.pdf</a>		x													x	x					
35	MA	MA Smart Growth/Smart Energy Toolkit Smart Parking Model Bylaw	9	<a href="https://www.mass.gov/files/documents/2017/11/03/Smart%20Parking.pdf">https://www.mass.gov/files/documents/2017/11/03/Smart%20Parking.pdf</a>		x													x	x					
45	MA	MAPC Low Impact Development Toolkit	12	<a href="https://www.mapc.org/resource-library/low-impact-development-toolkit/">https://www.mapc.org/resource-library/low-impact-development-toolkit/</a>		x															x	x			
65	MA	Mass Audubon Bylaw Review	17	<a href="http://www.massaudubon.org/outreach/conservation-work/advocacy/shaping-the-future-of-your-community/publications-community-resources/bylaw-review">http://www.massaudubon.org/outreach/conservation-work/advocacy/shaping-the-future-of-your-community/publications-community-resources/bylaw-review</a>		x	x										x				x	x			
71	MA	Massachusetts Smart Growth/Smart Energy Toolkit	18	<a href="http://www.mass.gov/enhr/smart_growth_toolkit/bylaws/model-csd-rep-zoning-final.pdf">http://www.mass.gov/enhr/smart_growth_toolkit/bylaws/model-csd-rep-zoning-final.pdf</a>	x	x	x			x							x				x	x			
78	MA	Massachusetts Climate Change Adaptation Report	20	<a href="https://www.mass.gov/files/documents/2017/11/09/FULL%20report.pdf">https://www.mass.gov/files/documents/2017/11/09/FULL%20report.pdf</a>	x	x	x			x	x	x	x	x	x					x	x				
Other States																									
24	Other State	Municipal Climate Adaptation Guidance Series: Site Plan Review Ordinances, Maine	6	<a href="https://www.maine.gov/cdcl/municipalplanning/docs/CAGS_08_Site_Plan_Review.pdf">https://www.maine.gov/cdcl/municipalplanning/docs/CAGS_08_Site_Plan_Review.pdf</a>		x	x												x	x					
34	Other State	Model Zoning Regulations for Parking for Northwestern Connecticut	9	<a href="http://northwesthillscon.org/PDF/Parking-report-phase-2-final-2003.pdf">http://northwesthillscon.org/PDF/Parking-report-phase-2-final-2003.pdf</a>		x													x	x					
69	Other State	Virginia Case Study, Manage Rising Flood Risks -Georgetown Climate Center	18	<a href="http://www.georgetownclimate.org/files/report/Vir%20Case%20Study%20Jan%202001%20%20%20%20date.pdf">http://www.georgetownclimate.org/files/report/Vir%20Case%20Study%20Jan%202001%20%20%20%20date.pdf</a>	x	x	x															x	x		
United States																									
4	US	USDA: The Effects of Urban Trees on Air Quality	1	<a href="https://www.nrs.fs.fed.us/urban/local-resources/downloads/Tree_Air_Qual.pdf">https://www.nrs.fs.fed.us/urban/local-resources/downloads/Tree_Air_Qual.pdf</a>	x					x	x				x										
5	US	EPA Green Infrastructure Cost-Benefit Resources	1	<a href="https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources">https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources</a>	x	x	x			x	x						x								
6	US	ECONorthwest Low Impact Development at the Local Level	2	<a href="https://s3-us-west-2.amazonaws.com/econw-publications/2009/Clarkamas-County-Low-Impact-Development.pdf">https://s3-us-west-2.amazonaws.com/econw-publications/2009/Clarkamas-County-Low-Impact-Development.pdf</a>		x									x						x				
7	US	EPA Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices	2	<a href="https://www.epa.gov/sites/production/files/2014/10/documents/2008_01_02_nps_lid_costs07u merits_reducingstormwatercosts-2.pdf">https://www.epa.gov/sites/production/files/2014/10/documents/2008_01_02_nps_lid_costs07u merits_reducingstormwatercosts-2.pdf</a>	x	x											x	x							
8	US	EPA Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs	2	<a href="https://www.epa.gov/sites/production/files/2015/10/documents/lid-ci-programs_report_8-6-13_combined.pdf">https://www.epa.gov/sites/production/files/2015/10/documents/lid-ci-programs_report_8-6-13_combined.pdf</a>	x	x																			
9	US	Georgetown Climate Center - Green Infrastructure Toolkit	2	<a href="http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/introduction.html">http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/introduction.html</a>		x																			
10	US	Center for Neighborhood Technology - The Value of Green Infrastructure	3	<a href="http://www.cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf">http://www.cnt.org/sites/default/files/publications/CNT_Value-of-Green-Infrastructure.pdf</a>	x	x																			
11	US	American Society of Landscape Architects - Banking on Green	3	<a href="https://www.asla.org/ContentDetail.aspx?id=41391">https://www.asla.org/ContentDetail.aspx?id=41391</a>	x	x					x				x	x									
12	US	National Institute of Building Sciences - Natural Hazard Mitigation 2017 Interim Report	3	<a href="https://www.fema.gov/natural-hazard-mitigation-saves-2017-interim-report">https://www.fema.gov/natural-hazard-mitigation-saves-2017-interim-report</a>	x										x										
17	US	Georgetown Climate Center-Analysis of Biggert-Waters Flood Insurance Reform Act (2012)	4	<a href="http://www.georgetownclimate.org/reports/analysis-of-the-flood-insurance-reauthorization-and-reform-law-2012.html">http://www.georgetownclimate.org/reports/analysis-of-the-flood-insurance-reauthorization-and-reform-law-2012.html</a>		x	x								x										
25	US	NIST Community Resilience Planning Guide	6	<a href="https://www.nist.gov/topics/community-resilience/community-resilience-planning-guide">https://www.nist.gov/topics/community-resilience/community-resilience-planning-guide</a>		x	x							x						x					
26	US	EPA Green Infrastructure Municipal Handbook	7	<a href="https://www.epa.gov/green-infrastructure/policy-guides#Municipal-Handbook">https://www.epa.gov/green-infrastructure/policy-guides#Municipal-Handbook</a>		x															x				



## Appendix D

### Sample Resiliency Language for Brookline's Wetland Regulations



# BROOKLINE WETLANDS REGULATIONS

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# BROOKLINE WETLANDS REGULATIONS

## 1 General Provisions

### 1.1 Authority

- A. These regulations are promulgated by the Town of Brookline Conservation Commission pursuant to the authority granted to it under Section 9 of the Town of Brookline Wetlands Protection By-Law (the By-Law). These regulations complement the By-Law, and have the force of law in implementing the By-Law. The By-Law, and these regulations, are intended to utilize the Home Rule authority of this municipality to protect additional ~~R~~resource ~~a~~Areas, for additional values, with additional standards and procedures stricter than those of the Wetlands Protection Act (M.G.L. c. 131, § 40, WPA) and Regulations thereunder (310 CMR 10.00); subject, however, to the rights and benefits accorded to agricultural uses and structures of all kinds under the laws of the Commonwealth.

### 1.2 Purpose

- A. The purpose of these regulations is to support and implement the By-Law and to protect the wetlands, water resources, and adjoining land areas in the Town of Brookline by controlling activities deemed by the Conservation Commission likely to have a significant or cumulative effect upon ~~R~~resource ~~a~~Area ~~v~~Values, including but not limited to the following: public or private water supply, groundwater, flood control, erosion and sedimentation control, storm damage prevention, water quality, water pollution control, wildlife habitat, rare species habitat including rare plant species, ~~and~~ recreation values, and climate adaptation and resilience.
- B. The By-Law identifies additional interests not recognized by the WPA. These include but are not limited to isolated wetlands larger than 2,500 square feet, vernal pools, ponds larger than 5,000 square feet, and intermittent streams. It also increases the ~~buffer-zone~~Buffer Zone around ~~wetland-r~~Resource ~~a~~Areas to 150 feet.
- C. All of the standards, requirements, and procedures set forth in the Massachusetts Wetlands Protection Act and regulations published at 310 CMR 10.00, et seq. are incorporated and made part of these regulations as if restated herein, except where they are less stringent than these regulations.

### 1.3 Areas Subject to Jurisdiction:

- A. The following areas are subject to jurisdiction under the By-Law:
1. Resource Areas:
    - (a) Land under lakes, ponds, rivers or streams (Land Under Water Bodies, LUW)
    - (b) Banks
    - (c) Any wetland, marsh, wet meadow, bog or swamp bordering on any lake, pond, river or stream (Bordering Vegetated Wetlands, BVW)
    - (d) Land subject to flooding bordering on any lake, pond, river or stream
    - (e) Any wetland, marsh, wet meadow, bog or swamp larger than 2500 square feet that is isolated from other ~~R~~resource ~~a~~Areas (Isolated Vegetated Wetlands, IVW)
    - (f) Riverfront areas
    - (g) Vernal pools
  2. Buffer Zones.

# BROOKLINE WETLANDS REGULATIONS

## 1.4 Definitions

- A. In addition to the definitions contained in the By-Law and those found at 310 CMR 10.04, terms in these regulations shall have the following meanings:

Act - The Massachusetts Wetlands Protection Act, Mass. Gen. Laws, c. 131. § 40. This Act also protects Riverfront Areas, and is sometimes referenced as the Rivers Protection Act. When used in these regulations, the term "Act" includes the regulations promulgated by the Department of Environmental Protection at 310 CMR 10.00.

