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**MEMORANDUM**

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TO: Jim Hunt, Bryan Glascock, Carl Spector, Maura Zlody, Heather Campisano, John Dalzell, Katie Pedersen

FROM: Devin O'Connor, J.D. 2012*

DATE: May 25, 2012

RE: Incorporation of climate change adaptation into the City of Boston's development review process under Article 80 of the Boston Zoning Code

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## I. Question Presented

How can the Boston Redevelopment Authority ("BRA") exercise its authority to build upon the work it is already doing to incorporate climate change adaptation into the development review process under Article 80 of the Boston Zoning Code?

## II. Brief Answer

The BRA has several options for further incorporating climate change adaptation into the development review process, including in the environmental review and design review components of Article 80 of the Zoning Code. The BRA has already been asking project developers to consider climate change impacts, such as sea-level rise, when designing their buildings. This memorandum recommends that the BRA expand upon its current efforts to incorporate climate change adaptation in Article 80 environmental review by amending the BRA's Development Review Guidelines to require project proponents to submit analysis of climate change impacts and to fill out a checklist of relevant impacts and adaptive design measures adopted in response. The proposed policy documents, the Climate Change Adaptation Guidelines and Checklist, are attached to this memorandum as Appendices A and B, respectively. These policy changes would be implemented by adding the proposed documents to the Development Review Guidelines; they would not require an amendment to Article 80.

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* Ms. O'Connor was a student in the Emmett Environmental Law & Policy Clinic. All questions and comments concerning this memorandum should be addressed to the Director of the Clinic, Wendy B. Jacobs, Esq. who can be reached at 617-496-3368 or wjacobs@law.harvard.edu.

## III. Discussion

### 1. Introduction

As part of Boston's ongoing effort to address climate change, Mayor Thomas Menino issued an Executive Order in April 2007 requiring the City to prepare a climate change adaptation plan to reduce the risks of harm caused by climate change.[1] The Mayor's Order directed the City to coordinate climate adaptation with neighborhood planning and economic development.[2] The BRA, in conjunction with the Boston Environment Department ("BED"), has already begun to implement the Mayor's directive by incorporating climate change adaptation into the development review process under Boston Zoning Code Article 80.[3] The City's 2011 report, *A Climate of Progress,* recognizes the early accomplishments of the BRA's climate change adaptation efforts.[4] For example, during the Article 80 review process, the BRA has asked developers of projects at greater risk of coastal flooding as a result of sea-level rise to examine this climate change effect.[5] Due to this climate change analysis, the developer of Spaulding Rehabilitation Hospital in the Charlestown Navy Yard raised the base elevation of the proposed building by two feet.[6]

The BED has also incorporated climate change adaptation into the Article 80 review process in its scoping comments that ask project proponents to discuss adaptation to climate change in their project impact reports. In response to the BED's scoping comments on climate change adaptation in 2008, the Seaport Square Project Impact Report included a climate change adaptation analysis and corresponding design measures, making the project better suited to adjust to future climate changes.[7] There are numerous other examples of BED comments asking

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[1] Exec. Order of Mayor Thomas M. Menino, *An Order Relative to Climate Action in Boston*, para. 4 (Apr. 13, 2007) ("Executive Order").

[2] *See* Executive Order, *supra* note 1.

[3] We are very grateful for the time and effort expended by all of the people we met with at the BRA and BED, who helped us learn about the current climate change adaptation work in Article 80 development review and who provided us with valuable feedback over the course of this project. We would like to extend a special thank you to Heather Campisano, Katie Pedersen, and John Dalzell of the BRA, and Maura Zlody and Carl Spector of the BED.

[4] *See* City of Boston, *A Climate of Progress: City of Boston Climate Action Update* 11 (2011), *available at* http://www.cityofboston.gov/climate/bostonsplan/ ("A Climate of Progress").

[5] A Climate of Progress, *supra* note 4.

[6] A Climate of Progress, *supra* note 4.