Adaptation - Measures designed or intended to protect resources from the impacts of climate change hazards and to protect the ability of community resources to mitigate the impacts of climate change hazards.

Alter - To change the condition of any Resource Area subject to jurisdiction under the By-Law. Examples of alteration include but are not limited to, the following:

- 1) the changing of pre-existing drainage characteristics, flushing characteristics, sedimentation patterns, flow patterns or flood retention areas;
- 2) the raising or lowering of the water level or water table;
- 3) the destruction of vegetation;
- 4) the changing of water temperature, salinity, biochemical oxygen demand (BOD), or other physical, biological or chemical characteristics of the receiving water.

Alternatives Analysis - An analysis provided by the applicant showing that the proposed project offers the best measures to assure compliance with the standards of the By-Law and these regulations over all other reasonable possible configurations of the project.

Area Subject to Jurisdiction under the By-Law - An area specified in the By-Law or the Act as a Resource Area or a Buffer Zone.

Bank - The land area which normally abuts and confines a water body; the lower boundary being the mean annual low flow level, and the upper boundary being the first observable break in the slope or the mean annual flood level, whichever is higher.

Best Management Practices - The use of design and maintenance criteria that minimize to the greatest extent possible adverse effects on the environment, including without limitation controlling and abating the discharge of pollutants and inadvertent alterations of Areas Subject to Jurisdiction under the By-Law.

Bordering Vegetated Wetland - The area characterized by a wetland plant community and wetland hydrology, adjacent to a pond or stream, as defined in M.G.L. c. 131 § 40.

Buffer Zone - That area of land extending 150 feet horizontally outward from the boundary of a Resource Area, except that riverfront areas and vernal pools shall have no ~~buffer zone~~ Buffer Zones.

## BROOKLINE WETLANDS REGULATIONS

Climate Change Hazards - The events and impacts of, but not necessarily limited to, (i) extreme heat; (ii) the timing, frequency, intensity, and amount of precipitation; (iii) storm surges and rising water levels; (iv) increased intensity and/or frequency of storm events or extreme weather events; or (v) frequency, intensity and duration of droughts.

Commission - The Conservation Commission of the Town of Brookline or its employee, representing the Commission or its agents.

Credible Evidence - Evidence from a competent source, as determined by the Brookline Conservation Commission, such as the Department of Environmental Protection, the Commission, or from a professionally qualified individual, which evidence was collected using acceptable scientific methodology or best available reliable practices or that which is based on personal knowledge.

Diameter Breast Height (DBH) – The measuring point for the diameter of a tree, which shall be 4.5' above ground level.

Drought (Extended Drought) - Those periods, in specifically identified geographic locations, determined to be at the "Advisory" or more severe drought level by the Massachusetts Drought Management Task Force, in accordance with the Massachusetts Drought Management Plan. See 310 CMR 10.58(2)(f).

Flood Control - The prevention or reduction of flooding and flood damage, both as currently expected to occur and as projected to occur based on the best available data regarding the impacts of climate change hazards.

Extreme Weather Event - Weather at the extremes of the historical distribution lying in the outermost 10 percent of a place's history, including but not necessarily limited to droughts, high winds and microbursts, blizzards and ice storms, excessive precipitation, wildfires, tornadoes, and severe thunderstorms or hurricanes.

Isolated Vegetated Wetland - An isolated wetland that is not hydraulically connected to another Resource aArea and is at least 2,500 square feet in size.

Land Subject to Flooding (Bordering) - An area that floods from a rise in a bordering waterway or water body. It is an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. It extends from the banks of these waterways and water bodies; where a bordering vegetated wetland occurs, it extends from said wetland. Or, an area designated as a 500-year floodplain by the Flood Insurance Rate Maps, community number 250234B, for the Town of

Brookline or a floodplain based on credible climate change projections. Where National Flood Insurance Program data are unavailable or deemed by the Commission to be outdated or inaccurate or not reflecting current or future conditions, the boundary of said land shall be based on the maximum lateral extent of flood water which has been observed or recorded, or other evidence presented and considered by the Commission, such as credible climate change projections. Such areas may or may not be characterized by wetland vegetation or soil characteristics.

Land Subject to Flooding (Isolated)- as defined in 310 CMR 10.00 Wetlands Regulations.

## BROOKLINE WETLANDS REGULATIONS

Land under lakes, ponds, rivers or streams (Land Under Water Bodies, LUW) - The land beneath any creek, river, stream, pond or lake. Said land may be composed of organic muck or peat, fine sediments, rocks or bedrock. The physical characteristics and location of LUW are critical to the protection of the interests identified. The boundary of LUW is the mean annual low water level.

Maintenance - Activity that maintains but does not enlarge a structure; does not alter its design, or change its runoff characteristics; or does not alter an existing landscape from its current condition.

Native vegetation - Vegetation native to the Northeastern United States, excluding any vegetation listed as non-native invasive by the Massachusetts Invasive Plant Advisory Group.

Person - Any individual, group of individuals, association, partnership, corporation, company, business organization, trust, estate, the Commonwealth or political subdivision thereof to the extent subject to Town By-Laws, administrative agency, public or quasi-public corporation or body, this municipality, and any other legal entity, its legal representatives, agents, or assigns.

Pond - A water body as so defined in the Wetlands Protection Act and 310 CMR 10.04, except that a minimum size threshold of 5,000 square feet shall apply.

Protection of Wildlife - The measures necessary to safeguard and otherwise preserve any and all of the following:

1. 1) Any plant or animal species listed as endangered, threatened, or special concern or placed on the Watch List by the Massachusetts Natural Heritage Program; listed as Federally Endangered or Federally Threatened by the U.S. Fish and Wildlife Service; and deemed locally threatened, in writing, by the Conservation Commission which decision shall be based on scientific data from a competent source.
2. Any non-domesticated mammal, bird, reptile, amphibian, fish, mollusk, arthropod, or other invertebrate, other than a species of the Class Insecta, or predaceous arachnids of the Order Arachnida that have been determined by the Commonwealth of Massachusetts or any agency thereof to be a pest whose protection under the provisions of the By-Law would be a risk to humans.
3. The ability of any Resource Area to provide food, breeding habitat, or escape cover for animal species set forth in these regulations at (2) above.

Quorum - Majority of the members of the Commission then in office. A majority of the quorum, duly convened, must vote to take any action. See 310 CMR 10.05(2). Provided however, a majority of the members must vote to issue an enforcement order under Section 3.4 of these regulations.

Rare Species - Without limitation, all vertebrate and invertebrate animal and plant species listed as endangered, threatened, or of special concern by the Massachusetts Division of Fisheries and Wildlife, regardless of whether the site in which they occur has been previously identified by the Division.

Resilience – The ability to withstand the negative impacts of climate change.

## BROOKLINE WETLANDS REGULATIONS

Resource Areas - Land under lakes, ponds, rivers or streams; any bank, marsh, wet meadow, bog or swamp bordering on any lake, pond, river or stream; land subject to flooding bordering on any lake, pond, river or stream; isolated land subject to flooding; isolated vegetated wetlands; riverfront areas; and vernal pools.

Resource Area Enhancement – Activity that removes or manages invasive species; removes man-made debris, garbage, or trash; stabilizes a Bank or other Resource Area; plants non-invasive species of vegetation; improves resilience and adaptation to climate change; or other activity approved by the Commission.

Wetland-Resource Area Values - Without limitation, public or private water supply, groundwater, flood control, erosion and sedimentation control, storm damage prevention, water quality, water pollution control, wildlife habitat, rare species habitat including rare plant species, and recreation values, and adaptation and resilience to climate change.

Riverfront Area –The area of land between a river's mean annual high water line and a parallel line measured horizontally, as so defined in the Wetlands Protection Act and 310 CMR 10.58(2), as they may be amended.

Significant or Cumulative Effect - The Commission shall determine whether the proposed activities will have a significant or cumulative effect on the Resource Area Values wetland values protected by the By-Law. This decision shall be made on case specific information, which shall include but not be limited to attritional loss and history of activities in the Area Subject to Jurisdiction under the By-Law.

Storm Damage Prevention - The prevention of damage caused by water from storms, as currently occurs and is predicted by best available data to occur from the impacts of climate change, including but not limited to erosion and sedimentation, damage to vegetation, property or buildings or damage caused by flooding, waterborne debris or waterborne ice.

Stream - An open body of running water, including brooks and creeks, which moves in a definite channel, in the ground, due to a hydraulic gradient and flows within, into, or out of an Area Subject to Jurisdiction under this By-Law. Such bodies of running water that are intermittent are streams, except for those that serve only to carry the immediate surface runoff from stormwater or snowmelt. A portion of a stream may flow through a culvert or beneath a bridge. Where a stream or river runs through a culvert more than 200 feet in length, the Buffer Zone or Riverfront Area stops at a perpendicular line at the upstream end of the culvert and resumes at the downstream end.

Vernal Pool - A confined basin depression that, at least in most years, holds water for a minimum of two continuous months during the spring and/or summer, and that is free of adult fish populations, as well as the area within 100 feet of the mean annual boundary of such a depression, and that is breeding habitat for amphibian species such as wood frog, spotted salamander, and fairy shrimp, regardless of whether the site has been certified by the Massachusetts Division of Fisheries and Wildlife. A vernal pool does not have a buffer zoneBuffer Zone.

Wetland Resource Area — An Area Subject to Protection under the Wetlands Protection Act, Mass. Gen. Laws c. 131, § 40, or the By-Law, or both.