[7] *See* Epsilon Associates, Inc., *Boston Environment Department Comments on the PNF and Responses to Comments*, Seaport Square Draft Project Impact Report § 9.4.4 (2009), *available at* http://seaportsquare.com/sub_page.html ("Environmental Department Comments"). The Seaport Square Project Impact Report addressed climate change adaptation by discussing the building's elevation in regards to sea-level rise and flooding, Environmental Department Comments, at § 9.4.4, BED.12, as well as building design and engineering measures to protect against sea-level rise, heat waves, and draught conditions due to climate change. Epsilon Associates, Inc., *Climate Change/Sea Level Rise*, Seaport Square Final Project Impact Report § 2.7 (2010), *available at* http://seaportsquare.com/. The BRA approved Seaport Square in September 2010 after the project passed Article 80B Large Project Review. BRA, *Seaport Square*, http://www.bostonredevelopment

project proponents to provide information on climate change adaptation in Article 80 environmental review.

In recent reports, the City has identified sea-level rise, increased intensity and frequency of heat waves, and increased intensity of storms as the most serious consequences of global climate change facing Boston's citizens and workforce.[8] The state government of Massachusetts has also released a report on adaptation, which provides scientific predictions of climate change impacts on the state as well as short-term and long-term strategies for dealing with these impacts.[9] The policy proposals provided in this memorandum and its appendices aim to incorporate the information from these reports into the Article 80 development review guidance documents.

This memorandum and the attached policy proposals are intended to aid the BRA in taking the next step to provide more explicit instructions to project proponents for analyzing climate change adaptation in Project Impact Review. The approach recommended in the proposed policy documents is to modify the BRA's existing Development Review Guidelines rather than amending Article 80.[10] This memorandum will first analyze the BRA's options for further incorporating climate change adaptation into the development review process in the environmental review and design review components of Article 80. The practical and legal limitations of incorporating climate change adaptation into environmental and design review will also be addressed. Next, the memorandum will provide a detailed explanation of the policy approach taken in the proposed Adaptation Guidelines and Checklist. Finally, it will conclude with an exploration of future policy options the BRA could pursue in order to more comprehensively address climate change adaptation.

## 2. Options for Including Climate Change Adaptation in the Article 80 Development Review Process and Constraints on These Approaches

### 1) Environmental Review

The City has broad power to protect public health and safety through zoning regulations.[11] Under Article 80B-3(2) for Large Project Review, the BRA has authority to require that project

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authority.org/DevelopmentProjects/devprojects.asp?action=ViewProject&ProjectID=1305 (last visited Mar. 19, 2012).

[8] *See* A Climate of Progress, *supra* note 4, at 8; Climate Action Leadership Comm. & the Cmty. Advisory Comm., *Sparking Boston's Climate Revolution* 38 (2010), *available at* http://www.cityofboston.gov/climate/bostonsplan/.

[9] Mass. Exec. Office of Energy and Envtl. Affairs & the Adaptation Advisory Comm., *Climate Change Adaptation Report* 13-19, 36-49, 54-68, 75-84, 90-104, 108-18 (2011), *available at* http://www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html ("MA Climate Change Adaptation Report").

[10] BRA, *Development Review Guidelines* (2006), *available at* http://www.bostonredevelopmentauthority.org/econdev/econdev.asp ("Development Review Guidelines").

[11] *See* Enabling Act, 1956 Mass. Acts c. 665, § 2. The Enabling Act provides the purposes for which a zoning law may be adopted in Boston, which include "promoting the health, safety, convenience, morals or welfare of [the City's] inhabitants." Enabling Act, 1956 Mass. Acts c. 665, § 2.

applicants consider climate change adaptation as part of the environmental protection component of development review. The text of Article 80B-3(2) provides that the BRA shall require the project applicant (1) "to conduct studies that are necessary to determine the direct or indirect damage to the environment reasonably attributable to the Proposed Project," and (2) "to propose mitigation and design measures that are intended to mitigate, limit, or minimize, to the extent economically feasible, any direct or indirect damage to the environment reasonably attributable to the Proposed Project."[12]

The language of Article 80B is broad enough to fit climate change adaptation into the environmental review framework in two ways. First, climate change could affect the projects' impacts on the surrounding environment. For example, rising groundwater levels may increase a project site's risk of flooding and make the project more susceptible to decay and degradation. This climate change impact would then increase the probability that the project will harm the environment, such as by releasing materials from the building during a flood, contaminating water supplies, deteriorating the building in a way that creates a nuisance or hazard to people or surrounding property, and generally affecting public health and safety during a flood. Second, climate change will affect the background environmental conditions such that the project's impacts on the environment may differ. For example, background groundwater levels in many areas of Boston are rising and the impact of the project, even if itself unchanged by climate, could have a potentially greater impact on groundwater conditions.

However, there are legal constraints that limit how the BRA can require project proponents to consider climate change adaptation. Article 80B environmental review does not include consideration of climate change impacts that only affect the project because the premise of environmental review is to examine the impact of the proposed project on the environment. As a result, the effects of climate change on the building itself can only be considered under this section to the extent that they also affect the surrounding environment. For instance, if the location of a proposed project places it at risk of increased future flooding due to sea-level rise, then the BRA's authority under the environmental review component would apply to the building's increased damage to the surrounding environment, but not to the direct effects of flooding on the building itself. Building characteristics are addressed in the design review section of Article 80 (discussed below in Section II.B).

Another potential legal limitation on the BRA's authority to address climate change adaptation in environmental review is that Article 80B-3(2) expressly provides a list of environmental categories that the BRA can require project applicants to consider.[13] Though this language in Article 80B-3(2) and the Development Review Guidelines could suggest that the BRA is limited to considering only those categories of impacts listed in Article 80, that is not a necessary

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[12] Boston Zoning Code art. 80B-3(2) (2007).

[13] Article 80B-3(2) of the Boston Zoning Code states that environmental studies and mitigation measures may be required for fifteen specific elements: (a) wind; (b) shadow; (c) daylight; (d) solar glare; (e) air quality; (f) water quality; (g) flood hazard districts/wetlands; (h) groundwater; (i) geotechnical impact; (j) solid and hazardous wastes; (k) noise; (l) construction impact; (m) rodent control; (n) wildlife habitat; and (o) green building. Boston Zoning Code, *supra* note 12, at art. 80B-3(2).

conclusion. First, the language of Article 80B-3(2) does not expressly prohibit the BRA from including other categories and indicates the list of categories is merely suggestive. The text of Article 80B-3(2) that introduces the list of categories states, "[e]lements for which environmental studies and mitigation measures *may be required include* the following . . . ."[14] Second, though nearly all the categories in the environmental review component of BRA's Development Review Guidelines are listed in Article 80B-3(2), there are two review categories in the Development Review Guidelines not mentioned in Article 80 (stormwater and natural features).[15] The addition of these two review categories indicates that the BRA has flexibility to consider environmental impacts not explicitly listed in Article 80. Third, climate change impacts fit within many of the existing categories listed in Article 80B-3(2). For example, the solar glare element includes an analysis of the solar glare impact and solar heat gain,[16] which will be affected by overall temperature increases and other climate change effects. The air quality element involves an evaluation of a project's impact on local air quality from mobile and stationary sources,[17] which should involve how these impacts would change over time due to climate change. An adequate analysis of a project's effect on water quality, flood hazard districts, wetlands, and groundwater,[18] should certainly include climate change adaptation considerations, particularly given Boston's coastal location and the occurrence of sea-level rise. Without inclusion of climate change, the analysis of these issues would be incomplete and inadequate.

Because climate change will affect many of the environmental review categories project developers already analyze and adopt mitigation measures to address, inclusion of climate change in environmental review makes sense. Requiring project applicants to consider climate change at the project review stage will improve the quality of project impact review and promote resilient design. An amendment to the environmental component of the Development Review Guidelines will provide timely clarity and uniformity to the review process without the need for substantial political mobilization.