## **BROOKLINE WETLANDS REGULATIONS**

### **1.5 Jurisdiction**

- A. Except as permitted by the Commission or as provided in this By-Law, no person shall alter a ~~R~~resource ~~a~~Area or a ~~buffer-zone~~Buffer Zone. Resource areas shall be protected whether or not they border surface waters.

### **1.6 Exemptions and Exceptions**

- A. The application and permit required by the By-Law and controlled by this set of rules and regulations shall not be required for the following activities so long as the applicant complies with Section 3.1.D of these regulations:
1. Maintaining, repairing, or replacing, but not substantially changing or enlarging an existing and lawfully located structure or facility used in the service of the public to provide electric, gas, water, telephone, telegraph, or other telecommunication services, provided that written notice has been given to the Commission prior to commencement of work, and provided that the work conforms to performance standards and design specifications in regulations adopted by the Commission;
  2. Maintenance, as defined in Section 1.4.A of these regulations, of existing structures or landscaped areas;
  3. Work performed for normal maintenance or improvement of land which is lawfully in agricultural use, as defined in 310 CMR, at the time the work takes place;
  4. For emergency projects necessary for the protection of the health and safety of the public, provided that the work is to be performed by or has been ordered to be performed by an agency of the Commonwealth or a political subdivision thereof; provided that advance notice, oral or written, has been given to the Commission prior to commencement of work or within 24 hours after commencement; provided that the Commission or its agent certifies the work as an emergency project; provided that the work is performed only for the time and place certified by the Commission for the limited purposes necessary to abate the emergency; and provided that within 21 days of commencement of an emergency project a permit application shall be filed with the Commission for review as provided by this By-Law. Upon failure to meet these and other requirements of the Commission, the Commission may, after notice and a public hearing, revoke or modify an emergency project approval and order restoration and mitigation measures.
  5. The application of herbicides as specifically set forth in 310 CMR 10.03(6), as may be amended.
  6. Facilities constructed for the purpose of and designated as reservoirs by the Commonwealth of Massachusetts shall be exempt from the jurisdiction of this By-Law.
  7. Any bordering vegetated wetland, isolated wetland, bank, land under water, land subject to flooding, or riverfront area in existence for the purpose of stormwater management shall not require the filing of a Notice of Intent or a Request for Determination of Applicability to maintain the stormwater management system, provided that the work is limited to the maintenance of the stormwater management system and that the area is not altered for other purposes.

## BROOKLINE WETLANDS REGULATIONS

- B. Other than as stated in this section, the exceptions provided in the Wetlands Protection Act (M.G.L. c. 131, § 40) and Regulations (310 CMR 10.00) shall not apply under this By-Law.

### 2 Performance Standards for Areas Subject to Jurisdiction:

#### 2.1 Wetland-Resource Area Values Protected and Performance Standards Common to All Resource Areas

Subject to Jurisdiction under the By-Law.

- A. Preamble: The Commission shall presume that areas subject to jurisdiction under the By-Law function to protect Resource Area wetland-vvalues. Alterations to Resource Areas, and to Buffer Zones, are presumed to impact Resource Area Valueswetland values. Activities other than maintenance as defined in Section 1.4.A above and exemptions and exceptions as defined in Section 1.6.A above are subject to review by the Commission. A Permit for work in a Buffer Zone or a Resource Area shall only be issued if the Commission finds that any proposed activity will not impair the ability of the Resource Area or the Buffer Zone to perform its functions or protect Resource Area Values. wetland-values.

1. Persons engaging in activities in areas subject to jurisdiction shall ~~seek to~~ avoid impacts to the Resource Area or Buffer Zone. Unavoidable impacts shall be minimized, and all impacts shall be mitigated. Climate change shall be taken into account.
2. Any plans to mitigate impacts to jurisdictional areas shall be designed with the following goals and an applicant shall detail steps taken to address these goals:
  - (a) minimize disruption or removal of existing native vegetation, including trees
  - (b) minimize the creation of new impervious area
  - (d) maximize recharge from any impervious surfaces, with any necessary pre-treatment
  - (e) ensure that runoff from the site is minimized
  - (f) ensure that runoff from the site is treated to minimize pollutants
  - (g) develop designs that are functional, appropriately scaled and sized, and easy to maintain
  - (h) where feasible, manage runoff using surface, vegetative designs rather than underground piped infrastructure
  - (i) design with sensitivity to habitat characteristics both on-site and in adjacent areas

- B. Performance Standards: The following performance standards shall be met for activities proposed in all areas subject to jurisdiction under the By-Law:

1. Resource Area and Resource Area Value Preservation: Applicants There shall demonstrate that be no significant or cumulative alteration of wetland-Resource Areas or Resource Area Vvalues will as a result because ofef any proposed activities.
2. Stormwater Management: ApplicantsThere shall demonstrate that be no new direct discharge to Rresource aAreas will occur and stormwater has utilized low-impact development best management practices.



## BROOKLINE WETLANDS REGULATIONS

- ~~3-2.~~ The stormwater management system shall be designed to maximize treatment before discharge;

### 3. Climate Change Adaptation and Resilience

- a. The Applicant shall integrate considerations of adaptation and resilience planning into their project to promote climate change resilience so as to protect and promote Resource Area Values into the future.
- b. Climate projections, in addition to historic data, should be used when considering impacts of climate change hazards, stormwater management, and vegetative plantings. Applicants should use the Cornell University Northeast Regional Climate Center (NRCC) and Natural Resource Conservation Services (NRCS) precipitation frequency data or the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 Volume 10 (or as updated) for historic data and should consider the Massachusetts Executive Office of Energy and Environment's Statewide and Major Basin Climate Projections, Intergovernmental Panel on Climate Change /Other Credible Evidence for climate projections.

### 4. Vegetation Removal and Replacement and Wildlife Protection: Applicants shall provide a vegetation and replacement plan that prioritizes preserving wildlife habitat and the climate adaptation and resilience benefits.

(Note the paragraph concerning the MA Natural Heritage Program was moved to the Vegetation and Removal and Replacement and Wildlife Protection Standard below)

~~When an animal or plant species listed as rare, threatened, endangered, or of special concern by the Massachusetts Natural Heritage Program is known to inhabit or occur in an Area Subject to Jurisdiction under the By-Law, no activity will be permitted that will destroy or displace said species or will alter either permanently or temporarily, said species' habitat, niche, or food source. The Commission shall presume that any activity in an Area Subject to Jurisdiction under the By-Law where any listed species is known to inhabit or occur will adversely affect the species unless the contrary is proven by a preponderance of credible evidence presented to the Commission by the proponent.~~

- C. Activities that are subject to this By-Law are not exempt from Brookline Stormwater By-Law, Erosion and Sedimentation Control By-Law, and/or Storm drain Connection By-Law or any other applicable local state or federal permitting requirements.

### 2.2 Land under lakes, ponds, rivers or streams (Land Under Water Bodies and Waterways, LUW)

- A. Preamble: Land Under Water Bodies and Waterways (LUW) has a fundamental impact on water resources and habitat. The physical nature of LUW is highly variable, ranging from deep organic and fine sedimentary deposits to rocks and bedrock. The dynamic relationship between surface and groundwater within the "hyporheic zone", located below the stream channel, sustains communities of aquatic organisms which regulate the flux of nutrients, biomass and the productivity of organisms including fish within the stream itself. LUW plays an important role in the chemical, physical and biological processes that occur in water bodies and waterways, and alterations to LUW are presumed to alter these functions. The plant community composition and structure, hydrologic regime, topography, soil

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composition and water quality of LUW provide important food, shelter, migratory and overwintering areas, and breeding areas for wildlife.

- B. ~~Wetland Resource Area~~ Values Protected: LUW is significant to: ground water supply, flood control, storm damage prevention, water quality protection, water pollution control, prevention of pollution, protection of fisheries, wildlife habitat protection, rare species habitat protection, erosion and sedimentation control, flood control and storm damage prevention.
- C. Performance Standards: In addition to meeting the performance standards applicable to all areas subject to jurisdiction that are found at Section 2.1.B of these regulations, and to those found at 310 CMR 10.56(4), the following performance standards shall apply to any work performed in LUW:
  - 1. Work within LUW shall not:
    - (a) Impair the water carrying capacity within the defined channel, which is provided by said land in conjunction with the banks.
    - (b) Impair ground and surface water quality.
    - (c) Impair the capacity of said land to provide breeding habitat, escape cover and food for fisheries or the capacity of said land to provide wildlife habitat function.
    - (d) Cause alterations to flood elevations, or to the hydrologic regime during high or low flow conditions.
    - (e) Significantly alter the level of adjacent groundwater.
    - (f) Result in increased suspension or transport of pollutants, sediments, erosion or bank instability.