2) Design Review

During design review, the BRA reviews project plans to decide if a proposed project is consistent with the design guidelines set forth in the underlying zoning.[19] The design guidelines for different zoning districts "may relate to any planning area or district and may include, but need

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[14] *See* Boston Zoning Code, *supra* note 12, at art. 80B-3(2) (emphasis added).

[15] *See* Development Review Guidelines, *supra* note 10, at 15–21. The Development Review Guidelines allow the BRA to require a project applicant to analyze the following elements for environmental review: wind; shadow; daylight; solar glare; air quality; water quality and resources; flood hazard zone/wetlands; stormwater management; noise; solid and hazardous wastes; groundwater; geotechnical; construction impacts; and wildlife habitat/natural features. *Id*. at 15–21.

[16] *See* Boston Zoning Code, *supra* note 12, at art. 80B-3(2)(d).

[17] *See* Boston Zoning Code, *supra* note 12, at art. 80B-3(2)(e).

[18] *See* Boston Zoning Code, *supra* note 12, at art. 80B-3(2)(f)–(h).

[19] Cynthia A. Barr, Boston Zoning: A Lawyer's Handbook §§ 5.3.4, 5.5.2 (4th ed. 2010). *See* Boston Zoning Code, *supra* note 13, at art. 80B-3(3), 80E-4(1) (Large Project Review and Small Project Review, respectively).

not be limited to, particular architectural requirements, including building massing, proportions, setbacks, materials, fenestration, ground level treatment, and other related architectural characteristics."[20] Many of the climate change adaptive design elements on the proposed Adaptation Checklist (in Appendix B) would fall within the scope of the design guidelines. The principal advantage of addressing climate change adaptation in design review is that the BRA can directly require proposed projects to change building design elements.

Climate change adaptation specifications would be conceptually appropriate for inclusion within the design guidelines, but there are several disadvantages to this approach. First, it would require amendments to the Zoning Code. Second, there is the concern that specific design measures could conflict with, and therefore be preempted by the Massachusetts Building Code.[21] Perhaps at some time in the future the BRA could implement a Zoning Code amendment that would include climate change adaptation in design review while avoiding state Building Code preemption issues.

3. To Further Incorporate Climate Change Adaptation into Environmental Review We Recommend the City Adopt the Proposed Policy Documents

1) Climate Change Adaptation Guidelines

The text of the proposed Adaptation Guidelines, located in Appendix A, would modify the current BRA Development Review Guidelines to explicitly include climate change adaptation in the environmental component of Article 80 review. The purpose of this modification is to instruct project applicants on the types of information they must provide to the BRA in their Project Impact Review documents. The Adaptation Guidelines format is parallel to the other environmental sections of the Development Review Guidelines, which ask the project proponent to provide analysis and describe mitigation measures in fourteen existing categories.[22] The Adaptation Guidelines text in Appendix A would be inserted into the Development Review Guidelines at page 21, following the other environmental review categories.

The content of the Adaptation Guidelines builds upon the work that the BRA and BED are already doing with climate change adaptation. Section (a) of the Adaptation Guidelines asks project applicants to identify climate change impacts that can be expected to affect the project and, in turn, the project's impact on the surrounding environment. The text further explains that these impacts can come from (1) the project's direct impacts on the surrounding environment or (2) from climate change impacts on the background environment, which then affect the project's impact on the environment. This approach falls squarely within the legal bounds of environmental review by examining the impacts of a project on the environment while taking climate change into account. Section (a)(i) provides an example to illustrate how a project

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[20] Boston Zoning Code, *supra* note 12, at art. 80B-3(3), 80E-4(1).

[21] *See Enos v. City of Brockton*, 236 N.E.2d 919, 921 (Mass. 1968); Mass. Gen. Laws ch. 143, § 3A, 98 (2011); 780 Mass. Code Regs. § 102.1 (2012).