### 2.3 Banks

- A. Preamble: Banks are created by the natural rising and falling of water in the water body over the course of a typical year, with the low point, or toe of the bank, being the typical mean annual low water level and the top of the bank typically the mean annual high water level. Stable, vegetated banks are important to healthy water bodies, protecting water quality and habitat, maintaining cool temperatures, and reducing stream velocities. Bank instability and erosion can cause significant impacts to water bodies: excessive sediment and nutrient loading; scouring and undercutting of banks; widening and shallowing of stream channels; impacts to fish passage; loss of vegetative cover; and loss of instream habitat. Alterations in a watershed may result in significant changes in stream hydrology, which can destabilize banks. Protection of banks is a vital component of stream and pond protection.
- B. ~~Resource Area~~ ~~Wetland Values~~ Protected: Banks are significant to ground water supply, to flood control, to storm damage prevention, to the prevention of pollution, and to the protection of fisheries and wildlife habitat.
- C. Performance Standards: In addition to meeting the performance standards applicable to all areas subject to jurisdiction that are found at Section 2.1.B of these regulations, and to those found at 310 CMR 10.54(4), the following performance standards shall apply to any work performed in banks:
  - 1. Work in banks shall not impair in any manner the following:
    - (a) The physical stability of the Bank;
    - (b) The water-carrying capacity of the existing channel within the Bank;

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- (c) Ground and surface water quality;
  - (d) The capacity of the Bank to provide breeding habitat, escape cover, and food for fisheries; and
  - (e) The capacity of the Bank to provide wildlife habitat function.
2. Bank treatment and stabilization design should be sensitive to slope, stream hydrology, and surrounding habitat. In most cases, vegetative measures, using appropriate native species, are preferred for bank stabilization and protection. In some instances, slope or hydrology may require additional or alternative measures. Priority consideration should be given to bioengineering approaches (using natural structural materials such as vegetative mats, logs, root balls, fiber logs, etc.) in conjunction with vegetative measures. Traditional structural measures such as riprap are the least desirable bank stabilization technique.

### 2.4 Marshes, Wet Meadows, Bogs, Swamps (Vegetated Wetlands)

- A. Preamble: In wetlands, water saturation is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the surrounding environment. Wetlands provide many important functions including water quality enhancement, flood storage, thermal regulation, bank protection, and critical habitat area. Wetlands are sensitive to disturbances; natural wetland ecosystems, when disturbed, can easily be overrun by invasive species; changes in surface or groundwater hydrology can dramatically alter wetland size and type; fragmentation or isolation of wetlands can significantly reduce their function and value. Diverse wetland communities dominated by native species provide by far the most value.
- B. ~~Wetland Values~~ Resource Area Values Protected: Vegetated Wetlands, both bordering and isolated, are significant to the protection of ground water supply, flood control, storm damage prevention, the prevention of pollution, and the protection of fisheries and to wildlife habitat.
- C. Performance Standards: In addition to meeting the performance standards applicable to all areas subject to jurisdiction that are found at Section 2.1.B of these regulations, and to those found at 310 CMR 10.55(4), the following performance standards shall apply to any work performed in wetlands:
- 1. Work in wetlands shall not impair in any manner the following:
    - (a) Flood storage capacity;
    - (b) Ground and surface water quality;
    - (c) The capacity of said land to provide breeding habitat, escape cover and food for fisheries; and
    - (d) The capacity of said land to provide wildlife habitat function.
  - 2. Work in wetlands should not cause alterations to flood elevations, or to the hydrologic regime during high or low flow conditions
  - 3. Work within wetlands shall not significantly alter the level of adjacent groundwater
  - 4. Wetlands should in general be planted with appropriate native species
  - 5. When work is proposed in wetlands to support or provide for public access, such as the construction of boardwalks, care should be taken to minimize physical, visual and auditory impacts to surrounding wetlands, to minimize disruption of

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habitats, to avoid impacts to surface and groundwater flows and to avoid sensitive areas including endangered species habitat.

- D. Notwithstanding the provisions of this bylaw, the Conservation Commission may issue an Order of Conditions permitting work which results in the loss of up to 5,000 square feet of Bordering Vegetated Wetland when said area is replaced in accordance with 310 CMR 10.55(4)(b). In such a case, the provisions of this By-Law shall apply to the area of wetland replacement.

### 2.5 Land Subject to Flooding (Bordering and Isolated)

- A. Preamble: Lands Subject to Flooding are significant to flood control, storm damage prevention, public and private water supply, groundwater supply, water quality protection, water pollution control, prevention of pollution, wildlife habitat, and erosion and sedimentation control. Land Subject to Flooding provides a temporary storage area for flood water and/or high groundwater. During periods of peak run-off, flood waters are both retained (*i.e.*, slowly released through evaporation and percolation) and detained (*i.e.*, slowly released through surface discharge) by Land Subject to Flooding. Over time, incremental filling of these areas causes increases in the extent and level of flooding by eliminating flood storage volume or by restricting flows, thereby causing increases in damage to public and private properties. Certain portions of Land Subject to Flooding are also likely to be significant to the protection of wildlife habitat.
- B. Resource Area Wetland-Values Protected: Lands Subject to Flooding are significant to the protection of ground water supply, flood control, storm damage prevention, the prevention of pollution, and the protection of fisheries and to wildlife habitat.
- C. Performance Standards: In addition to meeting the performance standards applicable to all areas subject to jurisdiction that are found at Section 2.1.B of these regulations, and to those found at 310 CMR 10.57(4), the following performance standards shall apply to any work performed in Land Subject to Flooding:
1. Work within Land Subject to Flooding shall not impair in any manner the following:
    - (a) The water carrying capacity of the adjacent waterway, water body or wetland;
    - (b) Ground and surface water quality;
    - (c) The capacity of said land to provide breeding habitat, escape cover and food for fisheries; and
    - (d) The capacity of said land to provide wildlife habitat function.
  2. Work within Land Subject to Flooding shall not cause alterations to flood elevations, or to the hydrologic regime during high or low flow conditions.

3. The applicant shall take into consideration the impacts of climate change on the activities proposed on land subject to flooding, especially in terms of the compensatory flood storage as a climate change resilience strategy. Any such activity shall provide compensatory flood storage for all flood storage volume that will be lost at each elevation. Compensatory flood storage shall be at a 2:1 ratio, minimum, for each unit volume of flood storage lost at each elevation. Compensatory flood storage shall mean a volume not previously used for flood storage, shall have an unrestricted hydraulic connection to the same waterway or

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water body, and, with respect to waterways, shall be provided within the same reach of the river, stream, or creek.

Optional addition: No new parking areas or garages shall be used as compensatory flood storage. The Commission has found that use of such areas or garages results in a significant or cumulative effect upon the Resource Area Values protected by the by-law, and has found that these facilities can result in the uncontrolled acute or chronic release of these harmful materials into the Resource Areas protected by the by-law. The Commission has also found that using these structures for flood storage can result in the damage of vehicles and property under flooding conditions.

### 2.6 Riverfront Areas

- A. Preamble: The riverfront area can prevent degradation of water quality by filtering sediments, toxic substances (such as heavy metals), and nutrients (such as phosphorus and nitrogen) from stormwater, nonpoint pollution sources, and the river itself. Sediments are trapped by vegetation before reaching the river. Nutrients and toxic substances may be detained in plant root systems or broken down by soil bacteria. Natural vegetation within the riverfront area also maintains water quality for fish and wildlife. Riverfront areas are important wildlife habitat, providing food, shelter, breeding, migratory, and overwintering areas. Some predominantly upland species use, and may be seasonally dependent, on riverfront areas.
- B. Resource Area Wetland Values Protected. A Riverfront Area is significant to the protection of groundwater; flood control; the prevention of storm damage; the prevention of pollution; the protection of wildlife habitat; and the protection of fisheries.
- C. Performance Standards: In addition to meeting the performance standards applicable to all areas subject to jurisdiction that are found at Section 2.1.B of these regulations, and to those found at 310 CMR 10.58(4), the following performance standards shall apply to any work performed in wetlands:
1. Work in riverfront areas shall not impair in any manner the following:
    - (a) Flood storage capacity;
    - (b) Ground and surface water quality;
    - (c) The ability of the riverfront area to control erosion, filter pollutants, recharge stormwater, and reduce overland flows;
    - (d) The capacity of said land to provide breeding habitat, escape cover and food for wildlife; and
    - (e) The capacity of said land to provide wildlife habitat function.
  2. Work in riverfront areas should be sensitive to existing conditions, including hydrology, plant species, habitat uses, temperatures and soils. Removal of mature trees in the riverfront area should be minimized. In some cases, the Conservation Commission may require the preservation of a strip up to 50 feet wide of continuous, undisturbed vegetative cover.
  3. When work is proposed in riverfront areas to support or provide for public access, such as the construction of footpaths, care should be taken to minimize disruption of habitats, to avoid impacts to surface and groundwater flows and to avoid sensitive areas including endangered species habitat.



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### 2.7 Vernal Pools

- A. Preamble: Vernal Pools are essential breeding habitat, and provide other important wildlife habitat functions during non-breeding season as well, for a variety of amphibian species such as wood frog (*Rana sylvatica*) and the spotted salamander (*Ambystoma maculatum*), and are important habitat for other wildlife species. Protection of habitat for vernal pool obligate species, such as wood frogs and spotted salamanders, is particularly important in Brookline because these populations are small and their habitat is more limited, more fragmented and more isolated than is commonly the case in Massachusetts. Vernal pools are extremely sensitive to disruption of soils, vegetation, ground and surface water flows, and to alterations in water quality, chemistry, and temperature. Vernal pools are protected by the Brookline Wetlands By-Law whether or not they have been certified.
- B. Resource Area Wetland Values Protected: Vernal pools are significant to flood control; the prevention of storm damage; and the protection of wildlife habitat.
- C. Performance Standards: The Commission shall regulate this Resource Area in accordance with the provisions of the regulations of the Department of Environmental Protection at 310 CMR 10.04, 10.53(6), 10.57(1)(a)3, 10.57(1)(b)4, 10.57(2)(a)5 and 6, 10.57(2)(b)4 and 5, 10.58, 10.59, and 10.60. In addition to meeting the performance standards applicable to all areas subject to jurisdiction that are found at Section 2.1.B of these regulations, the following performance standards shall apply to any work performed in vernal pools:
1. Work shall not impair vernal pool habitat. Any alteration of vernal pools requires a detailed wildlife habitat evaluation. A finding that alterations to vernal pools will not impair habitat will only occur under rare and unusual circumstances. Avoidance of impacts to vernal pools is almost always necessary to meet performance standards.
  2. Work in vernal pools shall not disrupt wildlife passage.
  3. Work in vernal pools shall not alter ground or surface water flows or temperatures.