[22] *See* Development Review Guidelines, *supra* note 10, at 15–21.

considers a climate change impact. The text in section (a)(ii) directs the project proponent to consider the project location, type, and life span as well as the probability and severity of each risk. This provision tailors the analysis to the particular circumstances of the project, allowing project proponents to focus on climate change impacts that will actually affect their projects. For example, the location of one project near the Boston harbor may make sea-level rise a serious concern while the location of another project upland may eliminate sea-level rise concerns even under the most severe predictions.

Section (a) of the Adaptation Guidelines asks project proponents to use "historic trends" and "best available science" to identify and analyze climate change impacts relevant to their projects.[23] The reason for using this language in the Guidelines is that the City has not yet adopted an official climate change model or a data set that applicants could use, such as for predicting sea-level rise and temperature. It would be preferable for the City to develop a climate change model or data set because (1) the City would control the quality of the science and (2) it would be more efficient for one centralized authority to provide the information rather than requiring individual project developers to find and calculate it. Therefore, it is recommended that the City replace the language "historic trends" and "best available science" in section (a) once the City develops and officially adopts a climate change model or data set. Until then, the Adaptation Guidelines require project applicants to use both historic climate data in an area and the best available science relating to climate change predictions. The Massachusetts Climate Change Adaptation Report defines "best available science" as "the most current and established science and technology."[24] The combination of historic trends and best available science will require project applicants to use the most advanced science available to them while at the same time relying on historic data to provide a baseline. Although historic data alone is no longer accurate to predict future conditions, it provides a point of certainty and uniformity from which a project applicant can then extrapolate to predict the impacts of climate change based on the best available science.

Adaptation Guidelines section (b) requires project proponents to describe any applicable adaptive strategies that the project will employ to reduce or eliminate adverse impacts caused by the project due to climate change. Earlier drafts of the proposed Adaptation Guidelines used the term "mitigation" instead of "adaptive strategies" in order to parallel other subsections in the environmental component of the Development Review Guidelines.[25] However, based on the feedback from the BED, the phrase "adaptive strategies" was chosen in the final version of the Adaptation Guidelines in order to emphasize that climate change adaptation measures must be taken in building design to avoid impacts, rather than to "mitigate" them once they have already occurred.[26]

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[23] The Massachusetts Climate Change Adaptation Report supports the use of "best available science" as an approach. MA Climate Change Adaptation Report, *supra* note 9, at 25.

[24] MA Climate Change Adaptation Report, *supra* note 9, at 25.

[25] Development Review Guidelines, *supra* note 10, at 15–21.

[26] Development Review Guidelines, *supra* note 10, at 15–21.

Section (c) of the Adaptation Guidelines directs project proponents to fill out the Climate Change Adaptation Checklist (located in Appendix B and discussed below in Section III.B, *infra*). The Adaptation Guidelines and the Checklist require a project proponent to determine whether each category of climate change impact listed applies to the project and then to describe the analysis that led to that conclusion. For example, a project applicant would analyze the project's vulnerability to flooding due to sea-level rise based on its location. If the project faced a threat from sea-level rise, then the Adaptation Guidelines instruct the project proponent to identify any design elements that will be adopted to reduce the risk. If the project will not be vulnerable to sea-level rise, then the project proponent need not go beyond explaining why it reached this conclusion. The last sentence of Adaptation Guidelines section (c) asks project proponents to evaluate any additional climate change impacts relevant to the project that have not been listed on the Checklist. This catch-all provision will ensure that all relevant impacts are addressed and allow the BRA to learn about additional climate change impacts that can be incorporated into the Adaptation Checklist in the future.

Finally, Adaptation Guidelines section (d) directs project proponents to take climate change adaptation into account in their analysis of other categories in Article 80 development review. In particular, project applicants should be considering climate change in transportation, environmental, urban design, and tidelands analyses because future changes to the region's climate will necessarily affect these analyses.

2) Climate Change Adaptation Checklist

The proposed Adaptation Checklist, located in Appendix B, serves as a clear and streamlined tool for the BRA to use in asking project proponents to analyze climate change impacts and describe adaptive design elements they will employ to avoid adverse impacts. The Adaptation Checklist could be added to the BRA's Development Review Guidelines as Appendix 7. The proposed Adaptation Guidelines section (a) includes completion of the Checklist as a requirement of Article 80 environmental review. The purpose of the Adaptation Checklist is to ensure that project proponents look at climate change adaptation comprehensively by requiring that they consider each listed category. The Checklist features broad categories of impacts, including temperature, seas, precipitation, secure energy, and extreme weather events as well as more specific sub-categories. The Checklist includes sample adaptive design elements for each impact category and also asks project proponents to describe other adaptive design measures they plan to use that are not listed on the Checklist.

The structure of the Adaptation Checklist is modeled on the LEED Checklist, which the BRA currently uses in the Article 80 review process to ensure compliance with the green building requirements set forth in Article 37 of the Boston Zoning Code.[27] The Adaptation Checklist communicates more substantive content about the full range of climate change impacts and potential adaptive design elements than do the Adaptation Guidelines, which simply provide a framework for analysis. The content of the Adaptation Checklist is derived primarily from

[27] *See* Boston Zoning Code, *supra* note 12, at art. 37.

Massachusetts' recent *Climate Change Adaptation Report*.[28] The Checklist can be readily fine-tuned with experience.

The BRA could begin by requesting that project applicants use the Adaptation Checklist on a voluntary basis. Phasing in the Adaptation Checklist, first as a questionnaire, would allow the BRA to gather information about best practices and adjust the Checklist accordingly. Moreover, it would signal to project developers the need to begin including climate change adaptation in their analyses and project design.

4. Conclusion and Potential Next Steps

The proposed Adaptation Guidelines and Checklist provide a clear, uniform, and easily administrable way for the BRA to address climate change adaptation in major building projects in Boston. These documents would accomplish Boston's goal of more formally incorporating climate change adaptation in the Article 80 development review process while at the same time making this step forward a gradual one. The Adaptation Guidelines and Checklist comport with Article 80 and therefore can be adopted by the BRA without any amendment of the Zoning Code.

The approach taken in the proposed Adaptation Guidelines and Checklist could be expanded and improved by the BRA in the future in order to achieve a more direct and comprehensive incorporation of climate change adaptation into development review. Three possible avenues of future action will be explored here briefly, but would require further research if and when the BRA elects to pursue them. First, the BRA could go through the process of formally amending Article 80 if it wanted to create a different framework from the one that currently exists in Article 80B and in the Development Review Guidelines. For example, if the BRA wanted to apply the proposed Adaptation Guidelines and Checklist to projects not included in Large Project Review, it could amend Article 80 to do so. A climate change adaptation Amendment to Article 80 would be similar to the City's approach to LEED, which it incorporated by adopting Article 37 and amending the Development Review Guidelines.[29] Furthermore, the BRA may elect to amend Article 80 if it faces legal challenges to its inclusion of climate change adaptation in the existing Article 80B review process, though this risk is minimal.

Second, as discussed in Section II.B, the BRA could incorporate climate change adaptation into design review by amending the underlying zoning articles that apply to each district in Boston. These amendments would allow the BRA to directly require project proponents to adopt measures relating to building design, instead of relying on the more circuitous environmental review approach. As explained, the amendments to the Zoning Code need to be crafted so as to avoid conflicts with the State Building Code.

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[28] *See* MA Climate Change Adaptation Report, *supra* note 9, at 36-49, 54-68, 75-84, 90-104, 108-18.

[29] *See* Boston Zoning Code, *supra* note 12, at art. 37.