### 2.8 Buffer Zones

- A. Preamble: Buffer zones protect Resource Areas by filtering and removing pollutants from runoff, providing groundwater recharge, moderating water temperatures, stabilizing soils, and maintaining surface and groundwater flow volumes. They also provide essential habitat for wetland-associated species for use in feeding, roosting, breeding and rearing of young, and cover for safety, mobility and thermal protection. The intent of the Commission is to avoid, minimize and mitigate alterations in the buffer zone, and to keep all land alterations, structures and activities as far away as possible from any Resource Area, in order to protect Resource Area Values and wetland values and Resource Areas. Unavoidable alterations to the buffer zone must be mitigated to maintain the functions of the buffer zone and protect Resource Area Values and wetland values.
- B. Resource Area Wetland Values Protected: A Buffer Zone is significant to the protection of groundwater; to flood control; to the prevention of storm damage; to the prevention of pollution; to the protection wildlife habitat; and to protect fisheries.

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- C. Performance Standards: In addition to meeting the performance standards applicable to all areas subject to jurisdiction that are found at Section 2.1.B of these regulations, and to those found at 310 CMR 10.53(1), the following performance standards shall apply to any work performed in the ~~buffer zone~~Buffer Zone:
1. ~~To the maximum extent possible, B~~buffer zones shall be retained and maintained in a naturally vegetated condition. Where ~~buffer zone~~Buffer Zone disturbance is permitted during construction or other activities, revegetation with native vegetation may be required.
  3. Activities in ~~buffer zone~~Buffer Zones shall not substantially alter the hydrology of the site, including runoff rate, volume, water quality or flow paths. Activities in ~~buffer zone~~Buffer Zones shall not negatively impact critical wildlife habitat.
  4. Except as otherwise specified, the use of herbicides, pesticides, fungicides, fertilizers and other chemical treatments is prohibited.
- D. The Commission shall presume that alterations to the ~~buffer zone~~Buffer Zone shall alter the adjacent ~~wetland r~~Resource aAreas. This presumption may be rebutted by credible evidence that either:
1. The Buffer Zone does not play a role in the protection of any of the ~~Resource Area Values wetland values~~Resource Area Values applicable to the associated ~~wetland R~~Resource aArea; or
  2. The activity shall occur in such a manner so that potential adverse environmental impacts on the ~~Resource Area Values wetland values~~Resource Area Values applicable to the associated ~~wetland r~~Resource aArea are avoided, minimized, or mitigated.

### 2.9 Stormwater Management

- A. Preamble: Stormwater management is a valuable Resource Area Value because it supports numerous other Resource Area Values. Stormwater management in Resource Areas should prioritize natural solutions for retention and detention and utilize green infrastructure and pervious surfaces as a secondary solution. Stormwater management considerations should consider future climate change projections and impacts.
- B. Resource Area Values Protected: Stormwater management is a Resource Area Value that also supports the protection of ground water supply, flood control, storm damage prevention, and the prevention of pollution.
- C. Performance Standards
1. Applicants, at a minimum, shall demonstrate how the best management practices for stormwater management as set forth in the Stormwater Standards of the Massachusetts Department of Environmental Protection have been incorporated into the stormwater system design. The Commission may in its sole discretion require the applicant provide a runoff plan and calculations using the either the Cornell University Northeast Regional Climate Center (NRCC) and Natural Resource Conservation



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Services (NRCS) precipitation frequency data or the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 Volume 10 (or as updated) and based on the **ten-year, fifty-year and one-hundred-year-flood** frequency event period. Calculations shall show existing and proposed runoff conditions for comparative purposes

The Commission may require that the calculations also be based on projected design storms under climate change and a narrative on the proposed project's impact on climate change resilience of the Resource Area.

**Option:** This could be changed to specify a design storm or amended to use more broad language.

2. Applicants are required to adhere to the requirements set forth in Article 8.26 Stormwater Management By-Law even when the alterations do not meet the land disturbance threshold or other jurisdictional thresholds set forth in Article 8.26. Therefore, all alterations shall require an Erosion and Sediment Control Plan and a Stormwater Management Plan.
3. Applicants shall calculate stormwater runoff; describe how all stormwater will be managed onsite; and how the stormwater system will maximum treatment before discharge. This will also include information on how pollution will be mitigated or prevented (including nutrients from fertilizers, roadway runoff, etc.) from entering the Resource Area. The description should account for increases due to increased frequency and intensity of rainfall and extreme weather events.
4. Applicants shall describe if there would be any alteration to flood storage capacity on the site (include calculations and watershed maps).

### 2.10 Climate Change Adaptation and Resilience

- A. Preamble: Overall, annual precipitation is projected to increase in the future as a result of climate change. Rain events are projected to occur with greater intensity and duration. Storms will also occur with greater force and intensity. Flood control and storm damage protection offered by wetlands will be an even greater asset to our community and must be preserved into the future. Climate change is also expected to negatively impact wildlife and wildlife habitat. Resource Areas can provide habitat and additional benefits to the microclimate. For example, Resource Areas can provide urban cooling when shade trees are protected.
- B. Resource Area Value Protected: Resource Areas are critical to building a community's resilience/adaptation to the impacts of climate change due to their ability to provide for flood control, storm damage prevention, and other Resource Area Values. The impacts of climate change can adversely affect each Resource Area's ability to provide and promote the Resource Area Values protected by the by-law. Resource Areas and Resource Area Values are better protected by requiring applicants to adhere to performance standards that consider the potential impacts of climate change.
- C. Performance Standards:
  1. The Applicant shall consider the project's adaptation to potential climate change impacts by addressing the following:

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2. Describe project design considerations to limit storm and flood damage during extended periods of disruption and flooding as might be expected in extreme weather events under climate change.
3. Describe measures to protect proposed structures and minimize damage to structures due to the impacts of climate change.

### 2.11 Vegetation Removal and Replacement and Wildlife Protection

- A. Preamble: Vegetation controls flood and storm damage and provides shade, thereby mitigating potential impacts of climate change. Vegetation also provides numerous other Resource Area Values protected by the by-law, including biodiversity, wildlife habitat, sediment control, bank stabilization, pollutant uptake, aesthetics, and atmospheric purification. An adequate quantity and diversity of vegetation must be maintained so that Resource Areas protected by the By-law can provide the Resource Area Values protected by the By-law.
- B. Resource Area Value Protected: Vegetation in a Resource Area Value protected by the By-law is significant for wildlife, wildlife habitat, water quality, erosion control, storm damage prevention, pollution abatement, and recreational benefits.
- C. Performance Standards
  1. When an animal or plant species listed as rare, threatened, endangered, or of special concern by the Massachusetts Natural Heritage Program is known to inhabit or occur in an Area Subject to Jurisdiction under the By-Law, no activity will be permitted that will destroy or displace said species or will alter either permanently or temporarily, said species' habitat, niche, or food source. The Commission shall presume that any activity in an Area Subject to Jurisdiction under the By-Law where any listed species is known to inhabit or occur will adversely affect the species unless the contrary is proven by a preponderance of credible evidence presented to the Commission by the proponent.
  2. Describe project vegetation / planting plans and other measures to improve the resiliency of the wildlife habitat of the Resource Area to withstand potential temperature and rainfall changes (drought and excess) due to climate change.
  3. No vegetation in a Resource Area protected by the By-law shall be damaged, extensively pruned, or removed without written approval by the Commission and in-kind replacement. Extensive pruning is defined as removal of 20% or more of limbs or growth. For extensive pruning or removal of vegetation because of an Imminent Risk to Public Health and Safety, in-kind replacement shall be to the extent practicable as determined by the Commission.
  4. "In-kind replacement" shall refer to a combination of species type and surface area as defined by the area delineated by the drip line of the affected plant(s). "In-kind" means the same type and quantity of plant species that was removed, extensively pruned, or damaged, unless compelling evidence is presented in writing that explains why the Resource Area Values under the By-law are promoted through an alternative proposal, and planted within the same Resource Area or another Resource Area located in close proximity on the project site. Large shade tree

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plantings in Resources Areas also designated as hot spots in the 2017 Climate Vulnerability Assessment and Action Plan (or as updated) may be approved as in-kind replacements regardless of plant species removed. Notwithstanding the foregoing, only non-invasive plant species shall be planted as replacements.

5. The Commission shall consider species selection, location, and timing of the plantings when approving proposals for the removal of vegetation. Proposals for the removal of vegetation must include the reason and shall consider the following:
  - a. Health of Vegetation: Vegetation in a state of irreversible decay, or undesirable vegetation present as a result of unintentional lack of maintenance may be offered as a reason(s) for removal.
  - b. Bank or Slope Stabilization: A bank or slope stabilization plan requires the restructuring of soils occupied by vegetation.
  - c. Invasive Species: The vegetation being removed is an aggressive, invasive, or non-native species as confirmed by a wetlands scientist or as listed on a wetlands plant list acceptable to the Commission, such as, but not limited to that published by the United States Fish and Wildlife Service.
  - d. Ecological Restoration: The vegetation is being removed as part of a project whose primary purpose is to restore or otherwise improve the natural capacity of a Resource Area to protect and sustain the interests of the By-law; also called Resource Area Enhancement.
  - e. Vegetation Replacement: The vegetation is being removed and replaced elsewhere on the project site or within the same Resource Area, only if the Commission determines that such removal and replacement does not decrease the Resource Area's contribution to the Resource Area values protected by the By-law.
  - f. Imminent Risk to Public Health and Safety: The vegetation is an imminent risk to public health or safety or property as confirmed in writing and submitted to the Commission by the Brookline Tree Warden, Fire Department Representative, Public Safety Officer, or a certified arborist.
6. Application for Removal: For all projects, the application for vegetation removal shall be submitted as part of the application for permit or Notice of Intent as described by the By-law and these regulations. At a minimum, the application will include:
  - a. Narrative: The narrative shall describe the existing conditions, the proposed planting plan, the list of existing and proposed species, the size of existing and proposed species, and number of plants before and after the revegetation event. The narrative shall also provide the rationale for the removal, by addressing the criteria 2.11(C)(6)(a) through 2.11(C)(6)-f and discuss the proposed maintenance plan.
  - b. Affirmation of the Revegetation Activities: All plans for revegetation must be accompanied by written testimony and scaled diagram from a certified arborist or wetland scientist or landscape architect. At a

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minimum, this document must include the following information: (a) The need for vegetation removal; (b) The aerial extent of the vegetation proposed for removal based on the square footage of the dripline; (c) The inventory of the amount and species of plants that will be removed.

- c. Planting Plan: The proposed planting plan must be drawn to scale and identify properly the Resource Area and Buffer Zone and the project site. It must include the locations of each replacement species and the number of each species proposed for planting (in table form).

The planting plan shall include the location of the erosion control devices used during the restoration event. A brief narrative must accompany this planting plan describing the storage location of all motorized equipment.

The planting plan shall show the estimated tree canopies after 15 years of growth, the specific names, sizes and locations of trees to be planted, and the total area of square feet of the area shaded by tree canopies. In determining the shaded area, measure the shaded area assuming that the shaded area is only that area directly under the drip line.

- d. Existing Species List: Each species existing before the restoration shall be listed in terms of area of coverage (ft<sup>2</sup>) and number of individual plants and either height or dbh as specified in the tables below.

- e. Replacement Species List: The replacement of vegetation shall be according to the following table unless the Applicant proves that the amount of replacement vegetation will not survive or contribute in the long-term to Resource Area Values. A rationale for the species and size choice must be provided if the replacement is not "in-kind."

<u>Existing Trunk (dbh)</u>	<u>Replacement Quantity</u>
<u>3 to 8 inches</u>	<u>1</u>
<u>8 to 20 inches</u>	<u>2</u>
<u>20 inches</u>	<u>3</u>

- i. Native species are the preferred; invasive species are not allowed.
- ii. Replacement size shall be most common available substantial size, as approved by the Commission.
- iii. Vegetation replacement is not considered successful until the replacement plants have survived three full growing seasons.
- iv. For extensive pruning or removal of vegetation because of an Imminent Risk to Public Health and Safety, in-kind replacement shall be to the extent practicable as determined by the Commission.

For all trees:

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- a. If a plant is well-grown with a single stem, well-shaped and bushy, and has sufficient well-spaced side branches to give it weight and good bud qualities, it is an acceptable plant.
- b. On multi-stem trees, height shall be defined as the measurement taken from the ground level to the average uppermost point of growth of the plant.
- c. All replacement plants shall have ball sizes which are of a diameter and depth to encompass enough of the fibrous and feeding root system as necessary for the full recovery of the plant once planted.
- d. Sapling trees shall include deciduous trees with a dbh of 1 inch and less; evergreens of 2 feet or less and shall be replaced at the discretion of the Commission so as to reach an equivalent area of coverage and soil retention.

For Shrubs: The replacement of shrubs (bushes) shall be with bushes and shrubs of equivalent size. For bushes, the replacement must be well-grown with a single stem, well-shaped and bushy, and have sufficient well-spaced side branches to give it weight and good bud quality.

- ii. Rationale for Removal - Describe why the interests of wetlands protection are advanced by the revegetation plan.
  - iii. Maintenance Plan - Vegetation replacement is not considered successful until the replacement plants have survived three full growing seasons. The maintenance plan shall describe how the restoration will be evaluated annually for three years and reported to the Commission. The Commission reserves the right to require a revised replanting plan, or additional plantings on an annual basis in the event that the revegetation plants decay or die.
- g. The Commission may require one or more of the following measures to protect vegetation during work:
- i. Tree protection fencing – Prior to commencing work, four (4) foot-high snow fencing shall be installed and secured with wooden stakes (2" x 4" or 2" x 3") or 6-foot steel channel posts so as to create an enclosure at the dripline of tree(s) or other distance as the site conditions allow to be protected. Such fencing shall be securely erected, be vertically plumb and be maintained for the duration of the project and shall protect individual trees or groups of trees.

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- ii. Tree protection blanket – “BarkSavers” or similar armored blankets shall be installed and maintained according to product specifications.
- iii. No existing trees shall be used for crane stay, guys or other fastening.
- iv. Vehicles shall not be parked below the canopy of any existing tree or where damage may result to existing trees or tree roots.
- v. Construction materials shall not be stored beneath existing trees.
- vi. Following completion of work, shall a certified arborist monitor the health of trees on site for possible damage and take measures to repair damage.
- vii. Prior to work, a tree protection plan shall be prepared showing summary of all trees on site (including dbh, species, extent of canopy, roots and health) and specifying whether each tree shall be saved or lost.
- h. The Commission may require the placement of permanent bounds (e.g., granite or metal) to demarcate all or part of a Resource Area or vegetation mitigation area.
- a.i. The requirements of this section shall be met commensurate with the nature, scope, type, and cost of the proposed project or activity.

### 3 Procedures

#### 3.1 Filing Procedures

- A. Receipt and Acceptance of Applications: A Request for Determination of Applicability or Application for a Permit or Resource Delineation under the By-Law; or a Notice of Intent under the Wetlands Protection Act, may be filed with the Commission, and shall be submitted on the forms prescribed by the Commission and available at the Commission's office.
- B. Application Must Be Complete
  - 1. Inspection. The recipient of the filing shall inspect the submission for completeness in accordance with the requirements of these regulations and the Act and the regulations of the Department of Environmental Protection.
  - 2. Incomplete Submission. Where the request or notice is not complete, the request or notice shall not be accepted and the application shall be returned within seven (7) business days of receipt with a written reason for the non-acceptance.
  - 3. For contents, see Section 3.1 E (2) of these regulations.
- C. File Number Issuance
  - 1. Application for By-Law Wetlands Permit. Upon receipt of complete application materials, the Commission shall issue a file number. The designation of a file number shall not imply that the plans and supporting documents have been judged adequate for the issuance of a By-Law Permit, but only that copies of the minimal submittal requirements have been filed and the application is complete.



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2. Notice of Intent. The Department of Environmental Protection issues a file number upon receipt of a complete Notice of Intent. The Commission shall not close a public hearing until such file number is received, and by filing such the applicant submits to any such continuances as may be necessary to receive a file number from the Department of Environmental Protection.
- D. Requests and Applications under By-Law and Act
1. Discretionary Requests
    - (a) Determination of Applicability. An applicant may request the Commission to determine whether the Act or By-Law applies to the land or to the proposed work. The procedures for these requests may be found at 310 CMR 10.05 and the filing fees for such requests are found at 310 CMR 10.03(7) and at Section 3.2.B of these regulations.
  2. Mandatory Requests
    - (a) Application of Exemptions under Act. Any person who proposes to perform work, maintenance, or other activities within a wetland Resource Area on land in agriculture or aquaculture use, as those are defined in 310 CMR 10.04, shall submit a Request for Determination to the Commission as to whether such activity meets the conditions that would qualify such work or activity to be exempt under the Act.
    - (b) Activity within Wetland Resource Area under the Act or Area Subject to Jurisdiction under the By-Law. Any person who proposes to perform work within an Area Subject to Jurisdiction under the By-Law shall submit an application to the Commission that shall conform to the requirements of the Act and the By-Law and these regulations.
    - (c) Wetland Resource Area Delineation. A person who wishes confirmation that an Area Subject to Jurisdiction under the By-Law has been identified and delineated according to the By-Law definitions shall request the Commission to confirm or modify the delineation submitted. The Order of Resource Area Delineation shall be effective for three years.
    - (d) By-Law Wetlands Permit and Order of Conditions under the Act. A person who proposes to alter any Area Subject to Jurisdiction under the By-Law must submit an application for an Order of Conditions under the Act and an application for a By-Law Wetlands Permit under the By-Law before beginning work. A Notice of Intent Form and Application for By-Law Permit Form may be obtained from the Commission. The Commission may use the State Notice of Intent form for the By-Law Permit application. The commission may consider these applications at the same time.
    - (e) Emergency Certification. Any single member of the Commission, its agent, or employee may certify that the project is an emergency. The criteria and procedures of 310 CMR 10.06 shall apply to such certification.
- E. Filing Procedures for Determinations of Applicability, Wetland Resource Area Delineation, and Permits under the By-Law
1. By Hand or Certified Mail. The applicant shall submit, by hand or by certified mail, the Request for a Determination or Application for a Resource Area Delineation or By-Law Permit to the Commission.
  2. Contents of Application. The applicant shall submit, at a minimum, the following documents to the Commission:
    - (a) A completed form, which form is available at the Commission's office.