Third, if the BRA finds going forward that project applicants cannot adequately address climate change impacts through project-specific modification and on-site adaptive measures, the agency could implement an off-site mitigation program. The off-site mitigation program could be modeled after the existing Development Impact Project Exactions in Article 80B-7 for Large Project Review, which requires that certain projects in need of zoning relief make payments, or give in-kind contributions, to fund affordable housing and job training programs.[30] To establish an off-site mitigation program for climate change adaptation, the BRA would need to amend the Zoning Code. In addition, state legislation may be required to enact such a program.[31] This type of program would allow the City to fund large-scale public adaptation projects to meaningfully address climate change impacts throughout the City.

[30] Barr, *supra* note 19, at § 8.3.

[31] *See Bonan v. City of Boston*, 496 N.E.2d 640, 642 (Mass. 1986). In *Bonan*, the Supreme Judicial Court overturned a lower court decision that had found Zoning Code Article 26 (the Development Impact Project Exaction provision) to be invalid. However, the Court reversed on procedural grounds and did not reach the merits question of whether Boston could lawfully enact Article 26 based on its authority under the Enabling Act. The following year Massachusetts passed a statute expressly authorizing Boston's exaction program, which resolved the legal challenge to Article 26. *See* 1987 Mass. Acts c. 371. Therefore, the question remains open as to whether Boston could adopt a Zoning Code article establishing an off-site mitigation program for climate change adaptation without authorization by state statute.

## IV. Appendix A

Climate Change Adaptation Guidelines

[The following language would be inserted into the BRA's *Development Review Guidelines* at page 21]

15. Climate Change Adaptation
    a. The impacts of the proposed project on its surrounding environment attributable to climate change must be evaluated. Historic trends and best available science shall be used to identify any climate change impacts that can be expected to affect the proposed project and, in turn, the project's impact on the environment. These impacts can arise from the project's impact on the surrounding environment or from climate change impacts on the background environment, which then affect the project's impact on the environment.
        i. For example, an increase in groundwater levels may increase the risk of flooding at a project site and make the project more susceptible to decay and degradation, which in turn would increase the probability that the project will have deleterious effects on the surrounding environment in the form of the increased risk of the release of materials, contamination of water supplies, or general impacts to public health and safety. At the same time, climate change is altering background environmental conditions, so that for example, background groundwater levels in many areas of Boston are rising and the impact of the project, even if itself unchanged by climate, could have a differential and potentially greater impact on groundwater conditions.
        ii. In conducting the analysis, project location, type, and life span should be considered as well as the probability and severity of each risk.
    b. Adaptive strategies to reduce or eliminate adverse impacts from the project on the surrounding environment attributable to climate change must be described.
    c. Project proponents shall submit to the BRA the Climate Change Adaptation Checklist in Appendix 7, which requires consideration of each category of climate change impact listed. If no impacts from climate change are identified within a category, then briefly describe the analysis that led to this conclusion. If climate change impacts are identified, then identify the design elements that will be adopted to mitigate that climate change impact. Also evaluate any additional climate change impacts relevant to the project that are not listed on the checklist.
    d. This climate change adaptation analysis should inform the analysis in the transportation, environmental, urban design, tidelands, and other relevant sections of the project's impact report for the BRA.

**APPENDIX B**

Climate Change Adaptation Checklist

[The following would be attached to the BRA's *Development Review Guidelines* as Appendix 7]

| Climate Change Impact | Relevant to the Project? | Adaptive Design Elements |
|---|---|---|
| TEMPERATURE | | |
| Higher Maximum and Mean Temperatures and More Frequent Heat Waves | ☐ Yes<br>☐ No<br>Explain: | ☐ Energy efficiency in buildings (incorporate LEED guidelines)<br>☐ Increase light-colored surfaces such as white roof membranes and light-colored paving materials<br>☐ Increase vegetative cover through green roofs<br>☐ Increase green space using heat tolerant plants and trees<br>☐ Create more shady areas, e.g., by increasing tree planting<br>☐ Plan for decreased efficiency of energy production and distribution systems, as well as increased demand, caused by higher temperatures<br>☐ Increase capacity for natural and overall ventilation in structures<br>☐ Build to accommodate the potential health effects in vulnerable communities<br>☐ Describe other adaptive design elements proposed to be used: |
| SEAS | | |
| Sea Level Rise | ☐ Yes<br>☐ No<br>Explain: | ☐ Build to address potential for saltwater intrusion<br>☐ Design site drainage to accommodate more frequent and intense floods<br>☐ Plan for proper storage and disposal of contaminated waste water<br>☐ Use flood resistant materials on lower floors/basements and materials less susceptible to mold, bacteria, and decay<br>☐ Elevate lower building floors<br>☐ Relocate sensitive uses to upper floors of the building<br>☐ Describe other adaptive design elements proposed to be used: |