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(b) A project narrative ~~and description of~~ proposed activities and satisfaction of performance standards.

(c) A plan showing the topography, delineation of Areas Subject to Jurisdiction under the By-Law and Act, property lines, and nearby streets in accordance with the requirements of the Commission as specified on the application form.

(d) A certified list of abutters to abutters within 100 feet of the property line of the applicant, as provided at Section 8.27.6(a) of the By-Law. Certified abutters lists are available from the Brookline Assessors Office.

(1) Where there is an extensive project, such as a pipe line installation, the applicant shall only be required to notify abutters within 1000 feet from an Area Subject to Jurisdiction under the By-Law. The applicant should verify with the administrator of the Commission exactly which abutters should be notified in such a case.

(2) The applicant may request permission from the Commission to allow notification to a home owners association or condominium association and posting in a common area in the case of multiple connected or clustered residences or condominium developments.

(e) The names and addresses of the applicant(s), the applicant's representative(s), and the owner(s) of the property.

F. Public Hearing Process. The Commission shall hold a public hearing within twenty-one (21) days of the submittal of a complete Request or Application.

### 1. Opening Hearing

(a) Postponement of Opening the Hearing. The Commission may open the public hearing beyond the twenty-one (21) days with the written consent of the applicant.

(b) Notice:

(1) Duties of Commission. The Commission shall give notice of the time and place of the public hearing at the expense of the applicant not less than five business days before such hearing, by publication in a newspaper of general circulation in Brookline, see Section 8.27.6 of the Brookline Wetlands Protection By-Law, and by mailing a notice to the applicant and applicant's representative and the owner, if different from the applicant.

(2) Duties of Applicant. The applicant shall give notice to abutters by certified mail, return receipt requested, or by hand delivery, that an application has been filed, that a public hearing will be scheduled within twenty-one (21) days, and that information concerning the application and the date of the hearing is available at the office of the Commission. The applicant shall provide proof of such notice (i.e., return receipt cards for certified mail) to the Commission Office no less than 3 business days prior to the hearing. The applicant shall also provide written notice to the Town Engineer and to the Building Commissioner, and shall provide proof of such notice to the Commission no less than 3 business days prior to the hearing. See Section 8.27.6 of the By-Law for additional information regarding notification to abutters, and Section 8.27.7 regarding coordination with other boards and commissions.

### 2. Hearing Process

(a) Procedure. The Commission determines the order of the presentations and public participation at the public hearing. Said hearing shall be orderly and the

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Commission may stop such hearing for cause. The Chair may delegate the responsibility for conducting any hearing to any other Commissioner.

- (b) Continued Hearings. Where the public hearing is continued, the date, time, and place of said continued hearing shall be publicized in accordance in a manner consistent with the Massachusetts Wetlands Protection Act. Notice shall be sent to any person at the hearing who so requests in writing. Public hearings may be continued as provided in 310 CMR 10.05(5)(b).

### G. Closing the Public Hearing; Issuing the Decision.

1. Determination of Applicability under the By-Law and Act
  - (a) The Commission shall issue its Determination within twenty-one (21) days of the closing of the hearing, or by a later date agreed upon in writing by the applicant.
2. Determination
  - (a) Determination where Land is within Wetland Resource Area: The Commission shall find that the By-Law and these regulations apply to the land, or a portion thereof, if it is an Area Subject to Jurisdiction under the By-Law.
  - (b) Determination where Activity may Alter an Area Subject to Jurisdiction under the By-Law: The Commission shall find that the Wetlands By-Law applies to the work, or a portion thereof, if it is an activity subject to these regulations. An application for By-Law Permit shall be filed if the Commission makes such a positive determination, and all the procedures applicable to the application for By-Law Permit filing shall apply.
  - (c) Determination as to whether Activity is Exempt or excepted under the Act: The Commission shall, if applicable, determine that the proposed activity is exempt under the provisions of 310 CMR, or the limited project exception for public utilities and highway right-of-ways as specified in the Act and 310 CMR 10.53(3).
3. Wetlands By-Law Order of Resource Area Delineation: The Commission follows the procedures outlined in the Massachusetts Wetlands protection Act regulations 310 CMR 10.05 as amended.
4. By-Law Wetlands Permit
  - (a) Closing the Hearing: The Commission shall close the public hearing upon receiving sufficient information or testimony if requested to do so by the applicant.
  - (b) Decision
    - (1) Significance of Area Subject to Jurisdiction: In accordance with Section 1.3 of these regulations and the regulations of the Department of Environmental Protection at 310 CMR 10.03(5), where the applicant proposes to alter any Area Subject to Jurisdiction under the By-Law or wetland Resource Area protected under the Act, the Commission shall presume such are significant to protect Resource Area Values ~~wetland values~~ (interests) identified by the By-Law or the Act. Within twenty-one (21) days of the close of the public hearing, the Commission shall either:
      - a. Issue a decision that the area on which the activity is proposed to be done, or on which the proposed activity will remove, fill, dredge, or alter, is not significant to any of the values identified in the By-Law.

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- b. Issue a decision that the area on which the activity is proposed to be done, or on which the proposed activity will remove, fill, dredge, or alter, is significant to any of the values identified in the By-Law.
  - (c) Conditions and Work Prohibition
    - (1) The Commission shall impose conditions upon the work or the portion thereof that will, in the judgment of the Commission, result in the alteration of an Area Subject to Jurisdiction under the By-Law. Such conditions may include the preservation of a strip up to 50 feet wide of continuous, undisturbed vegetative cover.
    - (2) The Commission shall impose conditions setting limits on the quantity and quality of discharge from a point source (both open and closed channel) when said limits are necessary in the opinion of the Commission to protect the values identified in the By-Law.
    - (3) The Commission shall prohibit any activity or any portion thereof that cannot be conditioned to meet the applicable performance standards.
  - (d) Insufficient Information Resulting in By-Law Wetlands Permit Denial: If the Commission has requested necessary information and such has not been provided, the Commission may find that the information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the values identified in the By-Law, and the Commission may issue a By-Law Permit Denial on such grounds. The Commission shall specify the information that is lacking and why it is necessary.
  - (e) Recording: The Wetlands Permit shall be recorded in the Norfolk County Registry of Deeds or in the Land Court, whichever is appropriate, within 30 days of the date of issuance. Certification of such recording shall be sent to the Commission.
5. Amendment of By-Law Wetlands Permit: The Commission must assess necessary modifications to projects that may occur during construction in accordance with the following.
- (a) Preliminary Review by Commission: Because each modification is unique, it is impossible to determine in advance how the Commission will address any particular change. Therefore, the applicant must first contact the Commission, or its staff, and explain the modification. The Commission, or its staff, shall determine the appropriate category for the modification.
  - (b) Categories of Change
    - (1) Minor: Minor changes to a project are modifications that the Commission determines will have no likelihood of an impact or less impact on any Resource Area Values wetland value protected under the By-Law for that Area Subject to Jurisdiction under the By-Law. Minor changes are within the scope of deviations allowed for the receipt of a Certificate of Compliance.
      - a. The Commission shall consider the following criteria in making this determination: the extent of modification, the proximity to Area Subject to Jurisdiction under the By-Law, and the type of equipment required for the modification.
      - b. Minor changes need only the authorization from the Commission as documented in a letter signed by a majority of the Commission or authorized agent. The Commission will retain this Letter of Understanding in the file, and mail a copy to the applicant.
    - (2) Moderate: Moderate changes to a project are modifications that the Commission determines will have some likelihood of an impact on any Resource Area Values wetland value protected under the By-Law for that Area Subject to Jurisdiction under the By-Law.

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- a. The following may require an Amended By-Law Permit: a decrease in the distance from the Area Subject to Jurisdiction under the By-Law, a change that results in an increase in potential for erosion or sedimentation, an alteration of a land form, a change in size and location of structures and/or appurtenances, an increase in amount of vegetation removed, and activity beyond the limit-of-work.
  - b. Moderate changes require an Amended By-Law Permit, which requires a public hearing and issuance of an Amended By-Law Permit in accordance with the procedures for a request for a By-Law Permit pursuant to a By-Law Permit filing. If the Commission denies the request to amend the By-Law Permit, the applicant must follow the provisions of the By-Law Permit or file another application for a By-Law Permit.
  - (3) Significant: Changes that are not related to the originally permitted activity may require a new application for a By-Law Permit and a new public hearing rather than an amended By-Law Permit. The Commission considers any modification that will adversely increase the impact of the project on any ~~wetland value~~ Resource Area Values protected by the By-Law as requiring a new filing.
- H. Extension of By-Law Wetlands Permit: The Commission, in accordance with the provisions of Section 8.27.8(f) of the By-Law, may extend a By-Law Permit.
- I. Certificate of Compliance: A Wetlands By-Law Certificate of Compliance may be combined with a Certificate of Compliance as provided in the Act and 310 CMR 10.05(9).
1. Written Request; Content. The applicant or owner of the property shall request, in writing, the Commission to issue a Certificate of Compliance. The contents of the request shall be specified by the Commission in a guidance document that is obtainable from the Commission, and the applicant or owner shall use the request form provided by the Commission and available at the Commission's office.
  2. Review Process
    - (a) Time Limitation. Upon written request by the applicant or owner of the property, the Commission shall issue a Certificate of Compliance or refuse to issue a Certificate of Compliance within twenty-one (21) days of receipt of a completed request.
    - (b) Site Inspection. Before the Commission may act upon a Certificate of Compliance, a member or employee of the Commission, in the presence of the applicant or the applicant's agent, shall inspect the site and report the findings to the Commission.
  3. Decision. The Commission shall make its decision at a public meeting. The Commission shall not issue a Certificate of Compliance for part of the work, but may issue a status letter.
    - (a) Denial: If the Commission determines, after review and inspection, that the work has not been done in substantial compliance with the By-Law Permit, it shall refuse to issue a Certificate of Compliance.
      - (1) The Commission shall issue such refusal within twenty-one (21) days of receipt of a request for a Certificate of Compliance.
      - (2) Such refusal shall be in writing and shall specify the reasons for the denial and ordering the corrective actions that must be taken.