| Climate Change Impact | Relevant to the Project? | Adaptive Design Elements |
|---|---|---|
| PRECIPITATION | | |
| More Freezing Rain | ☐ Yes<br>☐ No<br>Explain: | ☐ Bury power and communications lines |
| | | ☐ Keep tree branches pruned around power lines where above ground |
| | | ☐ Plan for ice damage in building design |
| | | ☐ Plan for increased needs for de-icing of roadways and sidewalks and take measures to increase natural de-icing capacity, such as optimized solar exposure and slope. Ensure that ramps and other accessibility measures for disabled persons are properly de-iced. |
| | | ☐ Describe other adaptive design elements proposed to be used: |
| More Droughts | ☐ Yes<br>☐ No<br>Explain: | ☐ Implement water conservation and recycling measures |
| | | ☐ Use drought-resistant plants |
| | | ☐ Describe other adaptive design elements proposed to be used: |
| Increased Flooding | ☐ Yes<br>☐ No<br>Explain: | ☐ Anticipate shifts in 100-year flood line in building design and floor elevation |
| | | ☐ Design site drainage to accommodate more frequent and intense floods |
| | | ☐ Place mechanical and other sensitive equipment on higher floors not susceptible to flooding |
| | | ☐ Design buildings to maintain structural integrity after flooding and guard against degradation |
| | | ☐ Use flood resistant materials on lower floors/basements and materials less susceptible to mold, bacteria, and decay |
| | | ☐ Develop emergency plans, including evacuation plans and emergency housing plans |
| | | ☐ Plan for potential water supply contamination and for disposal of contaminated waste water |
| | | ☐ Describe other adaptive design elements proposed to be used: |
| SECURE ENERGY | | |
| Increased Vulnerability to Electricity Shortages and Outages | ☐ Yes<br>☐ No<br>Explain: | ☐ Plan for backup sources of electrical power and for renewable energy resources |
| | | ☐ Describe other adaptive design elements proposed to be used: |

| Climate Change Impact | Relevant to the Project? | Adaptive Design Elements |
|---|---|---|
| EXTREME WEATHER EVENTS | | |
| More Frequent Heavy Rainfall | ☐ Yes<br>☐ No<br>Explain: | ☐ Design site drainage to accommodate more intense storm events |
| | | ☐ Design storm water management systems according to more intense storm events |
| | | ☐ Use decay- and mold-resistant materials in design and construction |
| | | ☐ Design for increased need for storage and disposal of stormwater |
| | | ☐ Describe other adaptive design elements proposed to be used: |
| Stronger Wind Gusts | ☐ Yes<br>☐ No<br>Explain: | ☐ Plan for potential extreme wind gusts when designing structural engineering and orientation of buildings |
| | | ☐ Plan for increased and less predictable clean up of damaged or fallen trees and debris |
| | | ☐ Design cooling and ventilation system to deal with power outages |
| | | ☐ Describe other adaptive design elements proposed to be used: |
| Higher Storm Surge | ☐ Yes<br>☐ No<br>Explain: | ☐ Plan for increased need to pump out seawater and for storage and disposal of contaminated waste water |
| | | ☐ Design floodwalls so that their height can be increased in future |
| | | ☐ Describe other adaptive design elements proposed to be used: |