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- (b) Continuing Conditions: If the By-Law Permit contains conditions that continue past the completion of the work, the Commission shall specify which conditions shall continue in the Certificate of Compliance and repeat the continuing conditions in full on the Certificate. Examples of such conditions are maintenance and monitoring.
- 4. Recording: The Certificate of Compliance shall be recorded in the Norfolk County Registry of Deeds or in the Land Court, whichever is appropriate, within 30 days of the date of issuance. Certification of such recording shall be sent to the Commission.

### **3.2 Filing Requirements**

- A. Forms: The forms, together with any procedural requirements for the submission of Applications for By-Law Permit or Resource Area Delineation or Requests for Determinations, which the Commission may from time to time promulgate in writing, are incorporated by reference, and are expressly made a part of these regulations. These forms and policy statements are on file in the office of the Commission and may be obtained during normal business hours.
- B. Consultants
  - 1. Consultant Fees
    - (a) The Commission shall only require a consultant fee to pay for a consultant to advise it with respect to the By-Law.
    - (b) The Commission shall strive to limit the amount and scope of the consultant's work.
    - (c) The Commission shall determine whether a consultant fee is necessary on a case by-case basis.
  - 2. In cases where the Commission determines that a consultant is necessary, the consultant shall provide a written report to the Commission and at the same time to the applicant or the representative of the applicant. The Commission shall grant a request by the applicant to continue the hearing for purposes of reviewing and responding to the consultant's written report.
  - 3. Decision to Use Consultant. The Commission shall make its decision to use a consultant as soon as possible after the opening of the public hearing. In reaching a decision to retain an independent consultant to be paid by the applicant, the Commission shall consider the following:
    - (a) The size or scope of the project;
    - (b) The nature of the project, including but not limited to projects of particular benefit to the natural resources of Brookline;
    - (c) The need for an independent verification of information submitted with the application;
    - (d) The need for an independent review regarding compliance of the proposed project with the By-Law and these regulations; and
    - (e) The ability and willingness of the applicant to provide information deemed necessary by the Commission.
  - 4. Choosing the Consultant. The Commission shall make its decision to engage an independent consultant at a public meeting, consistent with the Massachusetts Uniform Procurement Act.

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5. Defining Scope of Work. The Commission shall establish the scope of work, which shall be consistent with the questions raised from the technical submissions under the application for a By-Law Permit relative to compliance with the By-Law and the performance standards.
6. Fee Amount. The Commission shall determine a reasonable consultant fee based on the cost of the services as estimated by the Commission at the public meeting or the cost of the services as estimated by the independent consultant.
7. Payment of Fee.
  - (a) The Commission may require that the consultant fee be paid by the applicant before services are rendered.
  - (b) The applicant shall not be responsible for payment of the consultant fee if the application for a By-Law Permit is withdrawn, provided that the Commission has not incurred costs associated with engaging the consultant.
  - (c) Failure by the applicant to pay the consultant fee associated with an application for a By-Law Permit shall render the application incomplete and may be cause for the Commission to deny all or a part of the proposed project.
8. Dispute Settlement: Problems or disputes over payment arrangements between the consultant and the applicant shall be settled at a regularly scheduled meeting of the Commission by a majority vote of a quorum of the Commission.

C. Filing Requirements for Application for a By-Law Permit and Resource Delineation. Notices of Intent under the Act, and Requests for Determinations. The required documentation that must be included in any application or request under the By-Law and Act may be obtained from the Commission. If a document is missing, the Commission will not accept the filing.

D. Site Visit: Marking Proposed Structures; Delineating Resource Area Boundaries: Before the Commission will make a site inspection, the applicant or agent must provide directions to the property and must:

1. Stake the corners of proposed houses or other structure nearest the Area Subject to Jurisdiction under the By-Law or ~~wetland~~ Resource ~~a~~Area;
2. Stake the septic tank and the leaching field location, if applicable;
3. Stake the limit of work;
4. Post the lot number or house number; and

5. Delineate all Areas Subject to Jurisdiction under the By-Law and State ~~wetland~~ Resource ~~a~~Areas, provided that the Buffer Zone is to be staked only at the boundaries that are nearest to the proposed project.

E. Limited Project Status

1. By-Law. The Commission may grant a By-Law Permit under a limited project status as specified in the regulations of the Department of Environmental Protection at 310 CMR 10.53 only where (1) the project will improve the natural capacity of the ecosystem to protect the Resource Area Values ~~wetland values~~ and (2) the applicant provides an alternatives analysis as provided in 310 CMR 10.58 (4)(c). Notwithstanding (1) and (2) above, the Commission shall not



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permit a limited project that will have any adverse effect on rare species habitat sites.

### 3.3 Security Requirements

- A. As part of a permit issued under this By-Law, in addition to any security required by any other municipal or state board, agency, or official, the Commission may require that the performance and observance of the conditions imposed thereunder (including conditions requiring mitigation work) be secured wholly or in part by one or more of the methods described below:
1. By a proper bond or deposit of money or negotiable securities or other undertaking of financial responsibility sufficient in the opinion of the Commission, to be released in whole or in part upon issuance of a Certificate of Compliance for work performed pursuant to the permit.
  2. By accepting a conservation restriction, easement, or other covenant enforceable in a court of law, executed and duly recorded by the owner of record, running with the land to the benefit of this municipality whereby the permit conditions shall be performed and observed before any lot may be conveyed other than by mortgage deed. This method shall be used only with the consent of the property owner.

### 3.4 Enforcement

- A. No person shall alter a ~~R~~resource ~~a~~Area or a ~~buffer-zone~~Buffer Zone, or cause, suffer, or allow alteration, or leave in place unauthorized fill, or otherwise fail to restore illegally altered land to its original condition, or fail to comply with a permit or an enforcement order issued pursuant to this By-Law.
- B. Upon the filing of either a Request for Determination or a Permit under this By-Law the applicant expressly permits and agrees that the Commission, its agents, officers, and employees shall have authority to enter upon privately owned land for the purpose of performing their duties under this By-Law and may make or cause to be made such examinations, surveys, or sampling as the Commission deems necessary. In the absence of the filing of a Request for Determination or a Permit, the Commission, its agents, officers and employees shall consult with Town Counsel prior to entering upon privately owned land for the purpose of determining compliance with this By-Law or for any other purpose in furtherance of the objectives of this By-Law.
- C. The Commission shall have authority to enforce this By-Law, its regulations, and permits issued thereunder by violation notices, administrative orders, and civil court actions. Any person who violates provisions of this By-Law may be ordered to restore the property to its original condition and take other action deemed necessary to remedy such violations, or may be fined, or both.
- D. In the case of civil action, the Commission, with the approval of the Board of Selectmen, may request the Town Counsel to take legal action as necessary to enforce the terms of this By-Law under civil law.
- E. Municipal boards and officers, including any police officer or other officer having police powers, shall have authority to assist the Commission in enforcement.

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- F. Any person who violates any provision of this By-Law, or regulations, permits, or administrative orders issued thereunder, shall be punished by a fine of not more than \$300. Each day or portion thereof during which a violation continues, or unauthorized fill or other alteration remains in place, shall constitute a separate offense, and each provision of the By-Law, regulations, permits, or administrative orders violated shall constitute a separate offense, not withstanding and in addition to remedies available herein or authorized by the Brookline Conservation Commission.
- G. As an alternative to criminal prosecution in a specific case, the Commission may issue citations under the non-criminal disposition procedure set forth in M.G.L. c. 40, § 21D, which has been adopted by the Town in Article 10.3 of the general By-Laws.

### **3.5 Burden of Proof**

- A. The applicant for a permit shall have the burden of proving by a preponderance of credible evidence that the work proposed in the permit application will not have unacceptable, significant, or cumulative effect upon the ~~R~~resource ~~a~~Area ~~v~~Values protected by this By-Law. Failure to provide adequate credible evidence to the Commission supporting this burden shall be sufficient cause for the Commission to deny a permit or grant a permit with conditions.

### **3.6 Appeal of Decisions**

- A. A decision of the Commission is reviewable under the By-Law in the Superior Court in accordance with M.G.L. c. 249, § 4. This in no way alters or amends an applicant's right to appeal as set forth in the Massachusetts Wetlands Protection Act M.G.L. c.131 § 40, or any other applicable state law.

### **3.7 Severability**

- A. The invalidity of any section or provision of this By-Law shall not invalidate any other section or provision thereof, nor shall it invalidate any permit or determination that has been issued previously.